PORT OF TILBURY LONDON

PLANNING ACT 2008 INFRASTRUCTURE PLANNING
(APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009
REGULATION 5(2) (xx)

PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

# TILBURY2

TRO30003

## Written Submission of Case at ISH of 18th April

PoTLL/T2/EX/94

TILBURY2

**PORT OF TILBURY LONDON LIMITED – TILBURY2 – DEVELOPMENT CONSENT ORDER APPLICATION**

**PLANNING POLICY AND ENVIRONMENTAL MATTERS ISSUE SPECIFIC HEARING**

**18 APRIL 2018**

**SUMMARY OF APPLICANT'S SUBMISSIONS**

| PINS' ISH Agenda Item/ Issue | Summary of PoTLL's Submissions Made in the Hearing | Relevant document references |
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| **General and Cross-topic Questions** | | |
| ***0.1 Control of Port of Tilbury London Limited (PoTLL) over its Tenants*** | | |
| ***i. Mr Colin Elliott cites his concerns over the apparent lack of control that PoTLL has over its tenants in the existing port on matters such as noise in his written representation (WR) ([REP1-042]). He asks what confidence he can therefore have with regard to control for Tilbury2. What assurances can the Applicant give to Mr Elliott on this matter with regard to Tilbury2?***<br>***ii. He also details concerns about*** | **Peter Ward,** Commercial Director of PoTLL, highlighted that it should be noted that the only complaints the port has received in relation to tenants is in relation to EMR. PoTLL has a robust process to deal with complaints including those related to tenants. All complaints are investigated and discussed with tenants. Where the enforcement is via a separate licence as in the case of the EMR site which is licenced by the Environmental Agency PoTLL works with the regulatory body, as is the case with EMR, to assist in resolving the issues raised. EMR are under constant monitoring by the EA in relation to noise and dust and have taken a number of corrective actions on site to resolve the issues raised. The EA keep PoTLL advised and updated in this regard.<br><br>He went on to say that PoTLL is not aware of any other complaints related to its tenants (which exceed 125 tenants in total) and there are none recorded and therefore there is no record of the port not controlling its tenants. In addition all agreements with tenants require them to ensure they conform with all legal requirements including those related to health and | OMP (REP1-008)<br>OCEP (APP-030) |

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| ***ongoing EMR plant noise. Would the Environment Agency update the hearing on progress with the EMR operator to resolve the noise issue?*** | safety.<br><br>**Robbie Owen,** of Pinsent Masons LLP, on behalf of PoTLL explained that, in respect of Tilbury2, the Operational Management Plan applies equally to tenants as it does to PoTLL as can be seen from the wording of that document, i.e. the obligations are expressed to apply to PoTLL and its tenants.<br><br>Complaints will also be dealt with in accordance with the provisions of the Operational Community Engagement Plan (APP-030). | |
| **0.2 Head of Terms for Section 106 Agreement - With reference to the Head of Terms for Section 106 Agreement between the Applicant and Thurrock Council (TC) (doc ref 5.3) [APP-029]:** | | |
| ***i. Would the Applicant and TC state the current position with the development of the Head of Terms for the Section 106 agreement, and the obligations that are currently envisaged to be included within it?*** | **Robbie Owen** introduced PoTLL's planning consultant, **Martin Friend** who updated the Panel on discussions regarding the S106.<br><br>**Martin Friend** explained that discussions are continuing regarding the S106 agreement, primarily with Thurrock Council but, given the proposed obligations, also with Gravesham Council and English Heritage.<br><br>The currently envisaged obligations within the S106 are :<br><br>• delivery of the measures set out in an Active Travel Study, comprising improvements to cycling and pedestrian facilities including improved crossing points, footpath/cycleway enhancements; resurfacing of the existing Fort car park; and a comprehensive waymarking scheme to encourage recreational access to the riverfront and Tilbury Fort;<br><br>• financial contribution to enhancements to information availability at the Tilbury-Gravesend Ferry Terminal;<br><br>• agreement to a Skills and Employment Strategy to maximise the benefits of the T2 proposals to the level of skills and access to employment within the area;<br><br>• a financial contribution to enhancement of Tilbury Fort as a visitor attraction; and<br><br>• a financial contribution to improvements in heritage interpretation on the riverside in Gravesend. | Draft s.106 Heads of Terms (PoTLL/T2/EX/83) |
| ***ii. Can the Applicant confirm the s106 agreement will be agreed*** | **Robbie Owen** confirmed that PoTLL intend to ensure that the S106 will be agreed and signed | |

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| ***and signed off prior to the close of the examination?***<br><br>Robbie Owen | prior to the close of the Examination and are working with stakeholders to ensure that this is the case. | |
| **Planning Policy** | | |
| **14.1 Tilbury2 and the proposed Tilbury Energy Centre (TEC) - RWE Generation Limited (RWE) states that the Order Limits of the site of the proposed TEC and Tilbury2 are almost certain to overlap (re RWE's WR [REP1-087]). Construction periods may run concurrently, and operational and maintenance elements of Tilbury 2 will affect the TEC proposals. RWE lists the various areas of concern that it has, and the interests that it needs to secure. These rights relate to:**<br><br>**a) preservation of access;**<br>**b) identification of a service corridor across the Tilbury2 site and associated rights;**<br>**c) provisions relating to the existing cooling water intake under the jetty within the River Thames at the eastern end of the Tilbury2 Order Limits, and within the proposed extended harbour limits forming part of the Tilbury2 application.** | **Robbie Owen** explained that as set out in the Applicant's Deadline 2 submissions in response to RWE's written representation, none of these rights or assets are proposed to be compulsorily acquired or subject to Order powers.<br><br>The Applicant and RWE are, however, in negotiation with RWE as to the practical construction and operation of Tilbury 2 and the Tilbury Energy Centre and how the interaction between the projects will be managed. Heads of Terms are likely to be agreed prior to Deadline 3. | |

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| ***i. Would RWE and the Applicant update the hearing on these matters?***<br><br>***ii. Would RWE and the Applicant update the hearing on the Heads of Agreement that are being drawn-up between RWE and the Applicant and the draft protective provisions that RWE would propose?*** | | |
| ***14.2 In the light of the Construction Materials and Aggregate Terminal (CMAT) Position Statement (Appendix B of the Applicant's Response to First Written Questions (FWQ) [REP1-016]) is there any operational relationship between the proposed RoRo terminal and the CMAT, i.e. either could operate independently of the other?*** | **Peter Ward** explained that there is no direct operational relationship between the CMAT and the RoRo terminal. However, they will both form important components of the wider operational port. Each includes berthing facilities and related land based facilities reflecting the specific purposes which they are intended to serve. Accordingly each comprises part of the Port NSIP for which development consent is sought (as well as elements of associated development).<br><br>He went on to say that:<br><br>• The RoRo terminal comprises berthing facilities for RoRo vessels together with storage and other facilities relating to the handling of RoRo cargo.<br><br>• Similarly, the proposed CMAT comprises a berth which is capable of accommodating a deep sea aggregates vessel, together with related port facilities including facilities for the handling and processing of aggregates prior to their onward transportation. It is important to recognise that this terminal, like the RoRo terminal, requires its own berth.<br><br>• The CMAT and the RoRo terminal can in principle operate independently, in the same way that other specialised facilities at the Port of Tilbury (e.g. the cruise line terminal) can operate independently from other port facilities.<br><br>• However, in practice there are significant efficiencies gained through the co-location of a variety of port facilities capable of handling different types of cargo, and the Port including Tilbury 2 should be viewed holistically. For example, the facilities can make use of single road and rail connections. In operational terms, Port management can | • |

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| | apply across the facilities.<br>• There are substantial economies of scale which bring benefits to the supply chain and therefore UK plc .<br>• This is evidenced at the existing Port as the Panel would have seen earlier this week. Whether they are PoTLL operations or tenanted operations, the various uses are facilitated by the significant infrastructure which exists and enables the port to operate effectively.<br>• Beside transport infrastructure, this also includes the wharves, locks and support functions such as marine operations and stevedoring which enable a port to function both for its own operations and those of its tenants.<br>• On Tilbury2, both the RORO and CMAT riverside operations will be operated by PoTLL staff who will enable and arrange the vessel berthing to the stevedores and who will supervise the unloading of the CMAT and RORO cargoes, including specifically the delivery of the aggregates by conveyor to the CMAT site where the tenant will then control its own operations in terms of processing.<br>• As such, no operations therefore whether tenanted or own operations whether on the existing port or on Tilbury 2 can operate in isolation or independently from the controlling functions of a port in much the same way as airlines do not function independently of an airport and its controlling functions such as air traffic control and ground service functions. | |
| ***14.3 How was the balance established between the RoRo (c26 Ha) and CMAT (c16 Ha) uses and land taken on the proposed site?*** | **Peter Ward** explained that the amount of land required for each element of the proposed development is set out in the Masterplanning Statement (APP-034). See in particular paragraphs 5.8-5.13 (RoRo terminal) and 5.14 (CMAT). Further explanation in respect of the CMAT land use requirements is set out in the CMAT paper.<br><br>In particular, Peter Ward noted that:<br>• The RoRo terminal area was determined by the volumes the terminal will handle and is based upon current port operations extrapolated to account for the increased capacity and storage area required along with required associated facilities such as the customs and border force checkpoints and to ensure efficient operations and traffic flow.<br>• The CMAT requirement has been determined by discussions with customers to take account of the stockpile areas required for the aggregate storage with a number of | |

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| | different products types which requires a 20 acre site. The remaining 25 acres is required for the productions facilities to be constructed along with storage areas.<br>• The development of the RoRo and CMAT proposals and an explanation of their land requirements is discussed in the Masterplanning Statement (ES Appendix 5A) (APP-034). | |
| **Noise and Vibration** | | |
| **16.1 Noise Mitigation** | | |
| ***i. Can the local authorities confirm, or otherwise, if the definition of which properties, or properties not yet built, which will be assessed for mitigation is adequate?*** | **Rupert Thornely-Taylor**, noise consultant on behalf of PoTLL, explained that:<br>• Receptors would be eligible for mitigation if the assessment shows that there would be a significant effect. Significant effects occur either where noise levels are above SOAEL and there is a change greater than 1dB or between LOAEL and SOAEL when there is both a major change and a change in overall noise levels of at least 3dB. Since neither CMAT and RoRo lead to levels above SOAEL at receptors the criteria leading to a significant effects are: Rating Level at least 10dB above Background Level - the major change, and Specific Level exceeding Ambient Level - the combination of two levels equal levels give rise to an increase of 3dB. | |
| ***ii. Ref FWQ 1.16.6 and PoTLL's Response to Written Representations, Local Impact Reports and Interested Parties' Responses to First Written Questions [REP2-007], is Gravesham Borough Council (GBC) satisfied that the noise sensitive receptors proposed are now representative and suitable for the re-assessment required under Requirement 10 – noise monitoring and mitigation? If not, what changes would GBC require?*** | **Rupert Thornley-Taylor** explained that it is established practice in the assessment of noise in major infrastructure projects to characterise the baseline and background noise levels by means of a set of spot locations chosen to represent the locations concerned. The selection of suitable locations depends on the likelihood that noise levels will vary with change in measurement/assessment location and this is dependent on the nature of the noise sources and their distances from the location concerned. The more distributed the sources (e.g. road traffic) and the greater the distance from source to receptor, the less the necessity for a large number of, and shorter distance between, assessment locations, In this case, the use of additional receptor locations is not likely to lead to a material change in the assessment results.<br>**Robbie Owen** explained that if it is necessary to vary the assessed receptor locations then that will clearly be the appropriate course. If new locations are identified they will be included in the assessment framework, as part of the agreement of the overall monitoring and mitigation scheme. | |

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| ***iii. GBC (LIR page 17) [REP1-056] has asked for more information on the PoTLL expectations about the on-going monitoring and mitigation regime and how acceptable noise levels will be agreed. Additionally, in SoCG update report 2; TC, 5.2.3 [REP1-021] "Receptor based mitigation - it is not defined who would become eligible / receive an assessment and the geographical boundaries of this - more information is required on this and how this will be funded. Clarification on this issue will be provided by PoTLL but in the first instance would refer to Schedule 2 of the DCO."***<br><br>***• Please would the local authorities and the Applicant comment on progress with these discussions?***<br>***• In the light of these discussions are changes required to the wording of requirement 10, and if so what?*** | **Robbie Owen** explained that:<br>• The noise assessment within the ES is based on a worst case scenario of CMAT operations. However, this is not necessarily the final layout of the CMAT and as such a monitoring and mitigation regime cannot be developed and agreed until this is finalised in detailed design.<br>• Indeed in that detailed design may lead to no significant effects being identified at all.<br>• The monitoring and mitigation regime will be based on that final layout, and as per the terms of the DCO, it must be agreed with Thurrock and Gravesham prior to the CMAT and RoRo terminals opening for public use.<br>• If it is necessary to provide mitigation (glazing and ventilation) for night time noise it may be necessary for windows to be closed at night with ventilation turned on.<br>• The framework is fully consistent with noise policy guidance which has now been well tested and established criteria are emerging.<br>• The well-established hierarchy of mitigation primarily at source, then in the path, and finally if necessary at the receiver will be followed, pursuant to the OMP, secured through the DCO.<br>• No changes are therefore required to Requirement 10. | |
| ***iv. Ref FWQ 1.16.13, ES para. 17.196 [APP-031] refers to properties in Dock Road and Calcutta Road for which '… there will be a perceptible increase in noise, giving rise to short term significant effect at these properties. The effect is negligible in the long term and the overall assessment is considered*** | **Rupert Thornely-Taylor**, explained that since the publication of the noise policy guidance documents (The NPSE, the NPS Ports and the Planning Practice Guidance) it has been necessary to implement both the policy guidance and established practice in the Assessment of Environmental Effects. This has led to the use of the term "significant" with two slightly different meanings, leading to complex wording in summarising effects. In policy terms, SOAEL has to be avoided, and between LOAEL and SOAEL mitigation and minimisation is required where practicable. In EIA terms, where there are significant effects, mitigation must be considered, after which significant effects can still occur | |

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| ***not to be significant.' The Applicant's answer at deadline 1 [REP2-008] does not appear to accord with what is written in the ES which states 'short term significant effect'. Would the Applicant please re-consider its answer to the original question?*** | PoTLL's Deadline 1 response should read: The short term impacts on Docks Road and Calcutta Road will have minor increases in noise and are not considered significant in EIA terms because the change is not "major" (para 17.91). These impacts are potentially significant in the short term in respect of Policy based on a professional judgement of; night time noise levels at these properties exceeding SOAEL based on traffic flows and the distance between the road, and the properties receiving a change greater than 1dB (para 17.94). Since the effects are negligible in the long term the overall balance between policy significance and EIA significance is that impacts are not significant. | |
| ***v. Dimensions of piles in ES Chapter 5 [APP-031] do not accord with underwater noise assessment in Chapter 17. Updated Chapter 5 provides different dimensions of piles, although it is unclear what each dimension represents. Would the Applicant state whether the assessment in the ES is still valid, as it assesses 610mm piles, but updated Chapter 5 refers to piles of 1.22m or 0.914m?*** | **Robbie Owen** confirmed that an update on the position in respect of piling would be provided at Deadline 3. At the Hearing this was indicated to be a 'Piling Note', but it has been determined that this would be most clearly set out in an update to the underwater noise assessment in Appendix 17.A of the ES.<br><br>This is therefore included at **Appendix 1** to this Summary, with new text highlighted in yellow. This update demonstrates that the conclusions of the ES are still valid. | |
| ***16.2 Noise impact from dredging - Re Port of London (PLA) FWQ comments [REP1-082]: For the reasons given in relation to FWQ 1.9.1 The PLA considers that maintenance dredging should not remain subject to regulation under the 1968 Act. Within that licensing process the PLA would expect ecological impacts such as noise to be fully assessed. Please would the Applicant respond to this request?*** | **Robbie Owen** set out that it is PoTLL's view that maintenance dredging is more appropriately governed under the protective provisions. The carrying out of maintenance dredging under article 43 of the Order will only be permissible to the extent that it is assessed in the environmental statement. Maintenance dredging has been the subject of appropriate noise assessment in the environmental statement. Furthermore, the carrying out of maintenance dredging will require the PLA's approval under the protective provisions included in the dDCO for its benefit. Under these provisions, the PLA is entitled to impose conditions to ensure that the works are carried out and are co-ordinated to result in minimal impacts; particularly given they have various environmental duties under their powers. | |

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| **16.3 Construction Materials and Aggregate Terminal (CMAT)** | | |
| ***i. Gravesham Council [RR-019] is concerned over 24 hour operation of the CMAT. The ES identifies major and significant effects from the CMAT at night time for receptors in Gravesend. Gravesham has requested the ExA to consider restricted hours of operation. The Applicant has argued that for commercial reasons the CMAT needs to be operated 24 hours, 7 days per week. What alternatives are there?*** | **Peter Ward** set out that:<br>• There are no alternatives to 24 hour working as this is required for the commercial operation of the facility and to ensure that it can operate in a competitive environment and have the same capability as its competitors in terms of productivity and vessel utilisation.<br>• The existing port has full 24 hour operating capacity and this will be required for the extension across all proposed operations which is in line with other UK ports and standard in the UK port industry. Not being able to operate 24 hours a day would have a direct impact on supply chains (and therefore UK plc) - 90% of the UKs goods are delivered by sea. To do so on a 24 hour basis ensures that the economy can function with the raw materials and good required for a modern sustainable economy<br>• Further detail on the need for 24/7 working can be found in Appendix 2 to the Applicant's Response to Relevant Representations (AS-049)<br>• The assessment has taken account of the guidance on noise from mineral working including in the web-based Planning Practice Guidance.<br>• At-source measures are provided for the in the Operational Management Plan (REP1-008), and it should also be noted that the noise assessment was carried out on a worst case basis.<br>**Robbie Owen**, noted that it would not be beneficial for the receptors to work on the basis of a noise limit imposed through the DCO, because that would be in place of the mitigation framework including noise insulation and alternative ventilation which could lead to potentially worse noise effects. | |
| ***ii. Ref Thurrock Council (TC)'s response to FWQ 1.16.12. [REP1-092] "… a potential concern is the uncertainty that effective mitigation could be achieved following the noise reassessment and with the*** | **Robbie Owen** noted that proposals for control of noise at source are detailed in the OMP in Section 6.4, 6.6 and 6.7. These measures have been developed to avoid unnecessary disturbance to the residents of Tilbury Town and Gravesend.<br>Examples of the measures in the OMP include: | Operational Management Plan (REP1-008) |

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| ***Operational Management Plan (paras. 17.225 & 17.226), without the necessity of improving the sound insulation of affected dwellings. While this may be an effective solution, noise control at source would be preferred wherever possible". What proposals can the Applicant suggest for noise control at source?*** | • Entry points to the CMAT facilities located away from residential areas.<br>• Engines not to be left idling when not in use.<br>• The use of inherently quiet equipment where possible. | |
| ***iii. Ref PoTLL's Response to Written Representations, Local Impact Reports and Interested Parties' Responses to First Written Questions, p111[REP2-007]: "It is noted that there are similar 24 hour aggregate operations in Gravesham near to Mark Lane, with vessels discharging anytime of day". Please would GBC comment on this response?*** | PoTLL did not respond to this point. | |
| **16.4 Barrier Design and Location** | | |
| ***i. The need for detailed design is acknowledged; however, the work numbers within which barriers are located span large areas on the works plans and could lead to visual impacts. The Applicant's statement in the ES [APP-031] does not prescribe a location, but what was assumed in the noise modelling regarding barrier locations?*** | **Rupert Thornely-Taylor** explained that:<br>• The noise barriers for the road and railway have been modelled parallel to and offset from the edge of the road/railway. The offset distance is approximately 2-3m to allow space for services, access and/or any other necessary equipment.<br>• The acoustic performance of the barriers are determined by the relative position of their tops to the edge of the road or railway. The principal factor is the geometry, with taller and closer barriers performing better than shorter and more distant barriers. The road barrier has been modelled at a height of 3m above road level. The rail barrier has been modelled at a height of 1.5m above rail level. | |

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| | • The performance of the noise barriers will be as per the EIA or better. The detailed location of the noise barriers has not been prescribed so as to allow the location to deviate with the limits of deviation applicable to the alignment of the road and rail, so as to provide optimum benefit. The ES requires the noise barriers to be a maximum of 3 m from the noise source. Given that the LoDs for the road and rail links are only 1 metre or to the centre line of the other adjacent link, they will therefore be located within that range. | |
| ***ii. Please can the Applicant provide further details of likely barrier design and location?*** | **Rupert Thornely-Taylor** provided the following information:<br>• The effectiveness of noise barriers is primarily a function of the geometry of their height and location, once basic requirements about the material from which they are constructed have been met. The residual noise reaching the receptor after installation of the barrier primarily comes over the top of the barrier, to an extent dependent on the path difference – the difference between a line from source to top of barrier and from top of barrier to receptor and the line straight from source to receptor passing through the barrier. The greater this path difference the better the noise reduction, and the path difference increases when the barrier is placed closer to the source or closer to the receptor.<br>• The noise barriers will be designed in accordance with BS EN 1793-2 2012. The barrier adjacent to the road will have a minimum height of 3 m with a minimum surface density of 15 kg/$m^2$. Where barriers are required adjacent to the rail these will be a minimum 1.5 m high with a minimum surface density of 15 kg/$m^2$. | |
| ***iii. Highways England has noted that "The Applicant should make arrangements to acquire any land needed to provide noise fences, screening and other structures adjacent to the SRN" [REP2-001]. What arrangements is the Applicant making?*** | • Noise barriers are not intended to be implemented adjacent to the SRN and therefore in no land is required. The assessment showed that impacts on the A1089 were minor in the short-term and negligible in the long-term, and therefore barriers are not proposed for this road. | |

| 16.5 Combined Noise Effects of the Operation of LTC with Tilbury2 | | |
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| ***i. Re PoTLL response para 3 [REP2-007] "…at a high level the combined noise effects of the operation of LTC with Tilbury2 are likely to increase noise levels in Tilbury due to increased road traffic movements with LTC routing through the transport corridor." Would the Applicant please advise: In the absence of traffic figures/data, how has this assessment been made?*** | **Robbie Owen** explained that this was a high level and qualitative comment and asked Martin Friend, the Port's planning consultant and co-ordinator of the Environmental Assessment to expand upon this.<br><br>**Martin Friend** explained as follows:<br><br>• As the ExA points out, and as confirmed by Highways England in their Deadline 2 responses (in particular their response to Essex County Council [REP2-003] the traffic and associated environmental implications of the LTC would have to be assessed by the Environmental Impact Assessment undertaken for the Lower Thames Crossing.<br><br>• This comment regarding the potential noise effects of traffic from the LTC with Tilbury2 is a professional judgement with two parts. For the section of LTC outside the Tilbury2 application boundary there would be a new road traffic noise source where none exists at the moment, which would give rise to an increase in noise levels at properties in Tilbury. For the section of LTC within the Tilbury2 application boundary it is assumed that the alignment of LTC would broadly follow the proposed Tilbury2 highway alignment, and that the combined traffic of LTC and that forecast to access Tilbury2 would be greater than the traffic forecast to access Tilbury2 in isolation, although clearly the distribution of traffic from Tilbury2 and the existing Port if the LTC was constructed has not been modelled. A judgement is made that for properties in Tilbury, the greater traffic flow with LTC would give rise to higher noise levels than considering Tilbury2 in isolation.<br><br>• However, what is key is that should any environmental impacts arise as a result of the implementation of LTC after Tilbury2, the mitigation will fall to the LTC.<br><br>• Mr Friend emphasised that at this stage know whether the LTC will be approved or not, and indeed whether there will be a link from it to Tilbury. Moreover, the extent of any environmental impacts or mitigation that may be required cannot be defined until the design of LTC is known, as well as the traffic predicted to use it. | |
| ***ii. What measures are proposed to mitigate the increased noise levels?*** | Mr Friend further confirmed that:<br><br>• The extent to which mitigation would be required could not be defined until the design of the LTC is known and traffic data is available. This mitigation would therefore be | • |

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| | established as part of the Lower Thames Crossing Environmental Impact Assessment, for which Tilbury2 has been identified as a Cumulative Effects Assessment project.<br>• This would be for LTC to design. Likely candidate measures would be noise barriers or noise bunds in combination with lower noise road surfaces. | |
| **Cumulative and Combined Impacts** | | |
| **7.1 Lower Thames Crossing (LTC) - The Applicant has repeatedly stated that it does not propose to consider the combined and cumulative impact of the LTC and the Tilbury2 Proposed Development (eg response to ExA's FRQs [REP1-016]) because there is insufficient information available on the LTC to undertake a meaningful analysis. The local authorities appear to accept this position. The Applicant also states that HE has accepted that the combined and cumulative impact will be undertaken as part of the LTC proposal, although HE also states in its response to ExA's FRQs Q1.7.1 [REP2-062] that it supports the request by Interested Parties for a cumulative effects assessment to be carried out and considers that there is sufficient evidence within the LTC Scoping Report for this.** | | |
| ***i. What documents does Highways England suggest should be regarded as representing the current stage of the proposals for the Lower Thames Crossing (LTC) for the purposes of cumulative assessment and in combination effects?*** | **Robbie Owen** introduced PoTLL's response to this by explaining that to assist the ExA, without prejudice to its formerly stated position regarding the matter, PoTLL had decided to undertake a high level, qualitative and proportionate assessment of the cumulative environmental effects of Tilbury2 with the Lower Thames Crossing.<br>He asked **Martin Friend**, the Port's planning consultant and co-ordinator of the Environmental Assessment to comment further on the basis on which this would be undertaken with respect of information currently available from Highways England.<br>**Martin Friend** commented that:<br>• PoTLL consider that the only information available is that contained within the LTC Scoping Report (October 2017) and the Scoping Opinion adopted by the Secretary of State in December 2017.<br>• Some high level traffic data was published in the Post-Consultation Scheme Assessment Report : Traffic and Economics Appraisal in March 2017. However, most fundamentally, this information was considering a scheme that did not include the Tilbury link.<br>• Furthermore, Highways England have set out in their Deadline 2 submissions that their traffic model is not yet in a position to be used as the basis of a cumulative assessment. | Qualitative Cumulative Effects Assessment of Tilbury2 with Tilbury Energy Centre and Lower Thames Crossing (PoTLL/T2/EX/92) |

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| ***ii. Would the Applicant update the hearing on its current position?*** | **Robbie Owen** expanded on the Port's position with regard to CEA of Tilbury2 with LTC.<br>• PoTLL considers that having regard to the uncertainty in respect of the LTC proposal, and bearing in mind the terms of the Regulations, an assessment of the cumulative effects of LTC is not necessary for the purposes of ensuring adequate environmental information is before the decision-maker;<br>• However, without prejudice to that position and to assist the ExA, PoTLL will undertake a proportionate, high level, and qualitative Cumulative Effects Assessment of Tilbury2 with LTC.<br>• The level of detail in this assessment will reflect the limited information available about the LTC proposals, and the uncertainty as to when they will come forward.<br>• It is particularly important to note the absence of traffic modelling data, the latter having been confirmed by Highways England in their Deadline 2 submissions; as the ExA notes, the local authorities accept this position. Accordingly the cumulative effects assessment will not engage in any quantitative assessment in respect of traffic and related impacts, but will be carried out on a qualitative basis.<br>**Martin Friend** added that:<br>• The CEA PoTLL will undertake will therefore be meaningful in so far as this is possible given the absence of traffic data and the wide range of environmental effects that could arise from the movement of vehicles along the route for which mitigation by the promoters of LTC may be necessary.<br>• To assist the ExA and other participants we intend to combine this with the CEA of the TEC that has already been undertaken, submitted at Deadline 1 as Appendix to PoTLL's Response to FWQs [REP1-016] in order to provide one document covering both projects individually and in combination.<br>• This update to the TEC CEA will also take into account TEC's Scoping Report which was released earlier in the week commencing 16 April 2018. | |
| ***7.2 Tilbury Energy Centre (TEC) - Similarly, what documents does RWE suggest should be regarded as representing the current stage of the proposals for the Tilbury*** | **Martin Friend** commented that :-<br>• PoTLL's CEA of Tilbury2 with TEC relies principally on the Consultation Booklet published by RWE "Tilbury Energy Centre Consultation booklet February 2018" which is | |

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| ***Energy Centre (TEC) for the purposes of cumulative assessment and in combination effects?*** | also attached as Appendix 1 to the TEC CEA Report prepared by PoTLL.<br>• In undertaking this CEA, as noted at para. 2.20 of that report, PoTLL has supplemented this information where appropriate through knowledge of a similar installation proposed by a previous NSIP known as Wrexham Energy Centre.<br>• In updating the CEA with TEC as part of the report with the LTC, PoTLL will review the Scoping Report in order to ensure that the information contained therein is also taken into account. | |
| ***7.3 Does Natural England accept the Applicant's reasoning set out in section 2 of its Response to Relevant Representations [AS-049] for excluding the LTC and TEC from assessment of in-combination effects?*** | **Robbie Owen** noted that PoTLL does not consider that there is a need to consider in-combination effects from the LTC and TEC for the purposes of carrying out a legally adequate HRA, due to the uncertainty in respect of those projects.<br>However, without prejudice to that position and as set out above, PoTLL are prepared to undertake, that a level, proportionate and largely qualitative assessment of the Cumulative Effects of Tilbury2 with LTC and TEC. So far as ascertainable this will include a qualitative assessment in respect of matters relating to European sites. | |
| **Historic Environment** | | |
| **13.1 Impact of Proposals and Mitigation – General** | | |
| ***i. Would the Applicant and Thurrock Council (TC) update the hearing on the assessment of the potential impacts of the Proposed Development on the settings of surrounding heritage assets, which TC asserts to be inadequate (re SoCG Applicant-TC Appendix 1 of SOCG Update Report [REP1-021])?*** | **Veronica Cassin,** of CGMs, built heritage advisor to PoTLL, advised that a visibility Section between St James West Tilbury and Tilbury Fort has been provided to Thurrock Council. The drawing is intended to demonstrate the interceding development at the worst case scenario section when viewing from St James Church towards Tilbury Fort.<br>**Nic Page** for Thurrock Council confirmed that the Visibility Section and the site visit had demonstrated the view to St James Church would not be interrupted.<br>Nic Page also stated that the impact of development had been downgraded in the CGMS assessment through the application of mitigation and that this would be discussed during a scheduled conference call on 23rd April.<br>This is under review by Thurrock Council and id recorded in the revised Statement of Common Ground submitted at Deadline 3 (PoTLL/T2/EX/93). | Response to Relevant Reps (AS-049), Appendix 4 |

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| ***ii. Would the Applicant and TC provide an update on TC's assertion that the proposed mitigation will reduce visual impact but will not mitigate against the harm caused by the Proposed Development, and TC's statement that the Applicant should promote a more robust landscape mitigation package (SoCG [REP1-021]; TC's written representation (WR) [REP1-090])?*** | **Nic Page** stated that there are few opportunities for meaningful mitigation and that the Applicant could look to enhancement opportunities to support the viability of the asset. The ExA Panel identified that this would be picked up in later questions related to Tilbury Fort.<br><br>**Richard Turney,** on behalf of PoTLL, highlighted that PoTLL has produced a Landscape Technical Note describing the nature & efficacy of planted screen mitigation has been provided to Thurrock Council, explaining the proposed landscape mitigation. This is provided at Appendix E to the Applicant's response to FWQs (Rep1-016).<br><br>This technical note is currently under review by Thurrock Council and is recorded in the revised Statement of Common Ground submitted at Deadline 3. | Deadline 1 Response to FWQ Appendix E |
| ***iii. Would the Applicant and TC provide an update on TC's statement that it considers the proposed heights within the Proposed Development are inappropriate (re SoCG [REP1-021])?*** | **Nic Page** suggested that containers could be reduced from the proposed 6 high stack and that breaking the continuous line of development on the western edge of the development site would reduce impacts on the visitor experience at Tilbury Fort.<br><br>**Richard Turney** stated that the Minimisation Statement explains the site layout and transient nature of container dwell times. He noted that there are limited opportunities for screening on the western edge due to an existing drainage ditch. With the caveat of operational requirements of the port, he suggested there might be a balance to be found.<br><br>PoTLL will continue discussion with Thurrock Council regarding mitigation through operational considerations. | |
| ***iv. Would the Applicant and TC provide an update on TC's statement that it considers the proposed lighting scheme to be inappropriate (re SoCG [REP1-021*** | **Nic Page** described a lighting corridor that might affect heritage assets and queried the cumulative impact of future developments.<br><br>**Richard Turney** stated that PoTLL has submitted additional detail of night time lighting including CGIs and will be preparing a Cumulative Effects Assessment of other development based on a limited amount of detail which is currently available. He also noted that the draft DCO requires approval of the final lighting strategy by TC, GBC and Historic England.<br><br>**Wendy Lane** for Gravesham Borough Council expressed that the submitted night time visuals gave them more comfort around the appearance and effect of the proposed development and that GBC would be happy to be consulted through the provisions in the draft DCO. | Lighting: Response to IPs D1 submissions (REP2-007) Appendix B |

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| ***v. Would the Applicant and Historic England (Hist E) give an update on the Terrestrial Written Scheme of Investigation (WSI)?*** | **Suzanne Gailey** CGMs, archaeology advisor to PoTLL, advised the panel that she would respond to both 13.1v and vi simultaneously.<br><br>She advised that the applicant was making positive progress towards finalising the draft Terrestrial and Marine Written Scheme of Investigations (WSI). Recent comments on both WSIs had been received from Historic England and were being addressed and updated drafts would be submitted at Deadline 3.<br><br>She advised that there were ongoing discussions with Historic England with regards the wording of the DCO and DML. Historic England have provided recommended wording for both the DCO and DML which the applicant would be happy to discuss further but the current position was that if the WSI was robust enough to allow it to be certified in accordance with the DCO then additional wording would not be need in the DCO/DML.<br><br>**Richard Turney** confirmed the position that it was felt unnecessary duplication for the wording within the draft WSIs to also be used in the DCO and DML. | • |
| ***vi. Would the Applicant, Hist E and Marine Management Organisation (MMO) give an update on the Marine WSI and Deemed Marine Licence?*** | **Suzanne Gailey** confirmed that the applicant had taken on board Historic England's comments on the WSI provided in their Written Representation at Deadline 1 and the updated draft would be submitted at Deadline 3. The draft will include reference to timescales and necessary controls to form a robust certified document within the DCO which would make it unnecessary to change the draft wording of the DML. Following the hearing, more comments were received from Historic England, and so the Marine WSI was not able to be submitted at Deadline 3.<br><br>**Robbie Owen,** of Pinsent Masons LLP, on behalf of PoTLL, confirmed that the draft DCO submitted at Deadline 1 included changes to Schedule 9 following discussions with the MMO. He also confirmed that discussions were ongoing with the MMO regarding the wording of the DML. | |
| **13.2 Tilbury Fort – Impact of Proposals** | | |
| ***i. Would the Applicant and English Heritage (EH) update the hearing on their discussions on points raised by EH (re EH's response to FWQs [REP1-047]) that the impacts*** | **Richard Turney** identified that PoTLL would produce a note from a film location specialist for Deadline 3 to bring context to EH's claims as to the impact of Tilbury2 on filming at Tilbury Fort (PoTLL/T2/EX/88). | Response to IPs D1 submissions (REP2-007) |

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| ***of the Tilbury2 proposals have not been fully assessed in the information submitted with the application, and that there will be a permanent effect upon the setting of the Fort that EH considers to be very significant?*** | Richard Turney also identified that the dredging of the moats is a capital expenditure that will need to be addressed by English Heritage regardless of the proposed development. Therfore this item was not considered reasonable or related to the proposed Tilbury2 development.<br><br>He referred to a Conservation Plan for the Fort, submitted by English Heritage, that shows that they agree with many aspects of the Applicant's Built Heritage Assessment. The proposed Active Travel Study responds directly to some of the issues identified in the Conservation Plan and the Applicant considers that this is a proportionate and reasonable offer that can realise direct benefits for the Fort, its commercial operation and the conservation of the fabric.<br><br>Further to the discussions at the Hearing, PoTLL would particularly note the following risks and opportunities identified in the English Heritage Conservation Plan that align with the position set out in the Built Heritage Assessment (ES Appendix 12.B), including:<br><br>• The character of the setting is industrialised, having been intensively developed to the north, west and east;<br><br>• Access is poor;<br><br>• Filming is a risk to the historic fabric of the fort and effects long periods of closure to the public;<br><br>• Presentation and interpretation at the fort could be improved;<br><br>• There are three areas in very bad condition: east bastion & south east curtain, the bridges and the moats. (The CP also states there are no plans/budget allocated to address these issues);<br><br>• The setting of the fort has been degraded by development (and is therefore sensitive to further development);<br><br>• Lack of security;<br><br>• Ecology management could conflict with management of Heritage significance;<br><br>• Obtaining consents causes delay and adds cost to conservation works;<br><br>• Heavy Goods Vehicles 'pounding' along Fort Road, and; | |

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| | • Risks associated to the riverside location and climate change. . | |
| ***ii. Would they also update the hearing re EH's assertion that a balancing exercise of harm to the Fort versus the public benefit of the scheme has not clearly been undertaken, and that the mitigation identified within the Tilbury2 proposals is not effective enough [REP1-047]?*** | **Richard Turney** summarised PoTLL's position that harm is outweighed, but noted that this exercise is ultimately for the ExA and SoS to decide. It is definitely not a matter for expert witness but evidence has been submitted to assist the decision.<br>Further to the discussions at the Hearing, PoTLL would also note:<br>• There are a number of public benefits of the Active Travel Plan in relation to Tilbury Fort. The Active Travel Plan is focussed on getting people moving around the wider Tilbury area, including improving access to Two Forts Way which connects Tilbury Fort and Coalhouse Fort along the river edge. Physical improvements to accessibility of the forts will lead to enhancement of the visitor experience and a potential increase in visitors, and repeated visits, to Tilbury Fort.<br>• The Tilbury Fort Paper also discusses the benefits of port development in relation to employment, Gross Value Added (GVA) and skills and training initiatives undertaken by the port.<br>• Additional to this the proposed Port development will supply the construction industry with bulk materials to meet the strong demand for housing in the south east. This is a central government prerogative that has far reaching public benefits. This is one of many public benefit reasons explained in PoTLL's Outline Business Case (AS-016). | Deadline 1 Tilbury Fort Paper Appendix D to Response to FWQs (REP1-016) |
| ***iii. Would they also update the hearing re EH's assertion that it is reasonable that additional compensation is included with the proposals if permitted, as conditions or Section 106 obligations [REP1-047]?*** | **Richard Turney** explained that PoTLL considers that the proposed improvements to the physical environment offer an enhancement to the quality of visitor experience that would directly benefit the fort. These would be secured via a Section 106 agreement with Thurrock Council.<br>English Heritage has set out a list of compensation measures in their responses to the panel's first written questions. The Applicant, through the Active Travel Study which is secured through the S106 with TC, is addressing the following items:<br>• Resurfacing the existing driveway to the Water Gate approach to the fort;<br>• Comprehensive signage and wayfinding through the Active Travel Study Area, including Heritage interpretation provided in consultation with English Heritage, TC, GBC and Historic England. | Deadline 1 Tilbury Fort Paper Appendix D to Response to FWQs (REP1-016)<br>Response to IPs D1 submissions (REP2-007) |

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| | PoTLL's response to EH's written representation also explains the Applicant's approach to mitigation and enhancement with English Heritage, and its view that all other measures suggested by English Heritage would not be appropriate mitigation measures for the impacts of Tilbury2. | |
| **13.3 Tilbury Fort – Monitoring and Mitigation for Piling Activities** | | |
| ***i. Would TC state whether it wishes to be a consultee under paragraph 10.2 of the Construction Environmental Management Plan (CEMP) [REP1-006]?*** | **Richard Turney** confirmed that Thurrock Council can be added to the CEMP.<br>This will occur at Deadline 4 as this change was erroneously not made at Deadline 3. | |
| ***ii. Would the Applicant state whether the monitoring and mitigation will include the tunnels beneath Tilbury Fort, as raised by TC in its written representation [REP1-090]?*** | **Veronica Cassin** stated that it is always the case with assets of such irreplaceable heritage significance that measures are in place to avoid potential damage to the fabric caused by other construction. To this end, monitoring is considered by the Applicant to be a crucial part of the contractor's remit. Monitoring is possible and would require appropriate pre-construction surveys to ensure that the regime dealt with the effects of Tilbury2 rather than any pre-existing issues with the tunnels.<br>English Heritage acknowledged on the site visit that there are existing settlement issues in these tunnels, and so it may be the case that pre-construction surveys are unable to be carried out at these locations. Where this was the case, the Applicant considers that it would not be required to monitor and mitigate such locations.<br>English Heritage confirmed in the hearing that safe access would be achievable in order to install monitoring equipment.<br>The CEMP has been modified at Deadline 3 to take account of these discussions. | Updated Construction Environmental Management Plan (PoTLL/T2/EX/71). |
| ***iii. Would the Applicant state whether the monitoring and mitigation would include the laser scan survey and vibration monitoring requested by EH in its response to the ExA's FRQs at*** | **Richard Turney** confirmed that the monitoring and mitigation regime would be consulted upon by PoTLL with English Heritage. This would include discussion of whether laser scan surveys would be necessary.<br>**Veronica Cassin** explained that there are existing issues with the tunnels and it is understood that tell tales have been in place for nearly a century. It is accepted by English | • |

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| ***deadline 1 [REP1-047]?*** | Heritage that there is already a level of degradation in the tunnels. There may potentially be a tolerable amount of movement, or a pattern of changes that has occurred over such a comprehensive period of monitoring. It would be essential to understand the behaviour of the tunnels in relation to seasonal shifts or tide movements before ascribing degradation through the construction period to the port development.<br><br>**Richard Turney** explained that, given the point above (i.e the Applicant should not mitigate or be responsible for dealing with existing issues), it is considered likely that this would form part of the regime.<br><br>**Veronica Cassin** explained that a 'traffic light' alert system, as is the industry standard, would likely be used to pick up any movement before it could impact the fabric of the fort. The monitoring methodology would set out the protocol for amber alert situations based on a thorough understanding of risk.<br><br>**Veronica Cassin** also emphasised that when dealing with a monument of irreplaceable significance, every effort to avoid impact should be undertaken and that remedies are a last resort.<br><br>This detail would be developed as part of the development of the regime, pursuant to the CEMP, as amended at Deadline 3. | |
| ***iv. Would the Applicant state whether any mitigation/contribution to repairs of Tilbury Fort will be secured through the DCO or through a separate agreement?*** | **Richard Turney** explained that direct piling mitigation would be part of the monitoring and mitigation regime secured through the CEMP.<br><br>No direct damage to the fabric of the Fort has been shown to arise from the Tilbury proposals. As such any direct repair would not be a mitigation measure, and would be an enhancement. | |
| **13.4 Tilbury Fort – Impact on Commercial Operation - A number of matters are stated to be under discussion with regard to the commercial operation of Tilbury Fort (re SoCG Applicant-EH Appendix 10 of SOCG Update Report [REP1-021]). Would the Applicant and EH update the hearing on their discussions on the following:** | | |
| ***i. The visitor experience at Tilbury Fort?*** | **Veronica Cassin** described how the visitor experience at Tilbury Fort is frustrated by the inadequate access and poor condition of the physical environment approaching the Water Gate entrance. Although there is signage in place, there is little that is inviting about the | Filming at Tilbury Fort (PoTLL/T2/EX/88). |

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| | arrival at the fort.<br><br>PoTLL has developed the Active Travel Study over a period of months in collaboration with the local authority to remedy some of the obstacles to accessing Tilbury Fort and realising wider benefits including improving the physical connection to Coalhouse Fort via Two Forts Way. | |
| ***ii. The commercial operations (residential, filing and visitor access/amenity) at Tilbury Fort?*** | **Richard Turney** noted that English Heritage in their representations appear to be prioritising filming at the Fort as a revenue stream that they believe has growth potential.<br><br>English Heritage has converged harm to significance with changes in the extended environment that will reduce the desirability of the fort as a filming location. To this end they have suggested commensurate compensation to support the ongoing conservation of the historic fabric of the Fort.<br><br>**Richard Turney** explained that change to the fort as a commercial operation should take the wider industrial character of the area into account. It is noted that the Fort has successfully undertaken filming projects in this context.<br><br>Further to the discussions at the Hearing, PoTLL would not the following:<br><br>• Compensation is not considered necessary as there is no test in the NPS for Ports requiring that long term viability of heritage assets is maintained. The changes to the setting of Tilbury Fort and any potential or feared effects on today's commercial operation therefore cannot be considered to increase the assessed level of harm to significance.<br><br>• Revenue from filming goes into a central English Heritage fund and isn't necessarily allocated directly to the conservation of fabric at the Fort, though it is available to the Fort, the mechanism of award is unclear.<br><br>• PoTLL is familiar with location filming as the existing Port is used frequently for filming. The industry can be erratic and, as happened last summer, can restrict visitor access to the Fort for extended periods of time (as also noted in English Heritage's Conservation Plan). In heritage terms, it is considered that visitors should have priority in accessing the Fort. The Active Travel Plan identifies that an increase in visitor numbers and associated spending is an appropriate benefit to the Fort and its ongoing conservation.<br><br>• The note on filming at Tilbury Fort submitted at Deadline 3 demonstrates that standard production practice will deal with sound effects and visual corrections, of the kind posed | Note on Filming at Tilbury Fort (PoTLL/T2/EX/88). |

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| | by the development, as a matter of course.<br>• In heritage terms the occupation of buildings is considered beneficial to both the preservation of fabric and the natural surveillance and security that residential use offers. It is not thought to be appropriate to increase the residential use beyond accommodations available in the officer's barracks. | |
| ***iii. The ecology, landscape treatment and setting impacts on Tilbury Fort?*** | **Richard Turney** summarised the following points:<br>• Additional information has been supplied at Deadline 1 in respect of the proposed landscape mitigation to the infrastructure corridor to better demonstrate its scope and effectiveness (Appendix E to response to FWQs).<br>• Consideration has been given to EH's suggested additional ecological mitigation, and explanation has been provided as to why this was not proposed or considered appropriate by the Applicant at Deadline 2.<br>• English Heritage's Conservation Plan recognises (at page 79) that ecological impacts have not yet been considered and would need to be considered in any proposals to dredge the moats. This is a point also made by PoTLL (page 102 of the Applicant's Deadline 2 submission, document reference PoTLL/T2/EX/60 / REP2-007).To the extent that the moats have any function in flood prevention (as is suggested by EH but which is otherwise unproven or unclear), this function will not be affected by the temporary re-alignment works or other works to watercourses associated with the Tilbury2 project which are remote from the moat features.<br>• Dredging the Tilbury Fort moats, as suggested by English Heritage as an enhancement measure, would have separate and potentially significant ecological implications given their inclusion in the Tilbury Marshes LoWS and the fact that they harbour plant species of interest. A detailed ecological understanding would be required to understand the potential implications of EH's suggestion for ecology generally and the lows specifically. POTLL understands that English Heritage have recently had an ecological survey undertaken as part of ongoing management duties, and PoTLL has requested a copy of the survey report so as to better understand EH's suggestion, but it is now understood that this information will be provided by EH on a 'need to know' basis, i.e. only if English Heritage consider it necessary. | Applicants response to FWQ (PoTLL/T2/EX/49 / REP1-016) and Appendix E<br>Response to the Written Representations, Local Impact Reports and Interested Parties Responses to First Written Questions (REP2-007) |
| ***iv. The degree of impact of the Proposed Development on the*** | **Veronica Cassin** explained that the required methodology and assessment criteria for the | ES CH12 Table 12.6 |

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| ***Fort's setting?*** | Environmental Statement are defined in Table 12.6 of the ES.<br><br>Historic England's assessment of Magnitude of Effect poses the test of 'Considerable Modification' to the setting of the asset. PoTLL considers that the proposals would instead result in the setting of the fort being 'Noticeably Changed'. Combined with recognising the Value of the Asset as 'Very High' results in a an assessment of 'Moderate/Major Adverse' Likely Significance of Effect<br><br>**Veronica Cassin** stated that the proposed changes will be noticeable, but due to various factors such as distance, temporality of vessel movements, existing interceding development and the industrial character of the general area, the development is recognised as an intensification of the existing industrial character in the setting of the fort.<br><br>**Veronica Cassin** explained that Considerable Modification would by contrast involve the encircling and dominance of the asset or the introduction of new land uses where previously the land use was compatible with the setting of the asset. | Definitions of Magnitude of Effect |
| ***v. The opportunities for enhancement to Tilbury Fort?*** | **Richard Turney** identified that there are a number of opportunities to enhance Tilbury Fort, including those which are identified in the English Heritage submission. This is also the subject of discussions with EGH.<br><br>He noted that the Applicant has offered the Active Travel Plan which includes improvements to the general environment, access, wayfinding and heritage interpretation, all of which are identified as lacking in the Conservation Plan. | |
| **13.5 Tilbury Fort – Mitigation Measures** | | |
| ***i. Would the Applicant and TC update the hearing on their discussions on the following proposed additional mitigation measures (re TC's response to ExA's FRQs Q1.13.5 [REP1-092]):***<br>***a) monitoring of tunnels beneath Tilbury Fort during construction;***<br><br>***b) utilising appropriate colours for the silo and other structures;*** | This item was not considered specifically at the Hearing and so PoTLL notes:<br><br>a) The monitoring of Tilbury Fort tunnels will be undertaken in consultation with English Heritage as operators of the Fort pursuant to the CEMP.<br><br>b) The colour finish of the Silo is specifically addressed in Schedule 2 of the dDCO. It will be determined in consultation with Thurrock Council and Historic England as their statutory consultee. The Applicant is currently preparing a General Specification document in consultation with Thurrock Council and Historic England to agree colour palettes, gradient painting, material choices particularly in regard to potential structures within the envelope that aren't already nominated in the dDCO. | |

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| ***c) reducing the maximum height of container storage within a zone adjacent to the western boundary of the main site; and***<br><br>***d) within the limit of deviation for this work, locating the silo as far as possible from the edge of the River Thames?*** | c) Drawn studies are currently being explored by the Applicant.<br><br>d) The operating requirements of the discharging vessels (and therefore its related silo) are explained in the Minimisation Statement (Appendix 6 to the Response to Relevant Representations (AS-049) which sets out the design parameters of the CMAT berth. There is a maximum pumping capability for most vessels of this nature which dictates the location of the silo, with the benefit that it is as far removed from Tilbury Fort as it can be. In heritage terms, this would be considered a priority over controlling or composing the more distant views from Gravesend. | |
| ***ii. Do other parties have any comments on these proposed additional measures?*** | n/a | |
| **13.6 Considerations South of the River** | | |
| ***i. Would the Applicant and Gravesham Borough Council (GBC) update the hearing on their discussions over the magnitude of the impact of the Proposed Development on the settings of the identified built heritage assets and the degree of harm or otherwise (re SoCG Applicant-GBC Appendix 2 of SOCG Update Report [REP1-021])?*** | **Richard Turney** confirmed that PoTLL and GBC have agreed the magnitude of impact for the relevant heritage assets and this is recorded in the revised Statement of Common Ground to be submitted at Deadline 3. | Statement of Common Ground Update Report (PoTLL/T2/EX/93) |
| ***ii. Would the Applicant and GBC provide an update on their discussions on further mitigation and enhancement measures*** | **Richard Turney** confirmed that PoTLL will make a contribution to GBC through s106. Discussions on this continue. | Draft section 106 agreement (PoTLL/T2/EX/83) |

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| ***beyond those set out in the ES?*** | | |
| ***iii. Would the Applicant and GBC provide an update on GBC's concern about the impact of lighting from the point of view of Gravesend?*** | • Further night time views were submitted at D2. GBC will be consulted by Thurrock Council on the final lighting scheme as secured through the dDCO.<br>• As discussed above at item 13.1 iv, GBC has accepted the night time views and the potential for effects as low is agreed in the revised Statement of Common Ground to be submitted at Deadline 3. | Statement of Common Ground Update Report (PoTLL/T2/EX/93 |
| **13.7 Applicants Response to FWQs** | | |
| ***i. Would the Applicant clarify the residual effects during construction on built heritage (re response to FWQs Q1.13.13 [REP1-016]?*** | It was agreed by the ExA to receive written representation on this item. This item was also more thoroughly explored by during examination of agenda item 15.1.2.<br>PoTLL notes as follows:<br>• The likely activities during construction phase are identified as site clearance, demolition, crushing, stockpiling, site access, river wall works, dredging and earthworks, phased construction of roads, new railway infrastructure, bridge crossing, silo, jetty modifications and construction<br>• The likely effects are identified as noise levels, vibration, dust, lighting, traffic and visual impacts. The proposed mitigation (captured in the CEMP) includes screening with hoardings, monitoring of vibration, monitoring of dust, limits on vehicle use and hours of operation, use of low key lighting and retention of the planted edge on the west boundary for screening purposes.<br>• The proposed mitigation would have residual beneficial effects, taking the 'Likely Residual Effect' to Moderate Adverse in relation to the Fort as the changes to the setting of Tilbury Fort would remain perceptible but would not constitute 'Considerable Modification' as defined at Table 12.6 of the ES. | |

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| ***ii. Would the Applicant confirm how the maximum construction period will be secured in the dDCO (re response to FWQs Q1.13.14 [REP1-016], which sought clarity over the construction period)?*** | **Richard Turney** explained that it would not be appropriate for a maximum construction period to be secured through the DCO, and this is not something that has been imposed on other major infrastructure proposals.<br><br>In particular, the DCO and its certified documents require a large number of consents and approvals. Whilst all efforts will be made by PoTLL to expedite the construction process, ultimately these approvals are out of its control and may extend matters. However, as such approvals would be pre-construction of the relevant element of the scheme, there would be no additional environmental effect.<br><br>Additionally, force majeure or extreme weather events could delay the process, and imposing a construction period restriction in the DCO could mean that a nationally important infrastructure project could be stopped from completing simply because of the weather. | |
| ***iii. Would the Applicant confirm if the measures detailed in para 5.1 of the CEMP and in answer to FWQ 1.13.16 will be undertaken (re Applicant's response to FWQs Q1.13.16 [REP1-016], which sought clarity on whether construction facilities have been considered within the ES)? The current wording of 'should' is unsatisfactory.*** | **Richard Turney** confirmed that the CEMP is secured through a requirement in the DCO. As such everything within it must be carried out. However, he confirmed that the CEMP would be reviewed throughout for use of the word 'should' to determine if changes need to be made.<br><br>The required changes have been made at Deadline 3. | Updated CEMP (PoTLL/T2/EX/71) |
| ***iv. Would the Applicant confirm in terms of significance what the residual effect would be with the identified mitigation (re response to FWQ Q1.13.19 [REP1-016], which asked what construction restrictions would be applied to minimise impacts on archaeology and cultural heritage)?*** | **Suzanne Gailey** confirmed that construction restrictions in relation to Terrestrial and Marine Archaeology will be secured through the Terrestrial and Marine WSIs. The wording to secure this will be agreed with Historic England. These restrictions will ensure an appropriate level of mitigation is undertaken ahead of and during construction activities and during operation. The residual significance of effect on potential archaeological assets following mitigation is considered to be generally neutral and at most low adverse.<br><br>**Veronica Cassin** explained that Residual Effects for built heritage will be addressed through the various measures set across the CEMP topics, e.g. LVIA, noise, traffic and air quality, | |

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| | resulting in a Moderate Adverse Likely Significance of Effect during construction. | |
| **Landscape and Visual Impacts** | | |
| **15.1 Landscape and Visual Mitigation – General** | | |
| ***i. Would the Applicant and Thurrock Council (TC) update the hearing on discussions between them on the landscape mitigation package, which TC asserts is limited and will not achieve benefits (re SoCG Applicant-TC Appendix 1 of SOCG Update Report [REP1-021])?*** | **Jim Meadowcroft**, of David Jarvis Associates, on behalf of PoTLL, described the main functions of the proposed landscape mitigation, as set out in the Landscape Technical note which formed Appendix E to PoTLL's response to FWQs (REP1-016):<br><br>• provides visual screening of road traffic during the winter season;<br>• incorporates proposed ecological mitigation as defined in the Landscape Strategy (ES Figure 9.9 (AS-027) and LEMP;<br>• reduces the visual impact of proposed acoustic barriers;<br>• screens the upper levels of road and rail traffic as viewed from residential property;<br>• is sympathetic to the landscape character of the Tilbury Marshes;<br>• reduces potential harm to the setting of Tilbury Fort;<br>• from the point of view of people using the corridor, screens detracting elements and provide an attractive and interesting travelling experience;<br>• reduces the extent of urban development in view south of the route; and<br>• creates a 30 metre margin south of the road, planted so as to achieve a transition from woodland to scrub, scrub grassland, an ecological mitigation ditch and a grazed marsh margin. | Applicants response to FWQ (REP1-016), Appendix E |
| **15.2 Landscape and Visual Mitigation – Tilbury Fort - Would the Applicant and TC update the hearing on their discussions on the further mitigation that TC would propose for Tilbury Fort (re TC's response to ExA's FWQs Q1.15.2 [REP1-092]):** | | |

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| ***a) Additional mitigation and enhancement works in the common land and remnant grazing marsh around Tilbury Fort to improve its immediate setting;***<br><br>***b) More significant boundary treatments around the Main Site and new infrastructure corridor;***<br><br>***c) Replacing poor quality fencing;***<br><br>***d) Restoring the ditch network;***<br><br>***e) Clearing previously dumped material; and***<br><br>***f) Provision of new hedges or trees further from the open marsh area?*** | **Richard Turney** confirmed that PoTLL remain in discussion with Thurrock Council with regard to landscape and visual mitigation. The technical note provided as Appendix E to PoTLL's Response to FWQs [REP1-016] is with TC for consideration.<br><br>He added that PoTLL is considering what further mitigation (if any) might be appropriate but it is for Thurrock Council to justify how these provisions would provide 'mitigation' for the Scheme, rather than just improvements to the Fort as a whole - i.e. they are existing problems.<br><br>In relation to the western boundary, it should be noted that there is a drainage ditch on site which prevents any additional screening above and beyond the proposed retained Monterey Pine tree line. | |
| **15.3 Landscape and Visual Mitigation – Historic England's Issues - Would the Applicant and Hist E update the hearing on the areas in which Hist E has queries remaining (re SoCG Applicant-Hist E Appendix 4 of SOCG Update Report [REP1-021]:** | | |
| ***a) future baseline;*** | **Deborah Priddy** of Historic England addressed the seven parts of this question in a combined statement, identifying:<br><br>• Impacts on setting of the Fort;<br><br>• Differing methods of assessment for EIA and NPS framework<br><br>• Magnitude of effect, embedded mitigation & residual effect<br><br>• Very limited scope for Mitigation of Effects from proposed development | |

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| | **Richard Turney** explained that in recognising Historic England's concern around the limited scope for mitigation of effects from the proposed development, PoTLL has considered the Conservation Plan submitted by English Heritage.<br><br>Further to the oral response at the hearing, PoTLL would note the following with regards to the Conservation Plan and the future baseline:<br><br>• The Conservation Plan is an objective and independent document prepared under instructions from English Heritage and including acknowledgements to Historic England and Deborah Priddy (Inspector of Ancient Monuments for Historic England) and Paul Pattison (Senior Properties Historian for English Heritage).<br><br>• The Conservation Plan identifies issues around visitor experience and access that could be improved through the Active Travel Study which has been undertaken by the Applicant in collaboration with Thurrock Council.<br><br>  • While the Conservation Plan has been prepared under the auspices of site management and is considered a best practice conservation tool, the facts of the site and its significance, including the contribution of setting to that significance, do not change. The Built Heritage Assessment (BHA) (Appendix 12B to the ES) has been prepared with due regard to the NPS, NPPF and Historic England GPAs, among other policy requirements to assess the impact of change on significance. The BHA is similarly aligned with the Conservation Plan in terms of interrogating the Fort's significance and its historical development, historical erosion of its relevant setting and the condition of the Fort and its setting as found today.<br>  • The BHA (and consequently ES Chapter 12) clearly, and necessarily, states that the assessments have been undertaken with regard to the future baseline which excludes Tilbury B and its chimneys from consideration. The wireline visuals have been prepared to assist this assessment and show the proposed wireline development with Tilbury B erased from view for the purposes of such assessment. This future baseline, however, cannot reasonably remove the interceding development that sits between the Fort and the proposed Tilbury2 development site which consists of the Anglian Water Treatment Works and the recently approved Stobarts operation. Behind the proposed development site a dense wireframe of electricity pylons are arrayed to the north east servicing a variety of power networks, lending further industrial character to the contemporary setting of the Fort. | |

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| ***b) locations of visual impact;*** | Although this item was not discussed in detail at the Hearing, PoTLL notes that locations of selected representative viewpoints in the BHA were agreed with HE and used for the purposes of effects on visual amenity and built heritage; and is seeking to have this recorded in the Statement of Common Ground. | |
| ***c) visibility of the silo;*** | **Veronica Cassin** stated that the operational requirements of the silo, in relation to the CMAT berth and pumping distances, also mean it is sited as far away as possible from the Fort which minimises the visual impact on the setting of the Fort. This is further explained in the Masterplanning Statement (APP-034) and the Minimisation Statement (Response to Relevant Representations Appendix 6 (AS-049)).<br><br>Further to the discussions at the Hearing, PoTLL would also note that the potential for gradient painting and RAL palette remains under discussion with Thurrock Council and Historic England . Gradient painting was discussed on the site visit to Gravesend as an 'architectural' project to identify significant views and choose a variety of colourways which would blend the silo to the sky at the upper reaches and to the surrounding context nearer to the ground. | |
| ***d) impact of berthed vessels on the setting;*** | **Veronica Cassin** explained that there will still be intermittent views afforded between vessel movements. Cross fire sight lines will remain entirely visible, except for a small segment which will be temporarily interrupted by berthed vessels, but would still be legible.<br><br>She explained that, as seen on the Accompanied Site Inspections, ships are part of active river life and dwell times vary according to function. The visual impact of berthed vessels is not permanent and does not erode the appreciation of the cross fire sight lines. Berthed vessels will temporarily interrupt a small segment of the fire range.<br><br>**Veronica Cassin** stated that, as seen on the site visit, the views to Gravesend Blockhouse, representing the Henrician period of defence will remain visible and views to New Tavern Fort, representing the 17-18$^{th}$ Century era of defence strategy will also remain appreciable when ships are berthed.<br><br>It is worth noting that, although vessel dwell times might exceed the average length of a visit to Tilbury Fort, this could change through repeat visits brought about by improved accessibility, wayfinding and interpretation materials. | |
| ***e) contribution of marshland to the setting of Tilbury Fort;*** | Although this item was not discussed in detail at the Hearing, PoTLL notes the following: | |

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| | • Historically, the marshland could be flooded if required in order to dissuade a landward attack. To this end, the marshland setting is part of the defence strategy of the fort and as described in the BHA (using the best practice guidance issued by Historic England in GPA3), is considered to make a contribution to the significance of Tilbury Fort, but it is a lesser contribution than the riverside setting of the fort which is a stronger representation of the generating circumstances for the fort.<br>• Views of the infrastructure corridor from the Fort will be screened by intervening existing obstacles (as seen on the Accompanied Site Inspection) and the Applicant's landscaping proposals (as described in the Landscape Technical Note (Appendix E to PoTLL's response to FWQs (REP1-016)). | |
| ***(f) description of activity within the Rochdale Envelope; and*** | **Richard Turney** stated that the Minimisation Statement explains the dynamic nature of operations at the fort and shows the dwell times of containers shifting frequently over a 24 hour period. The stacking and unstacking of containers is a fundamental activity within the Rochdale envelope. While the envelope afford flexibility about how these stacks are arranged, it would be impossible for the envelope to be fully occupied and for operations to continue. There is a minimum distance required for accessing in and around the containers which affords some visual relief and there will be periods where the containers will be stacked at different heights. | |
| ***g) disagreements over the level of significant of effects on Tilbury Fort?*** | Reference was made by the Applicant to ES Table 12.6 Definitions of Magnitude of Effect as noted in response to 13.4(iv):<br>**Veronica Cassin** explained, as noted above, that the difference between PoTLL and the Applicant in respect of assessment relates to defining 'Magnitude of Effect'. Historic England's definition of Magnitude of Effect poses the test of 'Considerable Modification' to the setting of the asset. The Applicant considers that the proposals would instead result in the setting of the fort being 'Noticeably Changed'. Combined with recognising the Value of the Asset as 'Very High' results in an assessment of 'Moderate/Major Adverse' Likely Significance of Effect<br>**Veronica Cassin** explained that the proposed changes, associated to Tilbury2 development, will be noticeable, but due to various factors such as distance, temporality of vessel movements, existing interceding development and the industrial character of the general area, the development is recognised as an intensification of the existing industrial character in the setting to the east of the Fort. | |

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| | **Richard Turney** emphasised that the description of the existing character of the area is held up in the Conservation Plan (prepared by Alan Baxter Ltd under instruction from English Heritage). For the purposes of assessment under the NPPF, NPS and EIA regulations, the future baseline excludes Tilbury B power station (to the east of the Fort site) in its consideration, however the Conservation Plan identifies industrial character to the north and west, and to the east of the Fort which would include the interceding Anglian Water Treatment Works, a dense wireframe of pylons associated to various power networks and the recently approved Stobarts operation. In describing the current condition of the Fort and its setting, the Conservation Plan states that 'Visitor's appreciation of the Fort's historic open and strategic position has been largely lost, to the detriment of the Fort's overall significance.'<br><br>**Veronica Cassin** stated that 'Noticeable Change' is PoTLL assessment in terms of Magnitude of Effect because 'Considerable Modification' would, by contrast, involve the introduction of encircling and dominance over the asset or the introduction of new land uses where previously the land use was compatible with the setting of the asset. PoTLL does not consider that this is in the case in respect of Tilbury2 and Tilbury Fort. | |
| **Biodiversity, Ecology and Natural Environment** | | |
| ***2.1 Why does Natural England (NE) consider the habitats on the proposed development site "arguably ... irreplaceable (in particular the Lytag site)" [REP1-074], and Buglife the site "unique and irreplaceable" [REP1-030] in their respective WRs? Is it the characteristics of the Lytag and PFA products themselves or the nature of the ground conditions on which they have been placed which gives rise to these circumstances?*** | **Dominic Woodfield,** of Bioscan, terrestrial ecologist for PoTLL, responded to these questions as follows:<br><br>• ***Is it "irreplaceable"?*** 'Irreplaceable' is a very high bar to set and is a term which is typically reserved for habitats which have developed over a long time period of hundreds or even thousands of years and for which that extended period of continuity of conditions is central to their interest: a prime example of which is ancient woodland. Logically it cannot apply to habitats which have arisen via replicable anthropogenic and artificial means, over a short time period, such as the Lytag Site which has developed since abandonment of industrial activity in the 1980's. These are markedly different timescales of habitat development.<br><br>• ***Is it "unique"?*** Studies undertaken by bodies such as Buglife[1] provide useful context to this question. In consideration of the Thames Gateway brownfield resource, within | |

[1] Buglife (2005-2012). <https://www.buglife.org.uk/campaigns-and-our-work/habitat-projects/all-buzz-thames-gateway>

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| | Thurrock alone, there are around 40 brownfield/post-industrial sites that have been identified as having high invertebrate interest, and of that number around 50% were identified as being of 'high potential' (i.e. in the same category as the Lytag site). Accepting that there have been some losses since the Buglife study, it remains clear that that the site falls within a regional hotspot for brownfield biodiversity, and that there are a number of sites in the locality which offer equivalent geographic conditions and are likely to support the same species pool.<br><br>• ***Characteristics of the Lytag and PFA products.*** **Dominic Woodfield** explained that PFA when fresh has high pH, high salinity and extremely low available nutrients, which makes for inhospitable conditions which in turn influence and delay normal vegetation colonisation succession. It is also free-draining, and absorbs thermal radiation to warm up readily, making it highly suitable for burrowing and thermophilic invertebrates. The Lytag material appears to allow the sparsely vegetated early phase of PFA succession to persist even longer than it would on pure PFA (possibly due to its pelleted nature). However, there still appears to be a tipping point at which the chemical properties that cause early-phase inhospitable conditions dwindle through leaching and through N-fixation. Following this a more rapid succession is seen. At Tilbury this has typically yielded MG12 *Festuca arundinacea* (*Schenodorus arundinaceus*) grassland with areas of the more expected legume-dominated grassland or birch scrub.<br><br>• ***Ground conditions.*** **Dominic Woodfield** explained that the ground conditions underlying the open mosaic habitat, being essentially relict former grazing marsh over flat topography, are not inherently interesting or unique, being characteristic of the Thames Gateway area and far beyond. Superimposed upon this there has been a power station (generating PFA as a by-product), and a Lytag production plant, which was subsequently demolished. The site is predominantly flat, with limited extent of mounds/banks and areas of compaction, albeit such features could be readily recreated or bettered in any new brownfield creation site.<br><br>• ***Replication of conditions.*** **Dominic Woodfield** said that the elements which together comprise the Lytag site (i.e. Lytag, PFA, FBA, concrete, railway ballast, etc) could be reproduced in a suitable location and over an equivalent scale. Indeed, part of the rationale for proposing to translocate substrate rather than recreate a site wholly from | |

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| | virgin materials is that it would allow for some at least of the constituent species to be transferred wholesale, rather than waiting for colonisation.<br><br>He added that whilst the site's precise layout and juxtaposition of microhabitats would not be precisely replicated in a new brownfield creation site, that is not to say that a site with equivalent conditions and components, and of equivalent quality/value could not be created on a suitable site, within a relatively short time-frame (potentially only 10-20 years or less). This is because a fresh Thames Gateway brownfield site (such the nearby A1 site[2]) would be drawing upon the same characteristics of geographical location, proximity to the Thames, and artificial substrates of anthropogenic origin.<br><br>He concluded that rather than trying to faithfully recreate the existing Lytag site though translocation, habitat creation on a compensation site provides an opportunity to supplement the existing Lytag site substrates with additional virgin PFA and other materials. This would allow elements fostering early successional conditions to be re-introduced to the Lytag assemblage, as well as re-starting the clock on succession of established habitats, and translocating some communities or species wholesale, thereby maximising the diversity of conditions and available ecological niches. | |
| ***2.2 Do NE, Buglife, the Applicant and the Environment Agency (EA) all agree the status of the Lytag Local Wildlife Site (LoWS) is of high quality and national importance, which is at risk of declining due to successional processes if left unmanaged?*** | ***Quality & importance.*** **Dominic Woodfield** set out that there is no dispute that the status of the Lytag LoWS is of high quality and that it supports an invertebrate assemblage of national significance. Whether the site is of national *importance* in its own right, as opposed to supporting biodiversity resources of national *significance* is a slightly more nuanced question. Whether the site is of national *importance* in its own right, is an assessment that has to be made in the context of available data for other sites in the Thames Gateway. The species list for the Lytag site is drawn from three years' worth of comprehensive survey data, a level of survey which few other brownfield sites in the area are likely to have benefitted from. Natural England's suggestion that the site could be designated as a SSSI has to be considered in context – at present it is not clear where the Lytag Site would sit in 'league-table' terms when seen in context of data from other brownfield sites in the Thurrock and wider Thames Gateway area. Such information has been requested (and is still awaited) from Natural England. This will enable the Tilbury2 assemblage to be compared against other brownfield sites in the Thames Gateway region in both quantitative and | ES Table 10.45 ('Key Receptors') values invertebrate interest component of Lytag Site as national. Also para 10.299 |

[2] Created by RWE pursuant to planning reference 07/00972/TTGFUL and related consents

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| | qualitative terms.<br><br>***Decline due to successional processes.*** **Dominic Woodfield** explained that it is an indisputable fact that successional processes will inevitably lead to a decline in site quality in the future, in the absence of management. While some sites with high levels of toxicity (metalliferous ex-mining sites, for example), can have successional processes held in abeyance for decades (Dr Heaver provided an example in the ISH), that is evidently not the case at the Lytag site, where a proliferation of birch scrub is developing over what was relatively recently parched, sparsely-vegetated grassland. If it would assist the ExA then Bioscan could provide photos to show these successional habitat changes since 2007 (i.e. over the timeframe that the Applicant's ecologists have been familiar with the site), showing the seral succession from open habitat to birch scrub.<br><br>He added that in acknowledging that indisputable trajectory of succession, one must also accept that there will be an inevitable loss of thermophilic invertebrate assemblages and plant communities dependent on open, parched conditions in response to being shaded out by closed-canopy birch woodland. | |
| ***2.3 Are EA, NE, Buglife (and Marine Management Organisation (MMO) if appropriate) content with the proposals for offsite compensation set out in the draft Ecological Mitigation and Compensation Plan (EMCP) submitted at Deadline 2? [REP2-009]*** | ***General off-site compensation:*** **Dominic Woodfield** explained that proposals for off-site compensation have been set out in the draft EMCP submitted at Deadline 2, but this is a travelling document and those proposals are as yet incomplete.<br><br>He explained that the current draft of the EMCP details proposals for the following at a site in Paglesham, South Essex:<br><br>- Creation of 30-37ha of coastal grazing marsh from arable reversion<br>- Creation of between 5 and 6ha of scrub habitat<br>- Creation of c.10ha of ungrazed or lightly grazed grassland habitats (including coastal grazing marsh) as receptor areas for reptiles<br><br>***Brownfield compensation:*** Dominic Woodfield explained that further site/s, including locations more proximal to Tilbury2 and Thurrock District are being explored for delivery of the brownfield components of the off-site compensation burden. Details of these are intended to be reported in future iterations of the EMCP.<br><br>He went on to explain that the applicant's ability to involve Natural England in detailed discussions about off-site compensation for brownfield interests has until recently been limited by the favoured site being subject to an NDA at the request of the landowner. Since | EMCP (REP-02-009) – Chapter 9 and Figure 4 |

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| | the land option which was subject to NDA has now been set aside, NE have been invited to become more closely involved in the process of selection and design of off-site compensation; however discussions need to be approached with caution as a result of commercial sensitivities and thus Natural England has been invited to enter into a NDA with the Applicant, prior to the Applicant revealing the identity of the specific sites under consideration. Natural England has, however, not been able to enter into such an agreement and therefore the Applicant is limited in the information that can be provided as a result. However, in lieu of providing details of specific sites, the Applicant has (at risk) provided details about the ongoing process of search and negotiation on an off-site compensation site, and has advised NE of the search criteria and some details related to proximity, as documented in the minutes of meetings appended to the Statements of Common Ground Update Report for Deadline 3.<br><br>**Dominic Woodfield** explained that POTLL await NE's confirmation that the terms of reference for that search are consistent with delivering an adequate scale and quality of mitigation / compensation for the brownfield interests that will be lost at Tilbury2, should the DCO be granted.<br><br>**Richard Turney** explained that the EMCP is intended to be the 'written details' of off-site ecological compensation required by Requirement 5 of the draft DCO. Whilst PoTLL will make every effort to agree the EMCP with stakeholders prior to the close of Examination, failure to do so will not mean that the proposals will cause biodiversity harm. This is because Requirement 5 is a pre-commencement requirement - i.e. PoTLL will not be able to start on site without these details agreed. PoTLL is therefore incentivised to finalise the EMCP as soon as possible. | |
| ***2.4 Does Highways England agree there are no implications arising from the draft EMCP for the Lower Thomas Crossing (LTC) works area?*** | **Dominic Woodfield** indicated that in the draft EMCP, proposals for on-site mitigation and compensation are presented at Figure 1, which effectively replicates Figure 1 of the LEMP and ES Figure 10.13. Unredacted versions of Figure 1 of the LEMP and ES Figure 10.13 were provided directly to Highways England on 09 March 2018 with further clarification provided to address HE's queries.<br><br>The information which is most relevant to Highways England (e.g. in terms of layout) has therefore already been provided to and reviewed by Highways England via the ES, LEMP and CEMP documents; and Highways England has confirmed that it is unlikely to interact with the existing Strategic Road Network. | EMCP/LEMP – Figure 1<br><br>'Qualitative CEA of Tilbury2 with the TEC and LTC' (document reference PoTLL/T2/EX/92) |

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| | **Dominic Woodfield** explained that dependent on the width and precise location of the Tilbury link road route within the LTC corridor there is potential for a route to pass through the Tilbury2 on-site mitigation area, parallel with the existing railway line, without direct impacts on the locations of Tilbury2's mitigation and compensation features intended for the Green Belt land. This is dealt with further in the Applicant's 'Qualitative Cumulative Effects Assessment of Tilbury2 with the Tilbury Energy Centre and Lower Thames Crossing' (document reference PoTLL/T2/EX/92). | |
| ***2.5 What is the position concerning the additional wintering bird survey data for February and March 2018 referred to in NE's WR [REP1-074] concerning land functionality linked to SPAs? In light of this information, does NE still consider that annual bird surveys are required (between 01 September to 31 March during the construction and operational phases)?*** | **Dominic Woodfield** explained that additional wintering bird survey data for February 2018 was issued to NE on 19 March 2018. This was followed by additional wintering bird survey data for March 2018, which was issued to NE on 09 April 2018. NE's response to the bird note is awaited.<br><br>He confirmed that the recent revision to the 'bird note' (provided at Appendix 1) is considered by the Applicant to be "fully consistent with the position presented in the ES and upon which the impact assessments in the ES and the associated HRA report are based".<br><br>The Applicant is not in a position to comment further on Natural England's recommendations for construction and operation phase wintering bird surveys until such time as a fulsome response to the bird note is received from NE, and in particular whether the information in the bird note obviates the need for any such requirement. | The 'bird note'. Original at Appendix 7 to the Applicant's Response to Relevant Representations (AS-049)<br><br>Latest revision is provided at Appendix 1 to this document |
| ***2.6 In light of the advice from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) [REP2-012, Annex 1] received for Deadline 2, does MMO agree that the approach and assessment methodology for marine ecology is appropriate?*** | **Jayne Burns** on behalf of the MMO confirmed that they are content and agree with the comments from CEFAS and that these points will be reflected in the next submission of SoCG. | |
| ***2.7 Can the Applicant explain how the functionally-linked habitat has been valued in the Environmental Impact Assessment (EIA) [APP-031] and the Habitats Regulations*** | **HRA**. **Dominic Woodfield** explained that there is no evaluation process inherent in HRA: the process begins at impact assessment, starting from the premise that the site/s being assessed are of international/European value and that any functionally-linked habitat supports the maintenance of that international/European value to a greater or lesser | |

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| ***Assessment (HRA) [APP-060] report?*** | degree. The intrinsic value of functionally linked habitats is not considered over and above their functional linkage and their potential as a route for an impact vector to the European/international interests, but it follows that the habitats are of less intrinsic value to the species/habitats in question than the designated site, otherwise logically they would have been included within the original designation boundary.<br><br>**EIA**. **Dominic Woodfield** explained that the intrinsic value of functionally linked habitat has been assessed in the ES by consideration of both the functional linkage to the relevant European Site (as a mechanism which could give rise to indirect effects on that site – see above) and also, separately, in terms of the component habitats and their intrinsic value both at that location, and as part of a collective wider resource, in particular where habitats with associated duties/obligations are concerned (e.g. S41 habitats: coastal saltmarsh and intertidal mudflat). | |
| ***2.8 To whom will the Ecological Clerk of Works provided for in the CEMP [REP1-006] be accountable for ensuring compliance with the EMCP, and what authority/powers is the post holder intended to have for this purpose?*** | **Richard Turney** provided a summary of the full answer to this question set out below:<br><br>• In response to recommendations set out in ECC's RR, the CEMP was revised in line with BS 42020:2013 to include provision for an ECoW, as follows:<br><br>*"6.2 An Ecological Clerk of Works (ECoW), specialist ecologist, or similarly competent person will be responsible for overseeing on-site ecological mitigation and ensuring that measures are implemented as set out in this and associated documents such as the Ecological Mitigation and Compensation Plan (EMCP). The ECoW will be present during the following times and operations:*<br><br>• *Prior to site clearance to oversee installation of biodiversity protection zones (see 6.4 below);*<br>• *Prior to removal of any trees with elevated suitability for bats in order to undertake update surveys (see 6.7 below);*<br>• *Prior to and during site clearance, to undertake physical translocations of species and habitats, install licensed mitigation and compensation measures, and advise on sensitive working practices (see 6.5 – 6.9 below);*<br>• *During works on or near watercourses to advise on Key Species Management (see 6.10 below).*<br><br>*6.3 The ECoW will report to the Contractor, and to the Port of Tilbury Senior Management and Engineering Team."*<br><br>• ***To whom will the ECoW be accountable for ensuring compliance with the ECMP?*** | |

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| | For licensed works relating to bats, badgers and water voles (i.e. EMCP chapters 1-3), the ECoW will be acting under the relevant licences as issued by Natural England. The ECoW will therefore be directly bound by statutory provisions, but beyond that will be accountable to PoTLL's Senior Asset Manager for Property, who is named as the Applicant and is intended will become the Licensee. For all other elements (i.e. EMCP chapters 5-11) the ECoW will be accountable to the Contractor, and ultimately to the Port of Tilbury Senior Management and Engineering Team (as per CEMP para 6.3).<br>• ***What authority/powers is the post holder intended to have for this purpose?*** For works relating to bats, badgers and water voles, the ECoW will either be the Named Ecologist on the relevant licence, or will be acting as an Accredited Agent of the Named Ecologist, and will have legal authority in that regard. The specification for the Contractor is in preparation and will include a clause that sets out the authority of the ECoW, i.e. that the ECoW has a responsibility to uphold the principles of the EMCP and CEMP, and the Contractor must act on the ECoW's advice.<br>Dominic Woodfield added that there is a further accountability mechanism within the CEMP and DCO, whereby for works affecting watercourses, there will be consultation with the Environment Agency prior to works commencing.<br>**Richard Turney** explained that this is how PoTLL will manage this through its contractual requirements. Ultimately however, the project must be constructed and operated in accordance with the provisions of the DCO, with any non-compliance with that (and related secured documents such as the CEMP, EMCP and OMP) will be a matter for enforcement against PoTLL by the relevant regulators and authorities, including the Secretary of State, Thurrock Council, Environment Agency, MMO and others. | |
| ***2.9 Implementation of the Landscape Environmental Management Plan (LEMP) [REP1-010] involves annual monitoring by a "suitably qualified ecologist" and a 5-yearly plan leading to updates of the LEMP as required. Similarly, to whom is the ecologist accountable and who will decide whether such revisions of the LEMP should take place?*** | ***To whom is the ecologist accountable?*** **Richard Turney** and **Dominic Woodfield** confirmed that the "suitably qualified ecologist" would be accountable to the Port of Tilbury Senior Management and Engineering Team, in accordance with the provisions of the DCO.<br>***Who will decide whether such revisions of the LEMP should take place?*** **Richard Turney and Dominic Woodfield** confirmed that the "suitably qualified ecologist" would assess whether any revisions were appropriate, and then present the information (in the form of a Five Year Monitoring Report) to relevant stakeholders, including Thurrock Council, Natural England, the Environment Agency and any others deemed relevant (LEMP para 5.7). "Such changes would be able to take place with the approval of Thurrock Council, in consultation with Natural England." (LEMP para 5.8) | • |

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| ***2.10 Further to its assessment in its WR [REP1-074] of the site as a potential Site of Special Scientific Interest (SSSI), what progress has NE made in considering the site for*** | PoTLL notes that Natural England is continuing to consider the suitability of the site for SSSI designation, and this is the subject of live discussion between Natural England and the Applicant, as set out in the meeting minutes appended to the SoCG update report (PoTLL/T2/EX/93). The Applicant is continuing to progress with the development of an appropriate mitigation and compensation scheme and have invited Natural England to engage more closely in this process. | Statements of Common Ground Update Report for Deadline 3 (PoTLL/T2/EX/93) |
| **Habitat Regulations Assessment (HRA)** | | |
| ***11.1 What are the Applicant's intentions for the revised version of the HRA report to be submitted for Deadline 3 in the light of NE's statement in its WR [REP1-074] about further work required to cover for example functionally-linked habitat, Invasive Non-Natural Species (INNS), waste and pollutants, dredging, noise, dust and in-combination effects?*** | **Dominic Woodfield** confirmed the intention to revise the HRA report at Deadline 4 to address NE's comments regarding functionally-linked habitat, Invasive Non-Native Species (INNS), waste and pollutants, dredging, noise, dust and in-combination effects. These could be characterised as matters of completeness given that they are generally already addressed in the ES.<br><br>**Dominic Woodfield** noted that NE recognises that assessments concerning INNS, waste and pollutants, dredging, noise and dust are already made in the ES and that in this context the revisions to the HRA are required primarily to deliver closer alignment between the two assessments.<br><br>He further noted in respect of functionally linked habitat that it is generally matters of syntax that NE wish to see revised.<br><br>PoTLL has requested that NE confirm the purpose of the requested changes to reference 'shingle/cobble beach' (as per page 11-12 of the Applicant's response to WRs). PoTLL also awaits NE's response to the bird note (latest version as issued 09 April 2018 provided at Appendix 1) in respect of the potential for LSE via functionally linked habitats and the need or otherwise for ornithological monitoring, as requested in NE's WR. Various other questions and points of clarification have been put to Natural England on which responses are awaited.<br><br>PoTLL is therefore awaiting further responses from Natural England before any more substantial updates can be made to the HRA report. On the understanding that NE will make their responses to the Applicant's queries available at Deadline 3, the Applicant | Applicant's response to WRs at pages 11-12 (REP2-011) |

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| | therefore intends to submit the revised HRA report at Deadline 4. | |
| ***11.2 The HRA report [APP-060] refers to the Conservation of Habitats and Species Regulations 2010 (as amended), which have since been replaced by the Conservation of Habitats and Species Regulations 2017. Can the Applicant confirm that the revisions made to the legislation would not affect the conclusions of the HRA?*** | **Dominic Woodfield** confirmed that the revisions made to the legislation since submission of the HRA report would not affect the conclusions of that report, and the relevant references will be updated in the forthcoming HRA report revision to confirm the point. | |
| ***11.3 What further mitigation measures to ensure compliance with the Habitats Regulations does NE have in mind, pursuant to its WR [REP1-074] and response to FWQ?*** | **Jonathan Bustard** of Natural England outlined potential impacts that need to be further considered within the HRA and/or which they considered may require further mitigation measures to ensure compliance with the Habitats Regulations. These were (with PoTLL's comments in italics):<br>• Avoidance of piling during sensitive season for overwintering bird species;<br>• Surface water pollution – *such measures should be consistent with those the EA would typically request;*<br>• Dredging – release of contaminated sediment with impacts on benthos and food resource for wading birds, thus may benefit from avoidance of sensitive season. [*Clarity is still being sought on whether NE had seen and reviewed the HR Wallingford report on hydrodynamic and sediment effects prior to making these comments]*<br>• Water discharge – may be best set within HRA context;<br>• Construction waste and pollutants – range of impact pathways that need to be set within the CEMP, not currently clear within the HRA;<br>• INNS – there is potential for traffic to the new port to introduce INNS;<br>• Further stages of HRA may be required, subject to review of bird note data. | |

| | | |
|---|---|---|
| | As set out in response to questions 2.5 and 11.1 above, PoTLL is awaiting fuller responses from Natural England on HRA matters, and it is anticipated that NE's WR at Deadline 3 will include clarification of and justification for the mitigation measures recommended. PoTLL therefore intends to respond more fully to any recommendations at Deadline 4, once in receipt of written responses from Natural England. | |
| **Dredging and Navigation** | | |
| ***9.1 Does the Environment Agency (EA) accept the analysis of the likely very limited relationship between the potential discharge of cooling water effluent from the proposed Tilbury Energy Centre (TEC) and intended maintenance dredging operations at the proposed port set out in the Applicant's high level Cumulative Effects Assessment (CEA) of the TEC with Tilbury2? How would this affect the Water Framework Directive (WFD) compliance of proposed maintenance dredging operations, and drafting of the Deemed Marine Licence (DML)?*** | **Robbie Owen** explained that the issues discussed were addressed by the Applicant as part of its response to FWQ 1.7.2 (REP1-016), the submitted CEA with the Tilbury Energy Centre submitted at Deadline 1 (REP1-016 Appendix 3), and will be part of the updated CEA to be submitted to Deadline 3 discussed above.<br><br>**Robbie Owen** stated that if the scheme is approved, PoTLL would become a Statutory Harbour Authority for Tilbury2, and as a public body it will be bound to regard the requirements set out in the Water Framework Directive. The PoTLL will consider these requirements when drafting their own maintenance dredging plans with consultation of regulatory bodies including the EA, MMO, and the PLA, pursuant to the terms of the DCO. | |
| ***9.2 What consideration has been given to the impact of capital dredging proposals for the port on the foreshore of Tilbury Fort?*** | **Suzanne Gailey** confirmed that the results from the hydrodynamic and sediment study from HR Wallingford were considered in the baseline investigation and provided references [APP-067] and [AS-030].<br><br>**Felipe Steigler** explained that:<br><br>• dredging will have a small impact on river flow condition and infill rate, and will not affect the overall hydrodynamic process; | |

| | | |
|---|---|---|
| | • the sediment dynamic simulations have shown that the landward extent of any influence of the dredging can be significantly limited by dredging being restricted to the ebb tide as currently proposed by PoTLL; and<br>• that considering this and the distance, no perceivable geomorphological changes to the foreshore of Tilbury Fort are expected.<br>Any effect can be mitigated through the controls on dredging the MMO can imposed via the DML. The MMO will consult with Historic England during the design of the dredging method | |
| ***9.3 Is National Grid Electricity Transmission (NGET) satisfied with the Applicant's response to FW! 1.9.11 [REP1-016] about dredging implications for the 400kV cable tunnel from Kingsnorth to Tilbury?*** | **Robbie Owen** set out that PoTLL has confirmed to National Grid that there will be no impacts in its Deadline 2 response to National Grid's written representation (REP2-007). The parties are discussing submitting a revision of the Limits of Dredging Plan at Deadline 3 to show clearly that the dredge will not affect their tunnel. | |
| ***9.4 Does the Applicant agree with the Port of London Authority (PLA)'s [REP1-080] and MMO's [REP1-073] WR that maintenance dredging should continue to be regulated by the PLC under the 1968 Act, governed by protective provisions and included in the DML as a licensable activity and not a power in the DCO?*** | **Robbie Owen** explained that PoTLL strongly believes that maintenance dredging should be permissible under the Order. The environmental impacts were fully assessed in the environmental assessment and the dDCO only permits the carrying out of maintenance dredging in accordance with what has been assessed in the environmental statement. Furthermore, the carrying out of maintenance dredging will require the PLA's approval under the protective provisions included in the dDCO for its benefit. Under these provisions, the PLA is entitled to impose conditions to ensure that the works are carried out and are co-ordinated to result in minimal impacts. As such, it would and should not be controlled under the 1968 Act.<br>**Robbie Owen** explained that PoTLL understood that the PLA was mainly concerned that whichever system was to be used, the PLA wished to be able to impose the same level of control. He confirmed that this is a matter still under discussion with the PLA. | |
| ***9.5 Is all dredging to be restricted to the ebb tide only, or just WID?*** | **Felipe Steigler** confirmed that it is only WID which will be restricted to ebb tide, mainly to protect environmental features from sediment deposition in the intertidal area, and that other dredging techniques are not deemed necessary to be restricted to ebb tide only. | |

| | | |
|---|---|---|
| ***9.6 Is the PLA content with the revised Limits of Dreading Plan submitted at Deadline 1? [REP1-013]*** | **Robbie Owen** explained that PoTLL understands that the PLA is concerned that article 2(3) provides that distances in the dDCO are stated to be approximate. This is mirrored on the dredging plan in respect of widths of the works (not depths).<br><br>He noted that Article 2(3), in providing for distances to be approximate, is well precedented, e.g. article 2(4) of the Thames Water Utilities Limited (Thames Tideway Tunnel) Order 2014, which very significantly affected the PLA's interests. Ultimately the width/extent of works is limited by the limits of deviation. | |

PORT OF TILBURY LONDON

PLANNING ACT 2008
INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

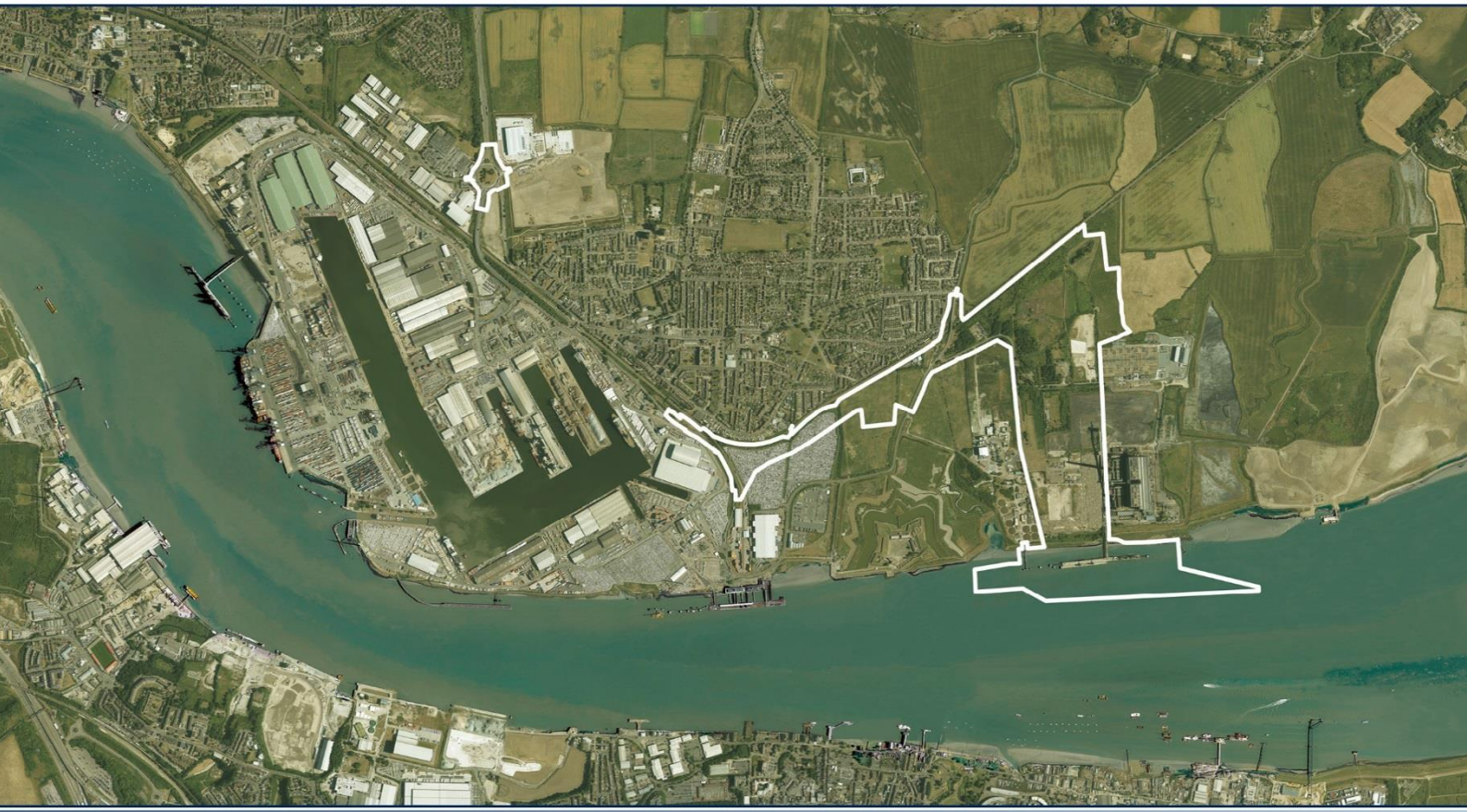
PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

# TILBURY2

TR030003

# APPENDIX 1: UPDATE TO ES APPENDIX 17.A: MONITORING BACKGROUND NOISE AND MODELLING OF CONSTRUCTION NOISE AT TILBURY DOCKS

TILBURY2 DOCUMENT REF: PoTLL/T2/EX/94



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# Monitoring background noise and modelling of construction noise at Tilbury Docks

Fergus Midforth, Tim Mason, Sam East

26/04/2018

**Subacoustech Environmental Report No. P203R0106**

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| *P203R0101* | *03/08/2017* | *F Midforth* | *T Mason* | *M Underhill, P Jindu (Atkins)* |
| *P203R0103* | *11/08/2017* | *F Midforth* | *S East* | *M Underhill, P Jindu, S Vince (Atkins)* |
| *P203R0104* | *01/09/2017* | *F Midforth, S East* | *S East* | *M Underhill, P Jindu, S Vince, S Rouse (Atkins), I Wright, S Willmore, D Housden (POTLL)* |
| *P203R0105* | *13/09/2017* | *F Midforth, S East* | *S East* | *M Underhill, P Jindu, S Vince, S Rouse (Atkins), I Wright, S Willmore, D Housden (POTLL)* |
| *P203R0106* | *26/04/2018* | *T Mason* | *S East* | *P Jindu (Atkins)* |

*This report is a controlled document. The report documentation page lists the version number, record of changes, referencing information, abstract and other documentation details.*

# List of contents

# 1 Introduction

Major development works have been proposed at the former Tilbury Power Station jetty, a part of Tilbury Docks in the Thames Estuary. The development of the site will involve impact piling operations to extend the existing jetty in the River Thames. These piling operations have the potential to generate underwater noise that could cause an impact on marine mammals and fish in the area.

To assess the potential environmental impact of works at the site, Subacoustech Environmental Ltd has undertaken a background noise survey from the existing Tilbury Power Station jetty to provide a baseline for noise levels in the area. In addition to this, underwater noise modelling has been carried out to ascertain noise levels that would surround the proposed jetty location during construction operations and ranges at which these could occur.

This report presents the results obtained from the background noise survey, the assessment criteria in respect of impacts on marine mammals and fish, and the modelling outputs for piling at the Tilbury Power Station jetty site.

# 2 Underwater noise

Sound travels much faster in water (approximately 1,500 $ms^{-1}$) than in air (340 $ms^{-1}$). Since water is a relatively incompressible, dense medium, the pressures associated with underwater sound tend to be much higher than in air. As an example, background noise levels in the sea of 130 dB re 1 µPa for UK coastal waters are not uncommon (Nedwell *et al.*, 2003a and 2007). It should be noted that stated underwater noise levels should not be confused with the noise levels in air, which use a different scale.

### *2.1.1 Units of measurement*

Sound measurements underwater are usually expressed using the decibel (dB) scale, which is a logarithmic measure of sound. A logarithmic scale is used because rather than equal increments of sound having an equal increase in effect, typically a constant ratio is required for this to be the case. That is, each doubling of sound level will cause a roughly equal increase in "loudness".

Any quantity expressed in this scale is termed a "level". If the unit is sound pressure, expressed on the dB scale, it will be termed a "Sound Pressure Level". The fundamental definition of the dB scale is given by:

$$Level = 10 \times \log_{10}\left(\frac{Q}{Q_{ref}}\right)$$

where $Q$ is the quantity being expressed on the scale, and $Q_{ref}$ is the reference quantity.

The dB scale represents a ratio and, for instance, 6 dB really means "twice as much as…". It is, therefore, used with a reference unit, which expresses the base from which the ratio is expressed. The reference quantity is conventionally smaller than the smallest value to be expressed on the scale, so that any level quoted is positive. For instance, a reference quantity of 20 µPa is used for sound in air, since this is the threshold of human hearing.

A refinement is that the scale, when used with sound pressure, is applied to the pressure squared rather than the pressure. If this were not the case, when the acoustic power level of a source rose by 10 dB the Sound Pressure Level would rise by 20 dB. So that variations in the units agree, the sound pressure must be specified in units of root mean square (RMS) pressure squared. This is equivalent to expressing the sound as:

$$Sound\ Pressure\ Level = 20 \times \log_{10}\left(\frac{P_{RMS}}{P_{ref}}\right)$$

For underwater sound, typically a unit of one micropascal (1 µPa) is used as the reference unit; a Pascal is equal to the pressure exerted by one Newton over one square metre; one micropascal equals one millionth of this.

Where not defined, all noise levels in this report are referenced to 1 µPa.

### *2.1.2 Sound pressure level (SPL)*

The sound pressure level (SPL) is normally used to characterise noise and vibration of a continuous nature such as drilling, boring, continuous wave sonar, or background sea and river noise levels. To calculate the SPL, the variation in sound pressure is measured over a specific period to determine the Root Mean Square (RMS) level of the time varying und. The SPL can therefore be considered a measure of the average unweighted level of sound over the measurement period.

Where SPL is used to characterise transient pressure waves such as that from seismic airguns, underwater blasting or impact piling, it is critical that the period over which the RMS level is calculated is quoted. For instance, in the case of pile strike lasting, say, a tenth of a second, the mean taken over a tenth of a second will be ten times higher than the mean taken over one second. Often, transient sounds such as these are quantified using “peak” SPLs.

### *2.1.3 Peak sound pressure level ($SPL_{peak}$)*

Peak SPLs are often used to characterise sound transients from impulsive sources, such as percussive impact piling and seismic airgun sources. A peak SPL is calculated using the maximum variation of the pressure from positive to zero within the wave. This represents the maximum change in positive pressure (differential pressure from positive to zero) as the transient pressure wave propagates.

A further variation of this is the peak-to-peak SPL where the maximum variation of the pressure from positive to negative within the wave is considered. Where the wave is symmetrically distributed in positive and negative pressure, the peak-to-peak level will be twice the peak level, or 6 dB higher.

### *2.1.4 Sound exposure level (SEL)*

When assessing the noise from transient sources such as blast waves, impact piling or seismic airgun noise, the issue of the duration of the pressure wave is often addressed by measuring the total acoustic energy (energy flux density) of the wave. This form of analysis was used by Bebb and Wright (1953, 1954a, 1954b and 1955), and later by Rawlins (1987) to explain the apparent discrepancies in the biological effect of short and long-range blast waves on human divers. More recently, this form of analysis has been used to develop criteria for assessing the injury range from fish for various noise sources (Popper *et al.*, 2014).

The sound exposure level (SEL) sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration the sound is present in the acoustic environment. Sound Exposure (SE) is defined by the equation:

$$SE = \int_0^T p^2(t)dt$$

where $p$ is the acoustic pressure in Pascals, $T$ is the duration of the sound in seconds, and $t$ is the time in seconds. The SE is a measure of the acoustic energy and, therefore, has units of Pascal squared seconds ($Pa^2s$).

To express the SE on a logarithmic scale by means of a dB, it is compared with a reference acoustic energy level ($p^2{}_{ref}$) and a reference time ($T_{ref}$). The SEL is then defined by:

$$SEL = 10 \times \log_{10}\left(\frac{\int_0^T p^2(t)dt}{P^2{}_{ref}T_{ref}}\right)$$

By selecting a common reference pressure $P_{ref}$ of 1 µPa for assessments of underwater noise, the SEL and SPL can be compared using the expression:

$$SEL = SPL + 10 \times \log_{10} T$$

where the $SPL$ is a measure of the average level of broadband noise, and the $SEL$ sums the cumulative broadband noise energy.

This means that, for continuous sounds of less than one second, the SEL will be lower than the SPL. For periods greater than one second, the SEL will be numerically greater than the SPL (i.e. for a sound of ten seconds duration, the SEL will be 10 dB higher than the SPL, for a sound of 100 seconds duration the SEL will be 20 dB higher than the SPL, and so on).

Weighted metrics for marine mammals have been proposed by the National Marine Fisheries Service (NMFS) 2016 and Southall *et al.,* 2007. These assign a frequency response to groups of marine mammals, and are discussed in detail in the following section.

## 2.2 Analysis of environmental effects

### *2.2.1 Background*

Over the past 20 years it has become increasingly evident that noise from human activities in and around underwater environments can have an impact on the marine species in the area. The extent to which intense underwater sound might cause an adverse impact in a species is dependent upon the incident sound level, sound frequency, duration of exposure and/or repetition rate of an impulsive sound (see for example Hastings and Popper, 2005). As a result, scientific interest in the hearing abilities of aquatic species has increased. Studies are primarily based on evidence from high level sources of underwater noise such as blasting or impact piling, as these sources are likely to have the greatest environmental impact and therefore the clearest observable effects, although there has been more interest in chronic noise exposure over the last five years.

The impacts of underwater sound on marine species can be broadly summarised as follows:

- Physical traumatic injury and fatality;
- Auditory injury (either permanent or temporary); and
- Disturbance.

The following sections discuss the agreed criteria for assessing these impacts in species of marine mammal and fish.

### *2.2.2 Criteria to be used*

The main metrics and criteria that have been used in this study to assess environmental effect come from two key papers covering underwater noise and its effects:

- The National Marine Fisheries Service guidance (NMFS, 2016) for marine mammals; and
- Sound exposure guidelines for fishes and sea turtles by Popper *et al.* (2014).

At the time of writing, these present the most authoritative criteria for assessing environmental effects for use in impact assessments.

#### 2.2.2.1 Marine mammals

Until recently, Southall *et al.* (2007) has been the source of the most widely used criteria to assess the effects of noise on marine mammals. The criteria from Southall *et al.* (2007) are based on M-Weighted

SELs, which are generalised frequency weighting functions to filter underwater noise data to better represent the levels of underwater noise various marine species are likely to be able to hear. The authors group marine mammals into five groups, four of which are relevant to underwater noise (the fifth is for pinnipeds in air). For each group, an approximate frequency range of hearing is proposed based on known audiogram data, where available, or inferred from other information such as auditory morphology. Southall *et al.* (2007) proposed a series of noise level threshold criteria, covering auditory injury, TTS (temporary threshold shift, a short-term reduction in hearing acuity) and behavioural avoidance.

Recently, NMFS (2016) was published, and was co-authored by many of the same authors from the Southall *et al.* (2007) paper. This paper effectively updates the Southall *et al.* 2007 criteria for assessing the risk of auditory injury.

Similarly, to Southall *et al.* (2007), the NMFS (2016) guidance groups marine mammals into functional hearing groups and applies filters to the unweighted noise to approximate the hearing sensitivity of the receptor. The weightings applied are different to the "M-weightings" used in Southall *et al*. The hearing groups given in the NMFS (2016) are summarised in Table 2-1 and Figure 2-1. A further group for Otariid Pinnipeds is also given in the guidance for sea lions and fur seals but this has not been used in this study as those species of pinnipeds are not found in this region.

| Hearing group | Example species | Generalised hearing range |
|---|---|---|
| Low Frequency (LF) Cetaceans | Baleen Whales | 7 Hz to 35 kHz |
| Mid Frequency (MF) Cetaceans | Dolphins, Toothed Whales, Beaked Whales, Bottlenose Whales (including Bottlenose Dolphin) | 150 Hz to 160 kHz |
| High Frequency (HF) Cetaceans | True Porpoises (including Harbour Porpoise | 275 Hz to 160 kHz |
| Phocid Pinnipeds (PW) (underwater) | True Seals (including Harbour Seal) | 50 Hz to 86 kHz |

*Table 2-1 Marine mammal hearing groups (from NMFS, 2016)*

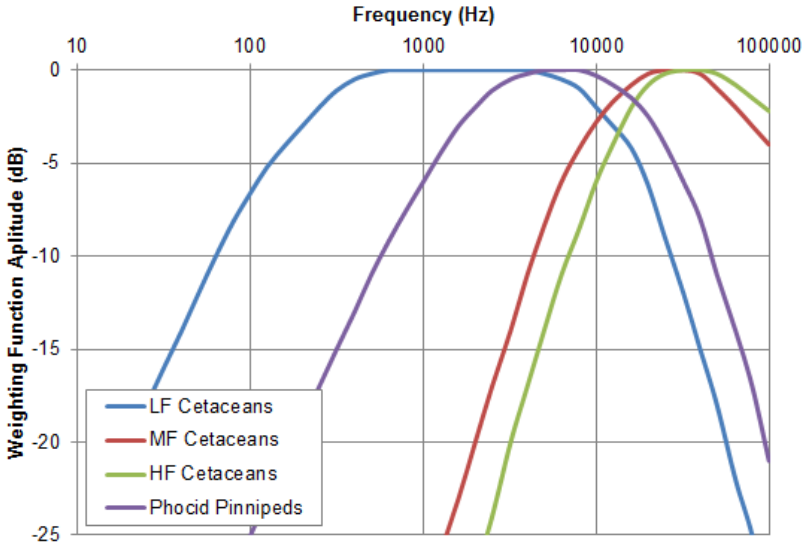


*Figure 2-1 Auditory weighting functions for low frequency (LF) cetaceans, mid frequency (MF) cetaceans, high frequency (HF) cetaceans, and phocid pinnipeds (PW) (underwater) (from NMFS, 2016)*

NMFS (2016) presents single strike, unweighted peak criteria ($SPL_{peak}$) and cumulative (i.e. more than a single sound impulse), weighted sound exposure criteria ($SEL_{cum}$) for both permanent threshold shift (PTS), where unrecoverable hearing damage may occur, and temporary threshold shift (TTS), where a temporary reduction in hearing sensitivity may occur in individual receptors.

Table 2-2 presents the NMFS (2016) criteria for onset of risk of PTS and TTS for each of the key marine mammal hearing groups.

| NMFS (2016) | **Unweighted $SPL_{peak}$ (dB re 1 µPa)** | **Weighted $SEL_{cum}$ (dB re 1 µPa²s)** | |
|---|---|---|---|
| | **Auditory injury (PTS)** | **Auditory Injury (PTS)** | **TTS (Temporary Threshold Shift)** |
| Low Frequency (LF) Cetaceans | 219 | 183 | 168 |
| Mid Frequency (MF) Cetaceans | 230 | 185 | 170 |
| High Frequency (HF) Cetaceans | 202 | 155 | 140 |
| Phocid Pinnipeds (PW) (underwater) | 218 | 185 | 170 |

*Table 2-2 Criteria for assessment of auditory injury and TTS in marine mammals (NMFS, 2016)*

Where $SEL_{cum}$ are required, a fleeing animal model has been used. This assumes that the animal exposed to high noise levels will swim away from the noise source. For this a constant fleeing speed of 1.5 $ms^{-1}$ has been assumed, which is a cruising speed for a harbour porpoise (Otani *et al.*, 2000). These are considered 'worst case' as marine mammals are expected to be able to swim much faster under stress conditions. The model assumes that a fleeing receptor stops if it reaches the coast before the noise exposure ends. The PTS and TTS criteria and results for low frequency cetaceans have been included for completeness although it is understood that species in this functional group are not considered a concern for this project.

Criteria for disturbance or behavioural reaction effects in marine mammals are in development by NMFS. For this assessment, thresholds as single strike SEL have been derived from data presented in Southall *et al.* (2007) for mid frequency and Lucke *et al.* (2009) for high frequency cetaceans. The disturbance threshold for seals is as per TTS. Criteria have not been presented for low frequency cetaceans, as these species are not generally present in the area.

| **Hearing group** | **Behavioural reaction SEL re 1 µPa²s** |
|---|---|
| Mid Frequency (MF) Cetaceans | 160 dB |
| High Frequency (HF) Cetaceans | 145 dB |

*Table 2-3 Criteria for assessment of disturbance/behavioural reaction in marine mammals*

It is worth noting that the behavioural criteria are based on a limited dataset and behaviour will be highly context dependent.

#### 2.2.2.2 Fish

The large variation in fish species leads to a greater challenge in production of a generic noise criterion, or range of criteria, for the assessment of noise impacts. Whereas previous assessments applied broad criteria based on limited studies of fish not present in UK waters (e.g. McCauley *et al.*, 2000), the publication of Popper *et al.* (2014) provides an authoritative summary of the latest research and guidelines for the assessment of fish exposure to sound.

The Popper *et al* (2014) study groups species of fish into whether they possess a swim bladder, and whether it is involved in its hearing. In the same way as NMFS (2016) the guidance gives specific criteria, as both $SPL_{peak}$ and $SEL_{cum}$ values, for a variety of noise sources. This assessment has used the criteria given for pile driving noise on fish where their swim bladder is involved in hearing, as these are the most conservative. The modelled criteria are summarised in Table 2-4. Similarly, to marine mammals for $SEL_{cum}$ results, a fleeing animal model has been used assuming a receptor flees from the source at a constant rate of 1.5 $ms^{-1}$ based on data from Hirata (1999).

| Type of animal | **Mortality and potential mortal injury** | **Impairment** | |
|---|---|---|---|
| | | **Recoverable injury** | **TTS (Temporary Threshold Shift)** |
| Fish: no swim bladder | >219 dB $SEL_{cum}$ or >213 dB $SPL_{peak}$ | >216 dB $SEL_{cum}$ or >213 dB $SPL_{peak}$ | >>186 dB $SEL_{cum}$ |
| Fish: swim bladder is not involved in hearing | 210 dB $SEL_{cum}$ or >207 dB $SPL_{peak}$ | 203 dB $SEL_{cum}$ or >207 dB $SPL_{peak}$ | >186 dB $SEL_{cum}$ |
| Fish: swim bladder involved in hearing | 207 dB $SEL_{cum}$ or >207 dB $SPL_{peak}$ | 203 dB $SEL_{cum}$ or >207 dB $SPL_{peak}$ | 186 dB $SEL_{cum}$ |

*Table 2-4 Criteria for assessment of mortality and potential mortal injury, recoverable injury and TTS in species of fish (Popper et al, 2014)*

It is worth noting the use of “greater than” and “much greater than” in these criteria. The limited data available for the calculation of these figures leads to a significant uncertainty, especially with the less sensitive fish species, as to what could cause such effect, and so the guidance is restricted to effectively a statement that the effect is likely to occur at noise exposures greater than that stated, without being able to define the level. The consequence in this assessment, in respect to fish, is that the calculated contours are expected to be somewhat conservative and are therefore are likely to overstate the risk.

Popper *et al* also consider behavioural effects in fish, which are defined as “substantial change in behaviour for the animals exposed to a sound. This may include long-term changes in behaviour and distribution, such as moving from preferred sites for feeding and reproduction, or alteration of migration patterns.”

The Popper *et al* (2014) guidelines conclude that there is insufficient data available to apply quantitative thresholds for behavioural effects on fish. Therefore, the behavioural effects for fish in this study have been considered qualitatively.

# 3 Baseline noise survey

A survey of the prevailing underwater noise levels was undertaken to establish a baseline of existing noise levels. A static, long-term underwater noise monitor was installed between 28th June and 12th July 2017 to continuously record noise levels. This period covered both spring and neap tides.

The approach and methodolgy was designed in accordance with the guidelines provided in the NPL Good Practice Guidelines (2014).

## 3.1 Methodology

### *3.1.1 Location*

Noise monitoring equipment was installed from a gantry between the main jetty and a small pier to the east. The location was chosen as it allowed for the hydrophone to be deployed away from structures in the water without presenting a risk to navigation.

The location is highly tidal with a tidal range of over 7 metres on the highest spring tides. The location chosen is on the inside of a bend in the river away from the main shipping channel the areas with the fast tidal stream to minimise the effect of water flow over the hydrophone.

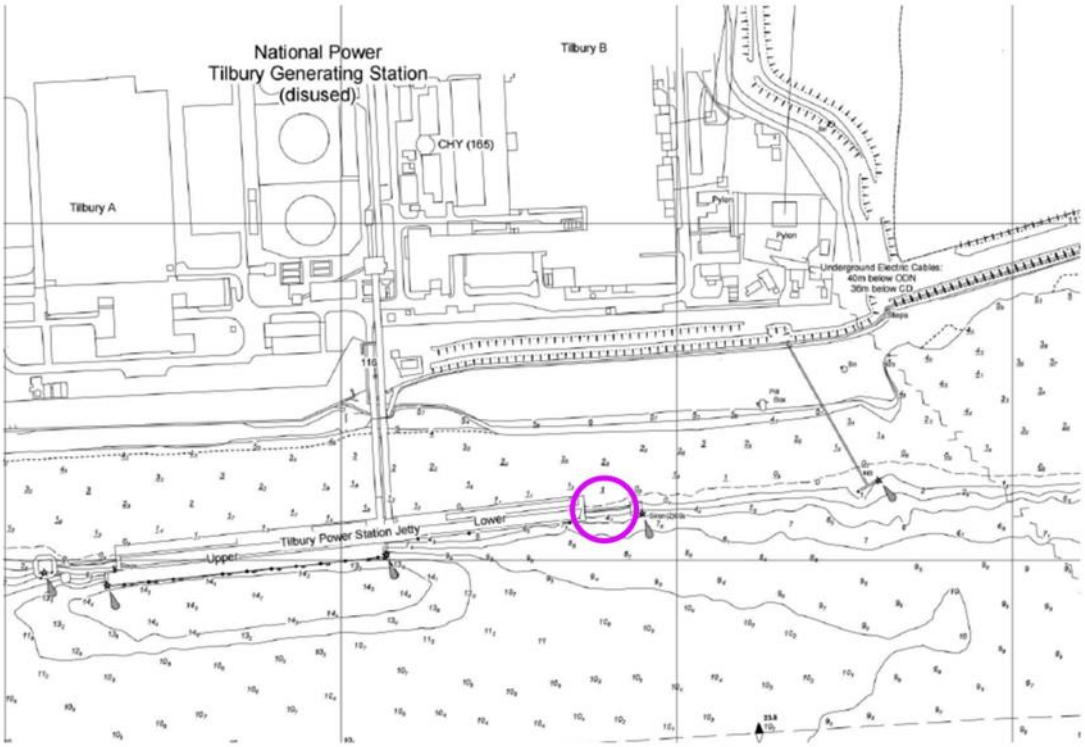


*Figure 3-1 Location of baseline acoustic recorder. Image from Port of London Authority hydrographic survey*

### *3.1.2 Equipment*

The baseline noise assessment was undertaken using, a fully calibrated Ocean Sonics icListen HF-RB9 (Serial No. 1445) digital hydrophone. The hydrophone is a self-contained package consisting of a (Reson) transducer, battery, digital processing and recording system. The hydrophone was calibrated by the manufacturer within the past 2 years and calibrated prior to deployment on site using a laboratory pistonphone. The calibration certificate is given in Appendix B.

The hydrophone was configured to continuously log processed FFT data every second using a sampling rate of 32 kS/s. In addition, raw audio data (.wav) was recorded for 1 minute every 10 minutes at a sampling rate of 512 kS/s.

### *3.1.3 Deployment*

The hydrophone was suspended on a line from the gantry with a 10 kg mass at the end of the line approximately one metre below the hydrophone. The arrangement was lowered into the water until the weight was firmly bedded in the sediment. The slack was then taken up and the line tided off. The mooring line both above and below the hydrophone was contained within a ribbed plastic sleeve to eliminate the effects of cable strum caused by hydrodynamic flow over the line under tension.

## 3.2 Results

The 1 second FFT data was processed to produce 10 second RMS values plotted as a time history in Figure 3-2. RMS values were used in accordance with the NPL 2014 guidelines as baseline noise is not expected to be impulsive in nature. Plotted alongside the noise data is the hourly tidal forecast data for Tilbury Docks published by the Port of London Authority.

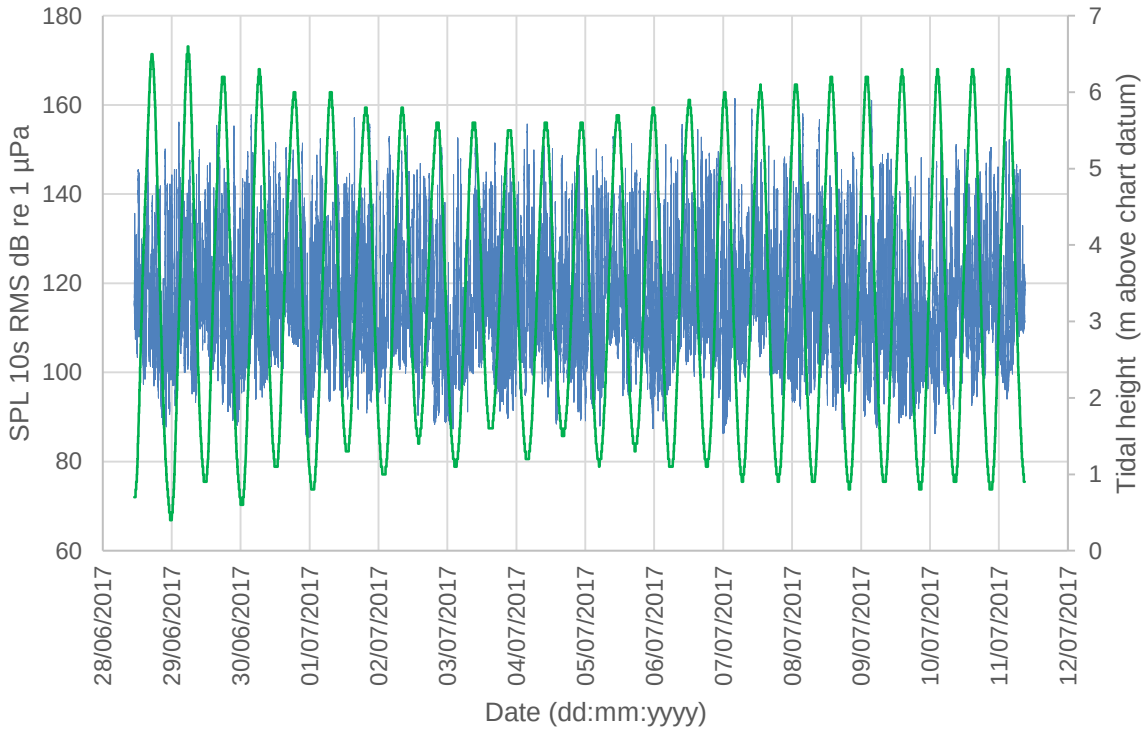


*Figure 3-2 Underwater noise levels (10 second RMS SPLs) measured from Tilbury Power Station Jetty between 10:00 on 28/06/2017 and 08:00 on 11/07/2017*

Baseline noise level is generally dependent on a mix of the movement of the water and sediment (especially in shallow water), weather conditions and shipping. There may also be a component of biological noise from marine mammal and fish vocalisation, as well as an element from invertebrates too.

In this instance, noise levels showed a high degree of variability and little correlation with tide height or tidal range. This is consistent with regular (but not continuous) vessel traffic transiting the area being the dominant contributor to average noise levels. The quietest periods were generally associated with night times and this is likely to be due to a reduction in vessel traffic.

The minimum, maximum and average noise levels for each day throughout the measurement period are presented in Table 3-1 and Table 3-2 below.

| Date | 28/06 | 29/06 | 30/06 | 01/07 | 02/07 | 03/07 | 04/07 |
|---|---|---|---|---|---|---|---|
| Maximum dB $SPL_{RMS,10s}$ | 154.7 | 156.1 | 157.8 | 157.1 | 153.0 | 155.1 | 155.7 |
| Minimum dB $SPL_{RMS,10s}$ | 87.8 | 88.1 | 85.4 | 85.5 | 88.4 | 87.3 | 88.4 |
| Mean dB $SPL_{RMS,24hr}$ | 123.1 | 126.3 | 125.3 | 124.9 | 125.0 | 123.3 | 124.7 |

*Table 3-1 Background noise levels sampled during the baseline noise survey (week 1)*

| Date | 05/07 | 06/07 | 07/07 | 08/07 | 09/07 | 10/07 | 11/07 |
|---|---|---|---|---|---|---|---|
| Maximum dB $SPL_{RMS,10s}$ | 152.9 | 155.7 | 161.5 | 158.0 | 161.1 | 151.1 | 152.2 |
| Minimum dB $SPL_{RMS,10s}$ | 87.4 | 86.2 | 86.4 | 87.2 | 87.7 | 86.2 | 94.0 |
| Mean dB $SPL_{RMS,24hr}$ | 123.8 | 125.6 | 126.4 | 125.1 | 122.5 | 124.4 | 124.3 |

*Table 3-2 Background noise levels sampled during the baseline noise survey (week 2)*

# 4 Piling noise modelling

## 4.1 Introduction

Modelling has been carried out using the INSPIRE underwater noise modelling software to ascertain noise levels from proposed piling operations in the River Thames at Tilbury.

The modelling considered four scenarios: two locations at high and low tide, which typically lead to the maximum and minimum noise propagation conditions, respectively. Tidal data was obtained from the Port of London Authority. The high tide modelling was undertaken at Mean High Water Springs (MHWS) and low tide at Mean Low Water Springs (MLWS). These are 6.4 m above LAT and 0.5 m above LAT respectively. The two locations are as follows:

| East | West |
|---|---|
| 51.4495° LAT<br>0.3922° LON | 51.4495° LAT<br>0.3802° LON |

*Table 4-1 Piling location coordinates used in modelling*

Modelling was undertaken assuming a 3.5 m diameter monopile with a maximum hammer blow energy of 555 kJ, a 1.22 m and 914 mm pile with a maximum blow energy of 208 kJ, and also a 610 mm pile with a blow energy of 74 kJ.

The actual piles and blow energy to be used was unknown at the time of modelling and as such the estimated blow energies was chosen as representative of maximum energies that may typically be used based on engineering predictions and Subacoustech Environmental's experience on similar projects. The locations used are the most eastern and western piling locations for the construction works.

Piling durations of one hour and a blow rate of one strike per second have been assumed in the modelling. As above, data specific to the Port of Tilbury project is not available, but these parameters are representative of similar piling projects seen by Subacoustech Environmental in the River Thames and other locations.

The outputs from the INSPIRE modelling are presented as maximum impact range tables and contour plot figures based upon absolute, unweighted noise levels and weighted noise levels for low, mid and high frequency cetaceans in as well as for phocid pinnipeds. Weightings for marine mammals are taken from the National Marine Fisheries Service (NOAA) in the United States (NMFS, 2016). Also highlighted is the range at which Popper *et al*, 2014 criteria of 186 dB SEL re 1 $\mu Pa^2s$ for temporary threshold shift in fish is exceeded.

## 4.2 INSPIRE Modelling

Subacoustech's INSPIRE model has been used in this study. INSPIRE is a semi-empirical, range dependent propagation model that is built on a large amount of measured data from a range of piling projects in UK waters. It takes full account of bathymetry and tidal conditions.

INSPIRE was previously used to model potential noise levels from piling on the River Thames for the Tideway project. Measurements were taken during the subsequent pile installations and the results were found to be in good agreement (within 1-2 dB) with the INSPIRE predictions giving confidence to the use of INSPIRE in this case.

## 4.3 Source levels

Underwater noise propagation modelling requires knowledge of the source level, which is the theoretical noise level at 1 m from the noise source. Subacoustech have undertaken numerous measurements of in-water impact piling and for piles on this scale have developed a sound level model based on the pile diameter and blow energy used during a piling operation. For smaller piles and have been shown to be primary factors when comparing piling operations and the subsequent subsea noise levels produced.

Figure 4-1 source level curve fit to the measured data. This holds well for the smaller pile sizes, although when considering the pile sizes in excess of 4 m the calculation is more complex. Note also that the curve shows the noise level in $SPL_{peak\text{-}to\text{-}peak}$, whereas the value used in the modelling against the NMFS and Popper *et al* criteria are in $SPL_{peak}$. For this noise type the $SPL_{peak}$ is approximately 6 dB lower than the $SPL_{peak\text{-}to\text{-}peak}$.

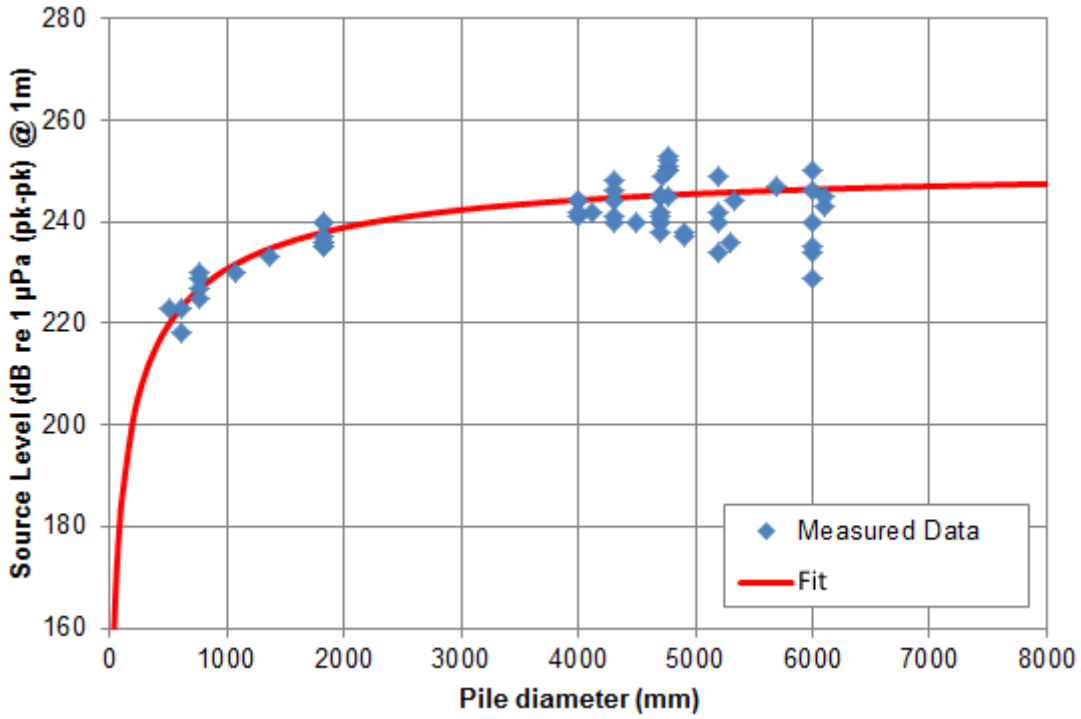


*Figure 4-1 Pile diameter vs source level estimator, where line-of-fit is aligned conservatively near the top of the measured data*

The predicted source noise levels used in the modelling are given in Table 4-2. An additional conversion factor is used to determine the equivalent SEL for a pile strike, based on Subacoustech's database of measured noise levels from piling events.

| | Source Level | |
|---|---|---|
| | $SPL_{peak}$, re 1 µPa | SEL, re 1 $\mu Pa^2s$ |
| 3.5 m Pile, 555 kJ | 238.8 dB | 212.3 dB |
| 1.22 m Pile, 208 kJ | 227.9 dB | 200.0 dB |
| 914 mm Pile, 208 kJ | 225.3 dB | 196.8 dB |
| 610 mm Pile, 74 kJ | 217.2 dB | 187.1 dB |

*Table 4-2 Source noise levels (unweighted) used in modelling*

# 5 Modelling Results

## 5.1 3.5 m Piles

The range outputs for the underwater noise modelling of the larger 3.5 m piles are outlined in the following sections in respect of the two modelled locations, and tidal depths. The maximum, minimum and mean ranges at which the various criteria are reached are identified. Due to the shape of the river, the minimum is typically limited to the point at which the transect reaches the nearest riverbank. The maximum range will always be in an unrestricted transect directly up or downstream from the piling location. Contour plots for the greatest ranges associated with the 3.5 m piles, and the lowest ranges associated with the 610 mm piles, are presented in 7Appendix A.

### *5.1.1 Marine mammals – permanent threshold shift (PTS)*

The following tables show the $SPL_{peak}$ and $SEL_{cum}$ ranges for marine mammals, modelled to the criteria NMFS (NOAA) 2016 criteria detailed in section 2.2.2. The $SEL_{cum}$ exposure ranges assume that the animal flees from the noise at a speed of 1.5 m/s, and the range represents the distance that the animal must be at the start of piling in order to not exceed the criteria.

| LF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$, 183 dB threshold | | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$, 183 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 40 | 40 | 3550 | 2800 | 40 | 40 | 3900 | 3250 |
| Min | 30 | 30 | 150 | 100 | 30 | 30 | 150 | 100 |
| Mean | 35 | 35 | 859 | 719 | 35 | 35 | 747 | 642 |

*Table 5-1 Range in metres for low frequency cetaceans – PTS thresholds*

| MF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$, 185 dB threshold | | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$, 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 20 | 20 | 50 | 50 | 20 | 20 | 100 | 50 |
| Min | 10 | 10 | 50 | 50 | 10 | 10 | 50 | 50 |
| Mean | 15 | 15 | 50 | 50 | 15 | 15 | 51 | 50 |

*Table 5-2 Range in metres for mid frequency cetaceans – PTS thresholds*

| HF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$, 155 dB threshold | | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$, 155 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 160 | 140 | 4050 | 3250 | 160 | 150 | 4550 | 3800 |
| Min | 140 | 110 | 150 | 100 | 140 | 110 | 150 | 150 |
| Mean | 153 | 132 | 900 | 772 | 153 | 138 | 783 | 689 |

*Table 5-3 Range in metres for high frequency cetaceans – PTS thresholds*

| Pinn. | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$, 185 dB threshold | | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$, 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 50 | 50 | 1750 | 1400 | 50 | 50 | 1900 | 1450 |
| Min | 40 | 40 | 150 | 100 | 40 | 40 | 150 | 100 |
| Mean | 45 | 45 | 593 | 472 | 45 | 45 | 528 | 433 |

*Table 5-4 Range in metres for phocid pinnipeds – PTS thresholds*

In all cases the weighted $SEL_{cum}$ criteria set lead to the greatest ranges compared to the equivalent $SPL_{peak}$. Over the shorter ranges (<100 m) the depth of water has a negligible effect on sound propagation, greater propagation loss is evident at low tide and increased ranges.

The minimum ranges are limited by the nearest river bank. The maximum ranges are limited by the distance to the bend in the river at Cliffe Pools to the east of the site.

### *5.1.2 Marine mammals – temporary threshold shift (TTS)*

The following tables show the modelled ranges within which a receptor receives exposure sufficient to cause TTS. As with the PTS, the range represents the distance that an animal must be from the noise source at the commencement of piling, before fleeing, for it to receive the stated dose.

| LF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$, 168 dB threshold | | Weighted $SEL_{cum}$, 168 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 4450 | 3850 | 4950 | 4350 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 929 | 800 | 805 | 712 |

*Table 5-5 Range in metres for low frequency cetaceans – TTS thresholds*

| MF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$, 170 dB threshold | | Weighted $SEL_{cum}$, 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 2100 | 1650 | 2300 | 1800 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 659 | 527 | 586 | 483 |

*Table 5-6 Range in metres for mid frequency cetaceans – TTS thresholds*

| HF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$, 140 dB threshold | | Weighted $SEL_{cum}$, 140 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 4450 | 3900 | 5000 | 4400 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 931 | 804 | 807 | 714 |

*Table 5-7 Range in metres for high frequency cetaceans – TTS thresholds*

| Pinniped | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$, 170 dB threshold | | Weighted $SEL_{cum}$, 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 4150 | 3350 | 4650 | 3950 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 908 | 780 | 789 | 695 |

*Table 5-8 Range in metres for phocid pinnipeds – TTS thresholds*

The maximum ranges for marine mammals in respect of TTS are up to 5000 m for High Frequency Cetaceans (e.g. harbour porpoise), which largely encompasses the stretch of the River Thames between the bends at Cliffe Pools and the entrance to the existing Port of Tilbury.

The limitations in these results are the same as those identified for the PTS modelling: minimum ranges will not be greater than the distance to the nearest river bank and maximum ranges will not be greater than the distance from piling to the east to Cliffe Pools. Beyond this, line-of-sight will be lost and exposures will drop.

### *5.1.3 Marine mammals – behavioural effects*

Avoidance/behavioural reaction in marine mammals for MF and HF cetaceans has been modelled using criteria derived from Southall et al. (2007) and Lucke et al. (2009). MF cetaceans are predicted to show avoidance behaviour at ranges up to 3,420 m from the piling. HF cetaceans are predicted to show avoidance behaviour out to 5,000 m from the piling, which encompasses the east-west stretch of the River Thames with effective line-of-sight to the piling. It should be noted that this is based on a single strike SEL as opposed to the cumulative SEL used for the TTS and PTS criteria above.

### *5.1.4 Fish – PTS and TTS*

Results of the underwater noise modelling in respect of fish criteria as presented in Popper *et al.* 2014 are given in Table 5-9 and Table 5-10 below. All thresholds are unweighted and for the most sensitive species, i.e. those with a swim bladder.

| Fish | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ >207 dB | | Unweighted $SEL_{cum}$, 203 dB threshold | | Unweighted $SPL_{peak}$ >207 dB | | Unweighted $SEL_{cum}$, 203 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 90 | 80 | 200 | 150 | 90 | 80 | 250 | 200 |
| Min | 80 | 70 | 50 | 50 | 80 | 70 | 50 | 50 |
| Mean | 85 | 75 | 131 | 103 | 85 | 75 | 129 | 103 |

*Table 5-9 Range in metres for fish (swim bladder involved in hearing) – recoverable injury thresholds*

In accordance with the criteria in Popper *et al.* (2014), risk of recoverable injury in fish is limited to within 250 m at high tide, for the most sensitive fish species, and where line-of-sight is maintained for the duration of the piling. For fish species without a swim bladder, any range of impact is likely to be somewhat less than this, although a precise threshold has not been defined in the literature.

| Fish | East | | West | |
|---|---|---|---|---|
| | Unweighted $SEL_{cum}$, 186 dB threshold | | Unweighted $SEL_{cum}$, 186 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 3300 | 2600 | 3600 | 3000 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 832 | 694 | 726 | 621 |

*Table 5-10 Range in metres for fish (swim bladder involved in hearing) – TTS thresholds*

Risk of TTS in the most sensitive category of fish, where the species has a swim bladder connected to their hearing (e.g. herring), temporary, recoverable effects on the fishes' hearing could occur at most at 3,600 m from the piling, at high spring tides. This is worst case, where less sensitive species are expected to be at lower risk and have consequently a lower range over which a risk is posed.

### *5.1.5 Fish – behavioural effects*

As stated in section 2.2.2.2, for effects where insufficient data exist to make recommendations for thresholds Popper *et al.* (2014) gives an indication of the relative risk of the effect. In each case three overarching distances for source are given along with a relative risk rating.

The three qualitative distances given are "near", "intermediate", and "far"; Popper *et al* (2014) states that "while it would not be appropriate to ascribe particular distances to effects because of the many variables in making such decisions, "near" might be considered to be in the tens of meters from the source, "intermediate" in the hundreds of meters, and "far" in the thousands of meters." These ranges are each given a risk rating or either "high", "moderate", or "low". The ratings are again split into noise type (in this case, pile driving) and type of fish.

Table 5-11 summarises the qualitative impacts for pile driving given by Popper *et al* (2014) for fish with swim bladders involved with their hearing, which are most sensitive. Table 5-12 shows the results from the two remaining categories, "no swim bladder" and "swim bladder not involved in hearing", which are less sensitive to sound.

| Effect | **Near ranges** | **Intermediate ranges** | **Far ranges** |
|---|---|---|---|
| Behavioural | High risk | High risk | Moderate risk |

*Table 5-11 Summary of the qualitative impacts on fish with swim bladder involved in hearing (most sensitive)*

| Effect | **Near ranges** | **Intermediate ranges** | **Far ranges** |
|---|---|---|---|
| Behavioural | High risk | Moderate risk | Low risk |

*Table 5-12 Summary of the qualitative impacts on other species of fish*

## 5.2 1.22 m Piles

The range outputs for the underwater noise modelling of the 1.22 m piles is outlined in the following sections in respect of the two modelled locations, and tidal depths. The maximum, minimum and mean ranges at which the various criteria are reached are identified.

### *5.2.1 Marine mammals – permanent threshold shift (PTS)*

The following tables show the $SPL_{peak}$ and $SEL_{cum}$ ranges for marine mammals, modelled to the criteria NMFS (NOAA) 2016 criteria detailed in section 2.2.2. The $SEL_{cum}$ exposure ranges assume that the animal flees from the noise at a speed of 1.5 m/s, and the range represents the distance that the animal must be at the start of piling in order to not exceed the criteria.

| LF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 30 | 30 | 1050 | 800 | 30 | 30 | 1100 | 850 |
| Min | 30 | 30 | 100 | 100 | 30 | 30 | 100 | 100 |
| Mean | 30 | 30 | 418 | 327 | 30 | 30 | 380 | 309 |

*Table 5-13 Range in metres for low frequency cetaceans for impact piling of a 1.22 m pile – PTS thresholds*

| MF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-14 Range in metres for mid frequency cetaceans for impact piling of a 1.22 m pile – PTS thresholds*

| HF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 70 | 70 | 2050 | 1600 | 70 | 70 | 2200 | 1700 |
| Min | 70 | 70 | 150 | 100 | 70 | 70 | 150 | 100 |
| Mean | 70 | 70 | 641 | 514 | 70 | 70 | 569 | 470 |

*Table 5-15 Range in metres for high frequency cetaceans for impact piling of a 1.22 m pile – PTS thresholds*

| Pinniped | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 40 | 40 | 100 | 100 | 40 | 40 | 100 | 100 |
| Min | 40 | 40 | 50 | 50 | 40 | 40 | 50 | 50 |
| Mean | 40 | 40 | 81 | 61 | 40 | 40 | 79 | 61 |

*Table 5-16 Range in metres for pinnipeds for impact piling of a 1.22 m pile – PTS thresholds*

The maximum PTS impact ranges for HF cetaceans is 2,200 m for $SEL_{cum}$ at the West pile. For all MF cetaceans and pinnipeds the impact range for PTS is very small.

### 5.2.2 *Marine mammals – temporary threshold shift (TTS)*

The following tables show the modelled ranges within which a receptor receives exposure sufficient to cause TTS. As with the PTS, the range represents the distance that an animal must be from the noise source at the commencement of piling, before fleeing, for it to receive the stated dose.

| LF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 168 dB threshold | | Weighted $SEL_{cum}$ 168 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 3900 | 3100 | 4350 | 3600 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 887 | 757 | 769 | 675 |

*Table 5-17 Range in metres for low frequency cetaceans for impact piling of a 1.22 m pile – TTS thresholds*

| MF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 50 | 50 | 50 | 50 |
| Min | 50 | 50 | 50 | 50 |
| Mean | 50 | 50 | 50 | 50 |

*Table 5-18 Range in metres for mid frequency cetaceans for impact piling of a 1.22 m pile – TTS thresholds*

| HF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 140 dB threshold | | Weighted $SEL_{cum}$ 140 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 4200 | 3450 | 4750 | 4050 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 912 | 785 | 792 | 700 |

*Table 5-19 Range in metres for high frequency cetaceans for impact piling of a 1.22 m pile – TTS thresholds*

| Pinniped | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 2400 | 1900 | 2600 | 2050 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 706 | 578 | 623 | 523 |

*Table 5-20 Range in metres pinnipeds for impact piling of a 1.22 m pile – TTS thresholds*

As with PTS, TTS ranges for MF cetaceans are comparatively small and the maximum range is 4,750 m for HF cetaceans and 2,600 m for pinnipeds.

### 5.2.3 *Marine mammals – behavioural effects.*

Avoidance/behavioural reaction in marine mammals for MF and HF cetaceans has been modelled using criteria derived from Southall *et al.* (2007) and Lucke *et al.* (2009). MF cetaceans are predicted to show

avoidance behaviour at ranges up to 670 m from the piling. HF cetaceans are predicted to show avoidance behaviour out to 4,320 m from the piling. It should be noted that this is based on a single strike SEL as opposed to the cumulative SEL used for the TTS and PTS criteria above.

### *5.2.4 Fish – PTS and TTS*

Results of the underwater noise modelling in respect of fish criteria as presented in Popper *et al.* 2014 are given in Table 5-41 and Table 5-42 below. All thresholds are unweighted and for the most sensitive species, i.e. those with a swim bladder.

| Fish | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 60 | 60 | <50 | <50 | 60 | 60 | <50 | <50 |
| Min | 60 | 60 | <50 | <50 | 60 | 60 | <50 | <50 |
| Mean | 60 | 60 | <50 | <50 | 60 | 60 | <50 | <50 |

*Table 5-21 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 1.22 m pile – recoverable injury thresholds*

| Fish | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 186 dB threshold | | Weighted $SEL_{cum}$ 186 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 750 | 550 | 800 | 600 |
| Min | 100 | 100 | 100 | 100 |
| Mean | 336 | 265 | 308 | 255 |

*Table 5-22 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 1.22 m pile – TTS thresholds*

### *5.2.5 Fish – behavioural effects*

The criteria identified in section 2.2.2.2 for fish behavioural effects is qualitative for pile driving and makes no distinction for different pile sizes or blow energies therefore the risks identified for 3.5 m piles (section 5.1.5) also apply for 1.22 m piles. Given the reduction in noise levels the ranges identified for near field (tens of metres) intermediate (hundreds of metres) and far field (thousands of metres) would be expected to be lower for a 1.22 m pile but the available literature does not allow for this to be quantified.

## 5.3 914 mm Piles

The range outputs for the underwater noise modelling of the smaller 914 mm piles is outlined in the following sections in respect of the two modelled locations, and tidal depths. The maximum, minimum and mean ranges at which the various criteria are reached are identified.

### *5.3.1 Marine mammals – permanent threshold shift (PTS)*

The following tables show the $SPL_{peak}$ and $SEL_{cum}$ ranges for marine mammals, modelled to the criteria NMFS (NOAA) 2016 criteria detailed in section 2.2.2. The $SEL_{cum}$ exposure ranges assume that the animal flees from the noise at a speed of 1.5 m/s, and the range represents the distance that the animal must be at the start of piling in order to not exceed the criteria.

| LF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 30 | 30 | 500 | 350 | 30 | 30 | 550 | 400 |
| Min | 30 | 30 | 100 | 100 | 30 | 30 | 100 | 100 |
| Mean | 30 | 30 | 251 | 197 | 30 | 30 | 237 | 192 |

*Table 5-23 Range in metres for low frequency cetaceans for impact piling of a 914 mm pile – PTS thresholds*

| MF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-24 Range in metres for mid frequency cetaceans for impact piling of a 914 mm pile – PTS thresholds*

| HF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | 70 | 70 | 1300 | 1000 | 70 | 70 | 1400 | 1050 |
| Min | 70 | 70 | 100 | 100 | 70 | 70 | 150 | 100 |
| Mean | 70 | 70 | 493 | 386 | 70 | 70 | 444 | 360 |

*Table 5-25 Range in metres for high frequency cetaceans for impact piling of a 914 mm pile – PTS thresholds*

| Pinniped | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <50 | <50 | <10 | <10 | <50 | <50 |
| Min | <10 | <10 | <50 | <50 | <10 | <10 | <50 | <50 |
| Mean | <10 | <10 | <50 | <50 | <10 | <10 | <50 | <50 |

*Table 5-26 Range in metres for pinnipeds for impact piling of a 914 mm pile – PTS thresholds*

The maximum PTS impact ranges is 1,400 m for $SEL_{cum}$ HF cetaceans at the West pile. For all MF cetaceans and pinnipeds the impact range for PTS is very small.

### *5.3.2 Marine mammals – temporary threshold shift (TTS)*

The following tables show the modelled ranges within which a receptor receives exposure sufficient to cause TTS. As with the PTS, the range represents the distance that an animal must be from the noise source at the commencement of piling, before fleeing, for it to receive the stated dose.

| LF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 168 dB threshold | | Weighted $SEL_{cum}$ 168 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 3450 | 2750 | 3800 | 3150 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 850 | 711 | 739 | 634 |

*Table 5-27 Range in metres for low frequency cetaceans for impact piling of a 914 mm pile – TTS thresholds*

| MF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | <50 | <50 | <50 | <50 |
| Min | <50 | <50 | <50 | <50 |
| Mean | <50 | <50 | <50 | <50 |

*Table 5-28 Range in metres for mid frequency cetaceans for impact piling of a 914 mm pile – TTS thresholds*

| HF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 140 dB threshold | | Weighted $SEL_{cum}$ 140 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 4000 | 3250 | 4500 | 3750 |
| Min | 150 | 100 | 150 | 150 |
| Mean | 898 | 769 | 781 | 686 |

*Table 5-29 Range in metres for high frequency cetaceans for impact piling of a 914 mm pile – TTS thresholds*

| Pinniped | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 1650 | 1300 | 1800 | 1350 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 569 | 451 | 509 | 416 |

*Table 5-30 Range in metres pinnipeds for impact piling of a 914 mm pile – TTS thresholds*

As with PTS, TTS ranges for MF cetaceans and pinnipeds are comparatively small and the maximum range is 4500 m for HF cetaceans.

### 5.3.3 *Marine mammals – behavioural effects.*

Avoidance/behavioural reaction in marine mammals for MF and HF cetaceans has been modelled using criteria derived from Southall *et al.* (2007) and Lucke *et al.* (2009). MF cetaceans are predicted to show avoidance behaviour at ranges up to 410 m from the piling. HF cetaceans are predicted to show avoidance behaviour out to 3230 m from the piling, this extends across the width of the River Thames at the site. It should be noted that this is based on a single strike SEL as opposed to the cumulative SEL used for the TTS and PTS criteria above.

### 5.3.4 *Fish – PTS and TTS*

Results of the underwater noise modelling in respect of fish criteria as presented in Popper *et al.* 2014 are given in Table 5-41 and Table 5-42 below. All thresholds are unweighted and for the most sensitive species, i.e. those with a swim bladder.

| Fish PTS | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-31 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 914 mm pile – recoverable injury thresholds*

| Fish TTS | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 186 dB threshold | | Weighted $SEL_{cum}$ 186 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 350 | 250 | 350 | 250 |
| Min | 100 | 50 | 100 | 50 |
| Mean | 192 | 142 | 183 | 142 |

*Table 5-32 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 914 mm pile – TTS thresholds*

### 5.3.5 *Fish – behavioural effects*

The criteria identified in section 2.2.2.2 for fish behavioural effects is qualitative for pile driving and makes no distinction for different pile sizes therefore the risks identified for 3.5 m piles (section 5.1.5) also apply for 914 mm piles. Given the reduction in noise levels the ranges identified for near field (tens of metres) intermediate (hundreds of metres) and far field (thousands of metres) would be expected to be lower for a 914 mm pile but the available literature does not allow for this to be quantified.

## 5.4 610 mm Piles

The range outputs for the underwater noise modelling of the smaller 610 mm piles is outlined in the following sections in respect of the two modelled locations, and tidal depths. The maximum, minimum and mean ranges at which the various criteria are reached are identified. Given the small ranges, contour plots are of little benefit and are not presented.

Measurements undertaken by Subacoustech have demonstrated that impact piling of sheet piles generates similar underwater noise levels to small tubular piles (600-800 mm).

### *5.4.1 Marine mammals – permanent threshold shift (PTS)*

The following tables show the $SPL_{peak}$ and $SEL_{cum}$ ranges for marine mammals, modelled to the criteria NMFS (NOAA) 2016 criteria detailed in section 2.2.2. The $SEL_{cum}$ exposure ranges assume that the animal flees from the noise at a speed of 1.5 m/s, and the range represents the distance that the animal must be at the start of piling in order to not exceed the criteria.

| LF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | | Unweighted $SPL_{peak}$ 219 dB | | Weighted $SEL_{cum}$ 183 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | 20 | 15 | <10 | <10 | 20 | 15 |
| Min | <10 | <10 | 10 | 10 | <10 | <10 | 10 | 10 |
| Mean | <10 | <10 | 17 | 13 | <10 | <10 | 16 | 13 |

*Table 5-33 Range in metres for low frequency cetaceans for impact piling of a 610 mm pile – PTS thresholds*

| MF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 230 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-34 Range in metres for mid frequency cetaceans for impact piling of a 610 mm pile – PTS thresholds*

| HF cetacean | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | | Unweighted $SPL_{peak}$ 202 dB | | Weighted $SEL_{cum}$ 155 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | 115 | 85 | <10 | <10 | 120 | 90 |
| Min | <10 | <10 | 40 | 30 | <10 | <10 | 40 | 35 |
| Mean | <10 | <10 | 75 | 57 | <10 | <10 | 72 | 58 |

*Table 5-35 Range in metres for high frequency cetaceans for impact piling of a 610 mm pile – PTS thresholds*

| Pinniped | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | | Unweighted $SPL_{peak}$ 218 dB | | Weighted $SEL_{cum}$ 185 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-36 Range in metres for pinnipeds for impact piling of a 610 mm pile – PTS thresholds*

The maximum PTS impact ranges is 120 m for $SEL_{cum}$ HF cetaceans at the West pile. For all MF cetaceans and pinnipeds the impact range for PTS is very small.

### *5.4.2 Marine mammals – temporary threshold shift (TTS)*

The following tables show the modelled ranges within which a receptor receives exposure sufficient to cause TTS. As with the PTS, the range represents the distance that an animal must be from the noise source at the commencement of piling, before fleeing, for it to receive the stated dose.

| LF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 168 dB threshold | | Weighted $SEL_{cum}$ 168 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 1650 | 1300 | 1800 | 1400 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 576 | 456 | 514 | 421 |

*Table 5-37 Range in metres for low frequency cetaceans for impact piling of a 610 mm pile – TTS thresholds*

| MF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | <50 | <50 | <50 | <50 |
| Min | <50 | <50 | <50 | <50 |
| Mean | <50 | <50 | <50 | <50 |

*Table 5-38 Range in metres for mid frequency cetaceans for impact piling of a 610 mm pile – TTS thresholds*

| HF cetacean | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 140 dB threshold | | Weighted $SEL_{cum}$ 140 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 2700 | 2150 | 2900 | 2350 |
| Min | 150 | 100 | 150 | 100 |
| Mean | 751 | 614 | 661 | 556 |

*Table 5-39 Range in metres for high frequency cetaceans for impact piling of a 610 mm pile – TTS thresholds*

| Pinniped | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 170 dB threshold | | Weighted $SEL_{cum}$ 170 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | 250 | 200 | 300 | 200 |
| Min | 100 | 50 | 100 | 50 |
| Mean | 164 | 125 | 156 | 123 |

*Table 5-40 Range in metres pinnipeds for impact piling of a 610 mm pile – TTS thresholds*

As with PTS, TTS ranges for MF cetaceans and pinnipeds are comparatively small and the maximum range is 2900 m for HF cetaceans.

### *5.4.3 Marine mammals – behavioural effects.*

Avoidance/behavioural reaction in marine mammals for MF and HF cetaceans has been modelled using criteria derived from Southall *et al.* (2007) and Lucke *et al.* (2009). MF cetaceans are predicted to show avoidance behaviour at ranges up to 100 m from the piling. HF cetaceans are predicted to show avoidance behaviour out to 900 m from the piling, this extends across the width of the River Thames at the site. It should be noted that this is based on a single strike SEL as opposed to the cumulative SEL used for the TTS and PTS criteria above.

### *5.4.4 Fish – PTS and TTS*

Results of the underwater noise modelling in respect of fish criteria as presented in Popper *et al.* 2014 are given in Table 5-41 and Table 5-42 below. All thresholds are unweighted and for the most sensitive species, i.e. those with a swim bladder.

| Fish | East | | | | West | | | |
|---|---|---|---|---|---|---|---|---|
| | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | | Unweighted $SPL_{peak}$ >207 dB | | Weighted $SEL_{cum}$ 203 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |

*Table 5-41 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 610 mm pile – recoverable injury thresholds*

| Fish | East | | West | |
|---|---|---|---|---|
| | Weighted $SEL_{cum}$ 186 dB threshold | | Weighted $SEL_{cum}$ 186 dB threshold | |
| Tide | MHWS | MLWS | MHWS | MLWS |
| Max | <10 | <10 | <10 | <10 |
| Min | <10 | <10 | <10 | <10 |
| Mean | <10 | <10 | <10 | <10 |

*Table 5-42 Range in metres for fish (swim bladder involved in hearing) for impact piling of a 610 mm pile – TTS thresholds*

### *5.4.5 Fish – behavioural effects*

The criteria identified in section 2.2.2.2 for fish behavioural effects is qualitative for pile driving and makes no distinction for different pile sizes therefore the risks identified for 3.5 m piles (section 5.1.5) also apply for 610 mm piles. Given the reduction in noise levels the ranges identified for near field (tens of metres) intermediate (hundreds of metres) and far field (thousands of metres) would be expected to be lower for a 610 mm pile but the available literature does not allow for this to be quantified.

## 5.5 Discussion

All species of fish and marine mammal have their own weightings and thresholds, and based on these the greatest ranges of impact are modelled for the HF cetaceans (i.e. harbour porpoises). The LF cetaceans have the next highest ranges, although species falling in this category (see Table 2-1) would be rare in the location of concern, and thus have been excluded from discussion.

For all pile sizes, the ranges of impact are typically slightly higher for the piling position furthest to the west, although the difference overall between the ranges calculated for the eastern and western extent is small. Similarly, the greatest noise propagation is found at high tide, with deeper water leading to larger calculated impact ranges.

The cumulative SEL exposure criteria are calculated assuming that, over the piling duration, the animal flees from the noise in a straight line. As a worst-case scenario, if the animal reaches the coast, it remains in this position and continues to be exposed. However, it is not unreasonable to assume that, in practice, an animal would seek shelter or turn a corner in the river, and losing 'line-of-sight' to the noise source would substantially reduce the level of exposure. The calculation methodology therefore is somewhat conservative.

The River Thames at the site is up to 1 km in width. During installation of the larger piles the large ranges would likely deter fish and marine mammals from entering or passing through the area. The greatest PTS impact ranges with the smaller piles does not extend to the mid-point of the river and it would seem likely that species less sensitive to acoustic pressure (such as salmon and trout) may still be able to pass during installation however, this is highly context specific and depend on the biological imperative of the animals.

It is worth noting that the impacts will be limited to the period in which piling occurs, and this is likely to represent only a few hours of any given day.

# 6 Other underwater noise consideration

Other noise sources have been considered qualitatively as impact ranges are expected to be considerably smaller than those predicted for piling. In each case the range at which the noise level will drop below 140 dB is indicated. 140 dB was selected as it is between the maximum and average baseline noise level and as such provides an indication of the range at which the noise level falls within the range of levels that might be typically expected in the area. Ranges to the average baseline levels (123 dB re 1 µPa) are also included and in all cases the noise levels are unweighted, and the ranges are therefore considered conservative.

## 6.1 Sheet piling

It is intended that sheet piling will be undertaken during the construction works. Detailed information regarding the installation methods were not available at the time of this study.

In the experience of Subacoustech, sheet piles are typically installed using a combination of vibro piling and, if required, impact piling. Vibro-piling has not been considered in detail and noise levels are generally very low in comparison to percussive piling. Previous studies have shown that percussive piling used to install sheet piles generates similar underwater noise levels to a small tubular pile (600-800 mm).

It is considered reasonable to use the modelling results from the 610 mm piles as an indicative measure of the likely impact of percussive piling of sheet piles until more detailed information is available.

Noise levels from vibro piling wound be expected to fall below 140 dB re 1 µPa within 870 m of the works.

## 6.2 Dredging

During the construction phase of the project, it is anticipated that dredging will be undertaken in addition to piling to make the jetty more accessible to larger vessels.

Underwater noise from dredging is highly dependent on the method used. For maintaining depths close to existing structures, backhoe dredging is commonly used. This method typically utilises an excavator mounted on a barge with all machinery located above the deck level.

Underwater noise from backhoe dredging is caused by noise from engines or hydraulic power units radiating through the hull of the barge into the water. As such, noise levels would be expected to be similar to a small vessel and below the noise levels produced by larger vessels underway which frequently transit the area. Noise levels would be expected to drop below 140 dB re. 1 µPa within 20 m and below the average baseline noise level within 140 m.

For this reason, noise from backhoe dredging is unlikely to be significant and detailed modelling of backhoe dredging has not been undertaken.

Suction dredging does generate higher noise levels than backhoe dredging but is not considered to be a significant contributor to overall noise levels. Noise levels from suction dredging would be expected to drop to below 140 dB re 1 µPa with 250 m and below average baseline noise with 1,500 m.

## 6.3 Operational

During operation, additional vessel traffic at the jetty will present an additional contribution to existing noise levels. The significance of this contribution is dependent on the size of vessel, number of additional vessel movements and the time vessels spend moored alongside the jetty. None of these is known at the time of the study and a qualitative review has been undertaken.

The River Thames is a busy commercial waterway with significant levels of existing vessel traffic. When vessels are alongside the jetty noise will be produced and radiated into the water from engines at idle or ancillary equipment such as generators and pumps. Noise levels from vessels alongside are expected to be significantly below the levels from existing traffic and so have negligible effect on the average noise levels except in the immediate vicinity (tens of metres) of the vessel. Noise levels from a stationary vessel would typically be expected to drop below the average baseline noise level within 120 m.

The additional noise resulting from vessel movements to and from the jetty is also expected to have minimal effect on the average noise levels in the river. A doubling of all vessel movements would be required to produce a 3 dB increase in average noise levels. Given the existing high levels of traffic, including large vessel manoeuvring in and out of the lock gates, the contribution from additional traffic to and from the jetty is unlikely to result in a significant increase in average noise levels. A more detailed study would be required to confirm or quantify this.

# 7 Summary and conclusions

Subacoustech Environmental has undertaken a study to assess existing baseline noise levels and the effect of impact piling noise during construction of the new port at Port of Tilbury. This report presents the results of the underwater noise measurements and modelling undertaken to ascertain the magnitude of these impacts to appropriate criteria.

The level of underwater noise from the installation of piles during construction has been estimated by using the INSPIRE underwater noise model. The modelling considers a wide variety of input parameters including bathymetry, hammer blow energy, pile size and the movement of a receptor species. INSPIRE has been previously used to estimate the level of noise from piling on the River Thames and subsequent measurements were in good agreement.

Two representative locations were chosen at the east and west of the site to give spatial variation. At each location, piles of 3.5 m, 1.22 m, 914 mm and 610 mm were installed with a maximum hammer blow energy of 555 kJ (3.5 m), 208 kJ (1.22 m & 914 mm) and 74 kJ (610 mm) were modelled. Ranges at each piling location were found to be similar for each pile size.

The modelling results were analysed in terms of relevant noise metrics to assess the impacts of the predicted impact piling noise on marine mammals (NMFS, 2016) and fish (Popper *et al.*, 2014). The receptors were broken down in terms of 'hearing groups' as per NMFS (2016) and Popper *et al*. (2014), and a summary of the ranges of impact for permanent threshold shift (PTS) and temporary threshold shift (TTS), underwater from piling, are given below for the worst case (3.5 m) piles:

*Marine mammals*

- Low frequency cetaceans (e.g. baleen whales): PTS could occur up to 3,900 m and TTS could occur up to 4,950 m from the piling.
- Mid frequency cetaceans (e.g. common dolphin): PTS could occur up to 100 m and TTS could occur up to 2,300 m from the piling.
- High frequency cetaceans (e.g. harbour porpoise): PTS could occur up to 4,550 m and TTS could occur up to 5,000 m from the piling.
- Pinnipeds (e.g. harbour seal): PTS could occur up to 1,900 m and TTS could occur up to 4,650 m from the piling in water.

Disturbance or avoidance effects are modelled to occur in mid-frequency and high frequency cetaceans at 3,420 m and 5,000 m range respectively. Avoidance in pinnipeds is modelled at 2,050 m, as per the TTS range. It should be noted that behavioural effects are highly context dependent.

Ranges for the smaller piles were considerably lower and extend to a minimum of 100 m for MF cetaceans and 900 m for HF cetaceans (610 mm pile).

*Fish*

Fish species are highly varied and impact ranges have been modelled based on the species with the most sensitive hearing, those for which their swim bladders are associated with hearing (e.g. herring). These impact ranges are summarised below for the larger (3.5m) pile:

- Recoverable injury could occur up to 250 m and
- TTS could occur up to 3,600 m from the piling.

As these impact ranges are associated with the most sensitive species of fish, they represent the worst case. Other species will be expected to have lower impact ranges.

Potential behavioural effects have been considered qualitatively for fish. At intermediate ranges (of the order of hundreds of metres from the piling) at least a moderate risk of behavioural effects exists. Beyond this a low risk exists, although there is a moderate risk for the most sensitive species of fish.

For the smaller (610 mm) pile TTS and recoverable injury is only likely in the immediate vicinity of the pile (<10m from the noise source).

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# Appendix A Modelling results: contour plots

## A.1 Marine mammals, 3,500 mm pile, eastern location

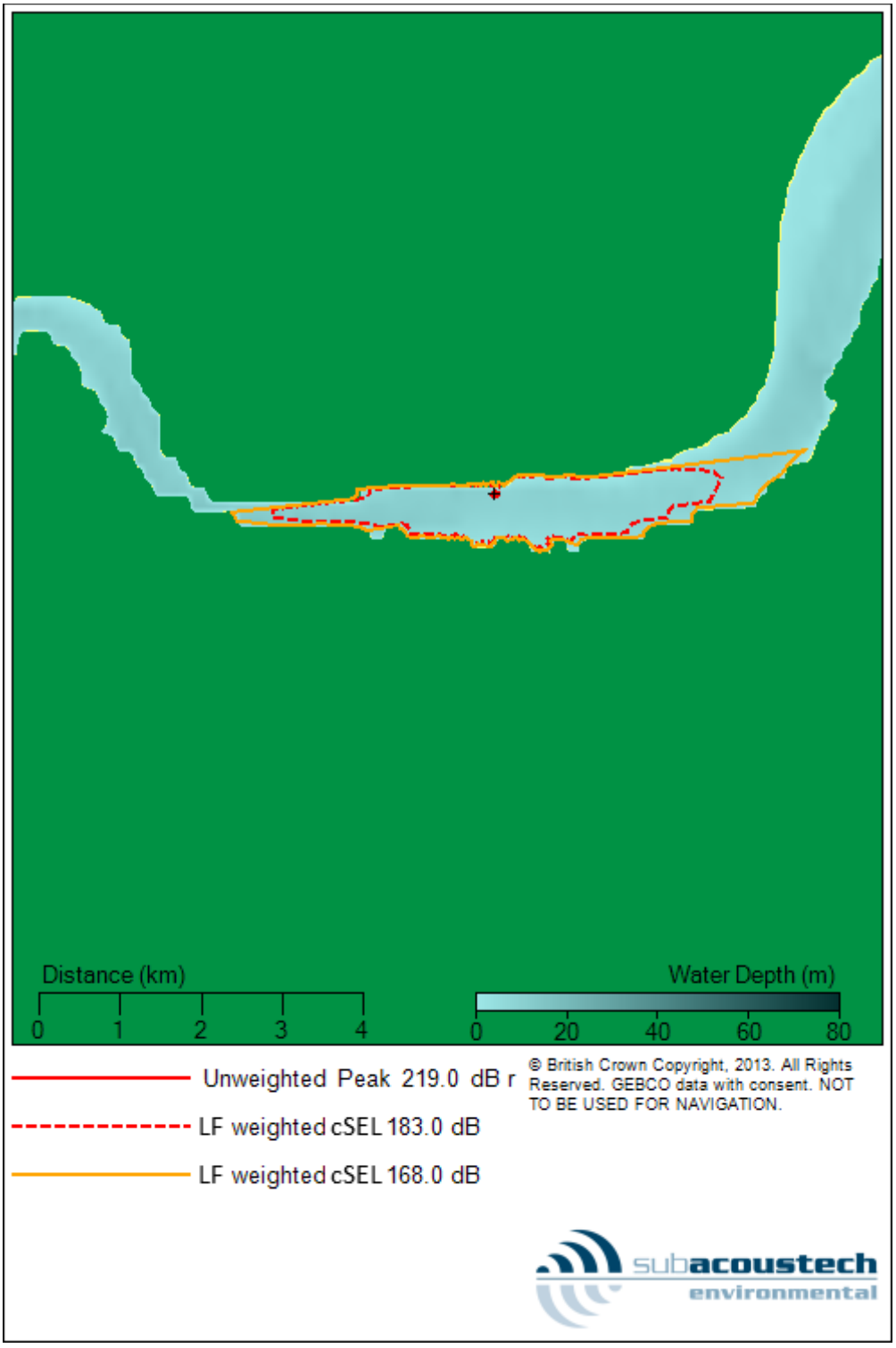



*Figure 7-1 Low frequency cetacean weighted model of piling at low tide at the eastern location (3.5 m pile)*

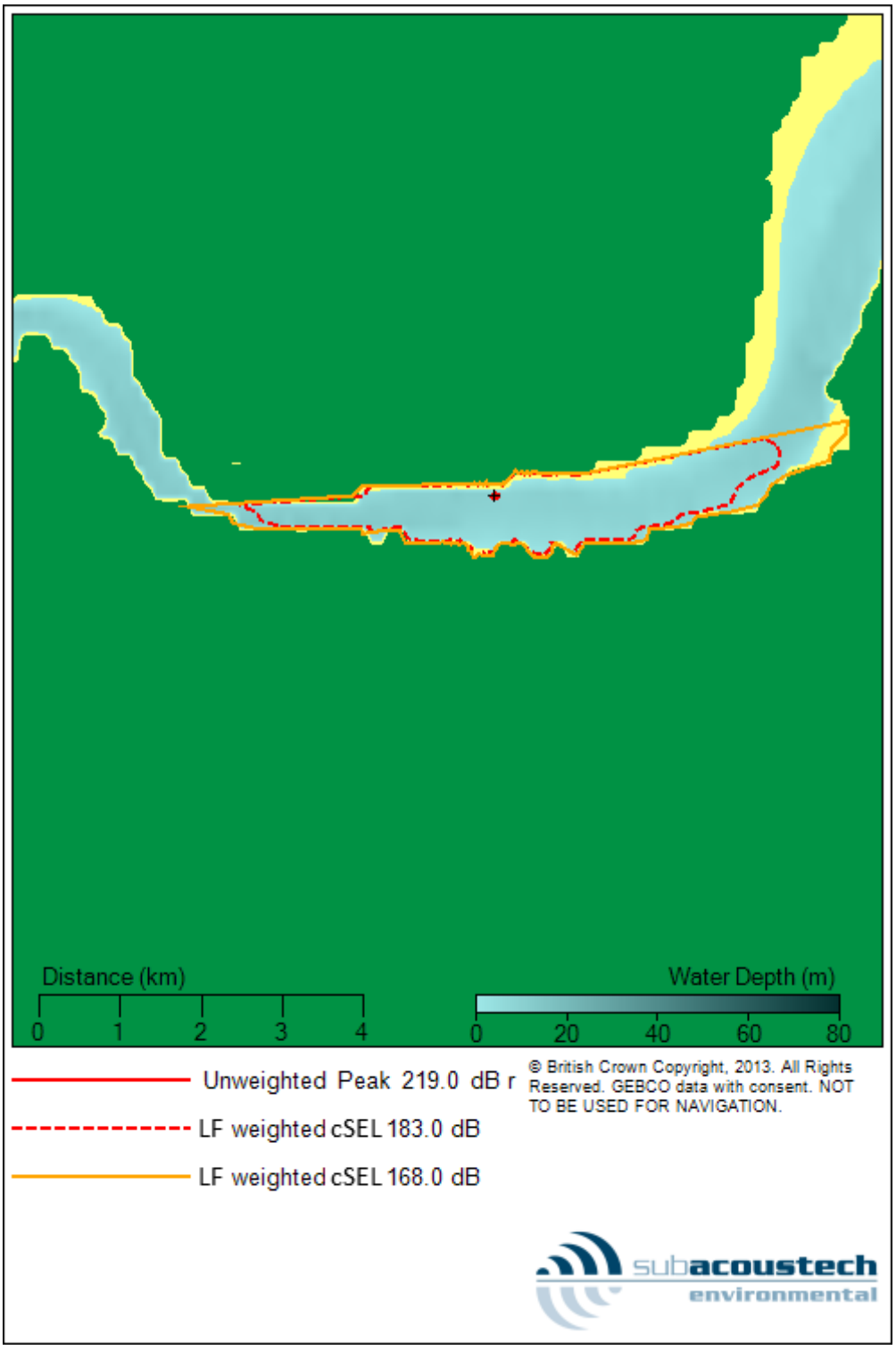



*Figure 7-2 Low frequency cetacean weighted model of piling at high tide at the eastern location (3.5 m pile)*

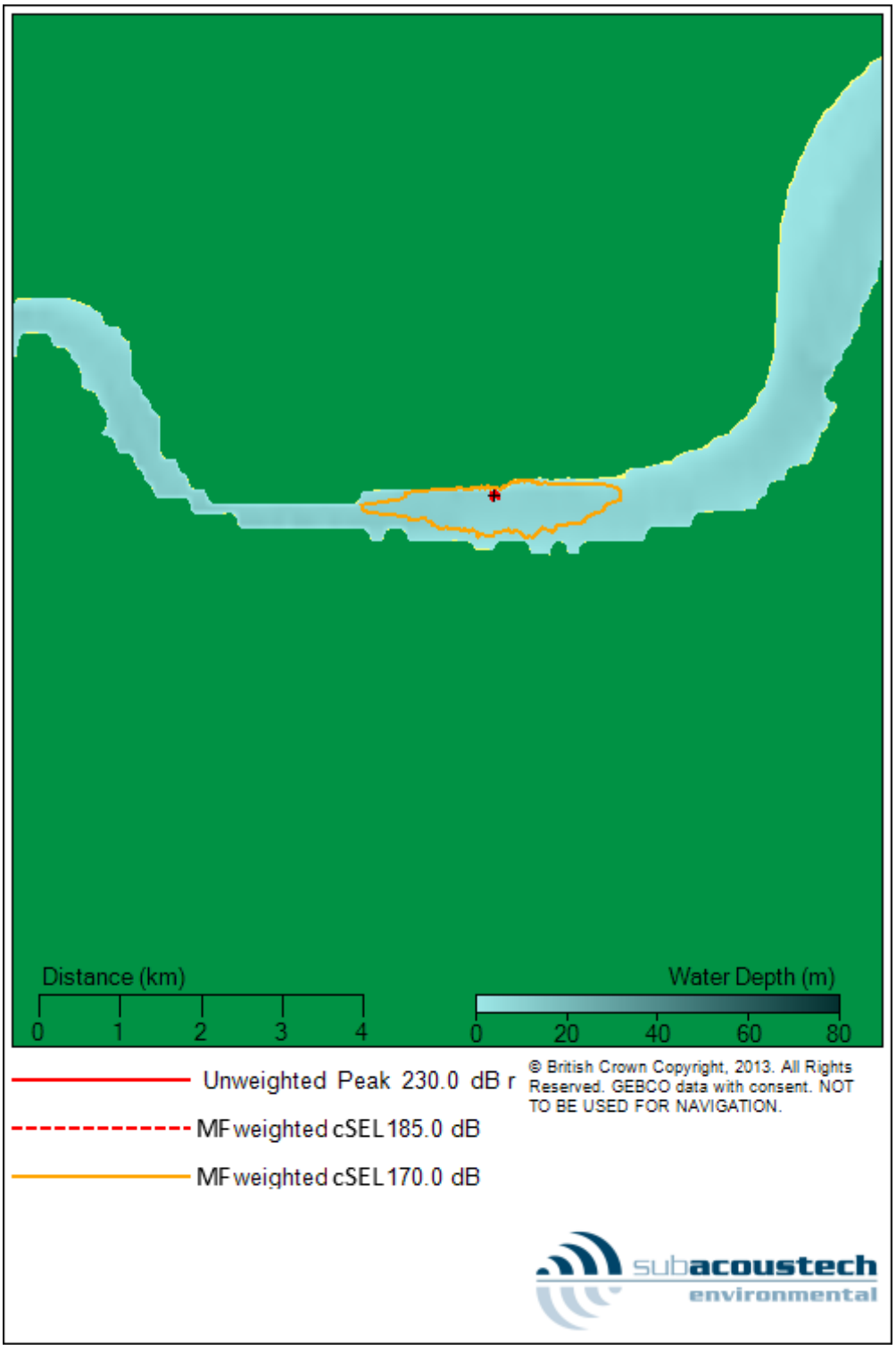



*Figure 7-3 Mid frequency cetacean weighted model of piling at low tide at the eastern location (3.5 m pile)*

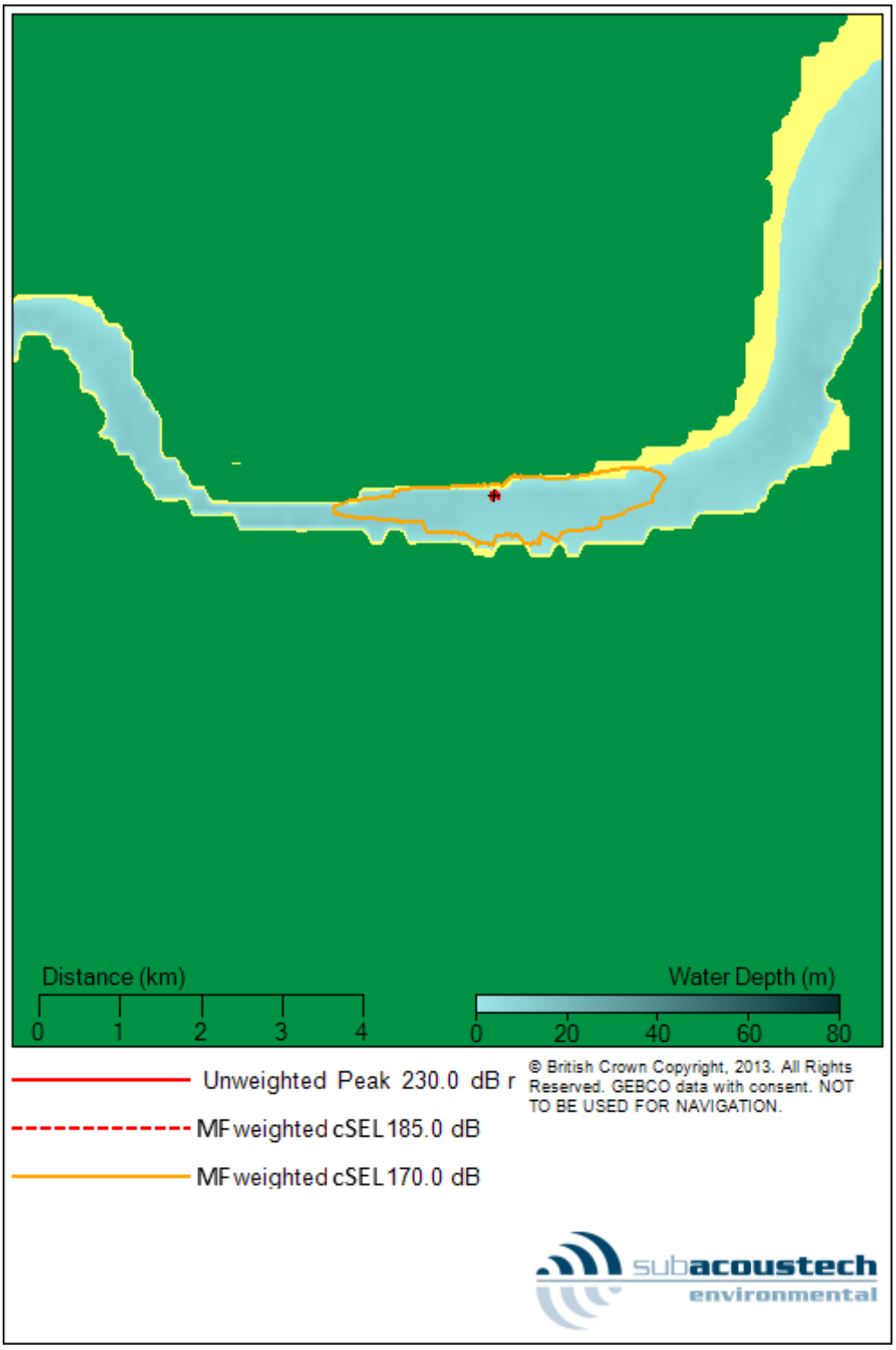



*Figure 7-4 Mid frequency cetacean weighted model of piling at high tide at the eastern location (3.5 m pile)*

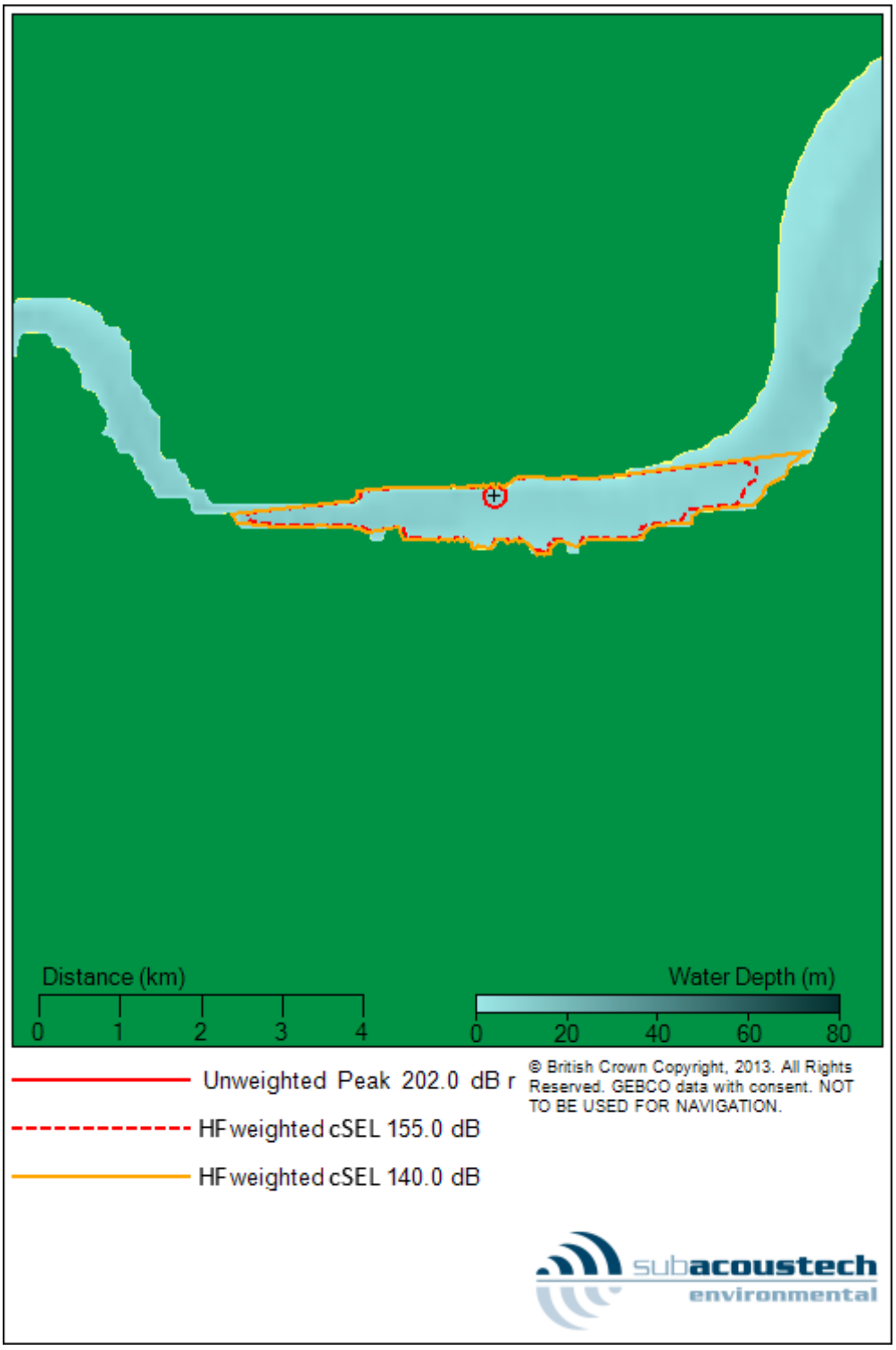



*Figure 7-5 High frequency cetacean weighted model of piling at low tide at the eastern location (3.5 m pile)*

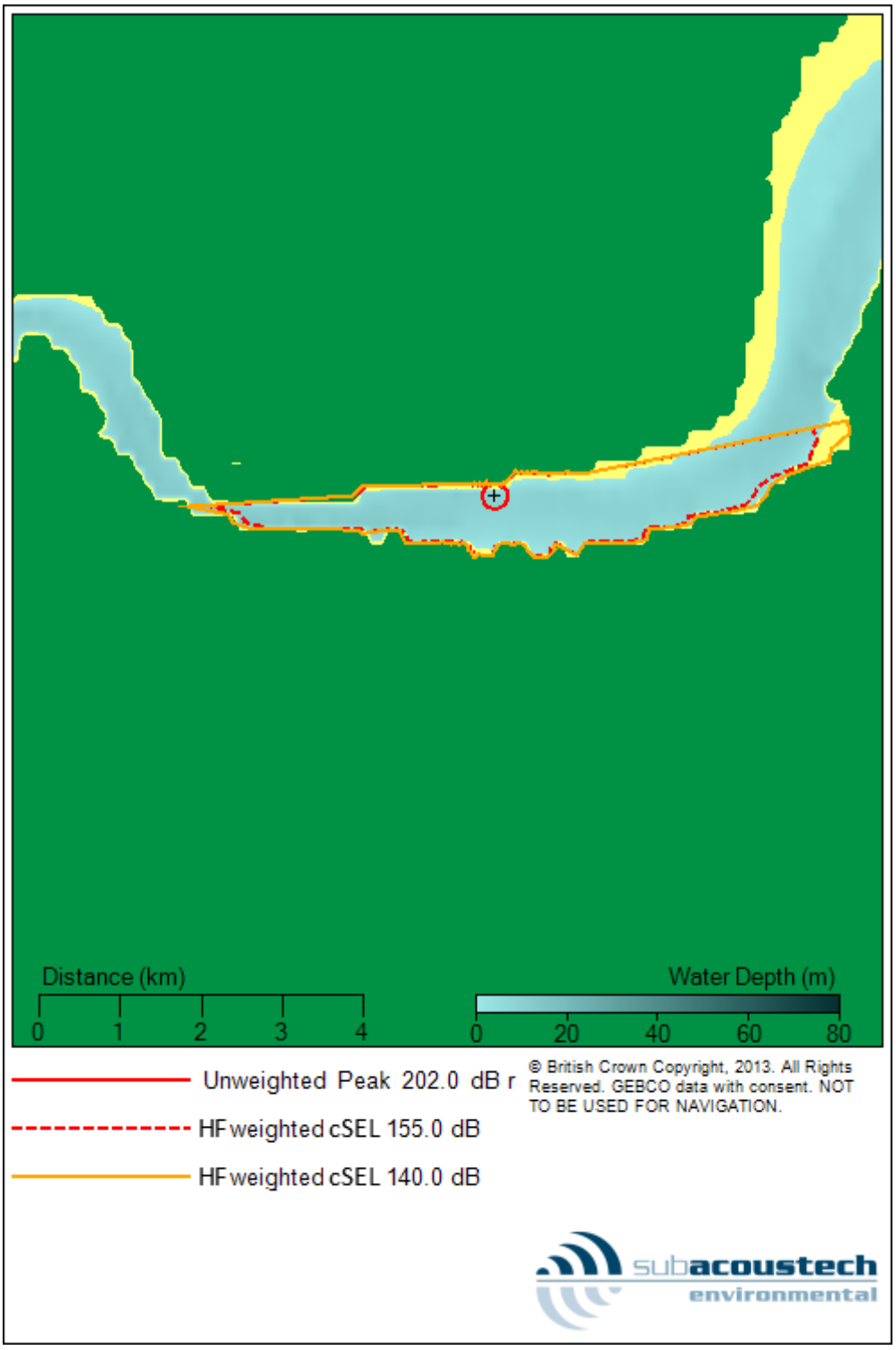



*Figure 7-6 High frequency cetacean weighted model of piling at high tide at the eastern location (3.5 m pile)*

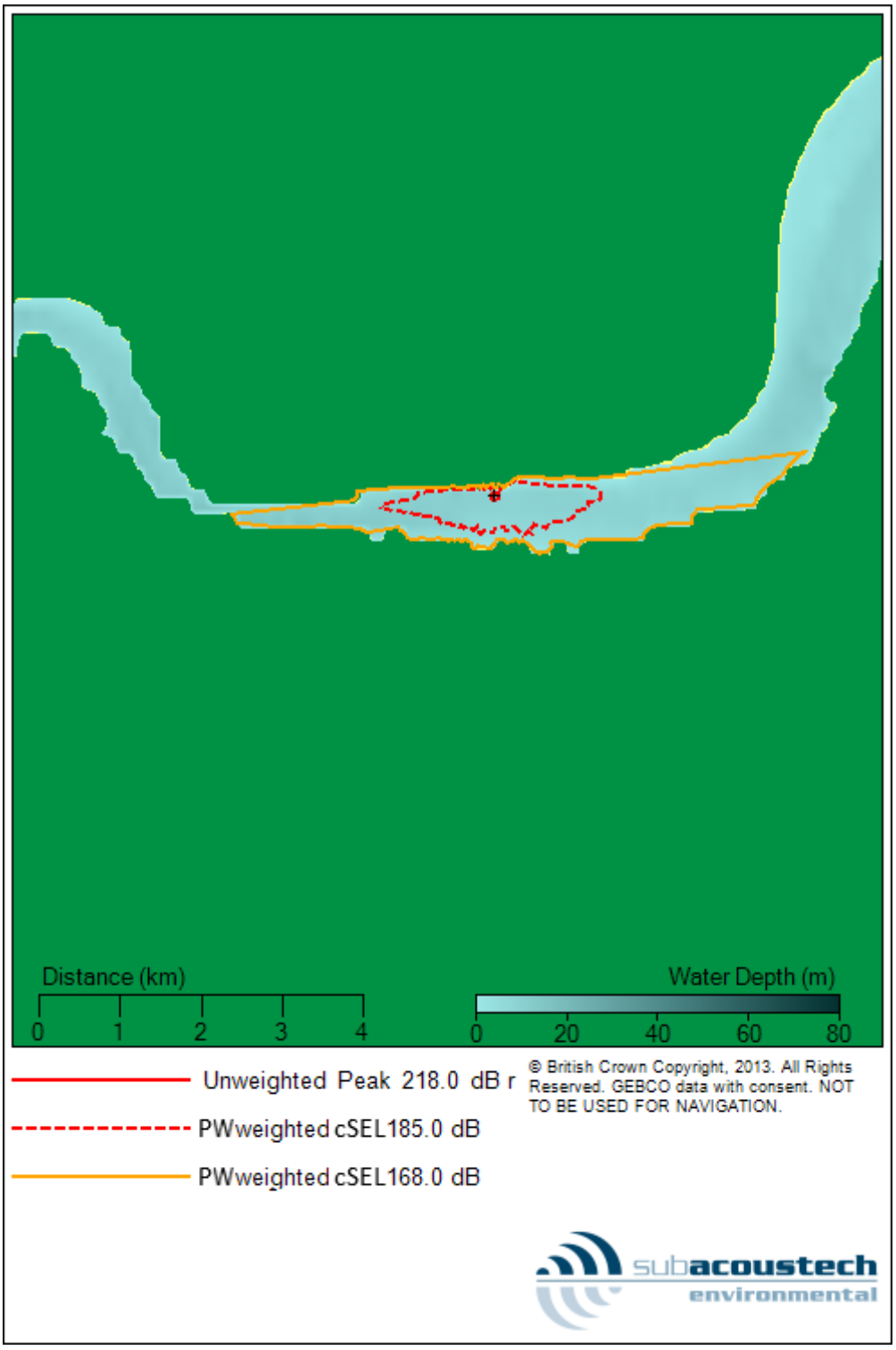



*Figure 7-7 Phocid pinniped weighted model of piling at low tide at the eastern location (3.5 m pile)*

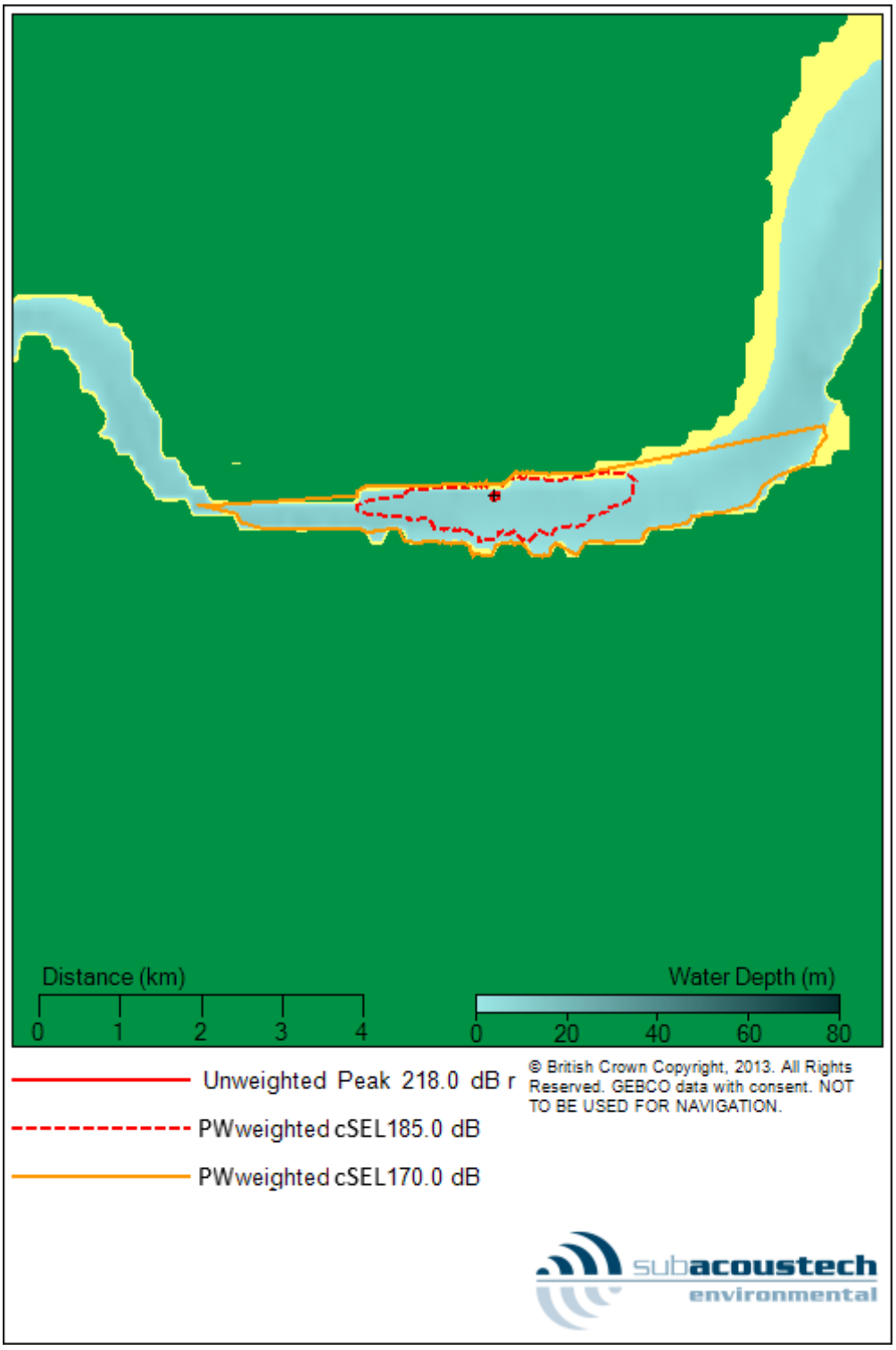



*Figure 7-8 Phocid pinniped weighted model of piling at high tide at the eastern location (3.5 m pile)*

## A.2 Marine mammals, 3,500 mm pile, western location

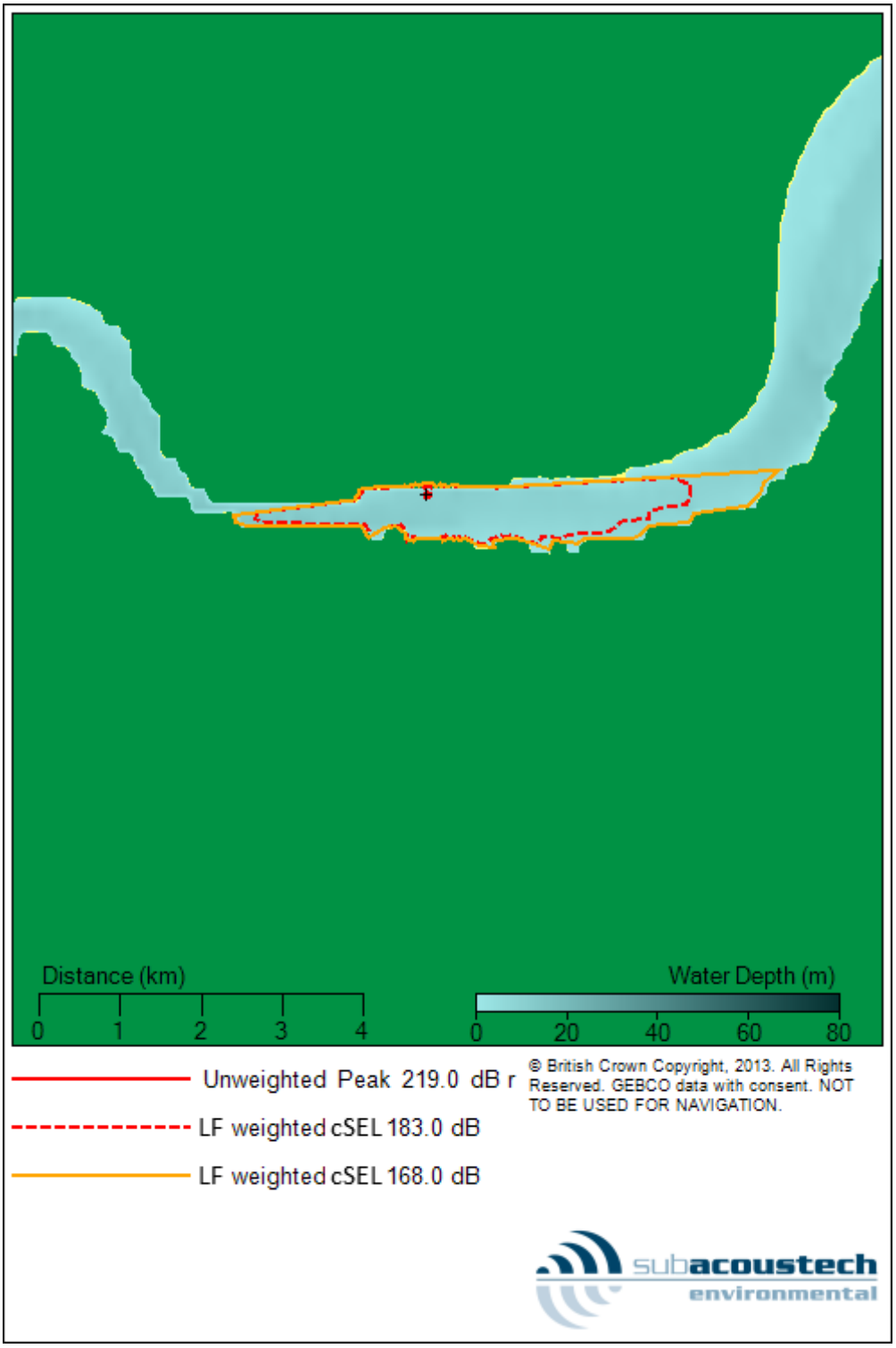



*Figure 7-9 Low frequency cetacean weighted model of piling at low tide at the western location (3.5 m pile)*

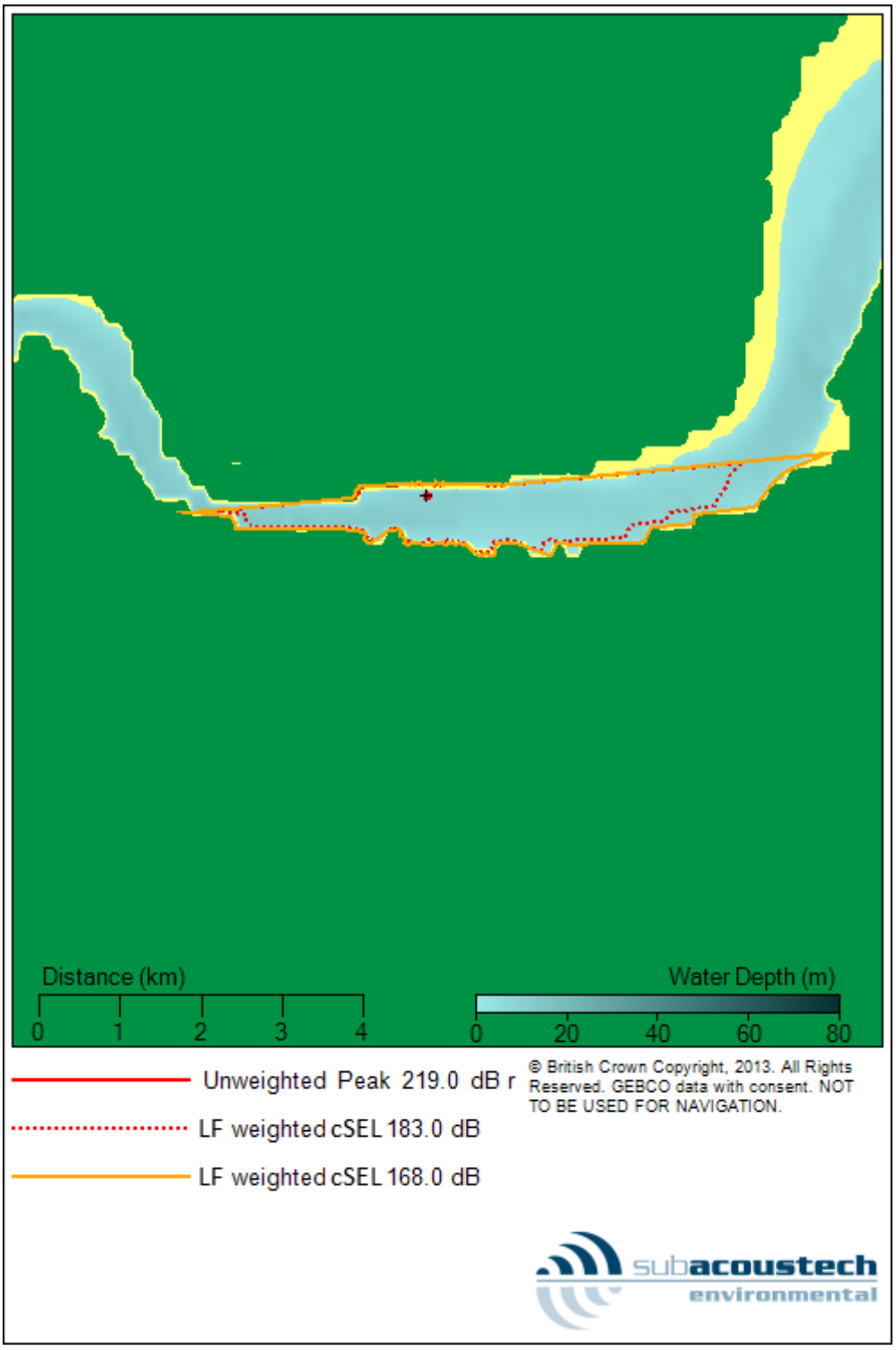



*Figure 7-10 Low frequency cetacean weighted model of piling at high tide at the western location (3.5 m pile)*

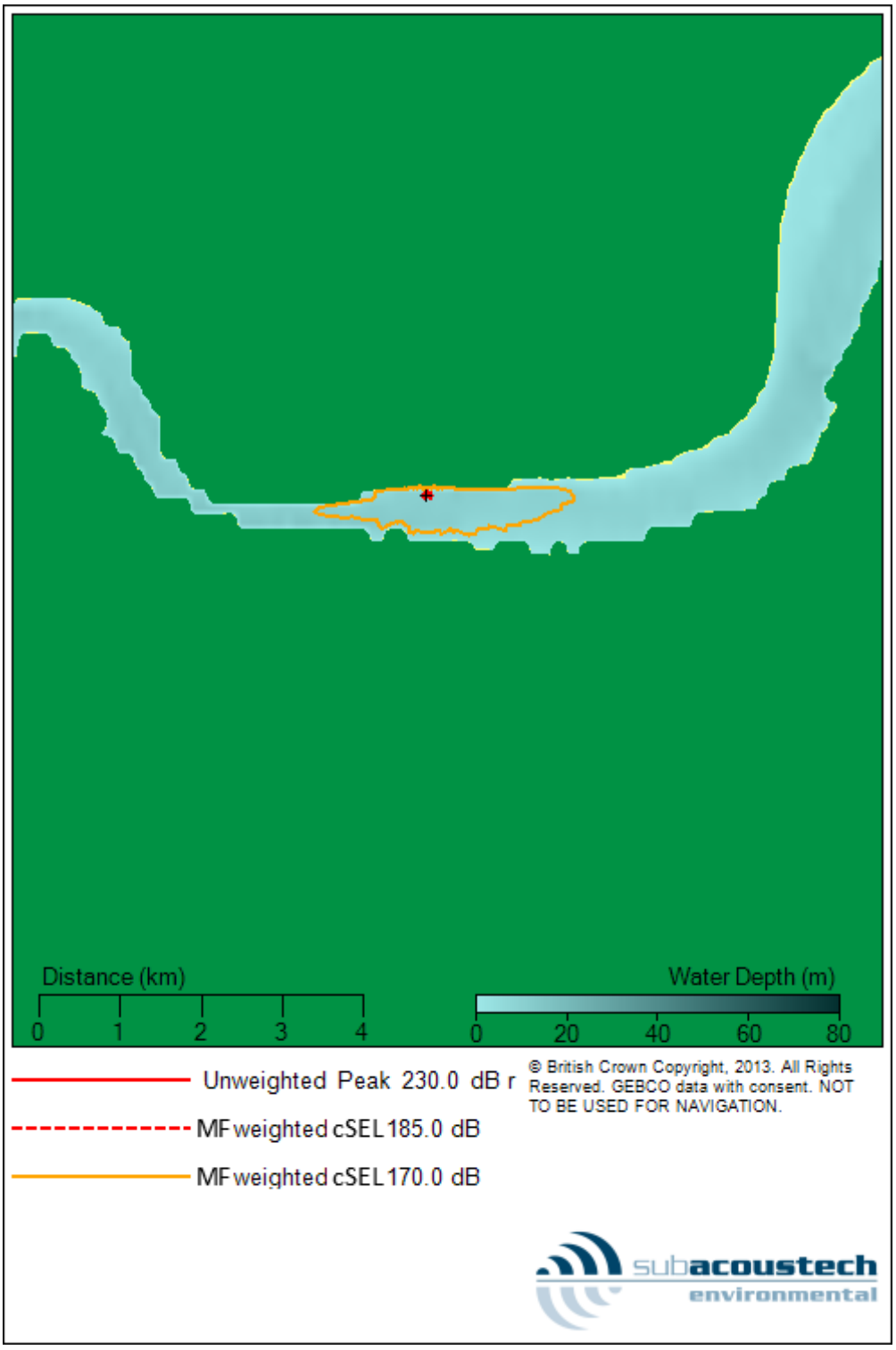



*Figure 7-11 Mid frequency cetacean weighted model of piling at low tide at the western location (3.5 m pile)*

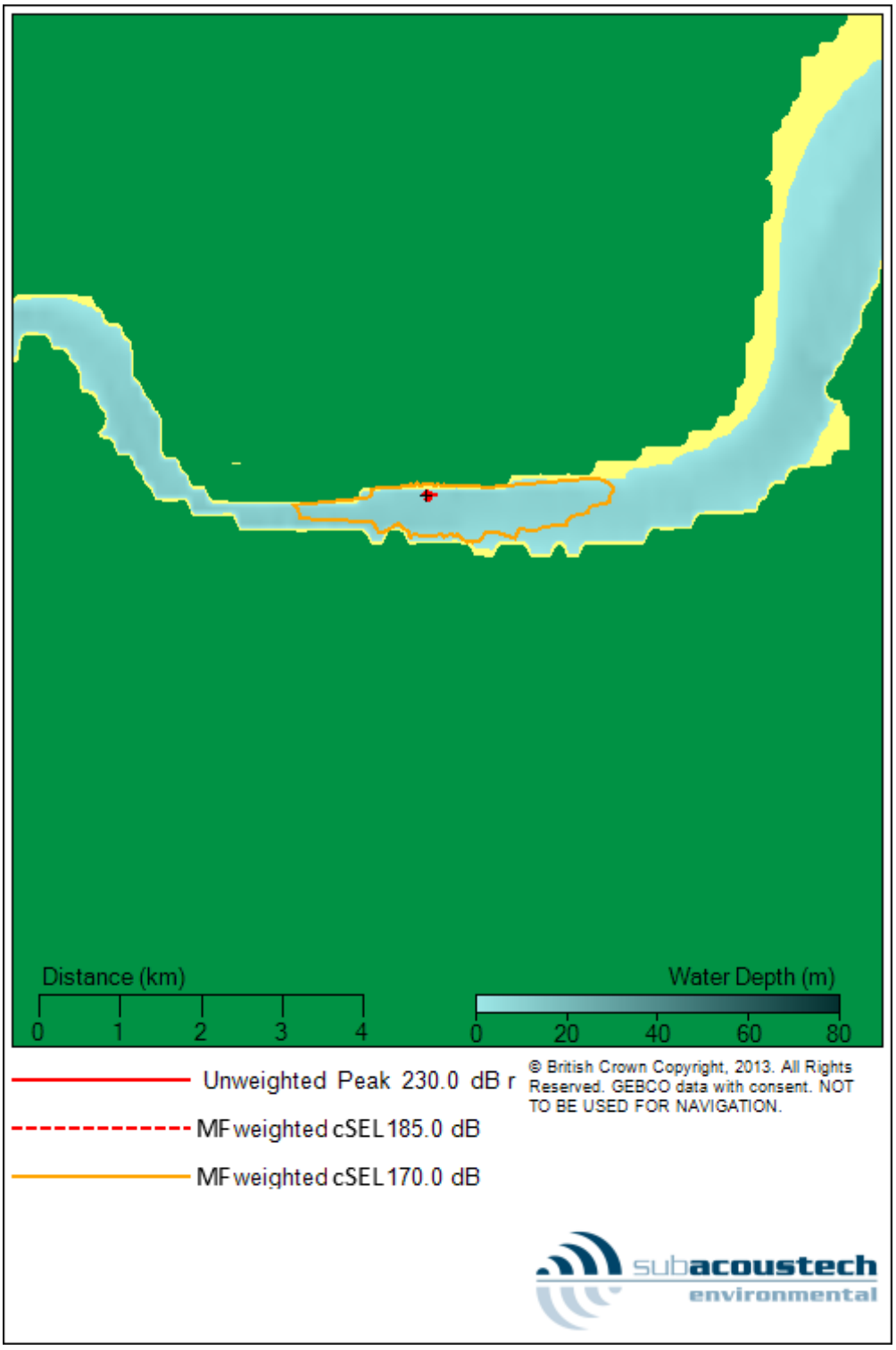



*Figure 7-12 Mid frequency cetacean weighted model of piling at high tide at the western location (3.5 m pile)*

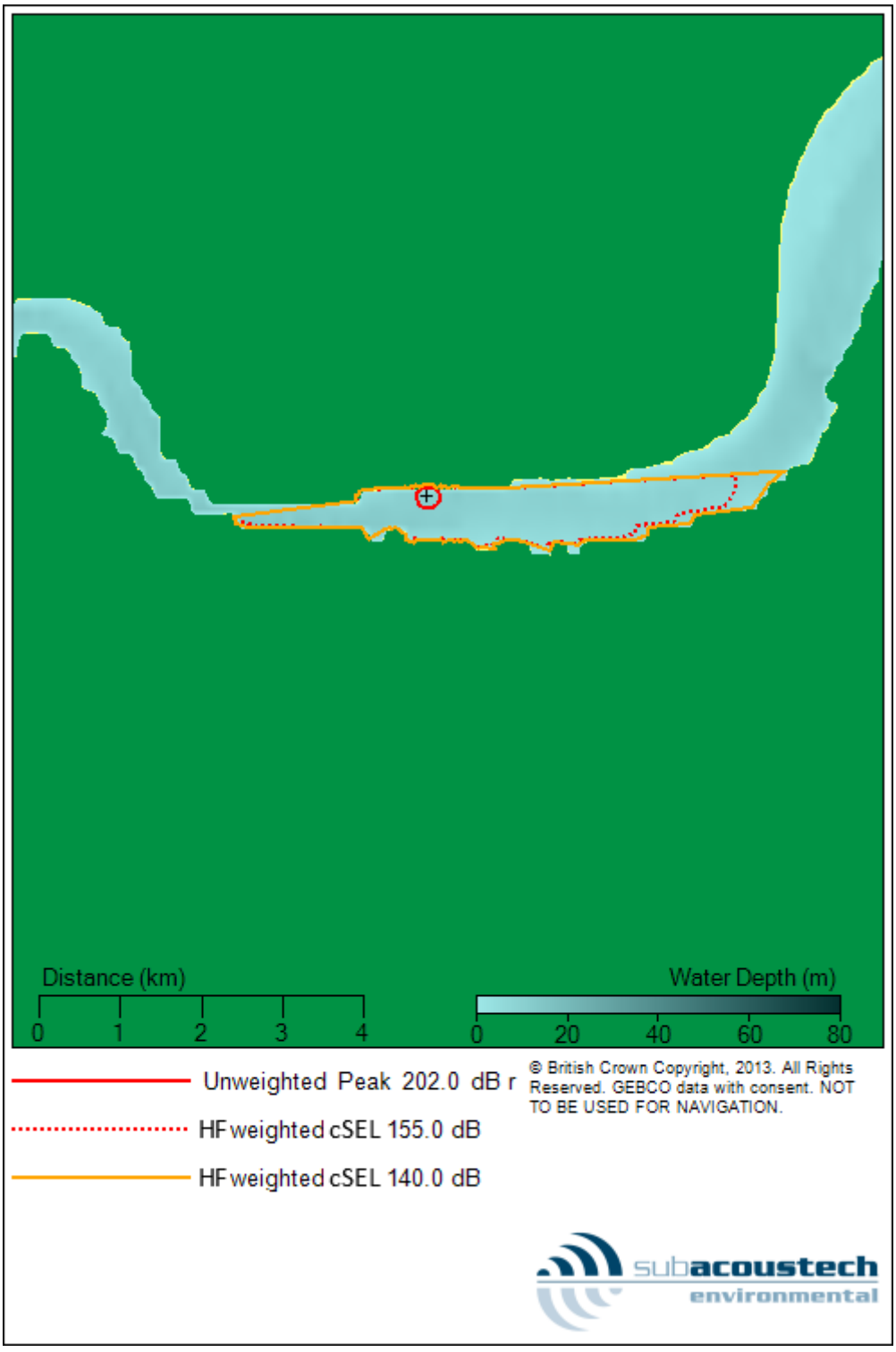



*Figure 7-13 High frequency cetacean weighted model of piling at low tide at the western location (3.5 m pile)*

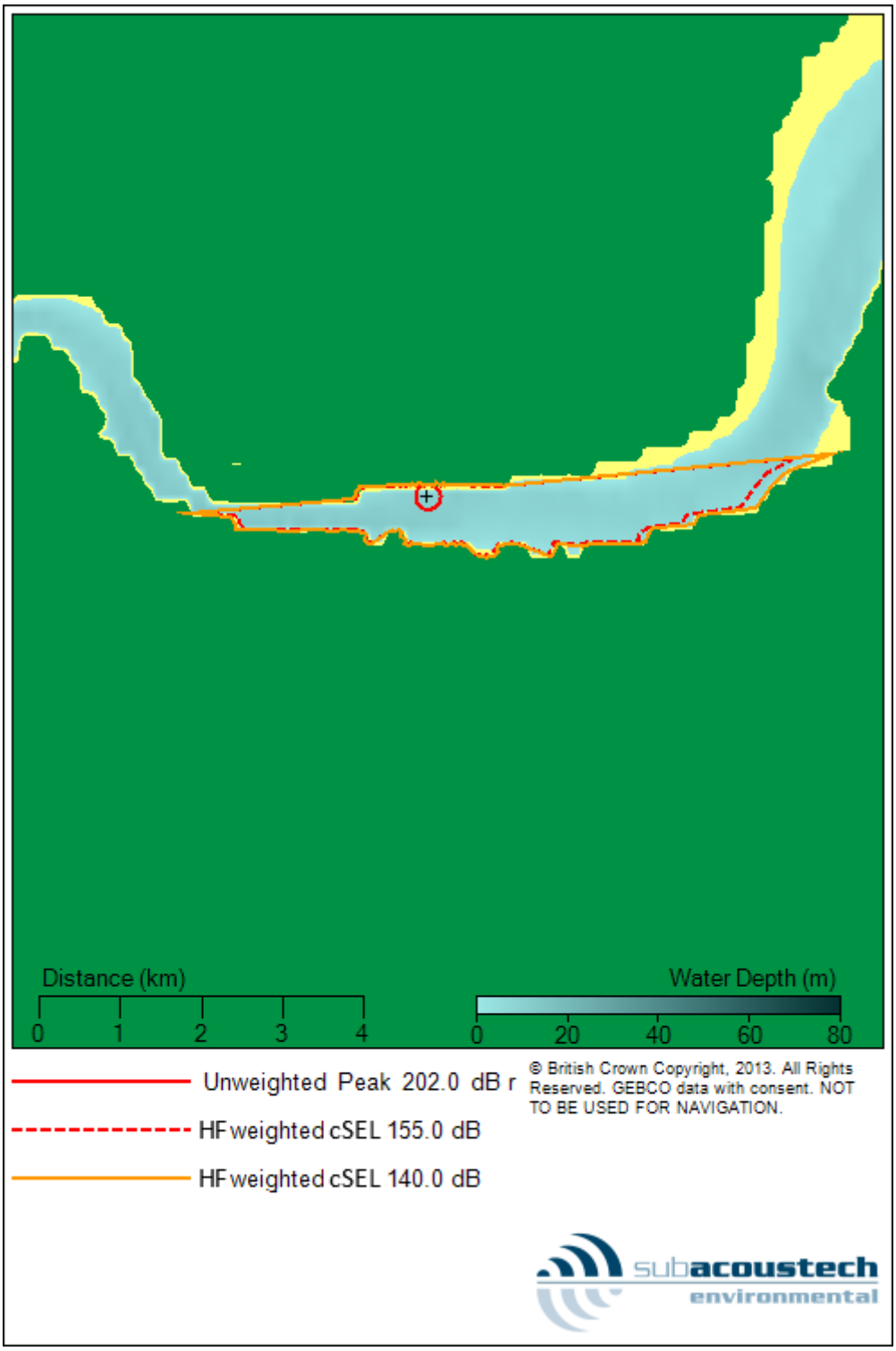



*Figure 7-14 High frequency cetacean weighted model of piling at high tide at the western location (3.5 m pile)*

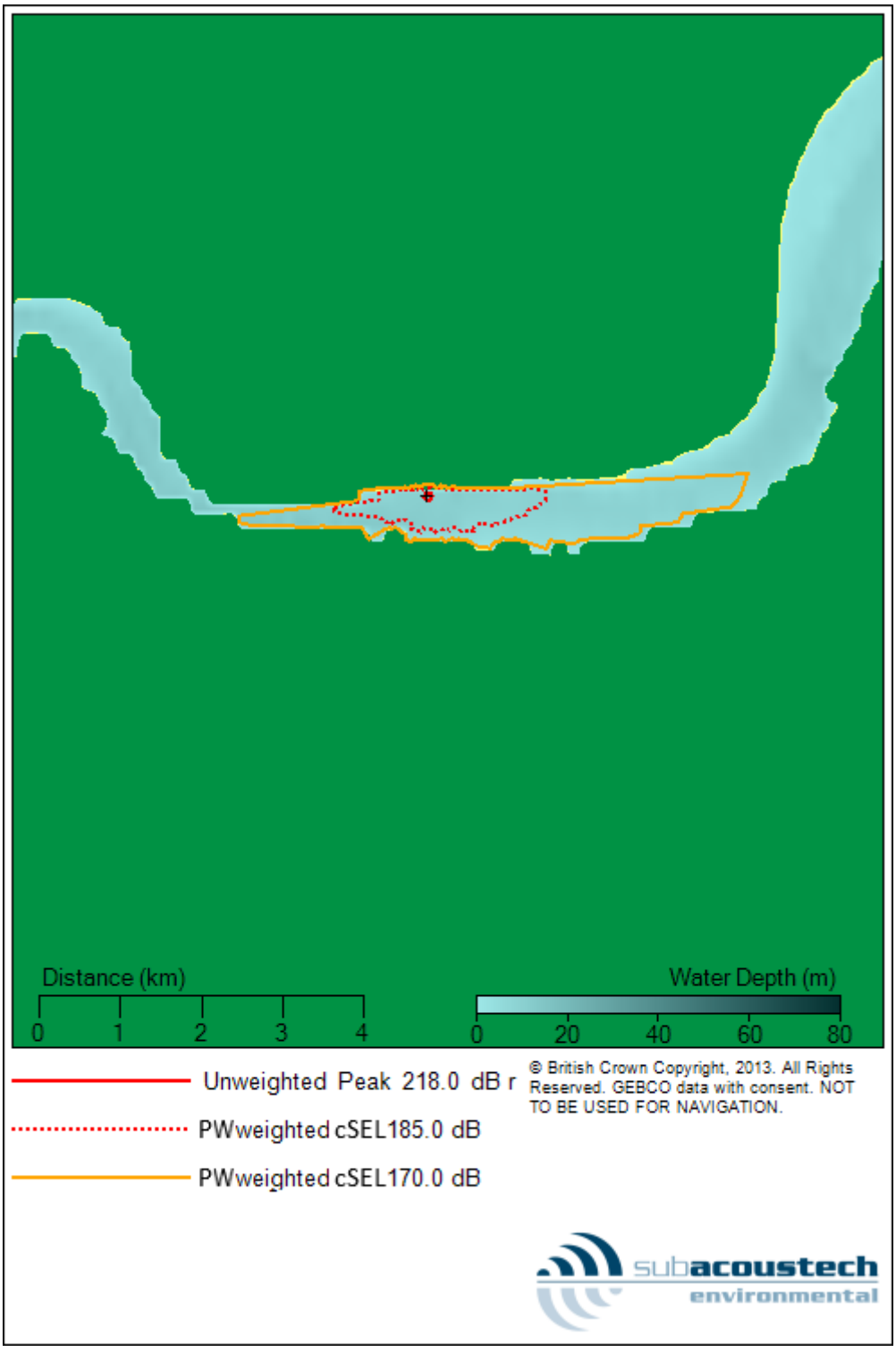



*Figure 7-15 Phocid pinniped weighted model of piling at low tide at the western location (3.5 m pile)*

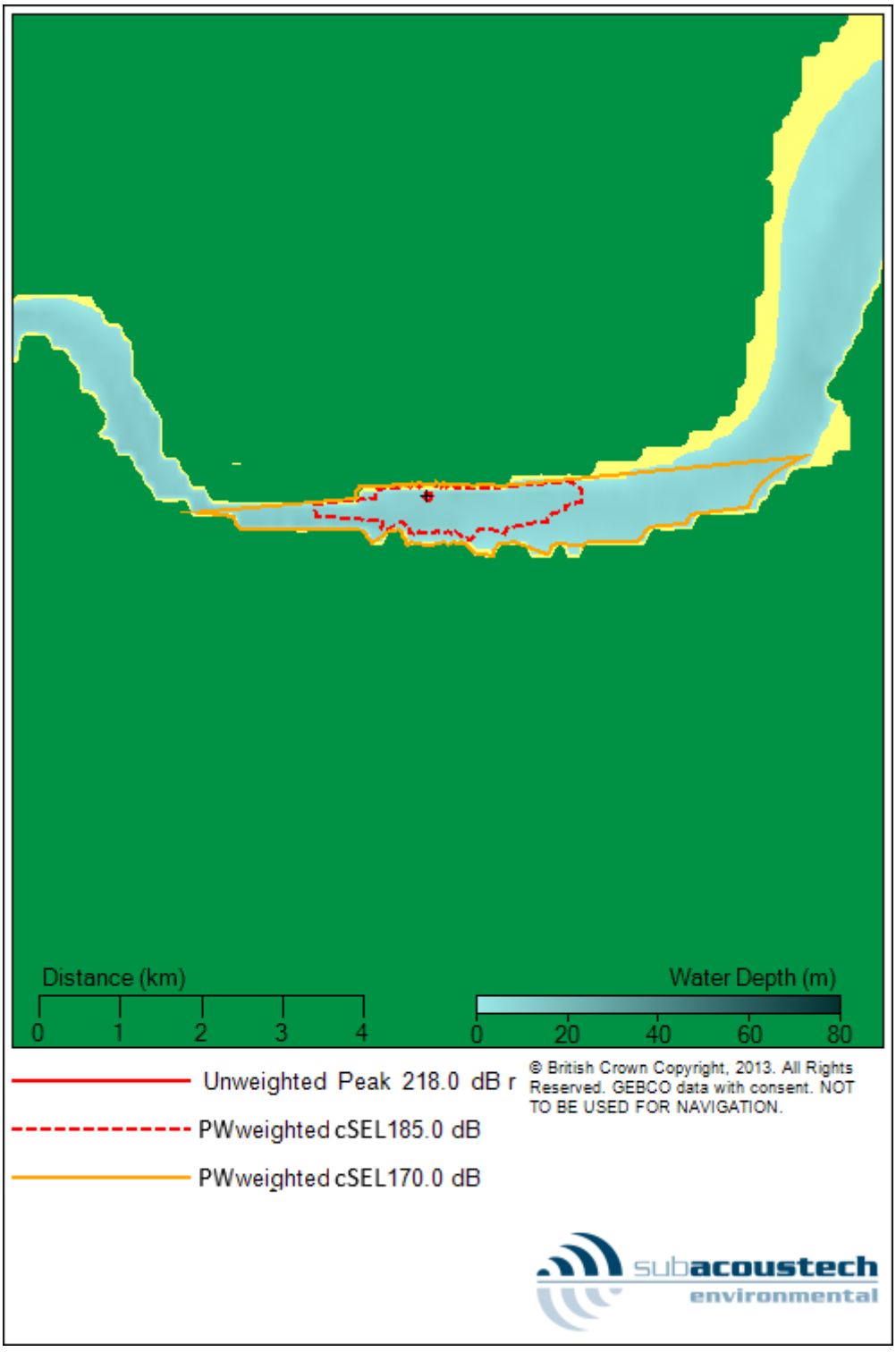



*Figure 7-16 Phocid pinniped weighted model of piling at high tide at the western location (3.5 m pile)*

## A.3 Fish, 3,500 mm pile, eastern location

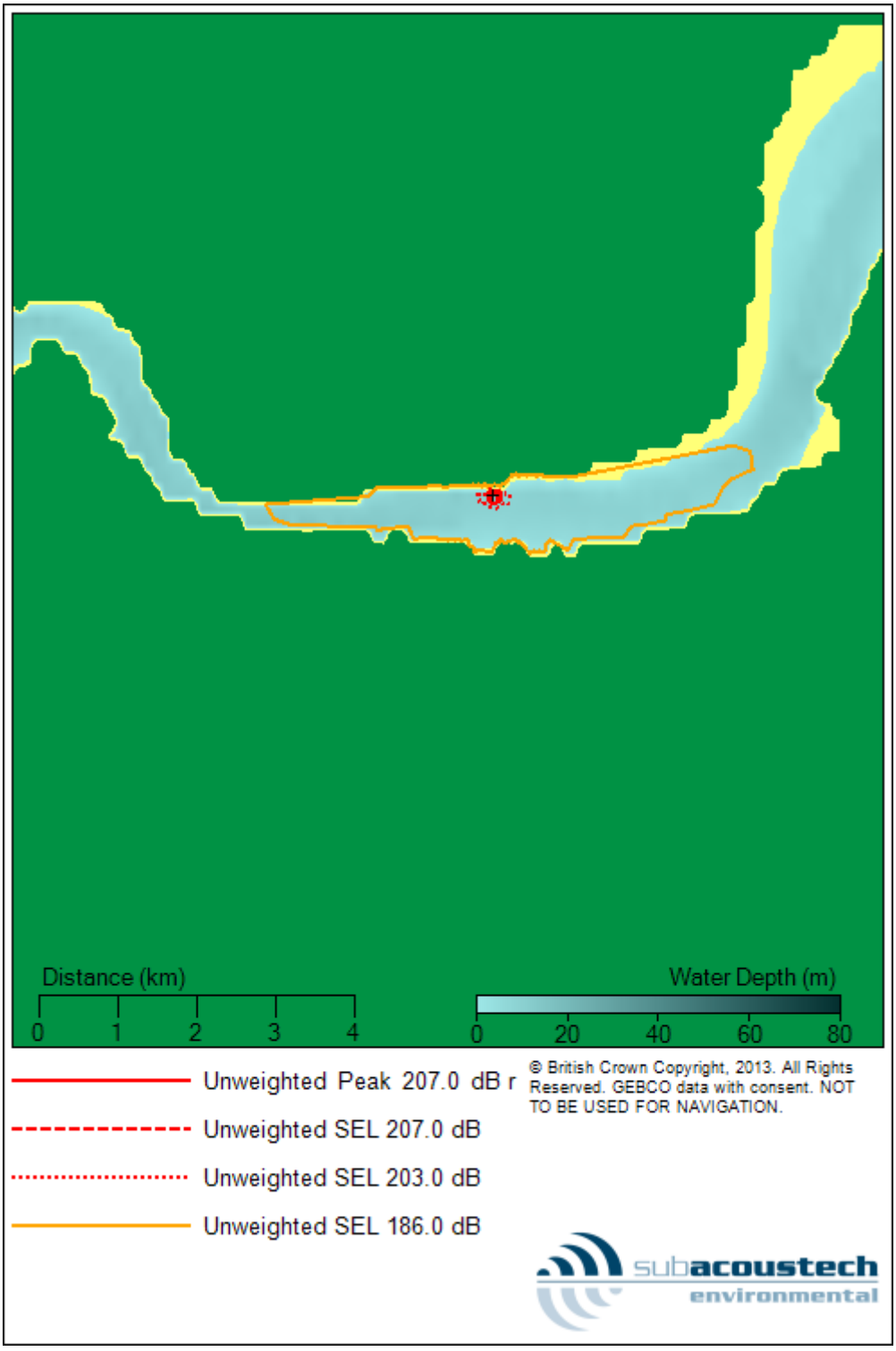



*Figure 7-17 Fish model of piling at high tide at the eastern location (3.5 m pile)*

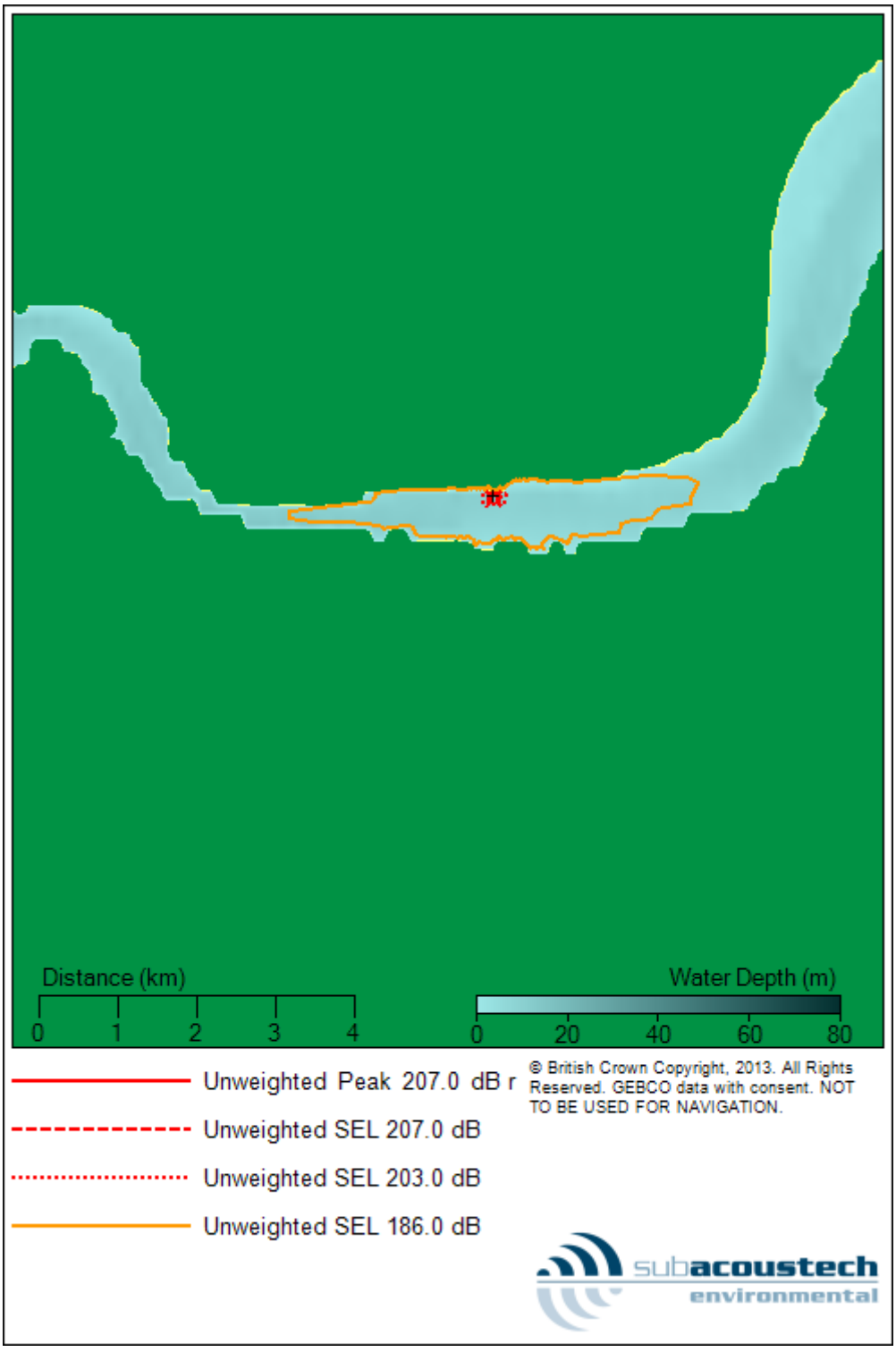



*Figure 7-18 Fish model of piling at low tide at the eastern location (3.5 m pile)*

## A.4 Fish, 3,500 mm pile, western location

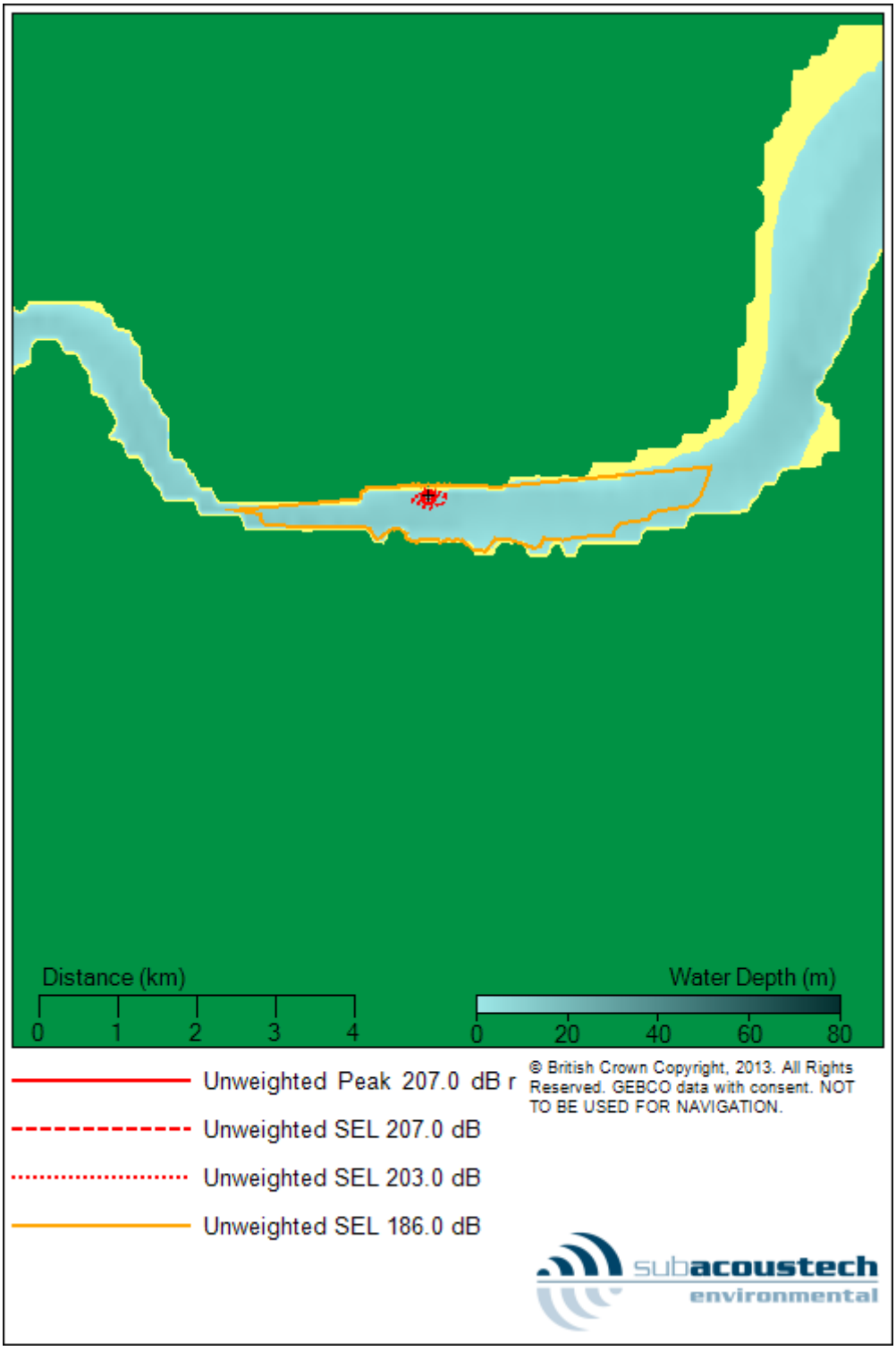



*Figure 7-19 Fish model of piling at high tide at the western location (3.5 m pile)*

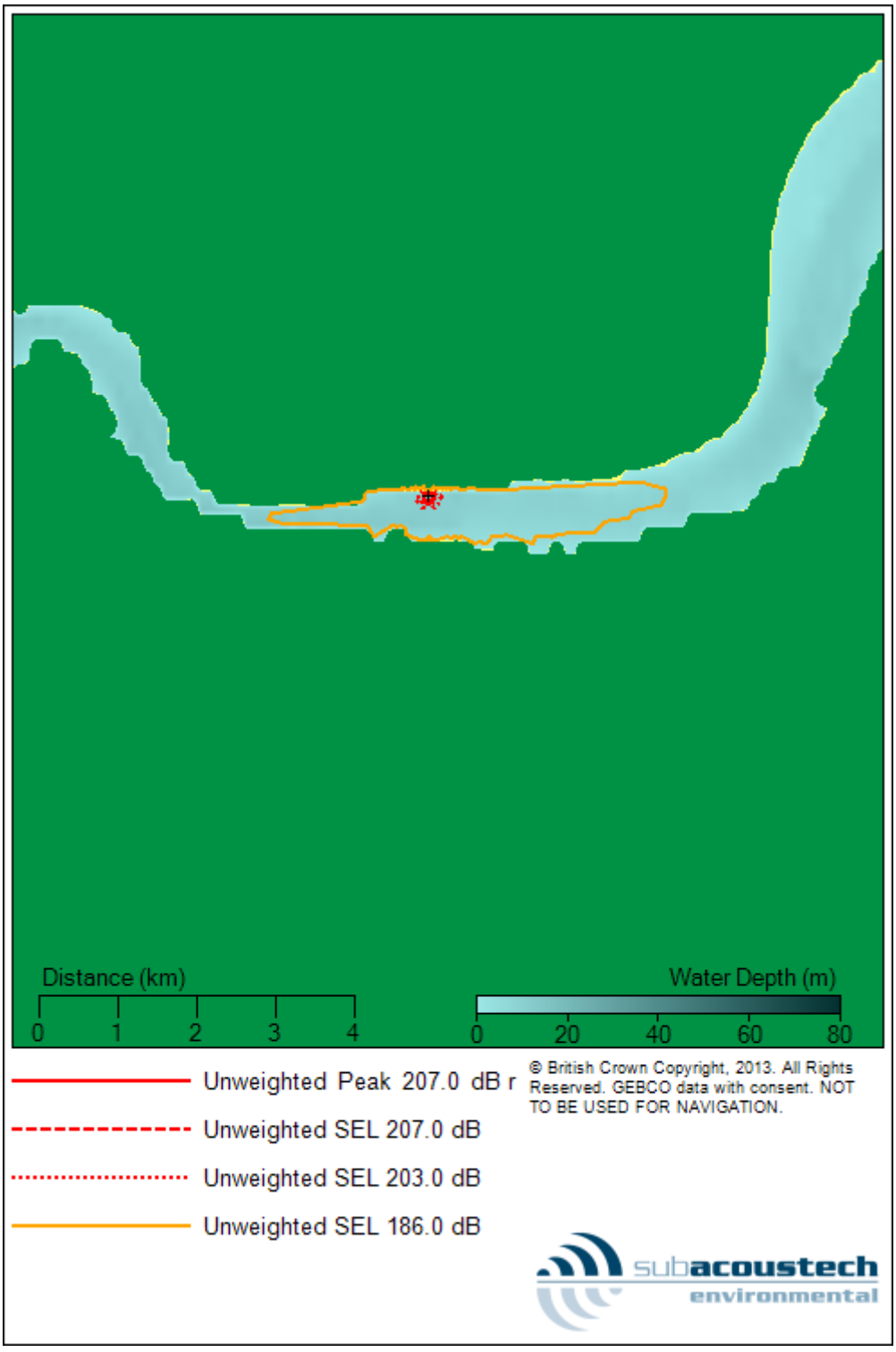



*Figure 7-20 Fish model of piling at low tide at the western location (3.5 m pile)*

## A.5 Marine mammals, 610 mm pile, eastern location

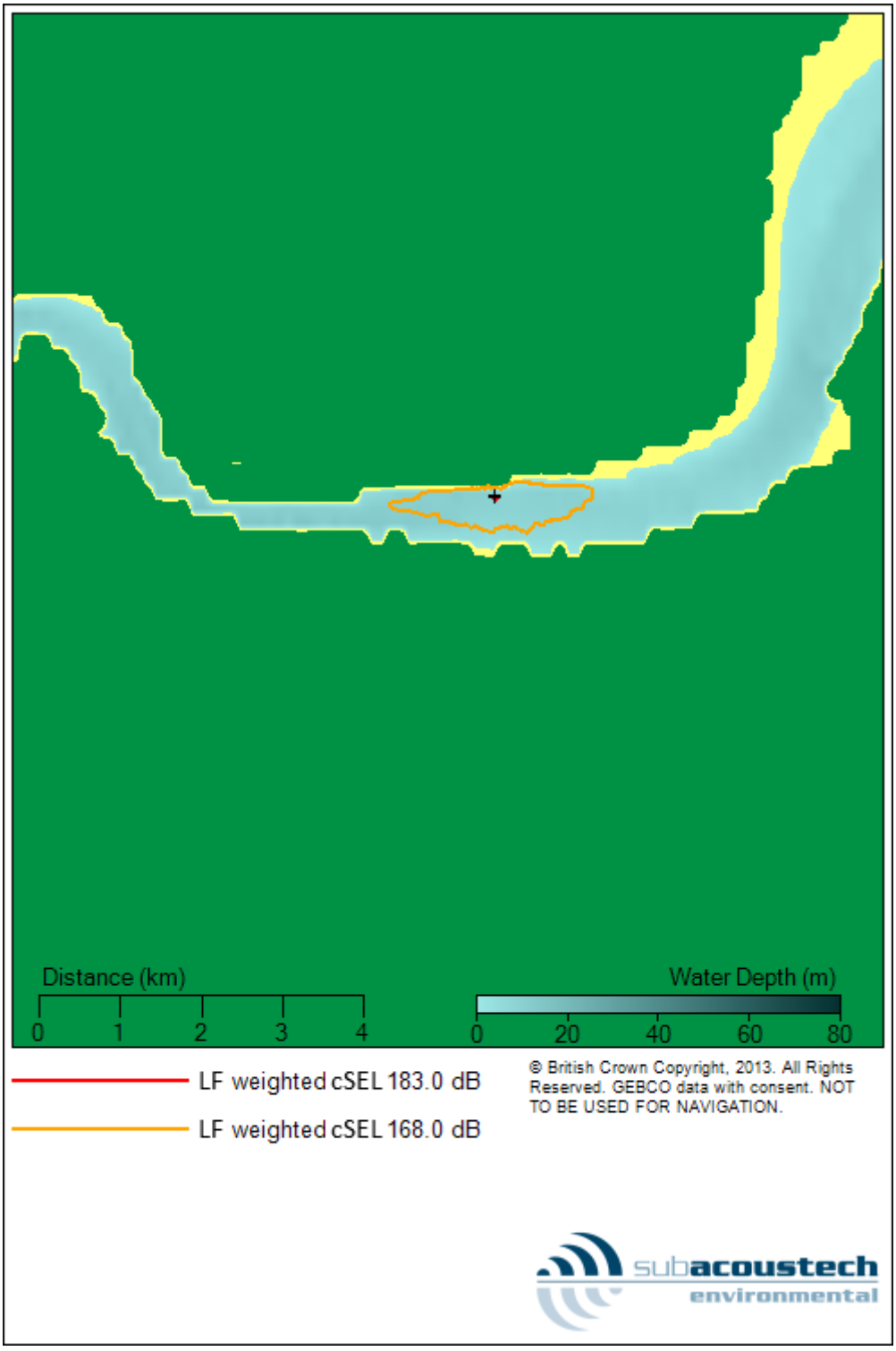



*Figure 7-21 Low frequency cetacean weighted model of piling at low tide at the eastern location (610 mm pile)*

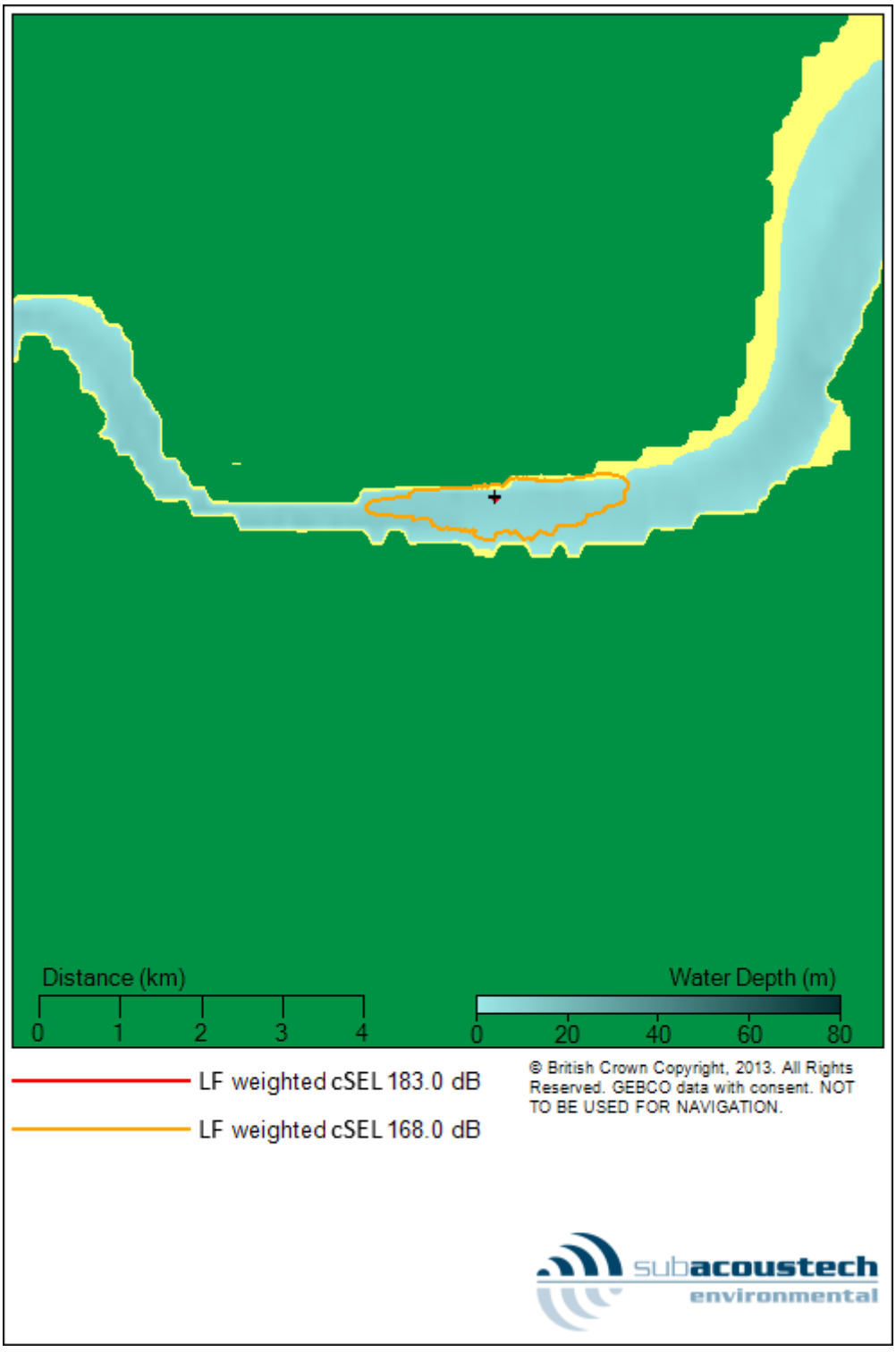



*Figure 7-22 Low frequency cetacean weighted model of piling at high tide at the eastern location (610 mm pile)*

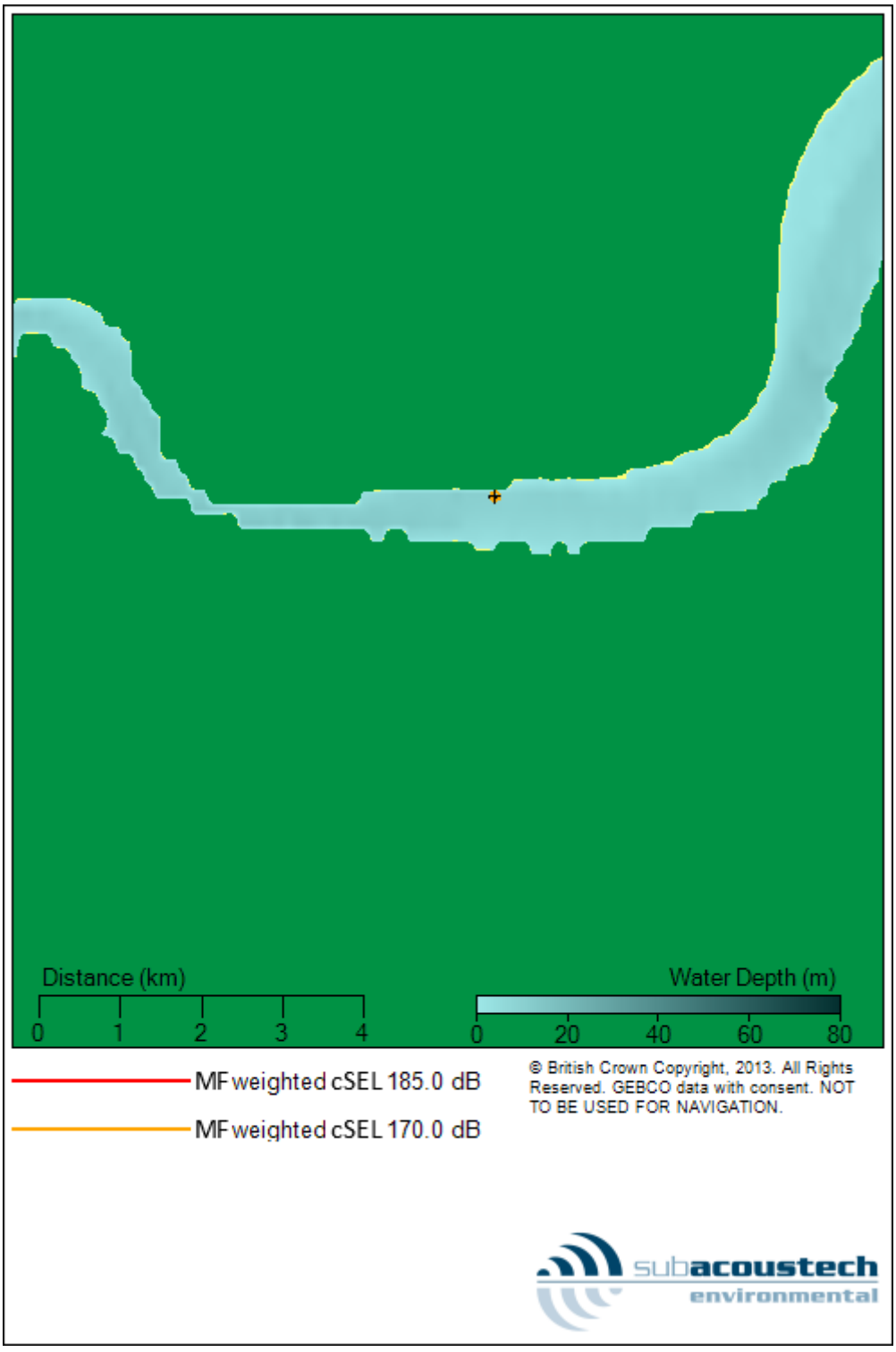



*Figure 7-23 Mid frequency cetacean weighted model of piling at low tide at the eastern location (610 mm pile)*

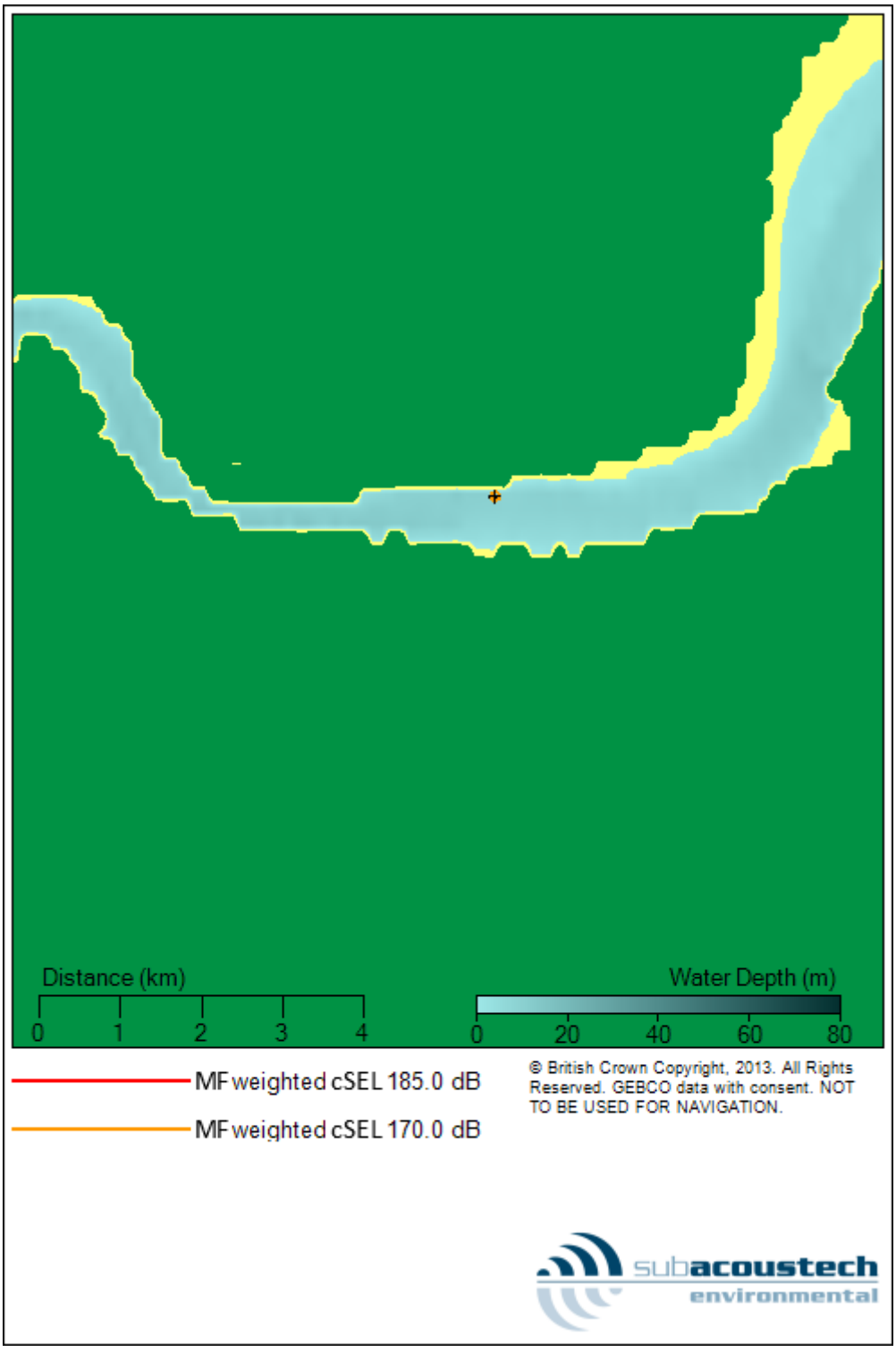



*Figure 7-24 Mid frequency cetacean weighted model of piling at high tide at the eastern location (610 mm pile)*

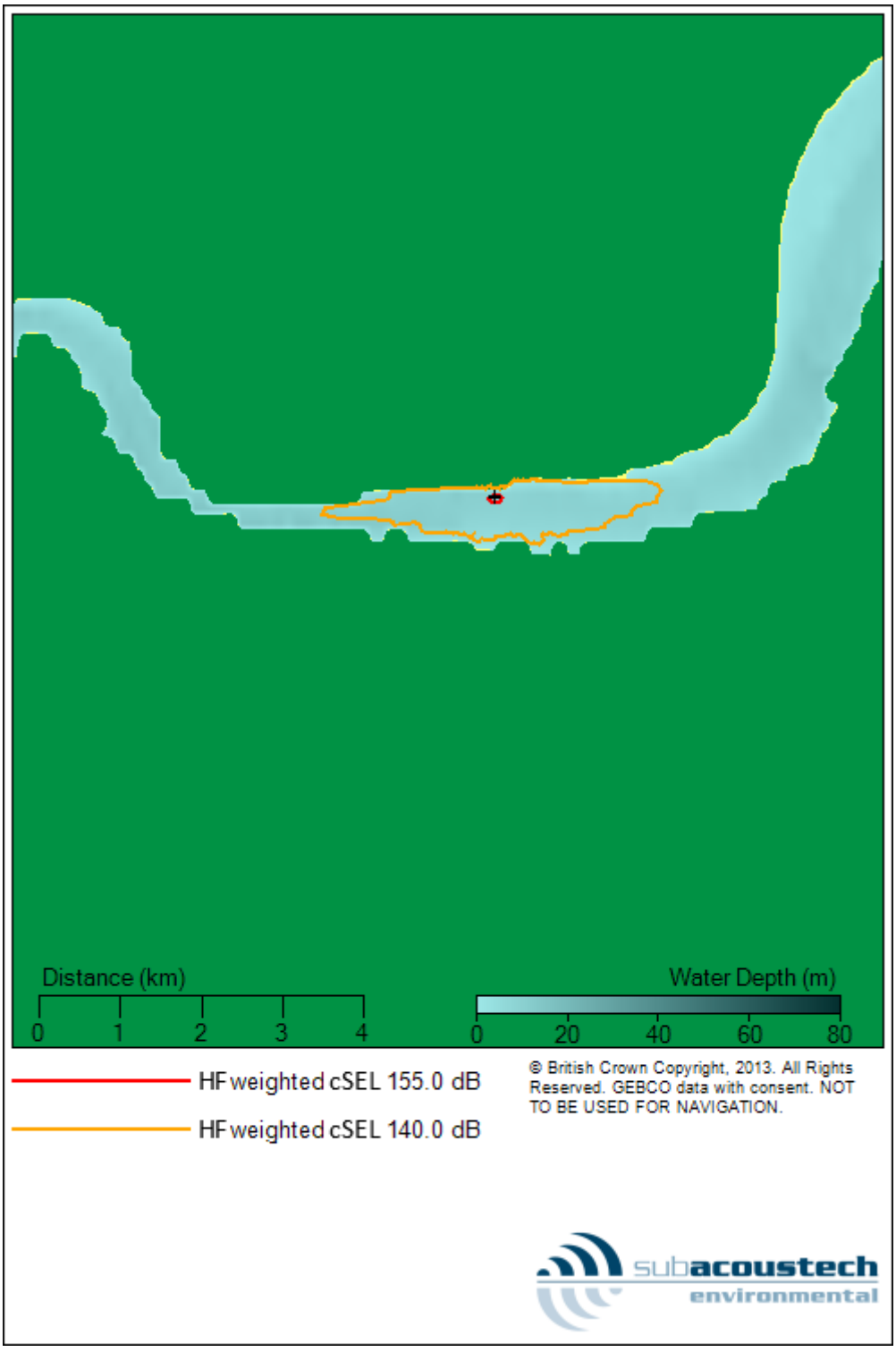



*Figure 7-25 High frequency cetacean weighted model of piling at low tide at the eastern location (610 mm pile)*

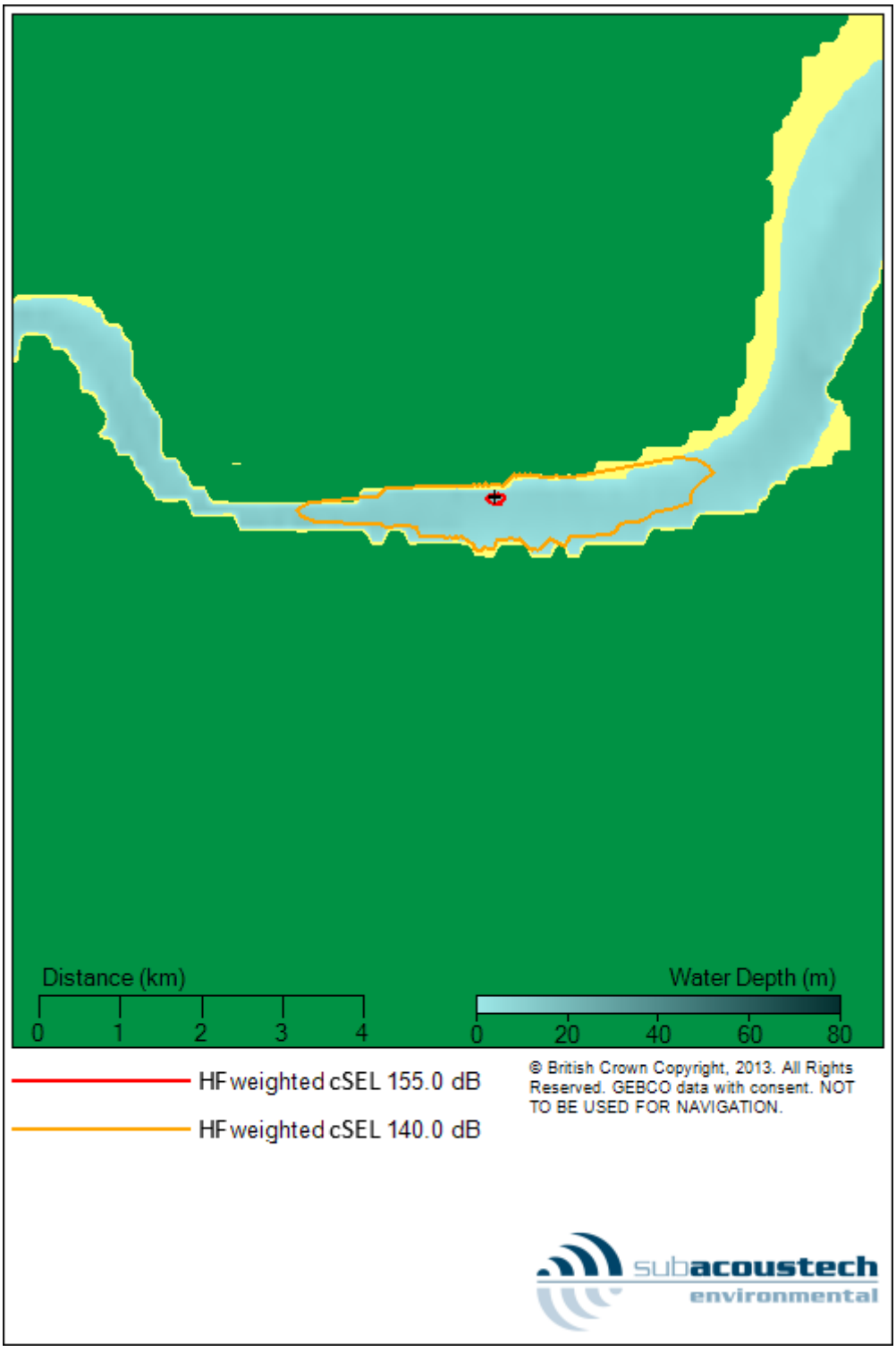



*Figure 7-26 High frequency cetacean weighted model of piling at high tide at the eastern location (610 mm pile)*

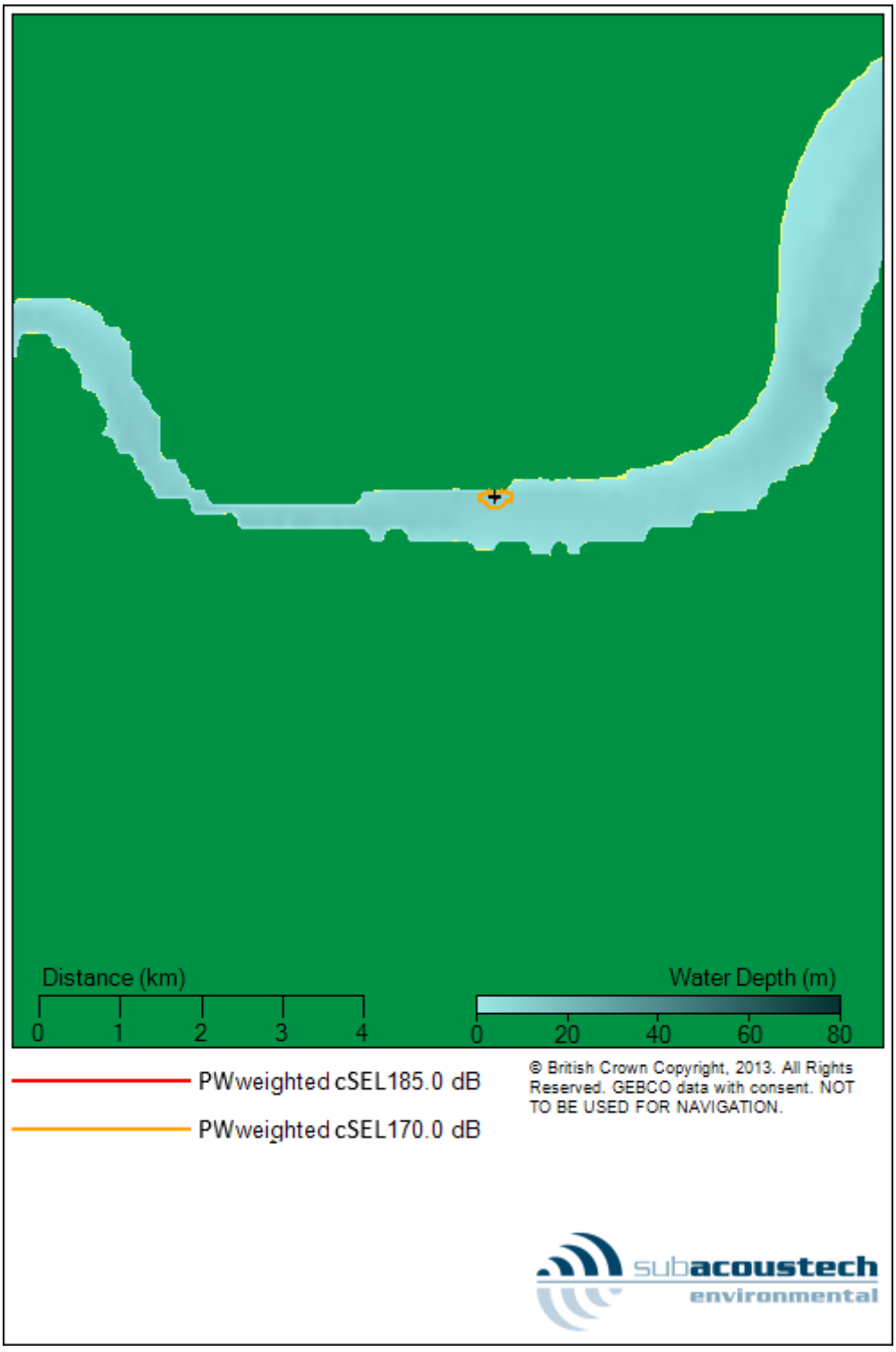



*Figure 7-27 Phocid pinniped weighted model of piling at low tide at the eastern location (610 mm pile)*

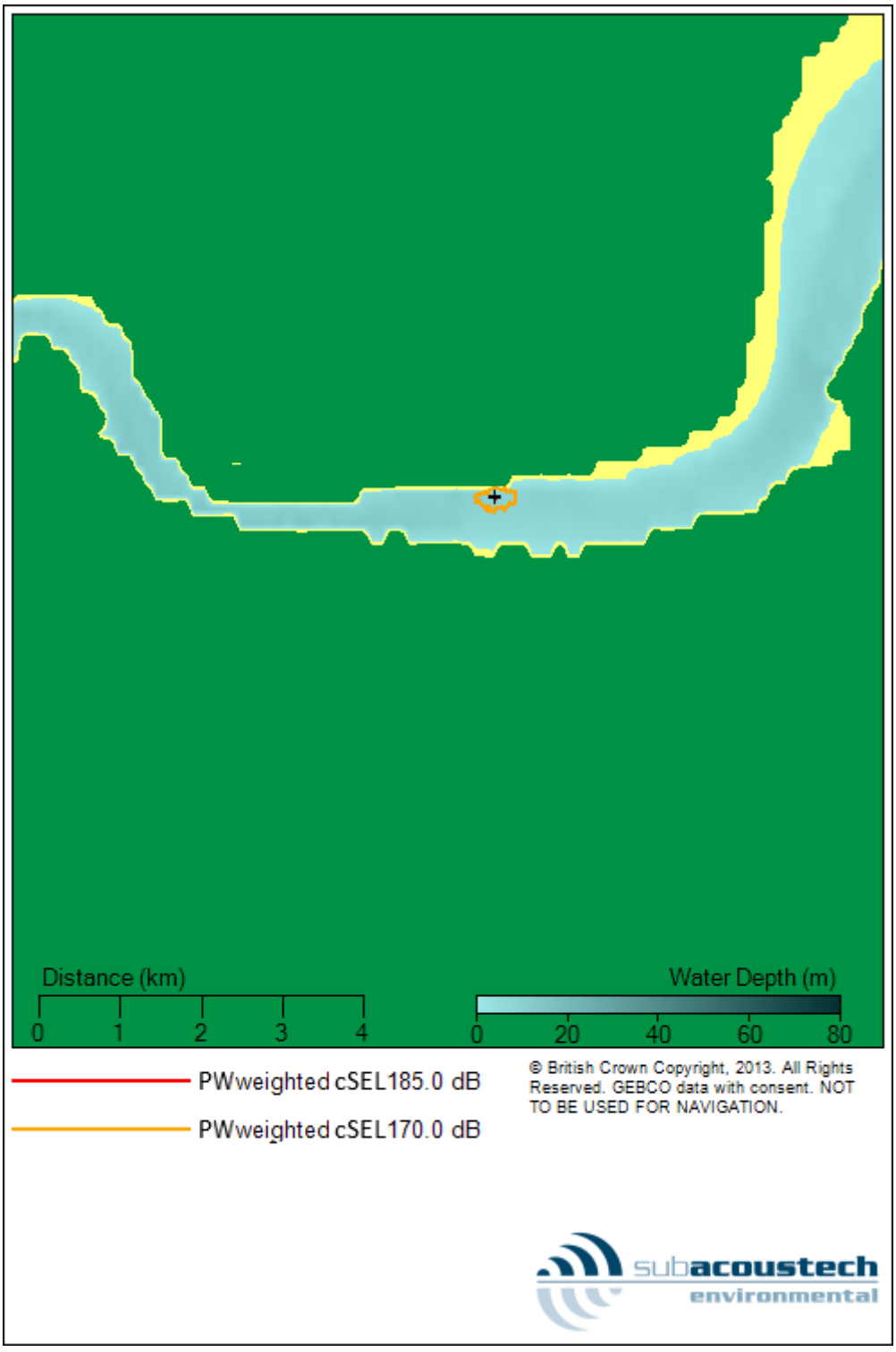



*Figure 7-28 Phocid pinniped weighted model of piling at high tide at the eastern location (610 mm pile)*

## A.6 Marine mammals, 610 mm pile, western location

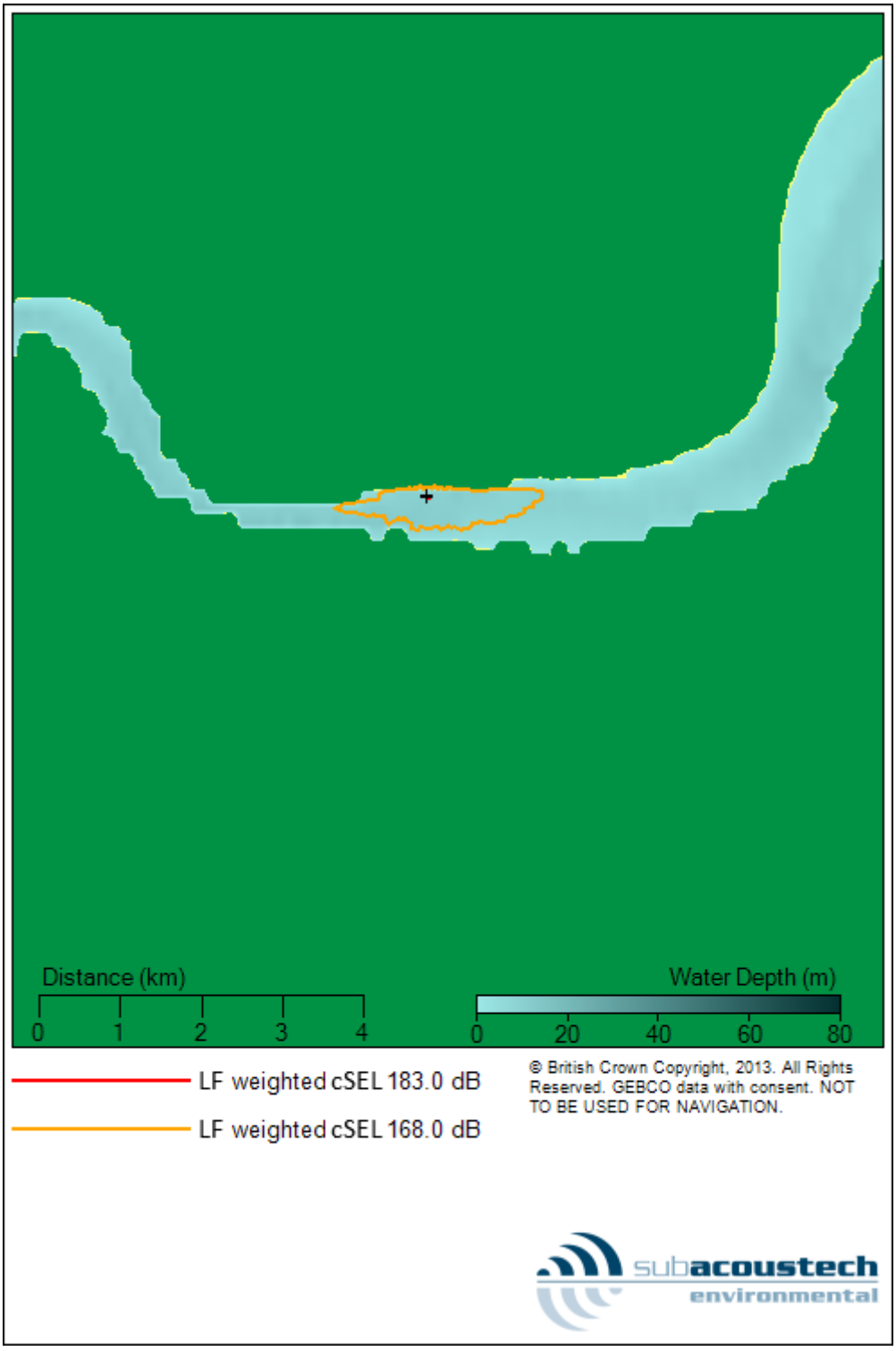



*Figure 7-29 Low frequency cetacean weighted model of piling at low tide at the western location (610 mm pile)*

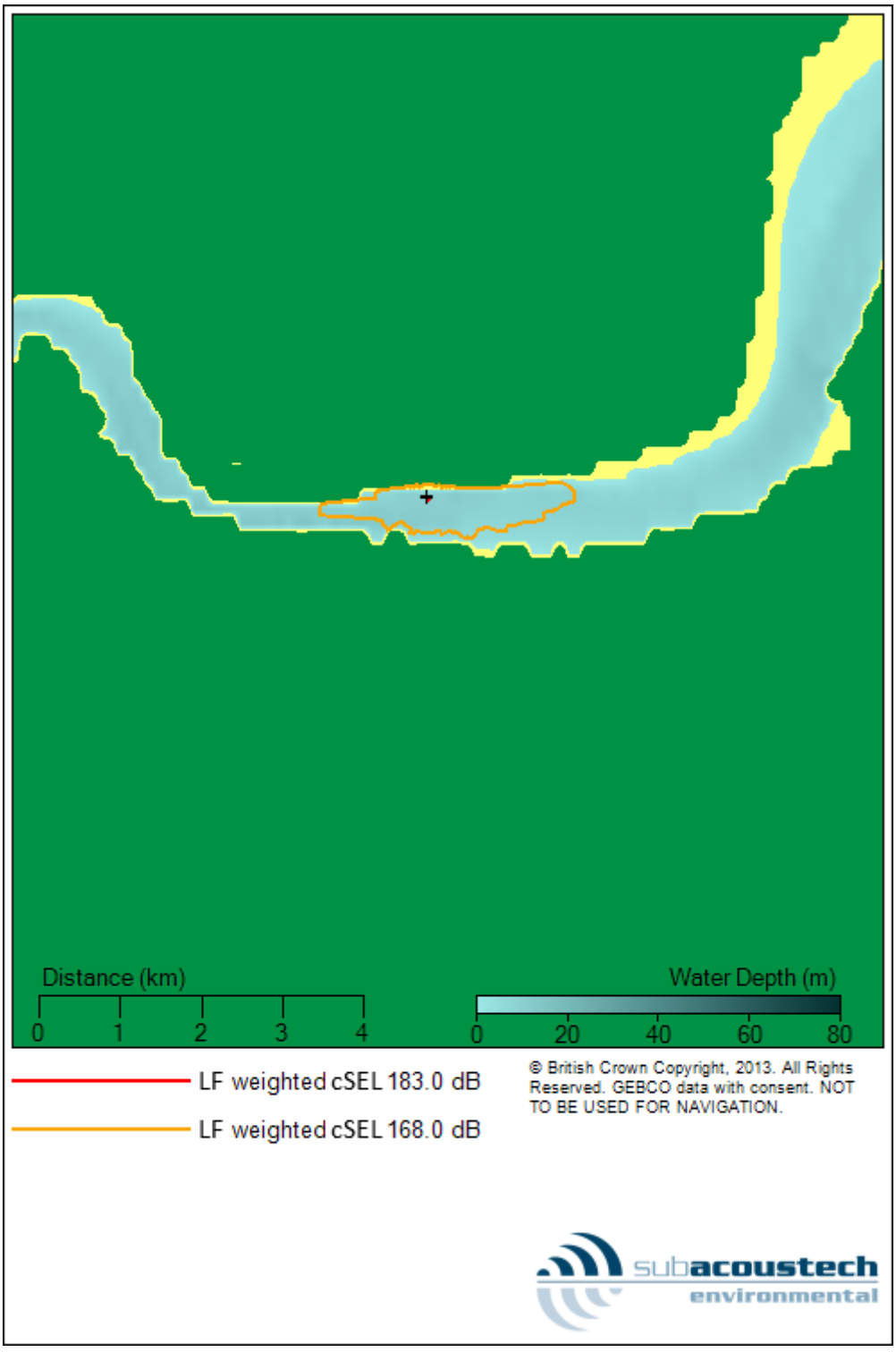



*Figure 7-30 Low frequency cetacean weighted model of piling at high tide at the western location (610 mm pile)*

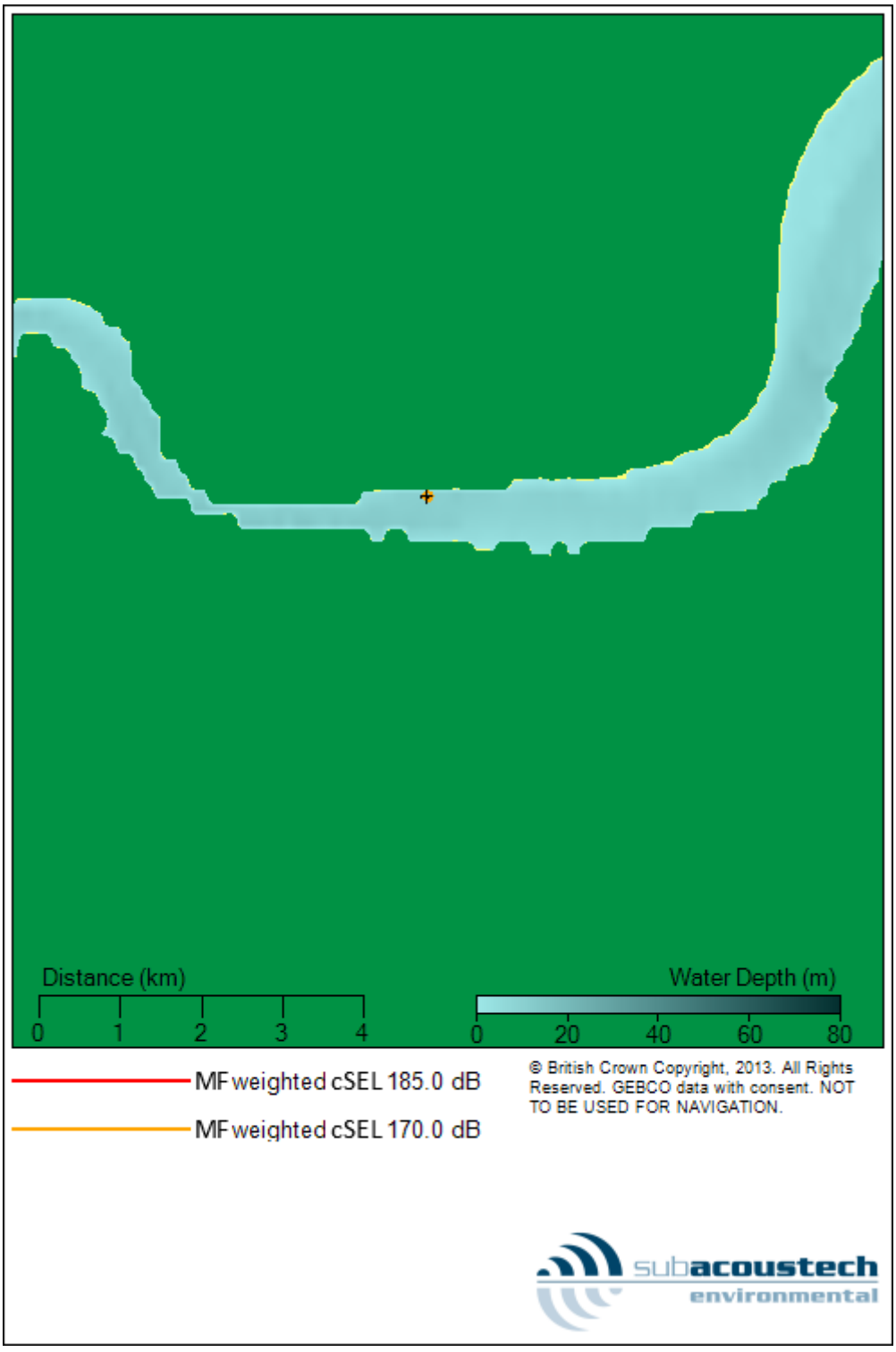



*Figure 7-31 Mid frequency cetacean weighted model of piling at low tide at the western location (610 mm pile)*

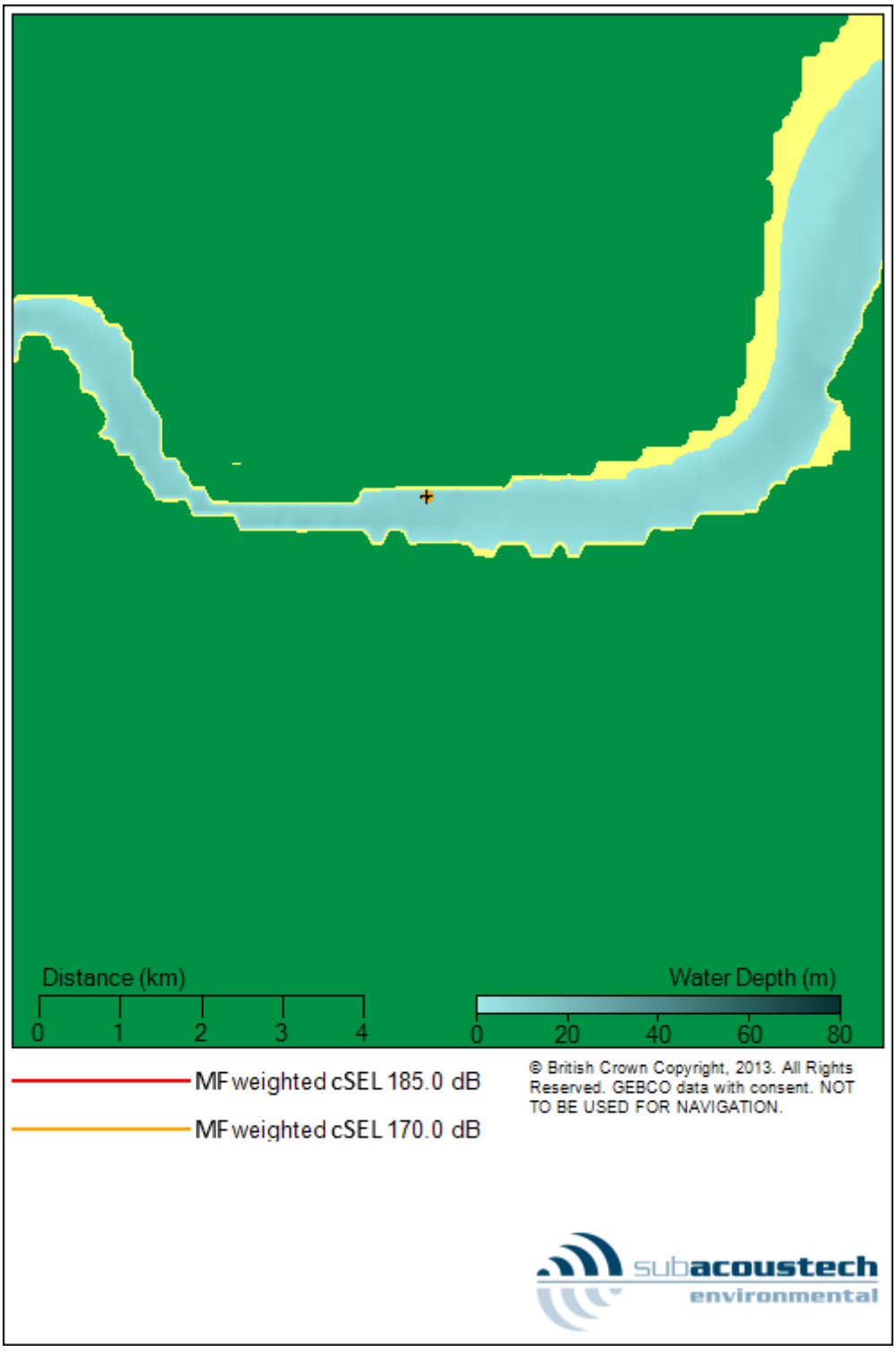



*Figure 7-32 Mid frequency cetacean weighted model of piling at high tide at the western location (610 mm pile)*

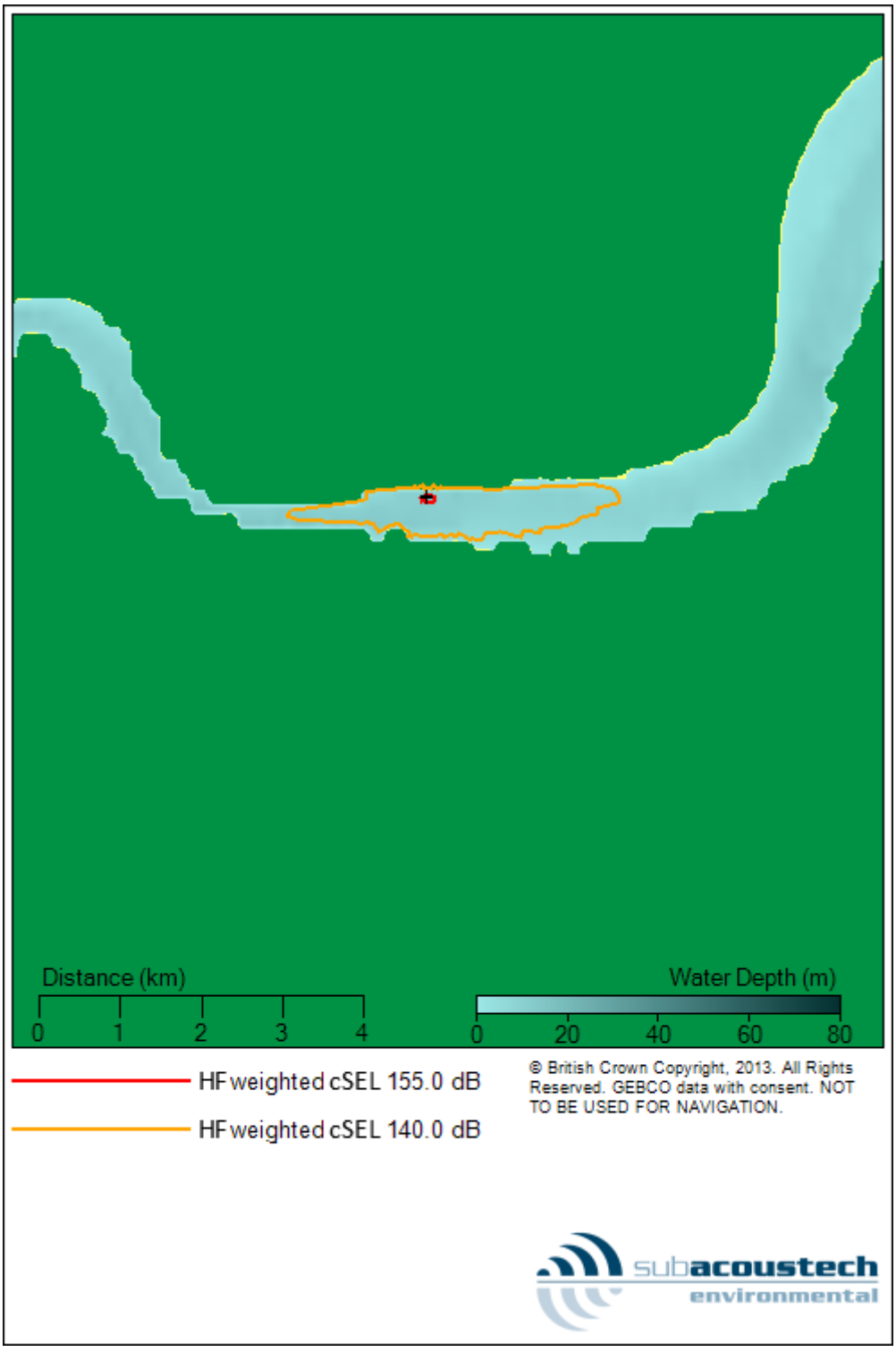



*Figure 7-33 High frequency cetacean weighted model of piling at low tide at the western location (610 mm pile)*

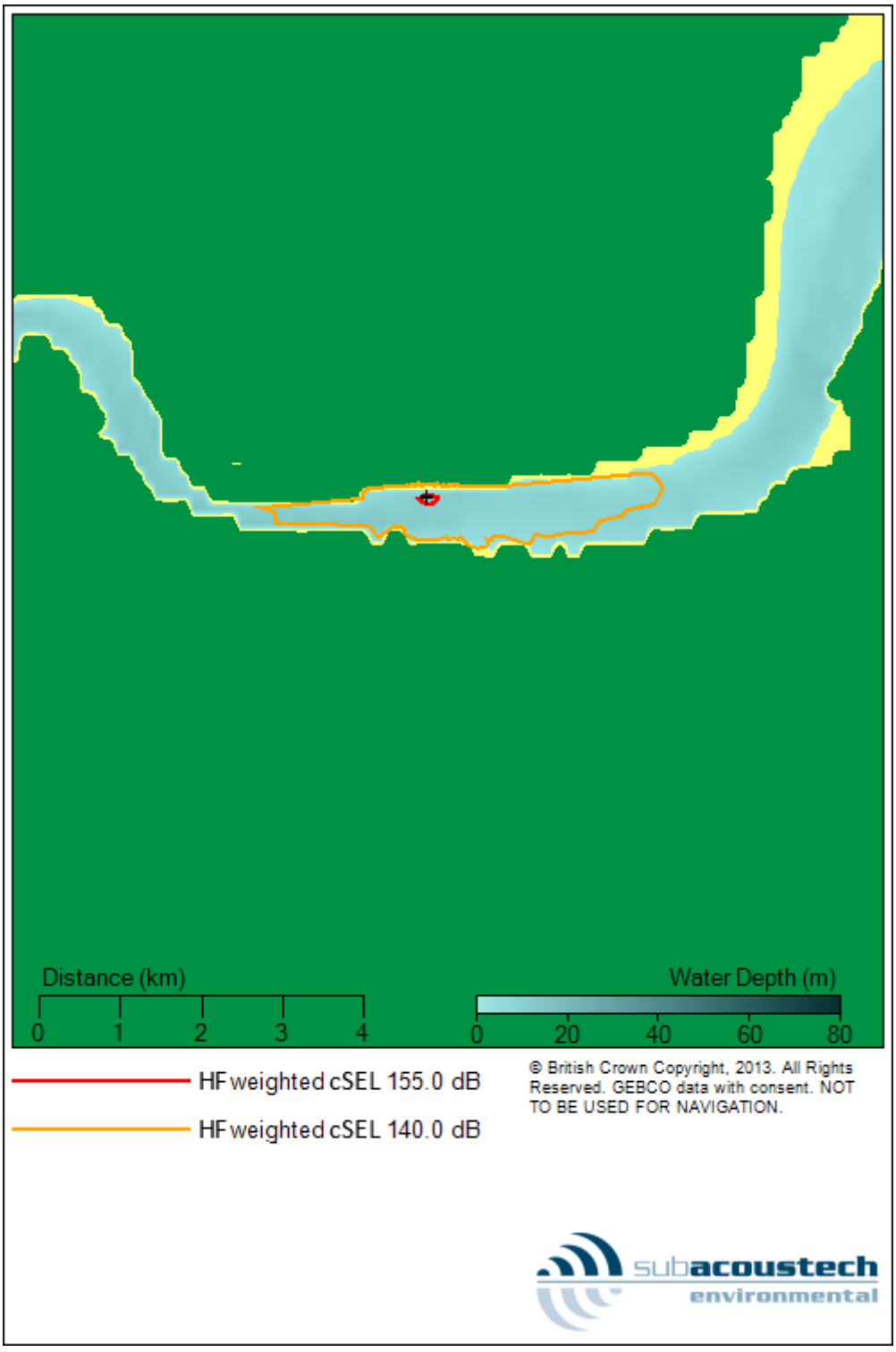



*Figure 7-34 High frequency cetacean weighted model of piling at high tide at the western location (610 mm pile)*

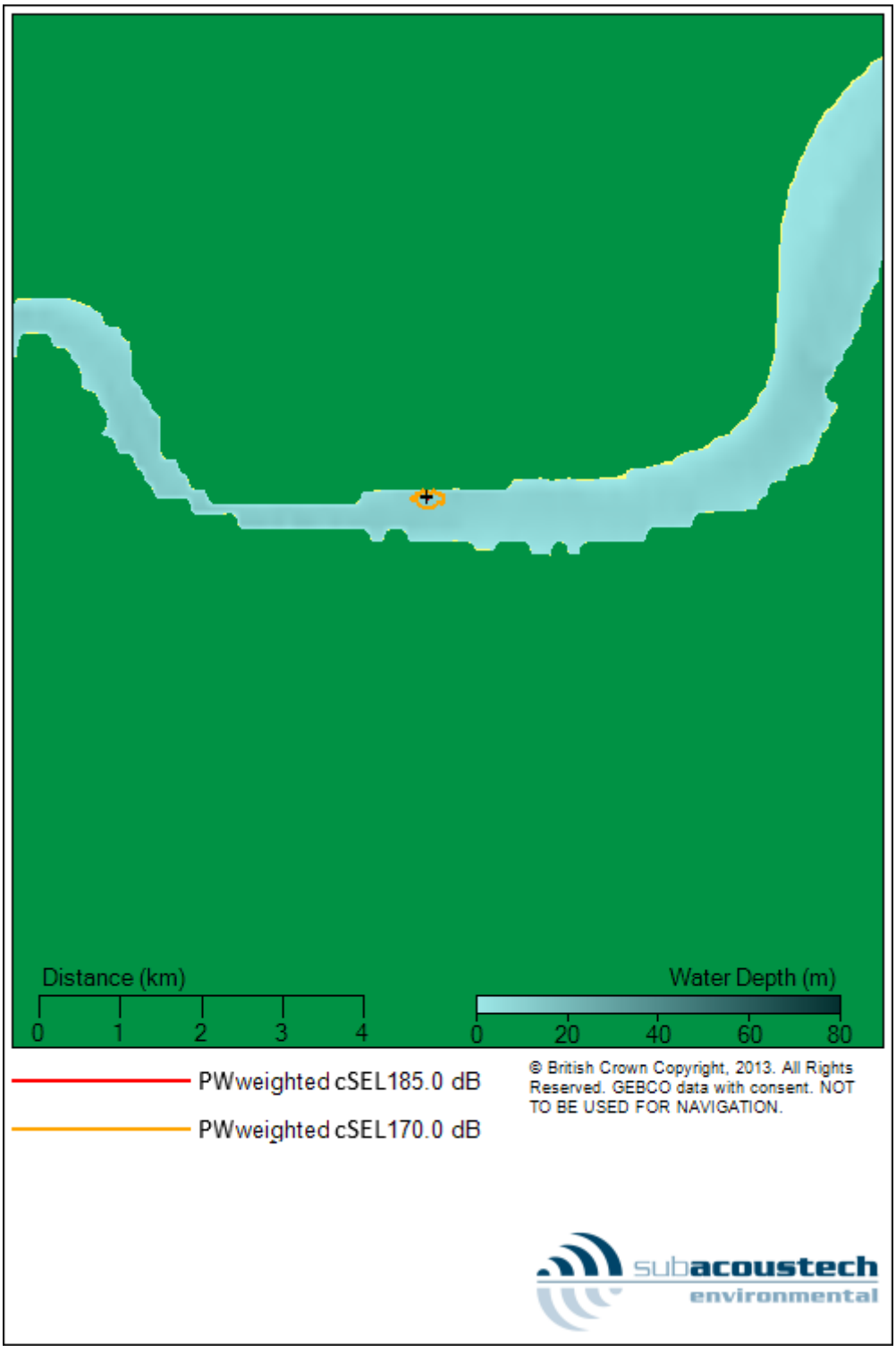



*Figure 7-35 Phocid pinniped weighted model of piling at low tide at the western location (610 mm pile)*

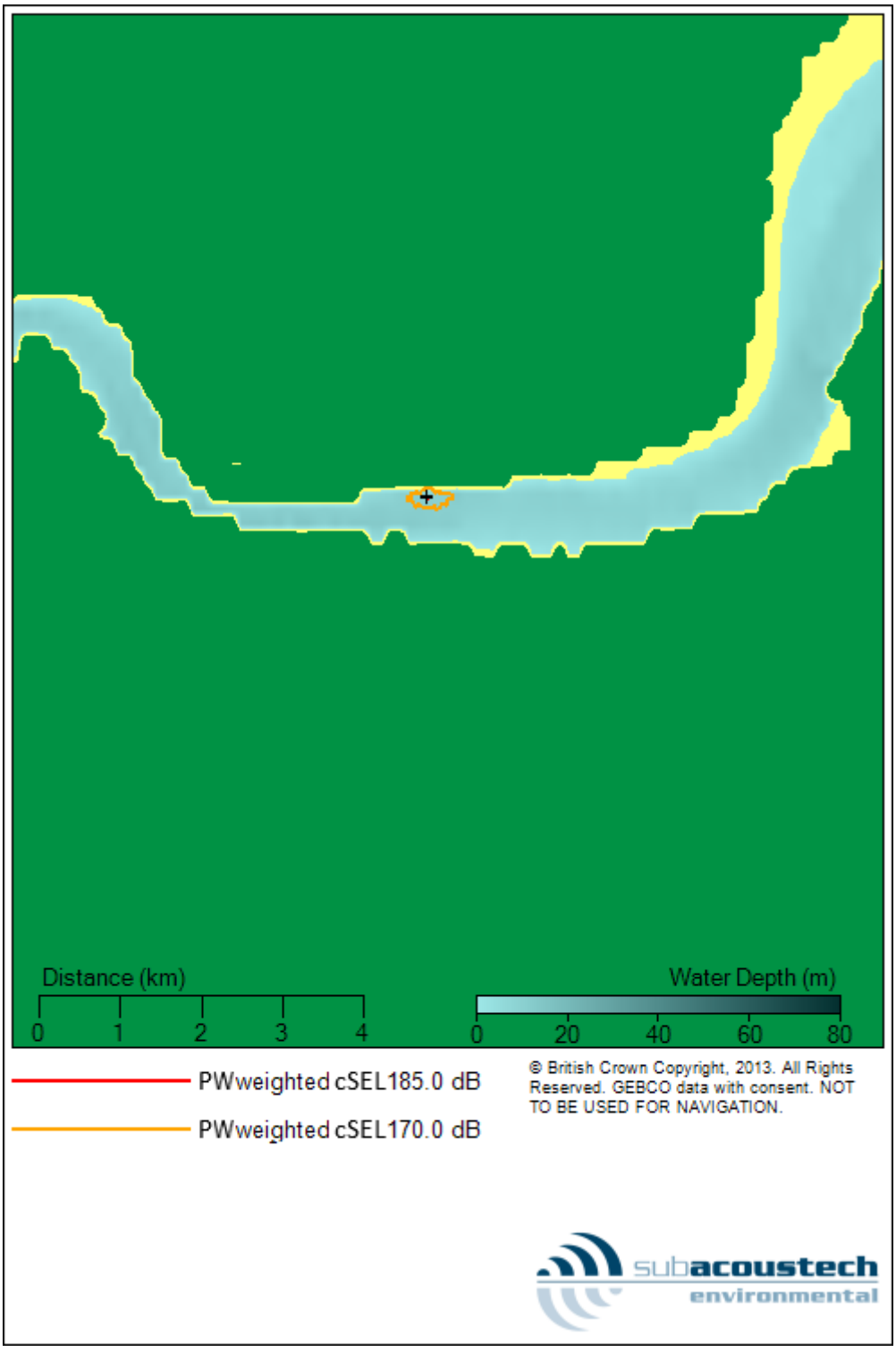



*Figure 7-36 Phocid pinniped weighted model of piling at high tide at the western location (610 mm pile)*

## A.7 Fish, 610 mm piles, east and west locations

The contours for fish with 610 mm piles are too small to effectively display at the scale of plot.

# Appendix B Hydrophone calibration certificate

Ocean Sonics

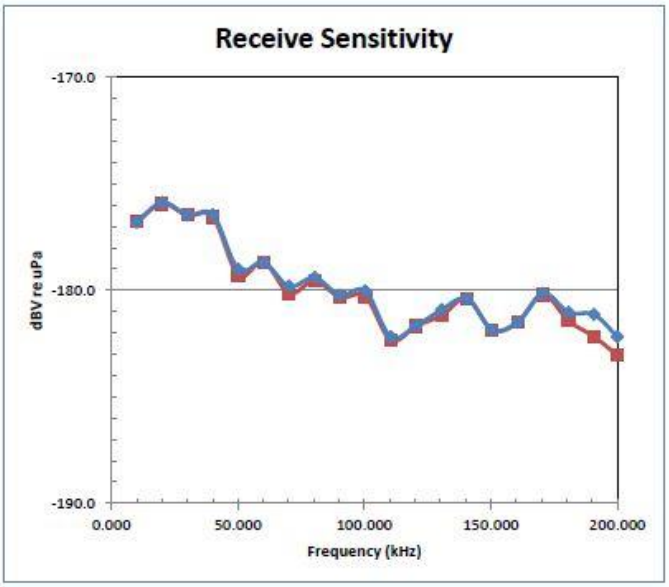
## Certificate of Calibration

Ocean Sonics, Ltd.

**Calibration Certificate Number: C3698**

**Test Result:** 10 kHz to 100 kHz: -178 ± 2.2
10 kHz to 200 kHz: -179 ± 3.2

| | | | |
|---|---|---|---|
| Model Number | RB9-ETH | Projector Manufacturer | Ocean Sonics |
| Serial Number | 1445 | Projector Model | TH2-SER-4F |
| Manufacture Date | 26-May-2016 | Projector Serial | 2210 |
| Measurement Date | 27-May-2016 | Measurement Distance | 1 m |
| Certificate Date | 27-May-2016 | Projector Mode | Wideband |
| Sensitivity @ 26 Hz | -178.7 dBV re µPa | Output Level | 129.7 dB re µPa @ 1.0 m |
| Case Type | Plastic | Reference Manufacturer | Ocean Sonics |
| Element Manufacturer | Reson | Reference Model | SB2-ETH |
| Element Model | TC4059 | Reference Serial | 1387 |
| Element Serial | 5114020 | Preamp Manufacturer | Ocean Sonics |
| Preamp Model | 300434-01 | Preamp Model | 300419-01 |
| Calibrated By | S.MacLean | Preamp Serial | 261 |
| Work Order Number | W1390 | Preamp Gain | 30 dB |
| Test Type | RX Sensitivity | ADC Manufacturer | Ocean Sonics |
| Test Proecdure | Complex RMS | ADC Model Number | 04-300423-01 |
| Test Location | Tank #2, 1 m | ADC Serial Number | 261 |




| Frequency | Sensitivity [dBV re µPa] | |
|---|---|---|
| kHz | 0 deg | 90 deg |
| 10.0 | -176.8 | -176.8 |
| 20.1 | -175.9 | -175.9 |
| 30.1 | -176.5 | -176.5 |
| 40.2 | -176.6 | -176.5 |
| 50.2 | -179.3 | -179.0 |
| 60.2 | -178.7 | -178.7 |
| 70.3 | -180.1 | -179.8 |
| 80.3 | -179.6 | -179.4 |
| 90.4 | -180.3 | -180.2 |
| 100.4 | -180.3 | -180.0 |
| 110.4 | -182.3 | -182.2 |
| 120.5 | -181.7 | -181.7 |
| 130.5 | -181.2 | -180.9 |
| 140.5 | -180.4 | -180.4 |
| 150.6 | -181.8 | -181.9 |
| 160.6 | -181.5 | -181.5 |
| 170.7 | -180.2 | -180.1 |
| 180.7 | -181.4 | -181.0 |
| 190.7 | -182.2 | -181.1 |
| 200.0 | -183.1 | -182.2 |

Ocean Sonics Ltd. Great Village, Nova Scotia Certificate of Calibration v 1.02 © 2015

# Report documentation page

- This is a controlled document.
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- Amendment shall be by whole document replacement.
- Proposals for change to this document should be forwarded to Subacoustech Environmental.

| Document No. | Draft | Date | Details of change |
|---|---|---|---|
| P203R0101 | 01 | 03/08/2017 | Initial writing and Atkins review |
| P203R0102 | 02 | 08/08/2017 | Minor corrections and addition of section 5 |
| P203R0103 | - | 11/08/2017 | Addition of 610 mm piles, issued to client. |
| P203R0104 | - | 01/09/2017 | 2.5 m piles revised to 3.5 m.<br>Updated TTS criteria for 610 mm piles.<br>Additional detail included for other noise sources. |
| P203R0105 | - | 13/09/2017 | Minor revisions and clarifications |
| P203R0106 | - | 26/04/2018 | Inclusion of 1.22 m and 914 mm piles |

| | |
|---|---|
| Originator’s current report number | P203R0106 |
| Originator’s name and location | F Midforth; Subacoustech Environmental Ltd. |
| Contract number and period covered | P203; July 2017 – September 2017 |
| Sponsor’s name and location | Port of Tilbury London Limited. |
| Report classification and caveats in use | COMMERCIAL IN CONFIDENCE |
| Date written | July 2017 |
| Pagination | Cover + i + 70 |
| References | |
| Report title | Monitoring background noise and modelling of construction noise at Tilbury Docks |
| Translation/Conference details (if translation, give foreign title/if part of a conference, give conference particulars) | |
| Title classification | Unclassified |
| Author(s) | Fergus Midforth, Tim Mason, Sam East |
| Descriptors/keywords | |
| Abstract | |
| Abstract classification | Unclassified; Unlimited distribution |

PORT OF TILBURY LONDON

PLANNING ACT 2008
INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

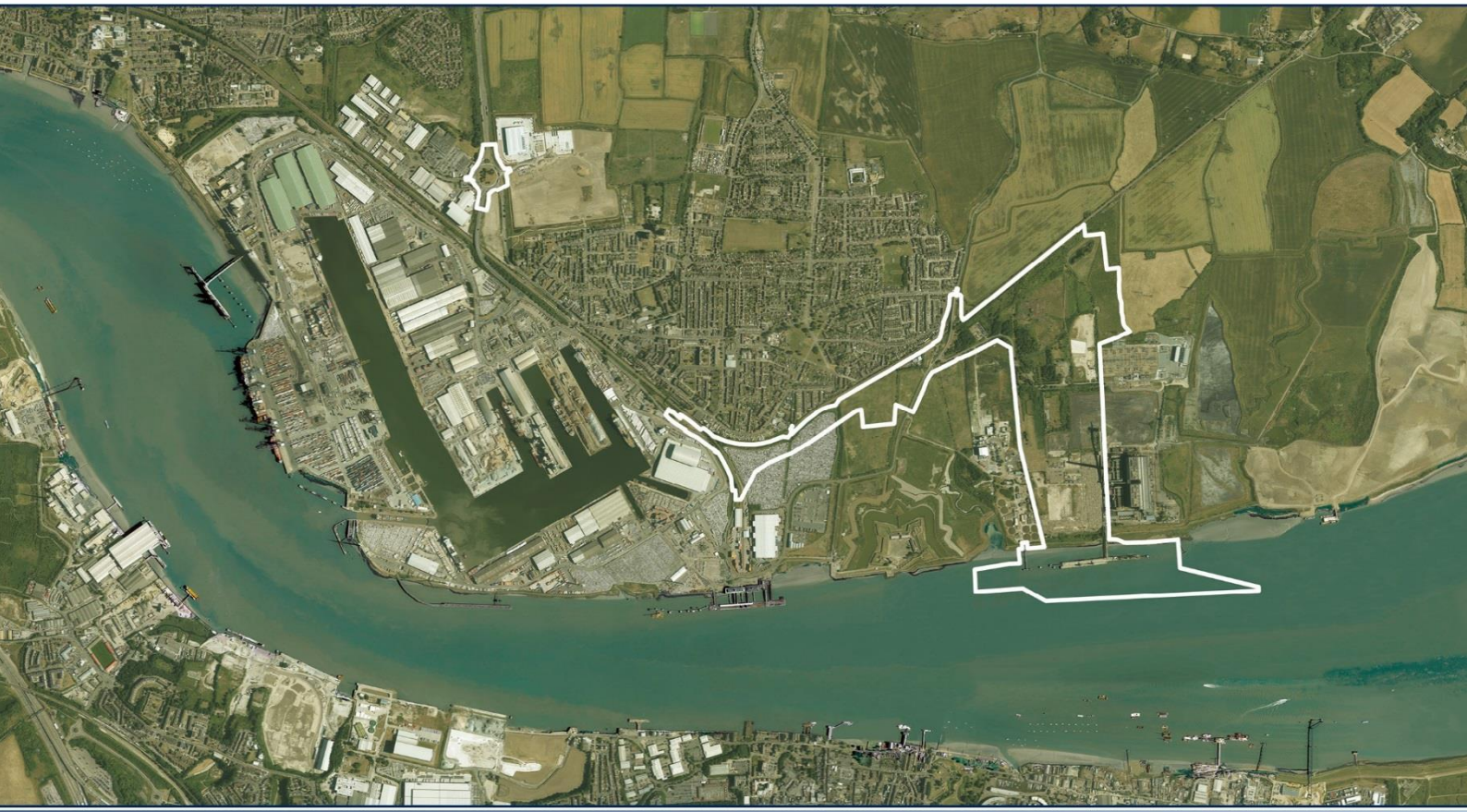
PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

# TILBURY2

TR030003

# APPENDIX 2: NOTE OF WINTERING BIRD USE OF THE INTERTIDAL AREA (APRIL 2018 REVISION)

TILBURY2 DOCUMENT REF: PoTLL/T2/EX/94



TILBURY2

**PROPOSED PORT TERMINAL AT FORMER TILBUY POWER STATION: TILBURY2**
**NOTE ON WINTER BIRD USE OF THE INTERTIDAL AREA**
**April 2018**

***Background and purpose of note***

1. Port of Tilbury London Limited (PoTLL) has submitted an application for a new port terminal on the north bank of the River Thames, on part of the site of the former Tilbury Power Station. The Development Consent Order (DCO) application was accepted for examination by the Planning Inspectorate on 21 November 2017[1,2]. The project is known as "Tilbury2" and will require improvements and extensions to the existing jetty including creation of a new RoRo berth, with associated dredging of berth pockets around the extended jetty and dredging of the approaches to the berth pockets.

2. To provide supporting information for the DCO application, monthly wintering bird surveys of the intertidal area within the vicinity of the jetty were carried out between November 2016 and March 2017, with additional surveys in September and October 2017, as reported in the Environmental Statement (ES) submitted with the application.

3. On 25 October 2017, Natural England issued an email under its Discretionary Advice Service (DAS), which stated [emphasis added by Bioscan]:

   *"We are pleased to see that surveys have been carried out in September and October of 2017, thus completing an overwintering season in conjunction with the 2016 data. We would, however, have expected the application to be supported by a number of years of full data and* ***consider that this limitation may have contributed to bird numbers identified being low****. Paragraph 1.277 of the ES gives limited detail relating to survey work prior to 2016. Any further data available should be presented within the ES to corroborate the findings of the most recent surveys.*
   *With regards to functionally linked land, Natural England notes that 'several of the bird species underpinning the European Site designations make use of intertidal habitats in closer proximity to the Tilbury2 site than the European Site itself.' From the information provided Natural England has been unable to ascertain which areas SPA birds are using, which species or in what numbers.* ***We note that it is considered that there is 'relatively low' usage of intertidal habitats within the area of 'potential disturbance' identified,*** *but would expect to see consideration of what the habitat is being used for and potential impacts on the species concerned. It is worth bearing in mind that whilst some key species are identified in the SPA conservation objectives, water bird assemblage is also a qualifying feature."*

4. Initially, no explanation was provided by Natural England as to the source of this query, nor any alternative evidence that informed their view that the low bird numbers recorded by Bioscan for the intertidal area adjacent to the proposed Tilbury2 site may be atypical. However, during a subsequent discussion at a meeting held at Port of Tilbury on 11 December 2017, it became apparent that the background data that had led to these comments, covered a much wider area extending from the Tilbury2 site to Coalhouse Fort. Bioscan's own studies had noted significantly greater concentrations of intertidal bird species downstream of the Tilbury2 site and adjacent to Coalhouse Fort, and it was conjectured in discussion with Natural England on 11

[1] The DCO application documents are available via the Planning Inspectorate website https://infrastructure.planninginspectorate.gov.uk/projects/south-east/tilbury2/
[2] Thurrock Borough Council scoping application reference: 16/01194/SCO.

December that the counts presented in the ES may have been viewed in the context of the higher numbers around Coalhouse Fort, leading to an incorrect supposition that the ES data for the zone of influence around the proposed DCO boundary was anomalous or unrepresentative.

5. It was agreed on the 11 December 2017 that Bioscan would produce a note providing additional context to the information presented in the ES. Natural England requested that any "*further data available should be presented ... to corroborate the findings of the most recent surveys*". This note duly provides details of wintering bird survey work which has been undertaken monthly between November 2017 and March 2018 (i.e. following on from the Environmental Statement submission). This is presented in the context of the Bioscan's previous intertidal wintering bird surveys (2016/17 and 2017), with further third-party and historic data being provided as part of this package of evidence in order to demonstrate that the level of bird use of this area is representatively portrayed and robustly assessed within the DCO application supporting documents (i.e. within Chapter 10 of the Environmental Statement, document reference 6.1; and ES Appendix 10.O Habitats Regulations Assessment (HRA) Report, document reference 6.2 10.O).

6. This note provides supporting evidence which is for clarification purposes and is not required for the assessment of likely significant effects. This supporting information includes the results of on-going monitoring which corroborates the findings of the most recent surveys provided in the ES. Such on-going monitoring is good practice. The information in this note does not constitute "further information" pursuant to Regulation 17 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009. It is evidence which supports our existing conclusions and it is not necessary in order to make the initial ES adequate; the data requested by Natural England was to corroborate the findings of the most recent surveys and that is what this note achieves. Those affected by the information presented have therefore already had an adequate opportunity to comment on it.

***Sites Designated for Bird Interest***

7. The specific portion of intertidal area along the River Thames adjoining the Tilbury2 site and extending upstream and downstream for over two kilometres is not designated as a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) or Ramsar Site. The nearest European nature conservation designation is the Thames Estuary and Marshes SPA and Ramsar Site, which is located approximately 2km to the south-east at its closest point (which is on the far side of the River Thames). A portion of the SPA is on the same side of the Thames as the site and is located at its closest point approximately 2.6km to the east.

8. The qualifying features for the Thames Estuary and Marshes SPA are as follows:

   Wintering populations of European importance of the following Annex I species:

   - Avocet *Recurvirostra avosetta*; and
   - Hen harrier *Circus cyaneus*.

Regular use by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed on Annex I):

- Ringed plover *Charadrius hiaticula* (passage);
- Grey plover *Pluvialis squatarola* (winter);
- Dunlin *Calidris alpina alpina* (winter);
- Knot *Calidris canutus islandica* (winter);
- Black-tailed godwit *Limosa limosa islandica* (winter); and
- Redshank *Tringa totanus totanus* (winter).

9. The site also qualifies under Article 4.2 as a wetland of international importance by regularly supporting at least 20,000 waterfowl. Over winter, the area is cited as regularly supporting 75,019 individual waterfowl (five-year peak mean to 21/03/2000) including: redshank, black-tailed godwit, dunlin, lapwing *Vanellus vanellus*, grey plover, shoveler *Anas clypeata*, pintail *Anas acuta*, gadwall *Anas strepera*, shelduck *Tadorna tadorna*, white-fronted goose *Anser albifrons*, little grebe *Tachybaptus ruficollis*, ringed plover, avocet and whimbrel *Numenius phaeopus*.

10. The Thames Estuary & Marshes is also designated as a wetland of international importance under the Ramsar criteria (The Thames Estuary & Marshes Ramsar Site). In relation to birds, the site qualifies under criterion 3 due to it supporting a wintering bird assemblage of international importance (5 year peak mean, 1998/99 – 2002/03, of 45,118 waterfowl) and under criterion 6 due to it supporting populations of qualifying bird species at levels of international importance (specifically migratory ringed plover and black-tailed godwit; and wintering grey plover, knot, dunlin and redshank).

11. The South Thames Estuary and Marshes SSSI is designated on the basis of its coastal wetland habitats and the rare/scarce plants and invertebrates they support, as well as the internationally important populations of certain bird species (as cited under the SPA and Ramsar designations), and nationally important numbers of certain other bird species. Such older data is provided as supporting explanatory and reference material only.

***Bird use of the affected areas: historical and third party data***

12. Some of the data described in the following paragraphs is of significant age and of questionable relevance to the current baseline position, hence much of these older data were not reported in the ES. Nevertheless, for completeness and to consider whether longer term trends have any relevance to Natural England's query, it is included below for completeness.

13. **Estuarine Waterbirds at Low Tide: the WeBS Low Tide Counts 1992-93 to 1998-99**. Over the winters of 1992/93 to 1998/99 a study of the bird use of the estuarine systems at low tide of the UK was undertaken (Musgrove *at al.*, 2003)[3]. In respect of the Thames Estuary this covered two winters: 1993-94 and 1998-99. The inner Thames between Barking and Tilbury was covered during the 1993-94 winter only; however, greater coverage of the estuary was achieved in

[3] Musgrove, A.J., Langston, R.H.W., Baker, H. & Ward, R. M. (eds) (2003) Estuarine Waterbirds at Low Tide: the WeBS Low Tide Counts 1992-93 to 1998-99. WSG/BTO/WWT/RSPB/JNCC, Thetford.

1998-99, as shown at Inset Figure 1 below. In respect of the Tilbury2 site, a low-tide recording compartment runs between the Tilbury jetty access eastward to Coalhouse Point, as indicated by the red arrow in Inset Figure 1 below (with the intertidal area between the jetty and 'London International Cruise Terminal' in Tilbury apparently omitted).

**Inset Figure 1: extract from Musgrove *at al.* (2003) showing survey compartments**

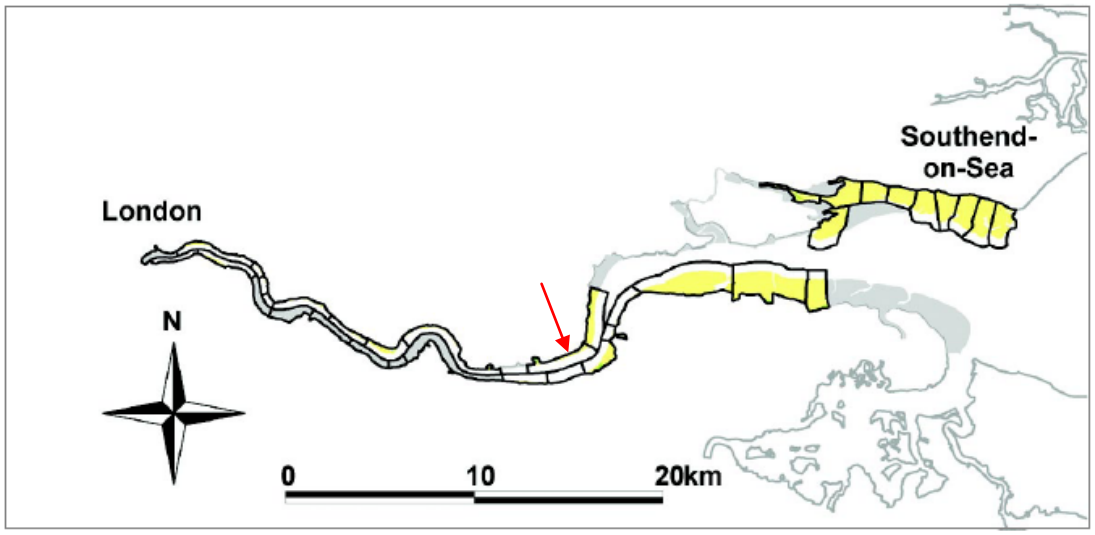



Figure 4.23.1: **LTC sections at the Thames Estuary, winters 1993–94 and 1998–99**

14. In contrast with the British Trust for Ornithology's (BTO's) standard methodologies for undertaking Wetland Bird Surveys (WeBS) core counts, which cover inland waterbodies and coastal areas at high tide (therefore aiming to survey high-tide bird roosts); the Musgrove *at al*. study aimed to cover the low tide period of estuaries to assess their importance for feeding birds. The published results of the Musgrove *at al.* study included a summary of the bird use at low tide of each of the main estuaries in the UK. The following is an extract in respect of the Thames Estuary [emphasis added by Bioscan to highlight references most pertinent to the Tilbury2 site]:

*"Due to the incomplete coverage achieved, care must be taken when attempting to interpret the maps. With this in mind, the totals and weighted totals maps pick out the shore north of* ***Coalhouse Fort (off East Tilbury Marshes)*** *as well as Higham Creek, Hadleigh Ray, Southend Flats and on the south shore from Egypt Bay eastwards.* ***High densities were also recorded on the inner Thames, although much smaller numbers of birds were involved due to the narrower shores here.*** *Many of the individual species were widespread but showed concentrations in one or more areas. Such species included* […] ***Dunlin (especially East Tilbury*** […]*).* ***Avocets were highly concentrated on the East Tilbury shoreline, with most of the Black-tailed Godwits also here*** *and along the North Kent shore.* ***Ringed Plovers were in their highest densities at*** *Thamesmead,* ***West Thurrock to Coalhouse*** *and* […]*."*

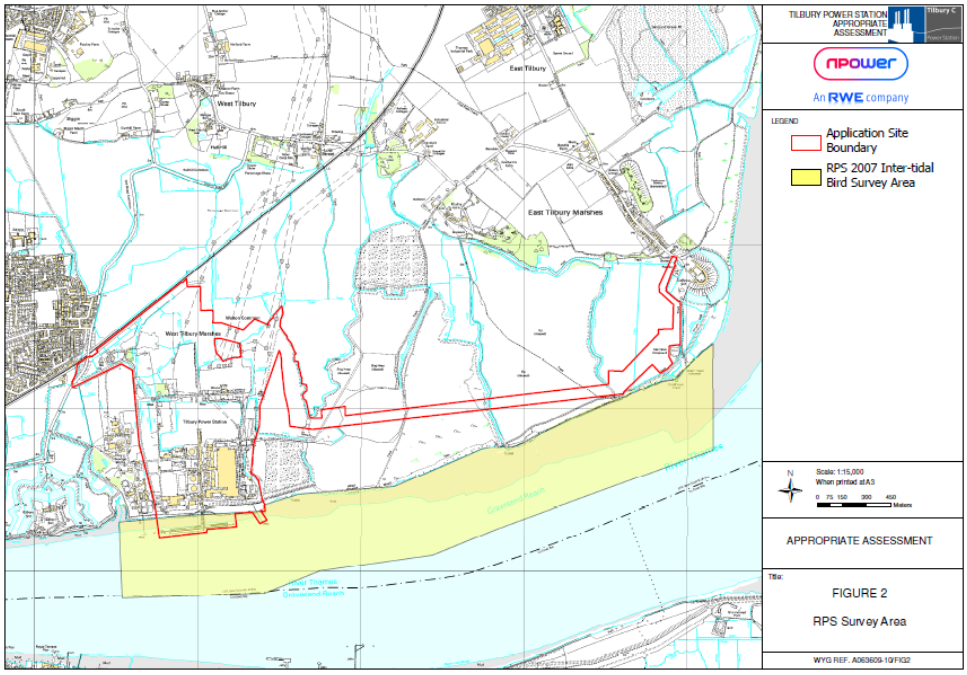
15. For each estuary system a series of dot-density maps were provided to show an indicative distribution of the various species surveyed in the Thames Estuary. In respect of the compartments adjacent to the Tilbury2 site (i.e. between the Tilbury jetty access eastward to Coalhouse Point – see Inset Figure 1 above with relevant compartment indicated by a red arrow), the dot-density maps show concentrations of lapwing, dunlin, shelduck, ringed plover, grey plover and redshank. However, as the dot-density maps present the distributions as an even coverage of birds within the compartment, when in fact the data was collected from a

coastal stretch >3km long which includes the Tilbury2 survey area and >1km beyond this to the east incorporating Coalhouse Point, the mapping is of limited value. Given this, and the time which has elapsed since the data was gathered (some of which is approaching 20 years in age), the degree to which this data can be relied upon to inform the current assessment is limited.

16. **Surveys to inform development proposals at Tilbury Power Station (2007-2008).** Targeted bird surveys of the intertidal area within the vicinity of the Tilbury2 site were conducted by RPS on behalf of RWE between January 2007 and May 2008 and documented in interim reports[4,5,6,7,8] with WYG providing a summary of all the RPS results (WYG, 2012)[9]. These records were further summarised within Table 10.39 of the Tilbury2 ES.

17. The RPS wintering bird surveys comprised intertidal surveys from January to March 2007 (low tide only), and September 2007 to March 2008 (two counts at low tide and two at high tide). Nocturnal intertidal surveys were also conducted and these comprised monthly visits between November 2007 and March 2008. The nocturnal surveys commenced after dusk and three hours prior to low tide and finished one hour after low tide. The area surveyed covered the intertidal section of the River Thames from Bill Meroy Creek to just north of Coalhouse Point (see Inset Figure 2 below), therefore encompassing the whole of the Tilbury2 DCO boundary and overlapping with the study area for the present ES. Table 1 below provides a summary of the results from these surveys, and the survey area is shown in Inset Figure 2 below.

**Inset Figure 2: extract from WYG (2012) showing intertidal bird survey area**




[4] RPS (July 2007) 'Tilbury Power Station: Intertidal Ornithological Survey Report. January-March 2007'
[5] RPS (February 2008) 'Tilbury Power Station: Intertidal Ornithological Survey Report. August-October 2007'
[6] RPS (March 2008) 'Tilbury Power Station: Intertidal & Terrestrial Ornithological Survey Report. November-December 2007'
[7] RPS (June 2008) 'Tilbury Power Station: Intertidal & Terrestrial Ornithological Survey Report. November-March 2008'
[8] RPS (June 2008) 'Tilbury Power Station: Intertidal Ornithological Survey Report. April-May2008'
[9] WYG (August, 2012). 'Tilbury B Biomass Phase 2 Project: Information for Appropriate Assessment (Assessment of Potential Impacts on the Thames Estuary and Marshes Special Protection Area and Ramsar Site)'. Produced in respect of RWE's [now shelved] biomass conversion project (planning reference: 12/00890/OUT).

**Table 1: Summary of results of intertidal wintering bird survey (RPS, 2012[10]; and Atkins, 2017[11]).**

| Month | Jan-2007 (Diurnal survey) | Feb-07 (Diurnal survey) | Mar-07 (Diurnal survey) | Sep-2007 (Diurnal survey) | Oct-2007 (Diurnal survey) | Nov-2007 (Nocturnal survey) | Nov-2007 (Diurnal survey) | Dec-2007 (Diurnal survey) | Jan-2008 (Nocturnal survey) | Jan-2008 (Dirunal survey) | Feb-2008 (Nocturnal survey) | Feb-2008 (Diurnal survey) | Mar-2008 (Nocturnal survey) | Mar-2008 (Diurnal survey) | 2016-17- Max count (High tide) | 2016-17- Max count (Low tide) | Max count SPA species within Bioscan survey area (Atkins 2016-17 data)* | Number of visits SPA species encountered within Bioscan survey area (Atkins 2016-17 data)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Source** | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | RPS | Atkins | Atkins | Atkins | Atkins |
| Avocet | 2 | 0 | 8 | 26 | 50 | 7 | 68 | 7 | 2 | 450 | 3 | 2 | 0 | 12 | 900 | 10 | 11 | 2 |
| Bar-tailed Godwit | 1 | 0 | 0 | 21 | 48 | 0 | 36 | 2 | 0 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | - | - |
| Black-headed gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 368 | - | - |
| Black-tailed Godwit | 16 | 6 | 0 | 105 | 1479 | 11 | 247 | 26 | 8 | 13 | 6 | 15 | 2 | 7 | 13 | 3 | 7 | 2 |
| Brent goose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | - | - |
| Canada goose | 0 | 0 | 0 | 26 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Common gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | - | - |
| Common sandpiper | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - | - |
| Common scoter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | - | - |
| Cormorant | 8 | 3 | 4 | 6 | 13 | 0 | 5 | 9 | 0 | 3 | 0 | 4 | 0 | 6 | 3 | 2 | - | - |
| Curlew | 36 | 20 | 3 | 5 | 40 | 11 | 38 | 27 | 22 | 54 | 27 | 37 | 9 | 4 | 20 | 52 | - | - |
| Dark-bellied Brent Goose | 0 | 0 | 0 | 0 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | - | - |
| Dunlin | 2,119 | 1,560 | 1 | 54 | 649 | 667 | 1,407 | 1,402 | 51 | 306 | 452 | 3,201 | 81 | 602 | 590 | 486 | 200 | 2 |
| Gadwall | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 40 | 40 | - | - |
| Great Crested Grebe | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | - |
| Great black-backed gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 9 | - | - |
| Green sandpiper | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Grey heron | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | - | - |
| Grey Plover | 30 | 12 | 4 | 7 | 23 | 25 | 22 | 28 | 10 | 21 | 75 | 28 | 6 | 26 | 18 | 23 | 10 | 1 |
| Greylag goose | 0 | 0 | 0 | 4 | 42 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Herring gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 14 | - | - |
| Knot | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 18 | 0 | 77 | 0 | 0 | 0 | 0 | - | - |
| Lapwing | 39 | 4 | 12 | 1 | 11 | 6 | 86 | 12 | 6 | 64 | 10 | 53 | 0 | 26 | 0 | 7 | - | - |
| Lesser black-backed gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 5 | - | - |
| Little egret | 0 | 0 | 0 | 5 | 4 | 0 | 6 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 1 | 2 | - | - |
| Little Grebe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Little Stint | 0 | 0 | 0 | 2 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Mallard | 43 | 15 | 9 | 48 | 65 | 1 | 69 | 61 | 0 | 61 | 0 | 47 | 2 | 36 | 138 | 68 | - | - |
| Oystercatcher | 0 | 4 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 11 | 3 | 11 | 2 | 3 | - | - |
| Pintail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | - | - |
| Redshank | 97 | 1 | 0 | 27 | 21 | 75 | 25 | 68 | 19 | 23 | 11 | 9 | 148 | 25 | 9 | 30 | 8 | 4 |
| Ringed Plover | 112 | 135 | 24 | 124 | 112 | 12 | 56 | 87 | 17 | 78 | 1 | 86 | 2 | 54 | 0 | 40 | 27 | 2 |
| Ruff | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Shag | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | - |
| Shelduck | 127 | 157 | 50 | 30 | 104 | 21 | 2 | 93 | 61 | 123 | 2 | 227 | 92 | 120 | 200 | 106 | 56 | 3 |
| Shoveler | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | - |
| Shoveler | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | - | - |
| Teal | 5 | 5 | 5 | 13 | 8 | 1 | 24 | 25 | 0 | 56 | 13 | 148 | 64 | 163 | 317 | 435 | - | - |
| Tufted Duck | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | - |
| Turnstone | 8 | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 6 | 0 | 2 | 0 | 1 | 5 | 2 | - | - |
| Whimbrel | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - |
| Wigeon | 0 | 0 | 0 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | - | - |

* Numbers taken from maps provided in Atkins (2017) report.

[10] WYG (August, 2012). 'Tilbury B Biomass Phase 2 Project: Information for Appropriate Assessment (Assessment of Potential Impacts on the Thames Estuary and Marshes Special Protection Area and Ramsar Site)'. Produced in respect of RWE's [now shelved] biomass conversion project (planning reference: 12/00890/OUT).

[11] Atkins Ltd (March 2017). 'Thames Tideway FLO JV: Winter Bird Survey Report - final'. Produced in respect of the Goshem's Farm jetty proposals (planning reference: 17/00224/FUL).

18. The report (WYG, 2012) indicates, in respect of the results of the 2007/8 diurnal intertidal surveys, that the waterbird assemblage was concentrated outside of Bioscan's survey area, towards the east:
*"By day, the majority of the survey area waterbird assemblage extensively utilised the eastern mudflats, east of an old pipeline/breakwater* [taken to be at TQ 67852 75750, equating to the eastern limit of Bioscan's intertidal survey area] *and to a lesser extent the central area. Teal and pied avocet distribution was divided between two areas, the sewage outfall to the west of the power station and the intertidal flats adjacent to the SPA. A discrete concentration of black-tailed godwits also utilised the former area*."

19. The report (WYG, 2012) does state that higher counts were recorded during the 2007/8 nocturnal intertidal surveys, although it acknowledges that there were limitations to undertaking surveys at night due to reduced visibility, despite using night-imagery equipment:
*"By night, waterbirds were generally spread more evenly throughout the survey area than during the day. In general, greater numbers of grey plover, dunlin, Eurasian curlew and common redshank foraged on the intertidal flat adjacent to the power station at night than during the day."*

20. The report then states in the evaluation section that relatively low numbers of waterbirds were recorded in the vicinity of the power station itself during the 2007/8 surveys:
*"In general, the zone within 500m of the Development Site boundary* [the former power station]*, or the Maximum Zone of Potential Disturbance due to construction works relating to the Tilbury B Biomass Phase 2 Project, held relatively low numbers of waterbirds in comparison with the intertidal survey area as a whole although, due to use of the area around the sewage outflow pipe to the west of the power station, some species were recorded in similar numbers to those recorded from the wider zone of potential disturbance."*

*"A large proportion of the species present within 500m of the Development Site were recorded in numbers which represented an insignificant proportion (i.e. <5%) of the SPA population. Mallard, great cormorant, common sandpiper, ruff and black-tailed godwit were the only species recorded within 500m of power station site in significant proportions (i.e. >5%) of the Thames Estuary & Marshes SPA population, although counts of great cormorant, common sandpiper and ruff are too small to be considered significant whilst mallard numbers are likely to be augmented by non-SPA birds and are, therefore, also not considered significant in SPA terms."*

*"Black-tailed godwit was present in significant numbers. Black-tailed godwit distribution within 500m of the Development Site was concentrated at the tributary mouth* [presumed to mean Bill Meroy Creek] *to the west of the existing Tilbury B station, approximately 300m to the east* [presumed typo for 'west'] *of the jetty. As for the Maximum Potential Disturbance Zone, the peak count of black-tailed godwit within 500m of the Development Site occurred in October consisting of 760 individuals which represents 37.2% of the autumn Thames Estuary and Marshes SPA 5 year autumn mean peak (2002/3-2006/7). The winter peak in November of 53 individuals also represents a significant proportion (7.4%) of the winter SPA population. Further analysis of the data for black-tailed godwits (Tables 2-5) shows that August to November are the months where the highest numbers of birds are present within 500m of the Development Site with relatively low numbers (<5% of the SPA population) present at other times."*

21. The above supporting material is essentially consistent with what is reported in the Tilbury2 ES and accompanying HRA report (with the exception of findings in respect of black-tailed godwit). The WYG (2012) report then goes on to summarise the 2007/8 survey findings, drawing a conclusion which is otherwise consistent with the findings of the Tilbury2 ES:

*"On the basis of six diurnal surveys between November and March 2007/08 and single nocturnal surveys in December 2007 and January 2008, the terrestrial habitat adjacent to the intertidal areas of the wider study area are considered to be of negligible importance to wintering waterbirds."*

22. **Essex Birdwatching Society records (2014-2017)**. Pre-existing records received from the Essex Field Club and KMBRC were reviewed as part of the desk-study that informed the DCO ES. In order to address Natural England's request that *"Any further data available should be presented ... to corroborate the findings of the most recent surveys"*, a further more recent review of the Essex Birdwatching Society's website[12] has been conducted to understand if there were further records available for the intertidal area within the vicinity of the Tilbury2 site. The review revealed a relatively large volume of records for this area, with the majority of these submitted by one recorder (Mr Larkin). Mr Larkin was contacted and kindly gave permission for these records to be referred to in this document. The records span from early 2014 to December 2017. In considering the wintering bird use of the wider area, records from the East Tilbury/Coalhouse Fort area were also reviewed.

23. The following two tables provide a summary of Mr Larkin's records of the SPA species (plus two other species which are regularly found in this area, curlew and shelduck) over the winter period. The records presented within Table 3 show those which encompass the c.3km long Bioscan survey area and extend >1km beyond to the east (i.e. covering, in total, a stretch of Thames shore from the London International Cruise Terminal eastward to just before Coalhouse Point – as shown at Figure 10.12). Those presented separately within Table 4 are Mr Larkin's records from around the East Tilbury/Coalhouse Fort area.

24. The below Tables 3 and 4 indicate that there were fewer total records from the East Tilbury/Coalhouse Fort area for most species, although this appears to be due to there being fewer visits to this area in comparison with the intertidal area adjacent to the Tilbury2 site, but that the counts for the majority of the species are higher and in some cases significantly higher for the East Tilbury/Coalhouse Fort area (Table 4) when compared with the intertidal area near the Tilbury2 site (Table 3). Redshank is the only citation species in the tables above for which counts are comparable or higher within the vicinity of the Tilbury2 site as compared with the East Tilbury/Coalhouse Fort intertidal area. For assemblage species, only lapwing and gadwall counts have been higher within Table 3 (nearer the Tilbury 2 site), and for the latter species this is because it preferentially forages in proximity to the sewage outfall.

**Table 3: Summary of Mr Larkin's 2014-2017 winter records from the Cruise Terminal eastward to before Coalhouse Point (encompassing Bioscan's c.3km long intertidal survey area and >1km beyond to the east).**

| SPA citation species | Number of records | Average | Maximum count | Minimum count |
|---|---|---|---|---|
| Avocet *Recurvirostra avosetta* | 66 | 12.8 | 119 | 1 |
| Black-tailed godwit *Limosa limosa* | 63 | 30.7 | 178 | 1 |
| Dunlin *Calidris alpina* | 30 | 148 | 928 | 1 |
| Grey plover *Pluvialis squatarola* | 10 | 7.8 | 16 | 1 |

[12] The Essex Birdwatching Society. http://www.ebws.org.uk/ebs/default.asp

| SPA citation species | Number of records | Average | Maximum count | Minimum count |
|---|---|---|---|---|
| Hen harrier *Circus cyaneus* | 1 | 1 | 1 | 1 |
| Knot *Calidris canutus* | 0 | 0 | 0 | 0 |
| Redshank *Tringa totanus* | 59 | 17.8 | 80 | 1 |
| Ringed plover *Charadrius hiaticula** | 18 | 32.9 | 246 | 1 |
| Assemblage species | | | | |
| Lapwing *Vanellus vanellus* | 34 | 47.6 | 199 | 4 |
| Shoveler *Anas clypeata* | 4 | 7.0 | 11 | 2 |
| Gadwall *Anas strepera* | 39 | 14.7 | 77 | 1 |
| Little grebe *Tachybaptus ruficollis* | 43 | 13.2 | 29 | 1 |
| Shelduck *Tadorna tadorna* | 60 | 9.7 | 43 | 1 |

* Passage period only [13]

No records for pintail, whimbrel, white-fronted goose

**Table 4: Summary of Mr Larkin's 2014-2017 winter records from the East Tilbury/Coalhouse Fort area (outside and to the east of Bioscan's survey area).**

| SPA citation species | Number of records | Average | Maximum count | Minimum count |
|---|---|---|---|---|
| Avocet *Recurvirostra avosetta* | 12 | 1200.4 | 3113 | 294 |
| Black-tailed godwit *Limosa limosa* | 24 | 456.8 | 2025 | 21 |
| Dunlin *Calidris alpina* | 20 | 729.5 | 4160 | 50 |
| Grey plover *Pluvialis squatarola* | 32 | 117.7 | 203 | 13 |
| Hen harrier *Circus cyaneus* | 2 | 1 | 1 | 1 |
| Knot *Calidris canutus* | 12 | 21 | 164 | 1 |
| Redshank *Tringa totanus* | 5 | 23.6 | 38 | 4 |
| Ringed plover *Charadrius hiaticula** | 18 | 100.4 | 378 | 1 |
| Assemblage species | | | | |
| Lapwing *Vanellus vanellus* | 6 | 57.2 | 95 | 17 |
| Shoveler *Anas clypeata* | 10 | 6.5 | 24 | 1 |
| Pintail *Anas acuta* | 2 | 1.5 | 2 | 1 |
| Gadwall *Anas strepera* | 5 | 11.8 | 18 | 5 |
| Little grebe *Tachybaptus ruficollis* | 24 | 18.7 | 31 | 7 |
| Whimbrel *Numenius phaeopus* | 3 | 1 | 1 | 1 |
| Shelduck *Tadorna tadorna* | 10 | 250.3 | 474 | 61 |

* Passage period only

No records for white-fronted goose

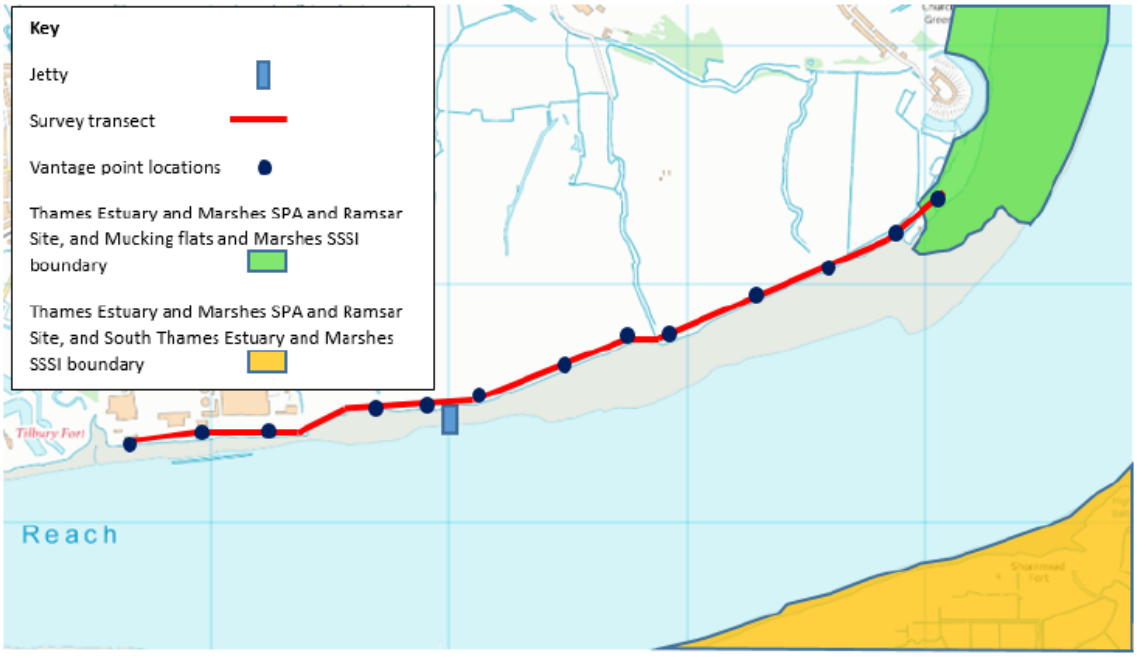
25. Detailed analysis of Mr Larkin's data appears to show a decline in the numbers of black-tailed godwit, ringed plover, avocet, and possibly lapwing and redshank, since late 2016 along the intertidal area (between the London International Cruise Terminal and Coalhouse Point). There does not appear to be a particular pattern for dunlin, but this could be due to lower number of records for this species. A review of Mr Larkin's data from the Coalhouse Fort area does not

[13] Taken to be May, August and September, as informed by: Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hall, C., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Balmer, D.E. (2017). *Waterbirds in the UK 2015/16: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT*. British Trust for Ornithology, Thetford.

appear to show the same pattern, although it should be noted fewer visits were made to this area in comparison with the area within the vicinity of the Tilbury2 site.

26. **Surveys to inform development proposals at Goshem's Farm (2016-2017).** Targeted bird surveys of the intertidal area within the vicinity of the Tilbury2 site were conducted by Atkins on behalf of Ferrovial Agroman UK Ltd and Laing O'Rourke between November 2016 and February 2017 (Atkins, 2017)[14]. A wintering bird survey was undertaken of the intertidal area between Coalhouse Fort (TQ 69364 76784) to the mud flats at the eastern boundary of Tilbury Power Station (TQ 65760 75341). The surveys comprised four spring high tide surveys (November 2016, December 2016, January 2017 and February 2017), and four spring low tide surveys (November 2016, December 2016, January 2017 and February 2017). The results from the survey were provided in a report which also included summary maps of the distribution of the SPA species. The survey route is shown in Inset Figure 3 and a summary of the results is provided in Table 1 above.

**Inset Figure 3: extract from Atkins (2017) showing intertidal bird survey transect**




27. The Atkins report states in the discussion section:

*"As can be seen from the distribution maps in Appendix C, qualifying species were recorded in low numbers throughout the survey area, with the largest counts being concentrated around Coalhouse Fort. This is within the Thames Estuary and Marshes SPA, Thames Estuary and Marshes Ramsar site and Mucking Flats and Marshes SSSI sites, and is approximately 2km from the proposed* [Goshem's Farm] *jetty.... These surveys indicate that the mud flats approximately 2km to the east of the proposed* [Goshem's Farm] *jetty support higher concentrations of wetland birds than the rest of the survey area."*

28. In summary the findings were consistent with Bioscan's over the same period, and similarly reflect the position reported by WYG in 2012, with low numbers of birds being found in proximity to the Tilbury2 site, as against greater numbers closer to Coalhouse Fort.

[14] Atkins Ltd (March 2017). 'Thames Tideway FLO JV: Winter Bird Survey Report - final'. Produced in respect of the Goshem's Farm jetty proposals (planning reference: 17/00224/FUL).

***Bird use of the affected areas: Bioscan wintering bird data***

29. Since November 2016, wintering bird surveys following the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) methodology have been carried out by Bioscan on the intertidal area between Tilbury Cruise Terminal (grid reference TQ 64516 75191) to a ditch outfall (TQ 67852 75750) approximately 1.1km south-west of Coalhouse Point (known in this report as the Bioscan survey area). The survey area encompasses a 3.4km stretch of coastline which includes the proposed DCO limits and the predicted zone of influence for noise, lighting and other effects around them, as reported in the ES.

30. A review of the BTO WeBS website for the ES found that this area does not appear to be covered by existing WeBS core counts (i.e. high tide count) and does not have any survey compartments. Nevertheless, part of this intertidal area is covered by a low-tide count compartment which appears to have been last counted over the winter of 1998/99. This compartment runs between the Tilbury jetty access eastward to Coalhouse Point.

31. Prior to the commencement of the surveys the intertidal area was divided into compartments based on the characteristics of the survey area and the nature and extent of the proposed development in order to collect relevant bird use data. The compartments were drawn onto large scale maps of the survey area, with the map then used to plot the approximate locations of all wildfowl and waders recorded during each survey. Once a survey was complete the numbers of individuals of each species was tallied for each compartment, with an overall bird count then calculated. Figure 10.12 provides the survey area and the extent of the compartments (with these extending down to low water mark in respect of the low tide counts).

32. Five monthly surveys were conducted between November 2016 and March 2017, with six further monthly surveys conducted thus far over the winter of 2017/18 (i.e. September, October, November and December 2017, and January and February 2018). In order to understand the bird use of the survey area during different tidal states the November 2016, December 2016, March 2017, September 2017 and October 2017 visits were undertaken during low tide; and the January and February 2017 visits were undertaken at high tide. From November 2017 to March 2018, both the high and low tide periods were covered during each visit.

33. In addition to the counts of the intertidal area, counts for waterfowl and waders were also undertaken of the moat around Tilbury Fort and of the area of grazed grazing marsh fields on common land to the north of the Fort in order to inform baseline conditions and impact assessments for the proposed new access road connecting Tilbury2 to the existing port.

34. Table 5 below provides a summary of the combined number of each species encountered during each survey of the intertidal area, in the moat of Tilbury Fort and in the fields to the north of the Fort (see Appendix 1 for details of the species and numbers encountered within each survey compartment). Figures 1-7 provide the location and numbers of the SPA birds (and curlew) encountered during the surveys, with the figures also showing the site boundary drawn with a 300m buffer.

**Table 5: Number of individuals recorded during each survey within the Bioscan survey area**

| Date | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 | Peak count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Count type** | Low tide | Low tide | High tide | High tide | Low tide | | Low tide | Low tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | |
| Avocet | 1 | 0 | 12 | 0 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 0 | 9 | 4 | 5 | 0 | 12 |
| Black-headed gull | 189 | 95 | 176 | 297 | 308 | | 473 | 247 | 296 | 304 | 152 | 88 | 244 | 90 | 77 | 49 | 325 | 84 | 473 |
| Black-tailed godwit | 0 | 0 | 0 | 0 | 0 | | 4 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 6 |
| Canada goose | 0 | 0 | 3 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 2 | 6 | 0 | 2 | 6 |
| Common gull | 0 | 4 | 3 | 4 | 0 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 |
| Common sandpiper | 0 | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coot | 0 | 0 | 4 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Cormorant | 0 | 0 | 1 | 2 | 0 | | 1 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 2 | 2 |
| Curlew | 19 | 32 | 11 | 2 | 21 | | 0 | 2 | 24 | 0 | 14 | 0 | 21 | 0 | 2 | 0 | 12 | 0 | 32 |
| Dunlin | 13 | 0 | 58 | 0 | 0 | | 33 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 58 |
| Gadwall | 0 | 14 | 59 | 40 | 0 | | 0 | 0 | 0 | 0 | 2 | 2 | 71 | 47 | 11 | 8 | 16 | 16 | 71 |
| Great Black-Backed gull | 0 | 1 | 1 | 0 | 0 | | 0 | 3 | 0 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 3 |
| Grey heron | 0 | 0 | 0 | 0 | 0 | | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 0 | 1 | 1 | 0 | 0 | 2 |
| Grey plover | 8 | 0 | 2 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Herring gull | 0 | 0 | 0 | 1 | 2 | | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 |
| Kingfisher | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Lapwing | 15 | 163 | 32 | 0 | 0 | | 0 | 0 | 4 | 0 | 9 | 1 | 2 | 0 | 95 | 0 | 0 | 0 | 163 |
| Lesser Black-Backed gull | 1 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Little egret | 0 | 2 | 0 | 0 | 0 | | 6 | 0 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |

| Date | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 | Peak count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Count type** | Low tide | Low tide | High tide | High tide | Low tide | | Low tide | Low tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | Low tide | High tide | |
| Little grebe | 18 | 24 | 15 | 14 | 8 | | 20 | 8 | 19 | 3 | 14 | 9 | 15 | 11 | 12 | 5 | 3 | 0 | 24 |
| Little gull | 0 | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Mallard | 134 | 53 | 81 | 90 | 35 | | 75 | 72 | 77 | 77 | 42 | 56 | 46 | 85 | 40 | 57 | 26 | 57 | 134 |
| Moorhen | 1 | 0 | 0 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Mute swan | 4 | 2 | 3 | 0 | 2 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 1 | 4 |
| Oystercatcher | 0 | 0 | 0 | 2 | 6 | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 11 | 0 | 6 |
| Pochard | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 1 | 0 | 2 | 2 | 59 | 2 | 80 | 3 | 0 | 0 | 80 |
| Redshank | 16 | 29 | 29 | 5 | 0 | | 1 | 1 | 18 | 0 | 26 | 27 | 14 | 1 | 20 | 12 | 6 | 1 | 29 |
| Ringed plover | 5 | 0 | 0 | 0 | 0 | | 10 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 44 |
| Ruff | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Shelduck | 4 | 0 | 13 | 1 | 15 | | 0 | 4 | 6 | 0 | 7 | 10 | 32 | 26 | 24 | 11 | 13 | 8 | 32 |
| Shoveler | 0 | 0 | 12 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 12 |
| Snipe | 0 | 0 | 1 | 0 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Teal | 125 | 194 | 204 | 171 | 47 | | 2 | 0 | 56 | 23 | 89 | 75 | 84 | 34 | 228 | 109 | 133 | 89 | 228 |
| Tufted duck | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Turnstone | 0 | 8 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |

35. The data set out in Table 5 above indicates that the survey area receives moderate levels of regular use by black-headed gull, gadwall, lapwing, little grebe, mallard, redshank and teal.

36. During the December 2017, January, February and March 2018 visits, surveys of the intertidal area to the east of Coalhouse Fort (outside the area surveyed for the ES) were conducted in order to understand relative bird use of this more distant downstream area. These counts were undertaken during a rising tide from one of the few slightly elevated positions to the east of the Fort; however, due to the low-lying nature of the area and the presence of saltmarsh vegetation between the observer and the intertidal mudflats, a small proportion of the mudflats beyond is obscured. Therefore, the numbers presented in Table 6 below from this area are considered to be minimum counts.

**Table 6: Number of individuals recorded within the intertidal area east of Coalhouse Fort during the December 2017, January and February 2018 visits**

| Species | 04/12/2017 | 19/01/2018 | 14/02/2018 | 22/03/2018 |
|---|---|---|---|---|
| Avocet *Recurvirostra avosetta* | 1160 | 714 | 707 | 670 |
| Bar-tailed godwit *Limosa lapponica* | 3 | 0 | 3 | 12 |
| Black-tailed godwit *Limosa limosa* | 0 | 20 | 1 | 852 |
| Cormorant *Phalacrocorax carbo* | 4 | 0 | 0 | 0 |
| Curlew *Numenius arquata* | 62 | 68 | 34 | 38 |
| Dunlin *Calidris alpina* | c.4200 | c.4800 | c.4300 | c.2600 |
| Gadwall *Anas strepera* | 0 | 2 | 0 | 0 |
| Great black-backed gull *Larus marinus* | 2 | 0 | 0 | 0 |
| Grey plover *Pluvialis squatarola* | 110 | 139 | 226 | 230 |
| Knot *Calidris canutus* | 0 | 0 | 0 | 45 |
| Mute swan *Cygnus olar* | 0 | 0 | 0 | 2 |
| Oystercatcher *Haematopus ostralegus* | 1 | 2 | 5 | 12 |
| Redshank *Tringa totanus* | 25 | 0 | 3 | 1 |
| Shelduck *Tadorna tadorna* | 210 | 10 | 38 | 12 |
| Teal *Anas crecca* | 0 | 21 | 50 | 358 |

37. Table 6 indicates that the numbers of key species using the intertidal areas around Coalhouse Fort and some 2km or more downstream of the Tilbury2 site are significantly higher than those found within the Bioscan survey area adopted for the EIA studies. By comparison, numbers of most SPA/Ramsar species using the intertidal habitats within the proposed DCO limits, within the wider 300m zone of influence around that, or even within 2km, are far lower than those that use the mudflats near and downstream of Coalhouse Point.

38. To put this further into context, and facilitate consideration of the levels of use of the Bioscan survey area by the species cited for the nearby Thames Estuary and Marshes SPA, Table 7 below provides the numbers on the citation sheet, more recent published counts for the SPA, and the maximum number found during the surveys. By reference to the SPA citation species, avocet, black-tailed godwit, dunlin, grey plover and redshank have been recorded within the survey area; although the numbers found are relatively low in the context of the designation, and all counts represent less than 1% of the recent peak mean figures for the SPA (see Table 7).

**Table 7: Comparison of winter bird counts in the Bioscan survey area with the Thames Estuary and Marshes SPA counts**

| SPA qualifying period | Species | Number of individuals listed on SPA sheet | Number of individuals (peak mean 04/05 to 08/09) [15] | Peak count in Bioscan survey area | No. of visits encountered in Bioscan survey area (out of 17 visits) | Percentage of peak number of individuals found within survey area (based on recent peak mean of 2004/05-2008/09) |
|---|---|---|---|---|---|---|
| Oct-Mar | Avocet | 283 | 1395 | 12 | 7 | 0.86 |
| Oct-Mar | Black-tailed godwit | 1699 | 5311 | 6 | 4 | 0.11 |
| Oct-Mar | Dunlin | 29646 | 37251 | 58 | 6 | 0.16 |
| Oct-Mar | Grey plover | 2593 | 5673 | 8 | 2 | 0.14 |
| Oct-Mar | Hen harrier | 7 | 0 | 0 | 0 | 0 |
| Oct-Mar | Knot | 4848 | 42871 | 0 | 0 | 0 |
| Oct-Mar | Redshank | 3251 | 4313 | 29 | 15 | 0.67 |
| Passage | Ringed plover | 1324 | 1186 | 10* | 1* | 0.84 |

* On passage only

39. In terms of use patterns within the survey area, the duck species (gadwall, mallard and teal) tend to be found within the vicinity of the Anglian Water sewage outfall (TQ 6564 7531). Teal tend to sit adjacent to the outfall at low tide, and then feed in the mud around high tide. Gadwall tend to swim and feed in the water within the vicinity of the outfall both at low and high tide. Mallard behaviour appears similar to gadwall but can be more spread out along the adjoining intertidal area. Black-headed gull are generally found in association with the outfall and inside the sewage works, whilst little grebe are exclusively found within Tilbury Fort moat. Low numbers of lapwing have been found along the intertidal areas with higher numbers found resting adjacent to Tilbury Fort moat. Redshank are generally found scattered and feeding in the mud along the whole foreshore area; however, small flocks (no more than 11 individuals) have been found within the vicinity of the sewage outfall.

***Summary of all survey data***

40. The wintering bird surveys of the intertidal within the vicinity of Tilbury2 conducted during the 1998-99 Low Tide Count, and by Mr Larkin, RPS, Atkins and Bioscan all show broadly consistent results. Higher aggregations of waders and wildfowl are recorded outside and to the east of Bioscan's survey area, closer to Coalhouse Point.

41. Analysis of Mr Larkin's data does indicate that there has been some decline in the numbers of black-tailed godwit, ringed plover, avocet, and possibly lapwing and redshank, since late 2016 for the intertidal area between the London International Cruise Terminal and Coalhouse Point. The same pattern was not found for the intertidal areas to the east of Coalhouse Point. The period during which lower numbers were recorded corresponds with the 2016-2018 period during which Bioscan and Atkins undertook survey work of this intertidal stretch and also recorded low counts. As such, whilst Bioscan's findings are validated by these concurrent studies, the results do appear to show that the intertidal area is currently experiencing a period

[15] Liley, D, (20 June 2011). 'What do we know about the birds and habitats of the North Kent Marshes? Baseline data collation and analysis'. Natural England Commissioned Report NECR082).

of lower waterbird numbers than the previous baseline. It is conjectured that this is could be due to the recent activities at Goshem's Farm.

42. The RPS data indicate that higher numbers of black-tailed godwit used this area over 10 years ago, but in view of the run of data since then showing significantly lower numbers (rarely exceeding 70 individuals), this strongly suggests either that 2007 was an unusual year for that species, or that there was a sudden decline afterwards that has continued.

43. In summary the data from these sources indicates sporadic to occasional use by low numbers of SPA species between London International Cruise Terminal and Coalhouse Point; and significantly higher numbers along the intertidal area within the vicinity of Coalhouse Fort (approximately 3km to the east of the Tilbury2 site boundary). This is fully consistent with the position presented in the ES and upon which the impact assessments in the ES and the associated HRA report are based.

**Appendix 1.**

Bioscan wintering bird surveys 2016-2018: raw data by compartment.

Appendix 1. Bioscan survey data: species and numbers within each survey compartment.

| **Species by compartment (see Figure 10.12)** | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| **IT1** | | | | | | | | | | | | | | | | | | |
| Avocet | | | 1 | | | | | | | | | | | | | | | |
| Black-headed gull | 10 | 5 | 4 | 210 | 42 | | 66 | 27 | 5 | | 3 | | 20 | | 8 | | 54 | |
| Black-tailed godwit | | | | | | | | | 3 | | | | | | | | 1 | |
| Common gull | | | 1 | 4 | | | | | | | | | | | | | | |
| Curlew | | | 8 | 2 | 1 | | | | | | 2 | | | | | | | |
| Dunlin | | | 36 | | | | | | | | | | | | | | | |
| Herring Gull | | | | 1 | 2 | | | | | | | | | | | | | |
| Lapwing | | | 7 | | | | | | 1 | | | | 2 | | | | | |
| Lesser black-backed gull | 1 | | | | | | | | | | | | | | | | | |
| Mute swan | | | 3 | | | | | | | | | | | | | | | |
| Oystercatcher | | | | | 2 | | | | | | | | | | | | 2 | |
| Redshank | 2 | 2 | 7 | 5 | | | | | 7 | | 3 | | 2 | | 1 | | 6 | |
| Shelduck | | | | | | | | | | | | | | | 2 | | | |
| Teal | | | 2 | | | | | | | | | | | | | | | |
| Notes | | | # | $ | | | | | | | | | | | | & | | |
| **IT2** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | 4 | 1 | | | | | 14 | 3 | | | | | | | 11 | | | |
| Curlew | 1 | | | | | | | | | | | | | | | | | |
| Lapwing | 13 | | | | | | | | | | 8 | | | | | | | |
| Oystercatcher | | | | | | | | | | | | | | | | | 2 | |
| Redshank | 2 | 5 | | | | | | | | | 6 | | | | 6 | | | |
| Teal | | | 1 | | | | | | | | | | | | | | | |
| Turnstone | | 4 | | | | | | | | | | | | | | | | |
| Notes | | | | | NB | | | | | | | | | | | | | |
| **IT3** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | 3 | | | | | | 5 | | | | | | | | | | |
| Curlew | 5 | | | | | | | | | | 1 | | | | | | | |
| Gadwall | | | 2 | | | | | | | | | | | | | | | |
| Lapwing | | 9 | | | | | | | 3 | | 1 | | | | | | | |
| Mallard | | | 5 | | | | | | | | | | | | | | | |
| Oystercatcher | | | | | | | 1 | | | | | | | | | | | |
| Redshank | 2 | 3 | | | | | | | 2 | | 2 | | 1 | | | | | |
| Teal | | 3 | 14 | | | | | | | | | | | | | | | |
| Turnstone | | 4 | | | | | | | | | | | | | | | | |
| Notes | | | | | NB | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

| Species by compartment (see Figure 10.12) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| **IT4** | | | | | | | | | | | | | | | | | | |
| Avocet | 1 | | 11 | | | | | | 1 | | | | 1 | | 3 | 4 | | |
| Black-headed gull | 12 | 8 | 30 | | 13 | | | 3 | | | | | | | 16 | | 12 | |
| Common gull | | | | | | | | | | | | | | | | | 1 | |
| Cormorant | | | | | | | | | | | | | | | | | | 2 |
| Curlew | | 1 | | | | | | | | | | | | | | | | |
| Dunlin | | | 19 | | | | | | | | | | | | | | | |
| Gadwall | | | 23 | 40 | | | | | | | | | | | | | | |
| Grey heron | | | | | | | | | | 1 | | | | | | | | |
| Mallard | | | 3 | 4 | | | 14 | | | 7 | | | | | | 3 | | |
| Redshank | 1 | 7 | 12 | | | | | | 2 | | | | | | | | | |
| Shelduck | 4 | | 1 | | 5 | | | 4 | 6 | | 6 | | 2 | | 6 | 2 | 5 | |
| Teal | | 14 | 101 | 126 | 16 | | | | | 8 | | | | | | 20 | 28 | 31 |
| Notes | | | | | | | | | | | | | | | | | | |
| **IT5** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | | | | | 62 | | 4 | | | | | | | | | |
| Black-tailed godwit | | | | | | | | | 3 | | | | | | | | | |
| Cormorant | | | | | | | | 1 | | | | | | | | | | |
| Dunlin | | | | | | | | | 1 | | | | | | | | | |
| Gadwall | | | 20 | | | | | | | | 2 | | 2 | | | | 3 | |
| Herring gull | | | | | | | 1 | | | | | | | | | | | |
| Mallard | 72 | 4 | | | 2 | | 36 | 66 | 36 | | | | | | 13 | | 2 | |
| Oystercatcher | | | | | | | | | | | | | | | | | 2 | |
| Redshank | 7 | 7 | | | | | 1 | 1 | 6 | | 11 | | 7 | | 9 | | | |
| Teal | 49 | 7 | 27 | | 5 | | | | 10 | | 41 | | 41 | | 32 | | 17 | |
| | | | | | | | | | | | | | | | | | | |
| **IT6** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | 9 | | | 74 | 29 | | 56 | 48 | 4 | | | | | | 6 | | 70 | |
| Common sandpiper | | | | | | | 1 | | | | | | | | | | | |
| Curlew | | 2 | 2 | | | | | | 1 | | | | | | | | | |
| Gadwall | | | 9 | | | | | | | | | | 53 | | | | | |
| Herring gull | | | | | | | | | | | | | | | | | 1 | |
| Little egret | | | | | | | | | 2 | | | | | | | | | |
| Little gull | | | | | | | 1 | | | | | | | | | | | |
| Mallard | 20 | 14 | 50 | 31 | 2 | | | | | | 14 | | 35 | | 9 | | 17 | 34 |
| Oystercatcher | | | | 1 | 1 | | | | | | | | | | 2 | 2 | 1 | |
| Redshank | | 1 | 7 | | | | | | 1 | | | | | | | | | |
| Shelduck | | | | | | | | | | | | | | | | | | 2 |
| Teal | 1 | 1 | 13 | 4 | 4 | | | | | | 6 | | 4 | | | | 4 | 1 |
| | | | | | | | | | | | | | | | | | | |

| Species by compartment (see Figure 10.12) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| **IT7** | | | | | | | | | | | | | | | | | | |
| Avocet | | | | | | | | | | | | | 3 | | 6 | | 5 | |
| Black-headed gull | 54 | 3 | | | 118 | | 70 | 90 | 74 | | 24 | | 46 | | 12 | | 106 | |
| Black-tailed godwit | | | | | | | | | | | | | | | | | 1 | |
| Common gull | | 1 | | | | | | | | | | | | | | | | |
| Cormorant | | | | 1 | | | | | | | | | | | | | | |
| Curlew | 1 | 1 | 1 | | 3 | | | 1 | 11 | | 7 | | | | 1 | | | |
| Dunlin | | | 1 | | | | | | | | | | | | | | | |
| Grey plover | | | 2 | | | | | | | | | | | | | | | |
| Mallard | | | 10 | 28 | 10 | | | | | | | | | | | | | 14 |
| Mute swan | | | | | | | | | | | | | | | | | 2 | |
| Oystercatcher | | | | | | | | | | | | | | | | | 2 | |
| Shelduck | | | 9 | | 1 | | | | | | | | 6 | | 2 | | 6 | |
| Teal | | 5 | 8 | 22 | 4 | | | | | | | | | | | | | 2 |
| Turnstone | | | 1 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **IT8** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | 38 | 3 | | | 62 | | 20 | 31 | 6 | | 12 | | 123 | | 12 | | | |
| Black-tailed godwit | | | | | | | 4 | | | | | | | | 1 | | | |
| Common gull | | 3 | | | | | | | 1 | | | | | | | | | |
| Curlew | 12 | 28 | | | 17 | | | 1 | 12 | | 4 | | 21 | | 1 | | 12 | |
| Dunlin | 13 | | | | | | 33 | 3 | | | | | | | | | 1 | |
| Great black-backed gull | | 1 | | | | | | 3 | | | | | 2 | | | | | |
| Grey heron | | | | | | | 1 | | | | | | | | | | | |
| Grey plover | 8 | | | | | | | | | | | | | | | | | |
| Herring gull | | | | | | | | | 3 | | | | | | | | | |
| Little egret | | 2 | | | | | | | 1 | | 1 | | | | | | | |
| Mallard | | 2 | | 2 | | | | | | | | | | | 2 | | 1 | |
| Oystercatcher | | | | | 3 | | | | | | | | | | | | 2 | |
| Redshank | 2 | 4 | 1 | | | | | | | | | | 2 | | 1 | | | |
| Ringed plover | 5 | | | | | | 10 | 44 | | | | | | | | | 3 | |
| Shelduck | | | | | 9 | | | | | | | | 24 | | 14 | | 2 | |
| Teal | | 85 | | | 2 | | | | | | | | 12 | | 150 | | 62 | |
| | | | | | | | | | | | | | | | | | | |
| **E1** | | | | | | | | | | | | | | | | | | |
| No birds recorded | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **E2** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | | | | | | | | | | | 30 | | | | | |
| | | | | | | | | | | | | | | | | | | |

| Species by compartment (see Figure 10.12) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| **E3** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | | | | | | | | | 5 | | | | | | | |
| Teal | | | | | | | | | | | 1 | | | | | | | |
| **E4** | | | | | | | | | | | | | | | | | | |
| Grey heron | | | | | | | | | | | | 1 | | | | | | |
| Mallard | | | | | | | | | | | 2 | 2 | | | | | | |
| Shelduck | | | | | | | | | | | | 7 | | | | | | |
| Teal | | | | | | | | | | | 3 | 5 | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **E5** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | 22 | | | | | | 55 | | 53 | | | | | | | 25 | | |
| Gadwall | | 8 | | | | | | | | | | 2 | 14 | 47 | 11 | 8 | 13 | 16 |
| Mallard | 38 | 6 | | | | | 5 | | 22 | 5 | 11 | 2 | | | 8 | 13 | 2 | 4 |
| Shelduck | | | | | | | | | | | | | | | | 2 | | |
| Teal | 59 | 40 | | | | | | | 16 | 14 | 26 | 51 | 22 | 34 | 14 | 83 | 14 | 40 |
| | | | | | | | | | | | | | | | | | | |
| **E6** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | | | | | 44 | | | | | | | | | | | |
| Gadwall | | | | | | | | | | | | | 2 | | | | | |
| Mallard | | | | | | | | | | 52 | | 47 | | 79 | | 30 | | |
| Shelduck | | | | | | | | | | | | | | | | 2 | | |
| Teal | | | | | | | | | | 1 | | 9 | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **E7** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | 18 | | | | | | | | | | | | | | | | |
| Mallard | | 4 | | | | | | | | 6 | | | | | | 3 | | |
| Shelduck | | | | | | | | | | | | 2 | | | | 1 | | |
| | | | | | | | | | | | | | | | | | | |
| **E8** | | | | | | | | | | | | | | | | | | |
| Cormorant | | | | | | | | | | | | 1 | | | | | | |
| Shelduck | | | | | | | | | | | | | | 24 | | | | |
| | | | | | | | | | | | | | | | | | | |
| **J1** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | 35 | 5 | | | | | | | 124 | 78 | 74 | | | | | | 12 |
| Common gull | | | 1 | | | | | | | | 1 | | | | | | | |
| Cormorant | | | 1 | | | | | 1 | | 1 | | | | | | | | |
| Great black-backed gull | | | 1 | | | | | | | 1 | 2 | 2 | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

| Species by compartment (see Figure 10.12) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| **J2** | | | | | | | | | | | | | | | | | | |
| Common gull | | | 1 | | | | | | | | | | | | | | | |
| Mallard | | 3 | | | | | 20 | 6 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **J2a** | | | | | | | | | | | | | | | | | | |
| Cormorant | | | | 1 | | | 1 | | 1 | | | 1 | | | | | | |
| Mallard | | | 12 | 14 | 10 | | | | 6 | 7 | 10 | 4 | 9 | 6 | | | | |
| Oystercatcher | | | | 1 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **J3** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | 1 | | | | 69 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **M1** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | 21 | | 4 | | | | | | 9 | 14 | | | | | | |
| Canada goose | | | | | | | | | | | | | 3 | 6 | | | | |
| Coot | | | 4 | 2 | | | | | | | | | | | | | | |
| Cormorant | | | | | | | | | | | | | | | 1 | | | |
| Gadwall | | 6 | 2 | | | | | | | | | | | | | | | |
| Grey heron | | | | | | | | | 1 | | 1 | | | 2 | 1 | 1 | | |
| Kingfisher | | | | | | | 1 | | | 1 | | 1 | | | | | | |
| Lapwing | | | | | | | | | | | | 1 | | | | | | |
| Little egret | | | | | | | 1 | | | | | | | | | | | |
| Little Grebe | 18 | 24 | 13 | 14 | 8 | | 20 | 8 | 19 | 3 | 14 | 9 | 15 | 11 | 12 | 5 | 3 | |
| Mallard | | 7 | | | | | | | 13 | | 5 | | 2 | | 2 | 4 | 2 | |
| Mute swan | | 2 | | | | | | | | | | | | | | | | |
| Oystercatcher | | | | | | | 1 | | | | | | | | | | | |
| Pochard | | | 2 | | | | | | 1 | | 2 | 2 | 59 | 2 | 80 | 3 | | |
| Redshank | | | 1 | | | | | | | | 3 | 4 | 1 | | | 12 | | |
| Shelduck | | | | | | | | | | | | | | 2 | | | | |
| Teal | | 2 | | | | | 2 | | 30 | | 12 | 10 | 5 | | 21 | | | |
| Tufted duck | | | | | | | | | | | | | 1 | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **M2** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | 4 | | 4 | | | | | | | 1 | | | | | 24 | 23 | 22 |
| Canada goose | | | 3 | 2 | | | | | | | | | | | 2 | 6 | | 2 |
| Dunlin | | | 2 | | | | | | | | | | | | | | | |
| Gadwall | | | 3 | | | | | | | | | | | | | | | |
| Grey heron | | | | | | | | 1 | | | 1 | | | | | | | |
| Kingfisher | | | | | | | | | | | 1 | | | | | | | |
| Lapwing | 2 | 154 | 16 | | | | | | | | | | | | 95 | | | |

| **Species by compartment (see Figure 10.12)** | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2018 | 19/01/2018 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tidal state** | LT | LT | HT | HT | LT | | LT | LT | LT | HT | LT | HT | LT | HT | LT | HT | LT | HT |
| Little egret | | | | | | | 4 | | | 1 | | | | | | | | |
| Mallard | 4 | 9 | 1 | 6 | 7 | | | | | | | 1 | | | 6 | 2 | 2 | 2 |
| Moorhen | 1 | | | | | | | | | | | | | | 1 | | | |
| Mute swan | 4 | | | | 2 | | | | | | | | | | 2 | 2 | 1 | |
| Pied wagtail | | | | 1 | | | | | | | | | | | | | | |
| Redshank | | | | | | | | | | | 1 | 23 | | 1 | 2 | | | 1 |
| Ruff | | | | | | | | | | | | 1 | | | | | | |
| Shelduck | | | 3 | 1 | | | | | | | 1 | 1 | | | | 4 | | 4 |
| Shoveler | | | 12 | | | | | | | | | | | | 1 | | 2 | |
| Teal | 16 | 37 | 38 | 19 | 12 | | | | | | | | | | | 6 | 8 | 12 |
| | | | | | | | | | | | | | | | | | | |
| **F1** | | | | | | | | | | | | | | | | | | |
| Lapwing | | | 6 | | | | | | | | | | | | | | | |
| **F2** | | | | | | | | | | | | | | | | | | |
| Mallard | | 4 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **F3** | | | | | | | | | | | | | | | | | | |
| Lapwing | | | 3 | | | | | | | | | | | | | | | |
| Mallard | | | | 5 | | | | | | | | | | | | 2 | | 3 |
| Mute swan | | | | | | | | | | | | | | | | | | 1 |
| Shelduck | | | | | | | | | | | | | | | | | | 2 |
| Snipe | | | | | | | | | 1 | | | | | | | | | |
| Teal | | | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | | | |
| **F4** | | | | | | | | | | | | | | | | | | |
| No birds | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **F5** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | | | | | 10 | | | | | | | | | | | | | |
| Little egret | | | | | | | 1 | | | | | 1 | | | | | | |
| Little grebe | | | 2 | | | | | | | | | | | | | | | |
| Mallard | | | | | 4 | | | | | | | | | | | | | |
| Redshank | | | | | | | | | | | | | 1 | | 1 | | | |
| Teal | | | | | 4 | | | | | | | | | | 11 | | | |
| Snipe | | | 1 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **Sewage Works** | | | | | | | | | | | | | | | | | | |
| Black-headed gull | 40 | 15 | 115 | 9 | 30 | | 17 | 40 | 150 | 180 | 20 | | 25 | | 12 | | 50 | 50 |
| Moorhen | | | | | 1 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

| Species (Non-WeBS) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2017 | 19/01/2017 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Along footpath** | | | | | | | | | | | | | | | | | | |
| Blackbird | | | 1 | | | | | | | | | | p | | | | p | |
| Blue tit | | | | | | | p | | | | | | | | | | | |
| Carrion crow | | | | | | | | | p | | | | p | | | | | |
| Collared dove | | | 1 | 1 | 1 | | | | | | | | | | | | | |
| Dunnock | | p | 3 | | 1 | | p | | p | | p | | | | p | | | |
| Feral pigeon | | p | 3 | | | | p | p | | | | | | | p | | | |
| Goldfinch | p | p | | 2 | | | p | | | | | | | | p | | | |
| Great spotted woodpecker | | | | | | | | | p | | | | | | | | | |
| Greenfinch | | | | | | | | | | | | | | | p | | | |
| Grey Wagtail | p | p | 1 | | | | | | | p | p | | p | p | | | | |
| Kestrel | | | 1 | | | | 2 | 1 | | | | | | | | 1 | | |
| Linnet | p | | 25 | 8 | 1 | | 62 | 24 | 6 | | | | | | | p | 10 | P |
| Long-tailed tit | | | | | | | | | | | | | p | | | | | |
| Magpie | | | | 2 | | | p | | p | | | | | | | | | |
| Meadow pipit | p | p | | 2 | 1 | | | 10 | p | | p | | | p | | | | |
| Mistle thrush | | | | | | | | | | 1 | | | | | | | | |
| Pied wagtail | p | p | | | | | p | 3 | p | | p | | | p | p | | | |
| Robin | | | | 1 | | | p | | | p | p | | p | | p | | p | |
| Song thrush | | p | 1 | | | | | | | | | | p | | | | | |
| Starling | | p | | | | | p | | p | | | | | | p | | | |
| Stonechat | 2 | 1 | | | | | 2 | 2 | | 1 | 1 | | | 1 | | 1 | | |
| Swallow | | | | | | | p | | | | | | | | | | | |
| Wren | | | 2 | 1 | 1 | | | 1 | | p | | | p | | | | p | |
| | | | | | | | | | | | | | | | | | | |
| **Fields (F1-F5)** | | | | | | | | | | | | | | | | | | |
| Blackbird | | | 1 | | | | | | | | | | p | | | | | |
| Carrion crow | | | 1 | | | | | | | | | p | | | | | | |
| Chaffinch | | | | | | | | | | | | | | p | | | | |
| Dunnock | | | 1 | | | | 1 | | | | | | | | | | | |
| Goldfinch | | | | | | | p | | | | | | | p | | | | |
| Great Tit | 2 | | | | | | | | | | | | | | | | | |
| Kestrel | | | | | | | | | | | | | | | | | | |
| Linnet | c.5 | p | | | | | 3 | | | | | 45 | | | p | | | |
| Magpie | 3 | p | 3 | 7 | 11 | | | 4 | p | | | p | | p | | p | | |
| Meadow pipit | | | | | | | 14 | | | | | p | p | | p | p | | p |
| Mistle thrush | | | | | | | | 1 | | | | | | | | | | |
| Pied wagtail | c.3 | | | | 3 | | | | p | | | | p | | | | | p |

| Species (Non-WeBS) | 18/11/2016 | 16/12/2016 | 26/01/2017 | 22/02/2017 | 16/03/2017 | | 19/09/2017 | 10/10/2017 | 08/11/2017 | 08/11/2017 | 04/12/2017 | 04/12/2017 | 19/01/2017 | 19/01/2017 | 14/02/2018 | 14/02/2018 | 22/03/2018 | 22/03/2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Skylark | | 1 | | | | | | | | | | | | | | | | |
| Song thrush | | | 1 | | | | | | | | | | | | | | | |
| Sparrowhawk | 1 | | | | | | | | | | | | | | | | | |
| Starling | | | | 35 | | | 330 | | p | | | | | p | | | | |
| Woodpigeon | | | 196 | 233 | 4 | | | | | | | | | p | p | p | | p |
| Yellow wagtail | | | | | | | 2 | | | | | | | | | | | |

**KEY**

IT= Inter-tidal

E= Estuary

F= Field

M= Moat

J= Jetty/Pier

NB = no birds

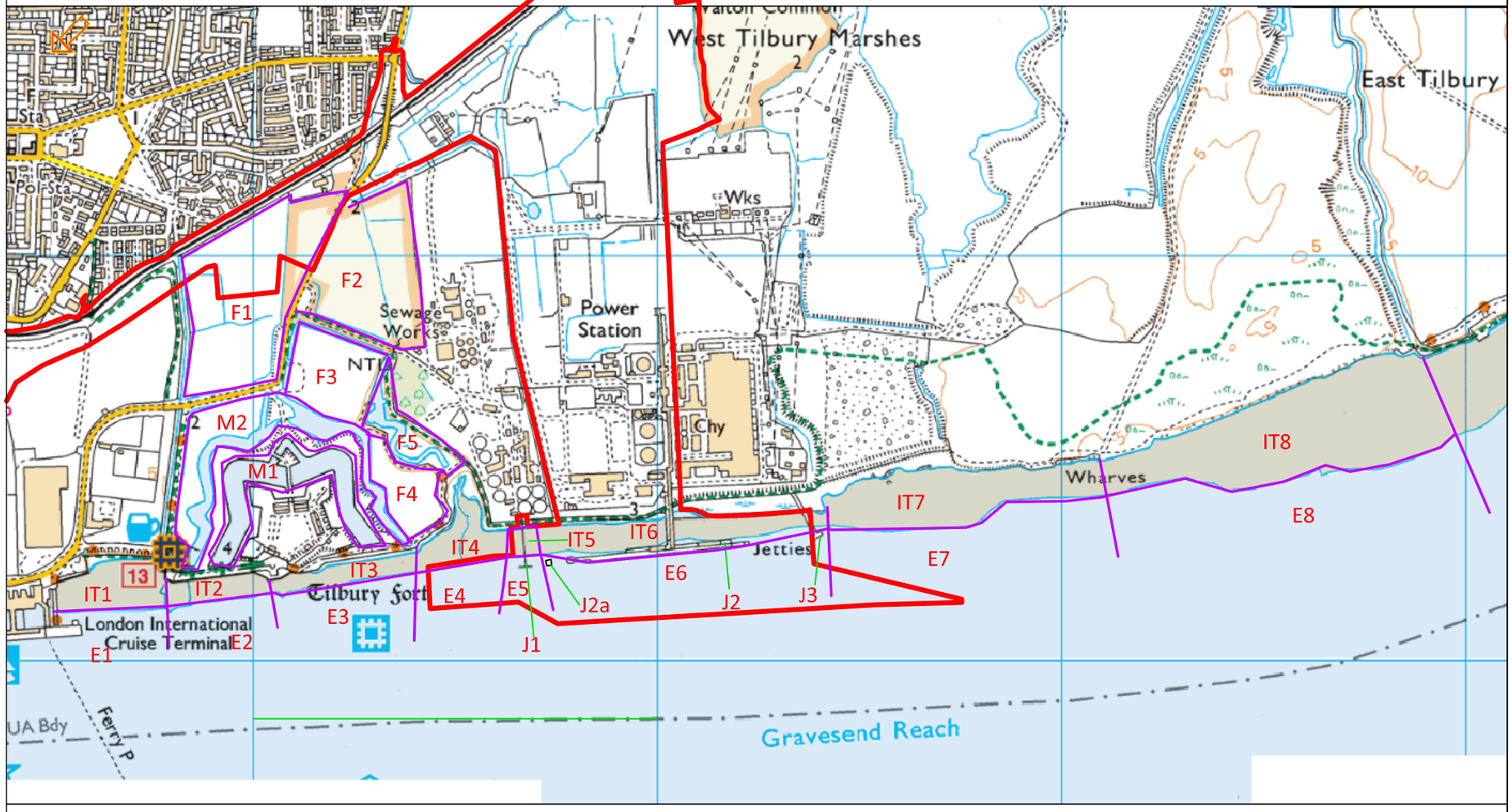
# All birds except swans on the only small area of remaining exposed mud- near to fort car park

$ All birds on the only small area of remaining exposed mud- near to fort car park

& Birds in upper slither of exposed mud of Bill Meroy creek which was not inundated despite being high tide.

**Figure 10.12.**

Bioscan wintering bird survey compartments (2016-2018).




ORDER LIMITS

BIRD SURVEY COMPARTMENT BOUNDARIES (WITH REFERENCE CODE*)

* IT= INTER-TIDAL
E= ESTUARY
J= JETTY
F= FIELD
M= MOAT



| REV | DATE | DESCRIPTION |
|---|---|---|

DRAWING TITLE

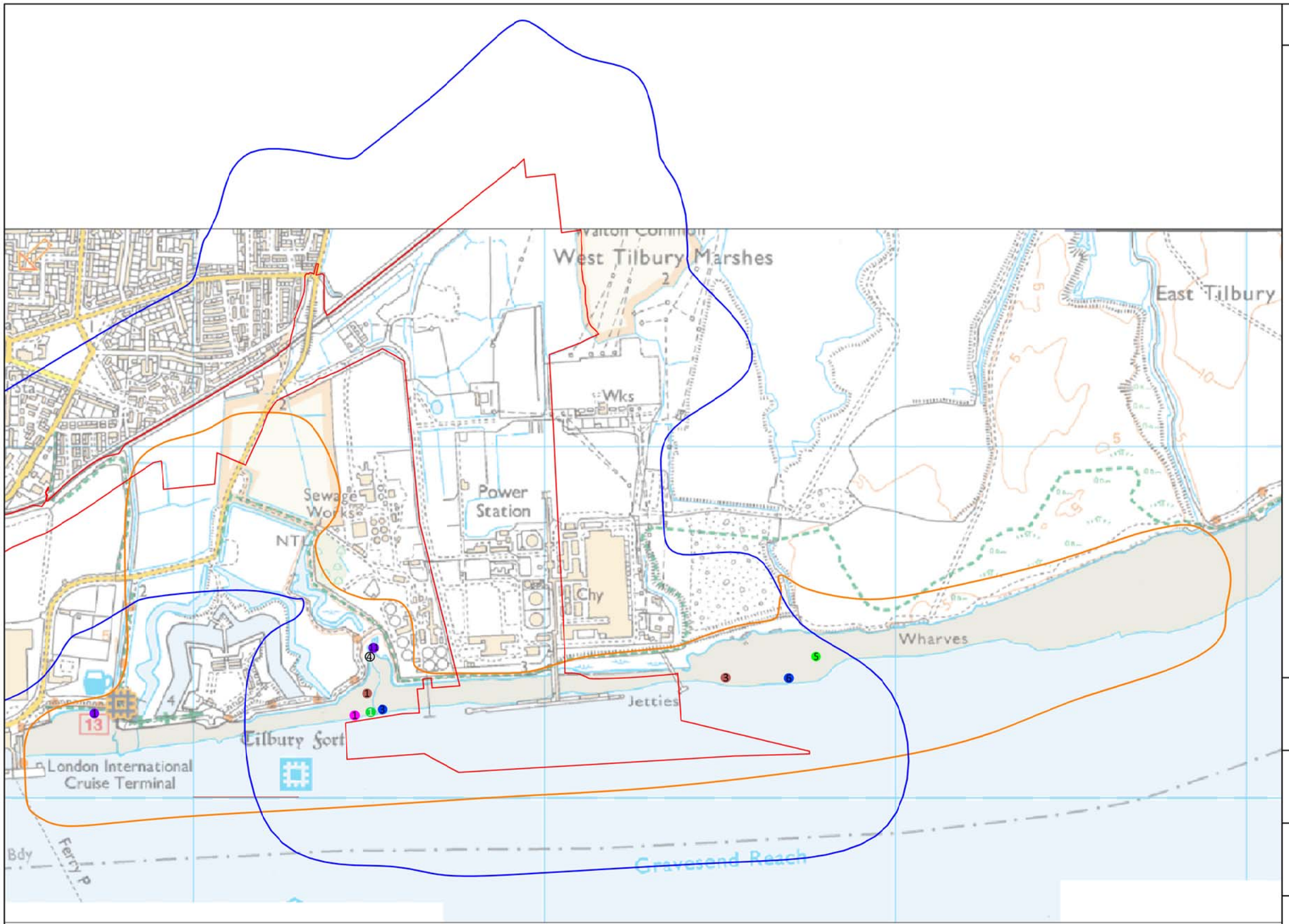
WINTERING BIRD SURVEY COMPARTMENTS 2016/17

| | | | |
|---|---|---|---|
| SCALE 1:12500 @ A3 | DRAWN BC | FIG. 10.12 |
| DATE OCT 2017 | CHECKED RR | |

TILBURY2

**Figures 1-7.**

Bioscan wintering bird survey data by species (2016-2018).




## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)
- November 2017 visit (low tide)
- January 2018 visit (low tide)
- February 2018 visit (low tide)
- February 2018 visit (high tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

**Title**

Numbers and distribution of avocet during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 1 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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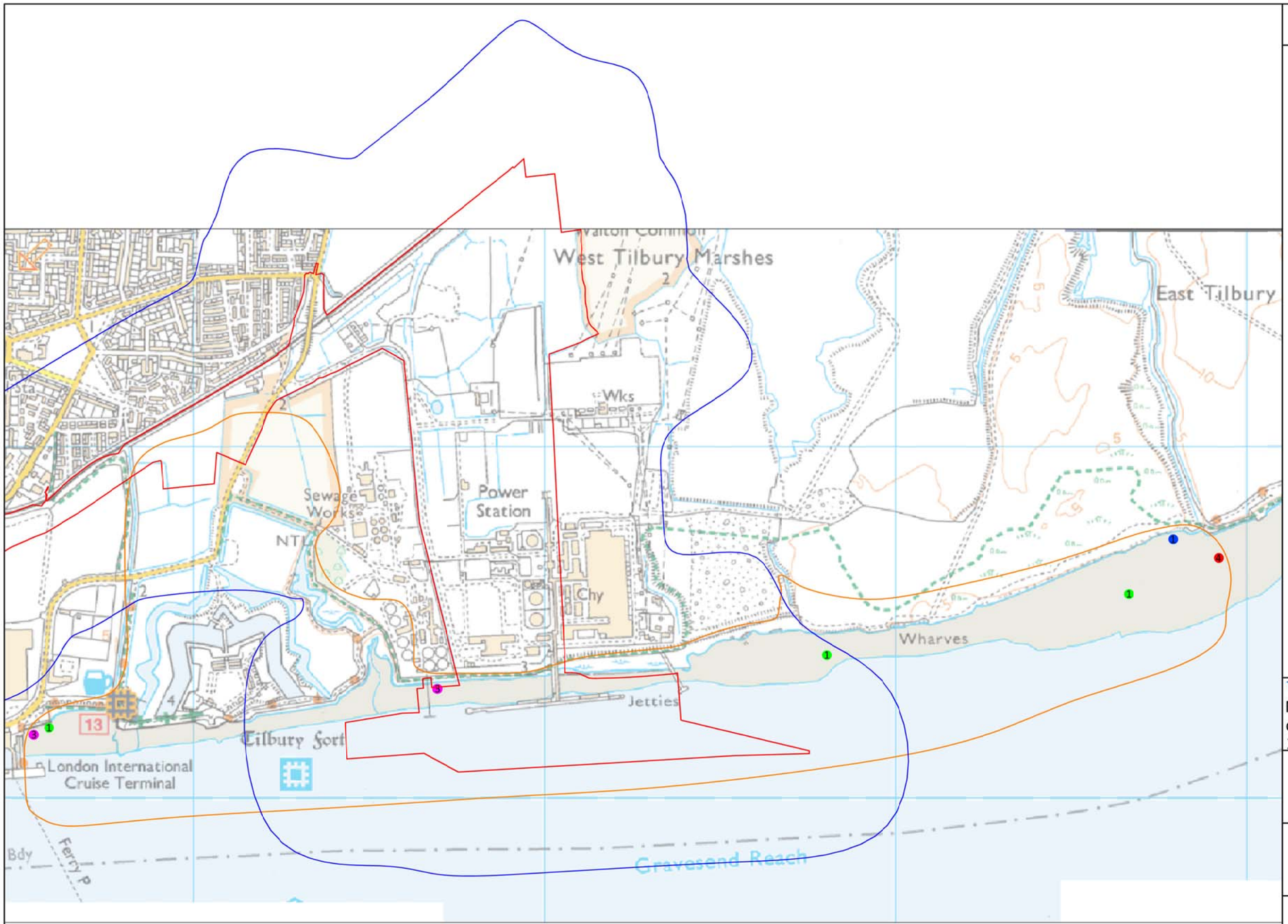


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- September 2017 visit (low tide)
- November 2017 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

**Title**

Numbers and distribution of black-tailed godwit during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 2 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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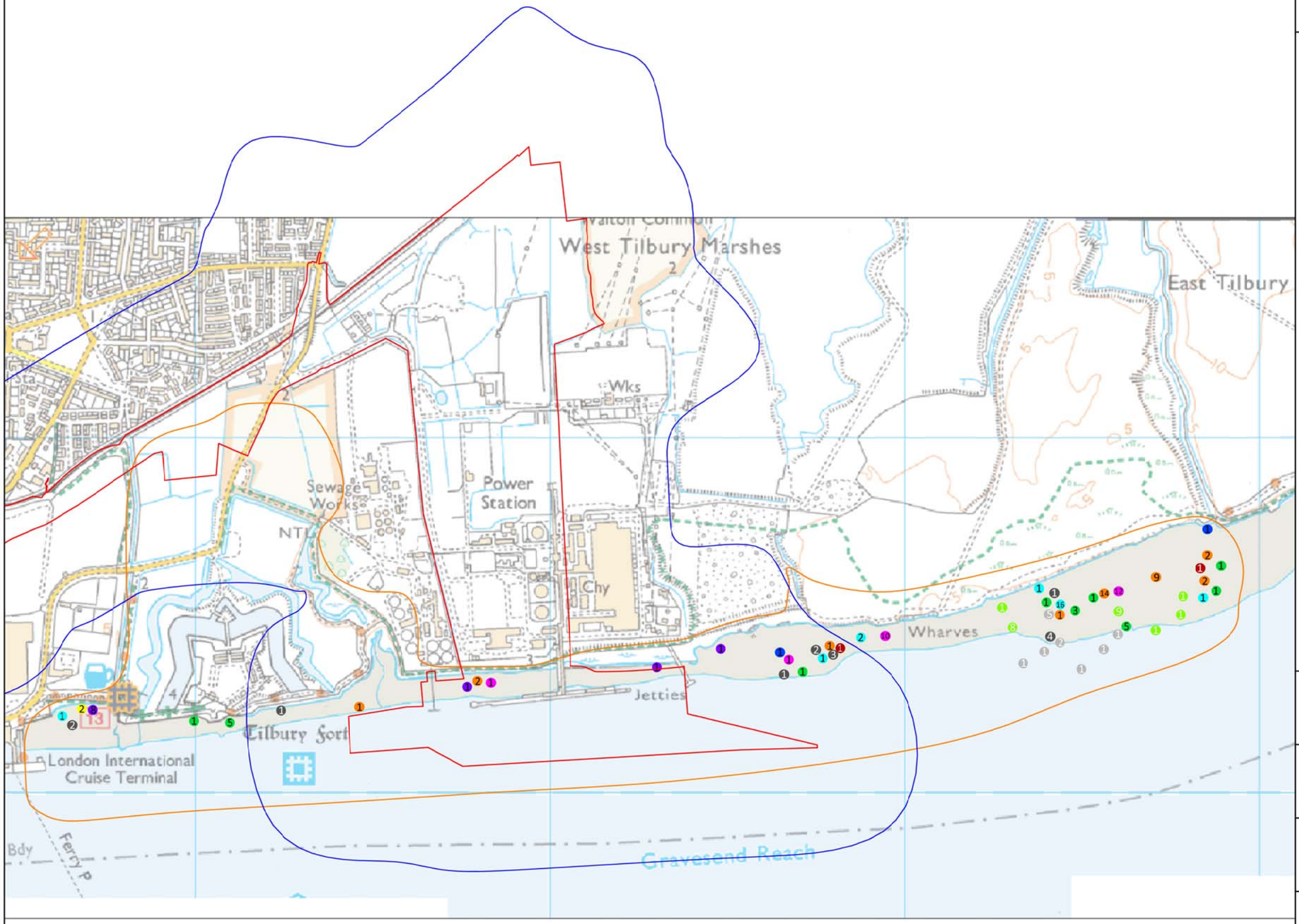


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- December 2016 visit (low tide)
- January 2017 visit (high tide)
- February 2017 visit (high tide)
- March 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- December 2017 visit (low tide)
- January 2018 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title

Numbers and distribution of curlew during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 3 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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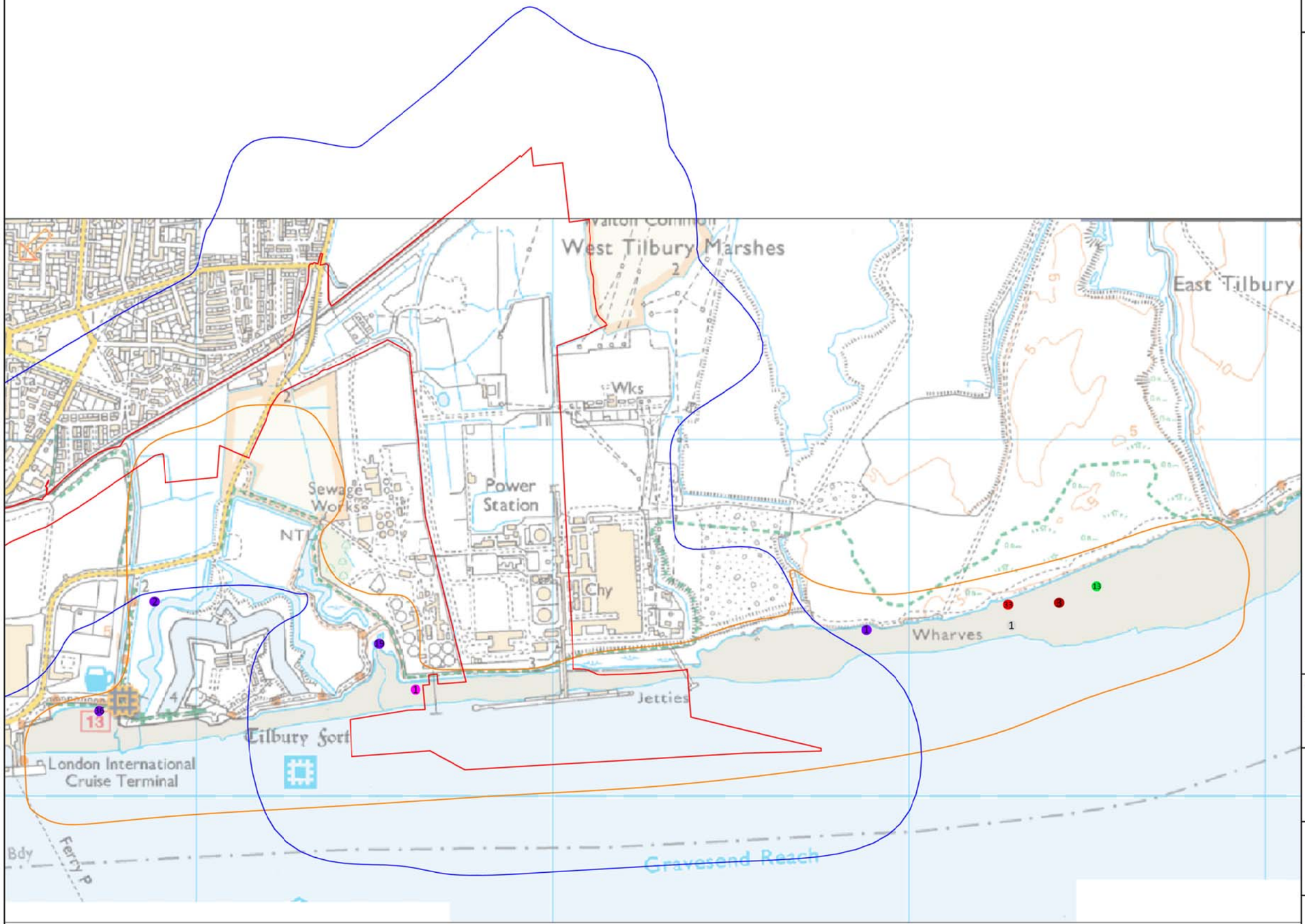


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- March 2017 visit (low tide)
- Number in circle relates to the number of individuals found at the location

DO NOT SCALE

**Title**

Numbers and distribution of dunlin during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 4 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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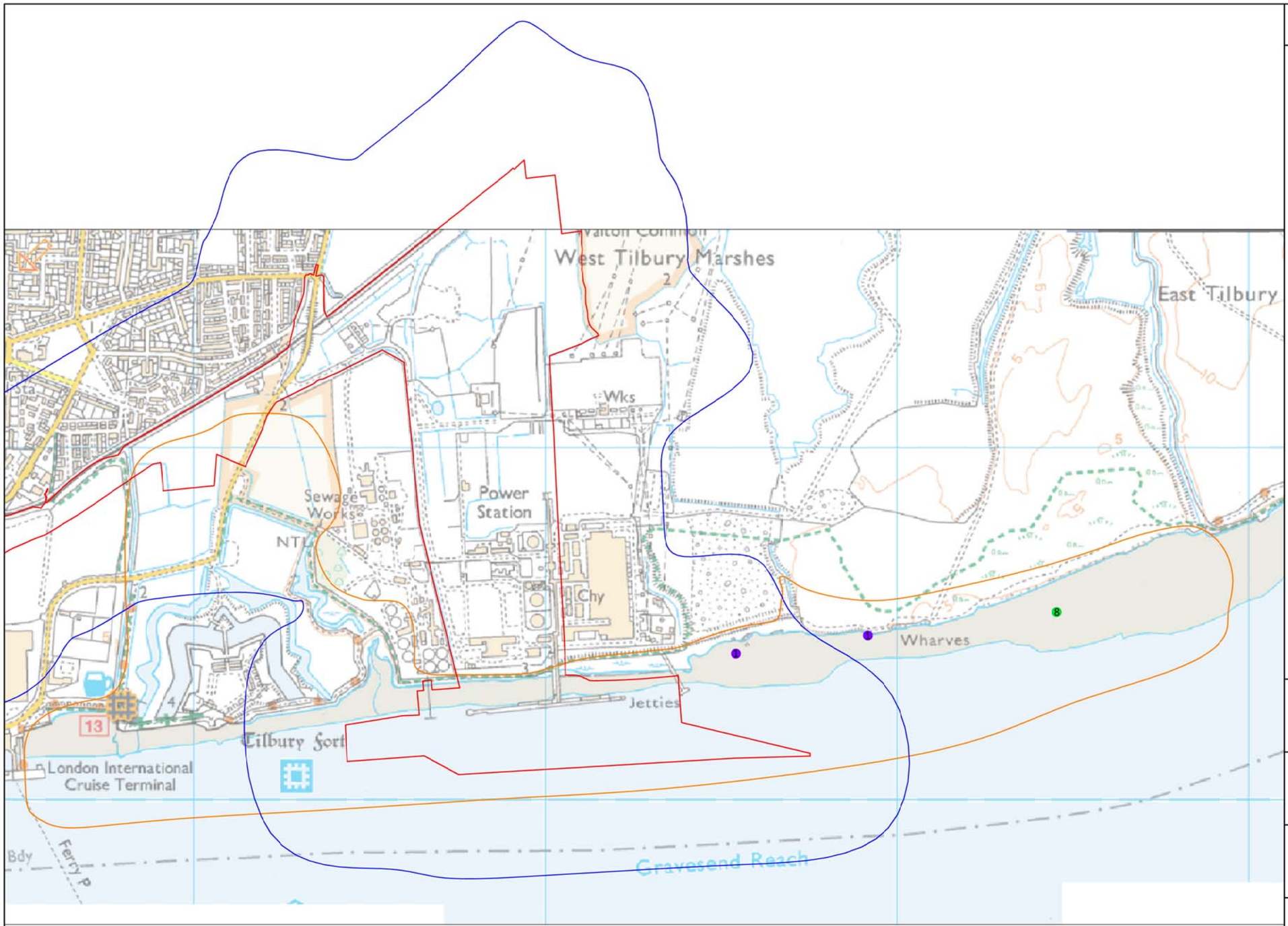


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)

DO NOT SCALE

**Title**

Numbers and distribution of grey plover during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 5 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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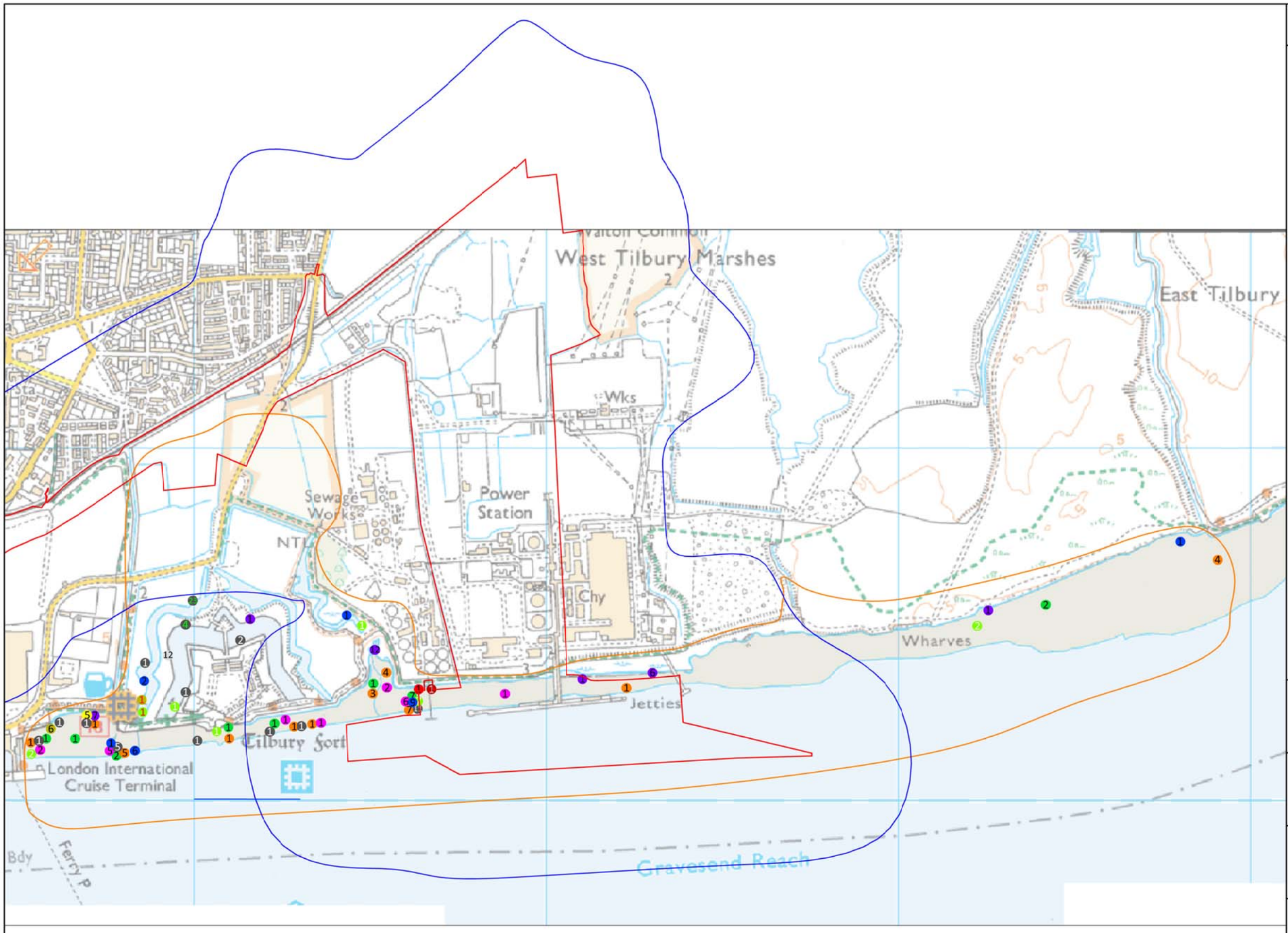


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- December 2016 visit (low tide)
- January 2017 visit (high tide)
- February 2017 visit (high tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- December 2017 visit (low tide)
- December 2017 visit (high tide)
- January 2018 visit (low tide)
- January 2018 visit (high tide)
- February 2018 visit (low tide)
- February 2018 visit (high tide)
- March 2018 visit (low tide)
- March 2018 visit (high tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

**Title**

Numbers and distribution of redshank during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 6 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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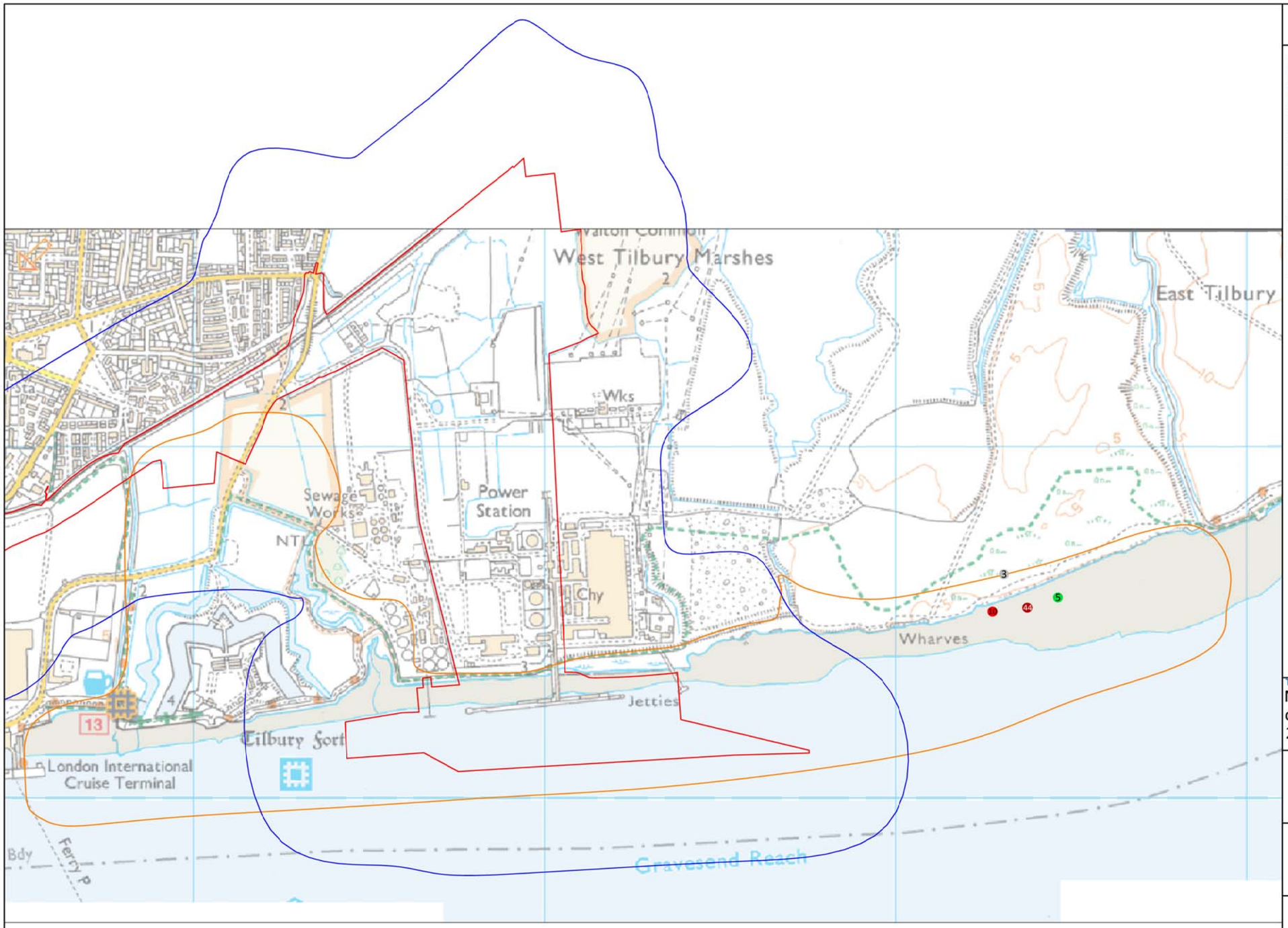


## Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- 1 November 2016 visit (low tide)
- 1 September 2017 visit (low tide)
- 1 October 2017 visit (low tide)
- 1 March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title
Numbers and distribution of ringed plover during wintering bird surveys in 2016/17 and 2017/18

| Project | Client |
|---|---|
| Tilbury2 | Port of Tilbury |

| Drawing No. | Revision | Project No. |
|---|---|---|
| Figure 7 | A | E1862 |

| Drawn | Date |
|---|---|
| BC | March 2018 |

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