H2Teesside Project

Planning Inspectorate Reference: EN070009

Land within the boroughs of Redcar and Cleveland and Stockton-on-Tees, Teesside and within the borough of Hartlepool, County Durham

The H2 Teesside Order

Document Reference: 8.17 Applicant's Response to Deadline 2 Submission

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Applicant: H2 Teesside Ltd

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1.0 INTRODUCTION

1.1 Overview

1.1.1 This document has been prepared on behalf of H2Teesside Limited (the 'Applicant'). It relates to an application (the 'Application') for a Development consent Order (a 'DCO'), that was submitted to the Secretary of State for Energy Security and Net Zero ('DESNZ') on 25 March 2024, under Section 37 of the Planning Act 2008 (the 'PA 2008') in respect of the H2Teesside Project (the 'Proposed Development').

1.1.2 The Application has been accepted for examination. The Examination commenced on 29 August 2024.

1.2 The Purpose and Structure of this Document

1.2.1 This document provides the comments of the Applicant in response to the submissions made by various Interested parties at Deadline 2 of the Examination. The document also contains the Applicant's response to the Late Deadline 2 Submissions made by National Highways [AS-032] and Stockton on Tees Borough Council [AS-033].

1.2.2 The document is structured in the following sections:

- Natara Global Limited
- Sabic Tees Holdings Limited and Sabic Petrochemicals BV And Sabic UK Petrochemicals Limited
- Industrial Chemicals Ltd
- Redcar Bulk Terminal Limited
- Boc Limited
- Anglo American
- Sembcorp Utilities (UK) Limited
- The South Tees Group
- Northern Gas Processing Limited
- Teesside Gas Processing Plant Limited
- Teesside Gas and Liquids Processing
- Air Products Plc and Others
- National Grid Electricity Transmission Plc
- National Gas Transmission Plc
- Ineos Nitriles (UK) Limited
- PD Teesport Limited
- Navigator Terminals Limited

- CF Fertilisers UK Limited
- North Sea Midstream Partners Limited
- Natural England
- Stockton-On-Tees Borough Council
- Kellas Midstream Limited and Cats North Sea Limited
- Ward Hadaway LLP on Behalf of Northumbrian Water Limited
- Lighthouse Green Fuels Limited
- Environment Agency
- Redcar And Cleveland Borough Council
- Venator Materials (UK) Limited

1.2.3 The Applicant has not commented on every point made within the Deadline 2 Submissions, instead the Applicant has sought to provide comments where it is helpful to the Examination to do so or where the Applicant considers that it would be appropriate for the Examining Authority ('ExA') to have the Applicant's view on the matter raised.

1.2.4 For the avoidance of doubt, where the Applicant has chosen not to comment on matters raised by an Interested Party, this is not an indication the Applicant agrees with the point or comment raised or opinion expressed.

1.2.5 Appendices have been provided where they are referred to in the response.

2.0 NATARA GLOBAL LIMITED

Table 2-1: Response to Natara Global Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Natara1	Written Representation [REP2-085]	• Progress made following site meeting and now much clearer on the Applicant's use of Natara Global's property • Reserving objection until updated Heads of Terms and Protective Provisions received and terms agreed.	The Applicant welcomes Natara Global's comments regarding the progress made between the two parties. The Applicant has issued a revised Option Plan to Natara Global for their consideration and requested a meeting to discuss the Heads of Terms with their legal representative. The Applicant believes, that, through continued correspondence, the parties will be able to come to a mutually acceptable agreement. In addition, discussions between the parties at the joint site meeting have helped to clarify the nature and extent of Natara Global's practical concerns relating to the proposed use of part of its site as a construction compound and for access. The Applicant's legal representatives are in the process of drafting additional protective provisions in order to address these concerns for potential inclusion in the dDCO in due course, subject to their agreement with Natara Global.

3.0 SABIC TEES HOLDINGS LIMITED AND SABIC PETROCHEMICALS BV AND SABIC UK PETROCHEMICALS LIMITED

Table 3-1: Response to SABIC Tees Holdings Limited and SABIC Petrochemicals BV and SABIC UK Petrochemcials Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
SABIC1	SABIC Tees Holdings Limited and SABIC Petrochemicals BV 'Any further information requested by the ExA' [REP2-097]	Article I. Request for Submission of a late RR to mirror that submitted by SABIC UK Petrochemicals Ltd and adopt the same WR. Article II. Notification of wish to attend ASI • Notification of wish to attend CA Hearing	Noted regarding wish to attend the ASI. The Applicant will be in touch to arrange this.
SABIC2	SABIC UK Petrochemicals Limited 'Any further information requested by the ExA' [REP2-098]	• Notification of Wish to attend ASI • Notification of with to attend CA Hearing • Confirmation that no AI has been used	Noted regarding wish to attend the ASI. The Applicant will be in touch to arrange this.
SABIC3	SABIC UK Petrochemicals Limited 'Responses to comments on Relevant Representations' [REP2-099]	1. Wilton International 1.a) SABIC requires access to its facilities and apparatus at all times. The measures contained in the Framework CTMP [APP-050] appear to be directed towards consultation and notification in respect of road closures and vehicle movements. Whilst these measures are welcomed, they do not address SABIC's issues around access. 1.b) SABIC's RR was based on the Application as made (and therefore does not consider the removal of plot 19/13). The Applicant's response does not address SABIC's point that the site is in active use by SABIC and the Applicant does not appear to have looked at other sites as an alternative. SABIC intends to respond separately to the Consultation relating to the Change Notification (PDA-019), as procedurally it is required to do. To the extent that the change is accepted, and Plots 9/10 and 9/13 are omitted from the Land Plans and Book of Reference, SABIC welcomes those changes. 1.c) Relating to the temporary possession of Plot 20/13 and adjacent plots and the Applicant's requirement of these plots for construction – SABIC notes that it is intended for their concerns to be dealt with in **PPs but has not yet received communication from the Applicant regarding SABIC's protective provisions.** 1.d) SABIC's relevant representation is and must be based on the application as made. The Applicant's response does not address SABIC's point that the site is in active use by SABIC and the Applicant does not appear to have looked at other sites as an alternative. SABIC intends to respond separately to the Consultation relating to the Change Notification (PDA-019), as procedurally it is required to do. To the	EN070009-001205-SABIC UK Petrochemicals Limited - Responses to comments on RRs.pdf (planninginspectorate.gov.uk) 1a) The Applicant notes SABIC's duties as a COMAH site Duty Holder and intends to coordinate with SABIC to ensure SABIC's access rights are preserved. It's the Applicant's intention to address access protections in the Protective Provisions being negotiated. 1b) The Applicant has now submitted a Change Application to the ExA that includes removal of plot 19/13 from the Order Limits. 1c) The Applicant has reviewed the draft protective provisions provided by SABIC as part of the consultation process. These are broadly aligned with the protective provisions included for SABIC's benefit in the Net Zero Teesside DCO, but there are a number of material differences. The Applicant is not opposed to agreeing alternative protective provisions, but on the basis of current information (including that provided in SABIC's DL2 representations) the rationale for these differences needs to be explained to the Applicant. The Applicant will liaise directly with SABIC to discuss this.. This detail would assist the Applicant to understand Sabic's position and review/consider accordingly. 1d) The Applicant has now submitted a Change Application to the ExA that includes removal of plot 20/10. 2a) Please see above in relation to 1c).

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		extent that the change is accepted, and Plot 20/10 is omitted from the Land Plans and Book of Reference, SABIC welcomes those changes. 2. North Tees Site 2.a) **SABIC awaits a detailed response on their proposed Protective Provisions** and asks the Applicant to confirm when this will be ready 2.b) In relation to compliance with SABIC's COMAH plan, **SABIC awaits a response on their proposed PPs** 2.c) Plot 10/9 is adjacent to SABIC's boilers, water plant and air compressors. This apparatus is in ongoing use by SABIC (and its contractors) in support of operating, inspecting and maintaining those assets. SABIC notes that it is intended to dealt with its concerns in protective provisions. **The Applicant has not yet communicated the extent to which it is prepared to accept SABIC's protective provisions.** 2.d) SABIC notes that it is intended to deal with its concerns in protective provisions. Plots 10/14 and 10/15 includes essential access to high hazard operations of both SABIC and CF Fertilisers, which cannot be compromised. All four plots (10/10, 10/14, 10/15, 10/16) contain high hazard pipework which it must be possible to access, inspect and maintain at all times. **The Applicant has not yet communicated the extent to which it is prepared to accept SABIC's protective provisions.** 3. River Tees 3.a) **SABIC awaits PPs** to address its concerns around the temporary exclusive possession of and rights in Tunnel No.2 3.b) The natures of the works contained in Works 6A.1 in the river are unclear. The Applicant's response (*The Applicant is proposing a new crossing over the River Tees below the riverbed using Microbored Tunnel or Horizontal Directional Drilling (HDD) techniques.*) does not identify how this commitment is secured in the draft Order. 4. Link Line Corridors 4.a) **SABIC awaits the Applicant's response on PPs** relating to the temporary possession of SABIC's rights and accesses in the Link Line Corridor 4.b) The Pipeline Statement (Document 5.5) sets out details of the design and location of the proposed hydrogen pipelines, including in relation to the use of Mirco-bored Tunnel or Horizontal Directional Drilling (HDD) techniques and whether sections will be above or below ground. It is unclear to SABIC how this commitment is secured in the draft Order.	2b) Please see above in relation to 1c). 2c) Please see above in relation to 1c). 2d) Please see above in relation to 1c). 3a) The Applicant is not proposing to use Tunnel No. 2, but instead install a new crossing beneath all existing services and tunnels. 3b) The tunnelling / boring works required for Work No. 6A.1 and its river crossing (as well as any other trenchless crossings) are described as part of the general works paragraph at the end of Schedule 1 (authorised development) to the Draft Development Consent Order [REP2-004]. This states: *'In connection with and in addition to Work Nos. 1 to 11, further ancillary development comprising such other works or operations for the purposes of or in connection with the construction, operation and maintenance of the authorised development but only within the Order limits and insofar as they are unlikely to give rise to any materially new or materially different environmental effects which are worse than those assessed in the environmental statement, including -* *…* *'(n) tunnelling, boring, piling and drilling works and management of arisings.'* In addition, paragraph 7 of Requirement 3 (Detailed Design) in Schedule 2 to the Draft Development Consent Order [REP2-004] provides that before works relating to the hydrogen distribution network (including Work No. 6A.1) can commence, save for the permitted preliminary works, details of the works (including details of any works involving trenchless technologies and their location) must be submitted and approved by the relevant planning authority in consultation with South Tees Development Corporation. 4a) Please see above in relation to 1c). 4b) Please see response to part 3.b) above. 5a) Please see response to 1a) above. 5b) The Applicant has now submitted a Change Application to the ExA that includes removal of plot 5/97. 5c) The Applicant has now submitted a Change Application to the ExA that includes removal of plot 5/94.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		5. Brine Fields and Reservoirs 5.a) SABIC requires access to its facilities and apparatus at all times. The measures contained in the Framework CTMP [APP-050] appear to be directed towards consultation and notification in respect of road closures and vehicle movements. Whilst these measures are welcomed, they do not address **SABIC's issues around access.** 5.b) Relating the removal of Plot 5/97 in the Change Application. SABIC's relevant representation is and must be based on the application as made. The Applicant's response does not address SABIC's point that the site is in active use by SABIC. SABIC intends to respond separately to the Consultation relating to the Change Notification (PDA-019), as procedurally it is required to do. To the extent that the change is accepted, and Plot 5/97 is omitted from the Land Plans and Book of Reference, SABIC welcomes those changes. 5.c) Relating the removal of Plot 5/94 in the Change Application. The Applicant's response does not address SABIC's point that the site is in active use by SABIC. SABIC intends to respond separately to the Consultation relating to the Change Notification (PDA-019), as procedurally it is required to do. It is not clear from the plans included with the Change Notification that Plot 5/94 is to be omitted as part of that change. To the extent that the change is accepted, and Plot 5/94 is omitted from the Land Plans and Book of Reference, SABIC welcomes those changes. 5.d) Regarding the use of Plot 6/3 which is planned as Right of Way for construction but SABIC is concerned about its proximity to an existing borehole. The Applicant has asserted that this will be covered by Protective Provisions but the Applicant has not yet communicated the extent to which it is prepared to accept SABIC's **PPs.** 6.a) Plot 5/21 and nearby plots fall within the zone around the WGEP in which SABIC seeks to prevent development from taking place due to the high hazard levels. SABIC's Compound 38 is the white land at the centre of temporary possession Plot 5/19. This is the point where an above ground ethylene pipeline (known as System 32) goes underground and becomes the WGEP. Plot 5/21, and plots immediately to the north straddle SABIC's access road to SABIC's high hazard assets in Compound 38. In light of these difficulties and constraints, SABIC does not believe that it is appropriate for the scheme to use this land and is very concerned that the Applicant has given due consideration to possible alternatives6.b). SABIC notes that it is intended to deal with its concerns in protective provisions. The Applicant has not yet communicated the extent to which it is prepared to accept SABIC's protective provisions. 7. More generally, SABIC is concerned in relation to the proposed powers in the draft DCO	5d) The borehole will be picked up during topographic surveys and marked on Engineering drawings (alignment sheets). A suitable buffer for construction vehicles will be established and enforced on site through signage / marking the borehole. Please also refer to 1c) above in relation to the current status of the protective provisions negotiations between the parties. 6a) The Applicant is aware of the MAHP in the area of 5/19 and will plan construction works accordingly. 5/19 has temporary rights only to support being able to get access to all sides of the proposed pipeline during construction. Operational access and maintenance is through 5/18. The Applicants proposal is to place an AGI south of the Linkline corridor in 5/21, and then use a Horizontal Directional Drill (HDD) to cross north under the Linkline, Seal Sands Road and Railway lines as a single crossing. Proposed drillpad for the HDD is within 5/25. This approach requires 5/22, 5/23, 5/24 south of the Linkline. The Applicant would seek to reach an agreement with SABIC for acceptable works within 5/19 and if any buffer from Compound 38 is required. A Quantitative Risk Assessment will be performed as part of Engineering to determine the impact on 3rd party facilities and potential escalation. The Applicant will liase directly with SABIC to explain how alternatives were ruled out. Excavations will follow best practice with positive isolation of buried services before starting work, and appropriate permitting. Loads will be limited at existing pipeline crossings through the use of temporary slabs if required. 6b) Please see above in relation to 1c). 7) Please see above in relation to 1c).

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
SABIC4	SABIC UK Petrochemicals Limited 'Written Representation' [REP2-100]	<u>Wilton International</u> • Requirement of adequate safeguards to prevent the forced shutdown of the Cracker (Plot 20/6) • Concerns surrounding temporary possession on Wilton Site roads and Sabic considers that the Applicant should use the access system established by Sembcorp • Plots 19/10 and 19/13 – these are in active use by Sabic and Sabic would like to see evidence of alternative sites being considered • Plot 20/13 and adjacent plots have underground storage cavities as well as the Trans-Pennine Ethylene Pipeline (TPEP) and underground water pipework – all require additional consideration • Plot 20/10 – covers approximately half of Sabic's B7 tank area and is integral to operations <u>North Tees Site</u> Sabic does not consider that its land in the North Tees site should be included in the Order Limits. <u>River Tees</u> • Concern around capacity of Tunnel No. 2 for further installations. • Requires clarification on Work 6A.1 <u>Link Line Corridors</u> Concern around how the CA powers and DCO may interfere with Sembcorp's system of balancing requirements of different apparatus owners within the corridor <u>Brine Fields and Reservoirs</u> Concerns around permanent acquisition of Plots 5/97 and proximity of plot 6/3 to an existing borehole. <u>Wilton to Grangemouth Ethylene Pipeline (WGEP)</u> • The WGEP goes from above to underground in the middle of Plot 5/19. The pipeline is a major accident hazard and is likely to present engineering challenges to the development. Any development close to the WGEP could also present serious operational difficulties to SABIC and would not usually be allowed. • SABIC welcomes the exclusion of Compound 38 from the Order Limits but will require access to this compound at all times.	<u>Wilton International</u> Temporary access for the Applicant's Works is not expected to prohibit Sabic from normal business operations. A passing lane around construction traffic, or a well-marked diversion route through Wilton will be established. Works will be performed through controlled permitting of which Traffic Management is a part. The existing Wilton access card & vehicle access system will be used and to meet CDM requirements this will be Controlled, Co-ordinated and Communicated in an agreed way to affected parties. Plots 19/10 and 19/13 – The Applicant has now submitted a Change Application to the ExA that includes removal of Plot 19/13. With regards to Plot 19/10, the Applicant is going to discuss the alternatives considered with SABIC in their next meeting. The Applicant intends to reach a voluntary land agreement for this plot. Plot 20/13 – The Applicant notes this existing infrastructure and is confident that this interface can be adequately addressed by prudent design and construction practices. Plot 20/10 – The Applicant has now submitted a Change Application to the ExA to remove this plot from the Order Limits. <u>North Tees Site</u> The Applicant has discussed this point with SABIC and this will be further discussed as part of protective provisions negotiations. <u>River Tees</u> • See SABIC3 Response 3.a) above. • See SABIC3 Response 3.b) above. <u>Link Line Corridor</u> The Applicant is aware of the management arrangements within the Link Line Corridors and is in discussions with Sembcorp with respect to how the Project can best be integrated into the existing arrangements. The Applicant does not consider that the powers set out in the dDCO would materially affect the practical operation or maintenance of third party apparatus in the Link Line Corridors, and if it is necessary for existing rights to be extinguished these would be replaced with substantially equivalent replacement rights as needed. Please see SABIC3 Response 3.b) above in respect of how the works are set out in the Draft Development Consent Order.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		• SABIC is unclear why the Order limits extend out south of the Link Line Corridor in this location. • The AGI in Plot 5/19 and adjacent plots fall within the zone around the WGEP – SABIC seeks to prevent development in this area due to high hazard levels. • These plots also straddle SABIC's access road to their high hazard assets in Compound 38 and the powers within the draft Order would allow the Applicant to prevent access to Compound 32. • SABIC does not therefore believe it is appropriate for the scheme to use this land and is concerned that the Applicant should give due consideration to alternatives • Any excavations or heavy loads in the vicinity of the WGEP would be of concern to SABIC. General Issues • The DCO includes powers which would allow the Applicant to exclude SABIC from some of its key facilities. • Lack of clarity on how the integrity of the North Tees site as a top tier COMAH site can be maintained • Does the Applicant intend the powers to prohibit passage over streets to apply • Concern about the extent of article 16 of the Draft Development Consent Order to regulate traffic.	Brine Fields and Reservoirs See SABIC3 Response 5.b) and 5.d) above. Wilton to Grangemouth Ethylene Pipeline (WGEP) • The Applicant is aware of the MAHP in the area of 5/19 and will plan construction works accordingly. 5/19 has temporary rights only to support being able to get access to all sides of the proposed pipeline during construction. Operational access and maintenance is through 5/18. • The Applicants proposal is to place an AGI south of the Linkline corridor in 5/21, and then use a Horizontal Directional Drill (HDD) to cross north under the Linkline, Seal Sands Road and Railway lines as a single crossing. Proposed drillpad for the HDD is within 5/25. This approach requires 5/22, 5/23, 5/24 south of the Linkline. • The Applicant would seek to reach an agreement with SABIC for acceptable works within 5/19 and if any buffer from Compound 38 is required. A Quantitative Risk Assessment will be performed as part of Engineering to determine the impact on 3rd party facilities and potential escalation. • • The Applicant will liase directly with SABIC to explain how alternatives were ruled out. • Excavations will follow best practice with positive isolation of buried services before starting work, and appropriate permitting. Loads will be limited at existing pipeline crossings through the use of temporary slabs if required. General Issues The Applicant notes that SABIC raised issues about the interface between the powers in the Draft Development Consent Order [REP2-004] relating to compulsory acquisition, streets and access, and SABIC's existing rights and operations and has responded to these in the Applicant's Comments on Relevant Representations and Additional Submissions (please see Table 3.24 in [REP1-007]). The Applicant has noted these concerns and believes the concerns will be resolved via the inclusion of appropriate Protective Provisions and anticipates the parties will be able to agree the same during the course of the examination. The Applicant has reviewed the draft protective provisions provided by SABIC as part of the consultation process. These are broadly aligned with the protective provisions included for SABIC's benefit in the Net Zero Teesside DCO, but there are a number of material differences.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			The Applicant is not opposed to agreeing alternative protective provisions, but on the basis of current information (including that provided in SABIC's DL2 representations) the rationale for these differences needs to be explained to the Applicant. The Applicant will liaise directly with SABIC to discuss this. This detail would assist the Applicant to understand Sabic's position and review/consider accordingly. In relation to the concern about the extent of the powers in article 16, the Applicant provided an explanation for the powers in article 16 in their response to ExQ1.9.17 of Response to ExQ1 Draft Development Consent Order [REP2-027]. In its response to ExQ1.9.18 [REP2-027], the Applicant set out its intention that the approval of the traffic authority is required when exercising powers under article 16(2) and inserted a new paragraph 4 into article 16 in the Draft Development Consent Order submitted at Deadline 2 [REP2-004] to provide this clarity.

4.0 INDUSTRIAL CHEMICALS LTD

Table 4-1: Response to Industrial Chemicals Ltd Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Ind-Chem1	Written Representation [REP2-079]	• Assurance that vehicular access rights over Huntsman Drive (Private Road) which Industrial Chemicals have rights over and adopted road network be will maintained to enable commercial operations to be maintained. Industrial Chemicals are unclear what the intended use of Huntsman Drive will be at construction and operational phase. • Clarification of road closures	The Applicant notes Industrial Chemicals Ltd's concerns and is of the opinion that the access concerns can be resolved by means of appropriate Protective Provisions. The Applicant is going to make contact with Industrial Chemicals Ltd to discuss Protective Provisions.

5.0 REDCAR BULK TERMINAL LIMITED

Table 5-1: Response to Redcar Bulk Terminal Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
RBT1	Written Representation [REP2-096]	• RBT's objection is not to the principle of the scheme, but to the inclusion of CA Powers as they affect the Terminal • To withdraw its objection, RBT requires: • A) H2T to enter into an agreement that will regulate the manner in which rights over plots are granted and the relevant works are carried out, and confirm that CA Powers will not be exercised in relation to such land • B) the removal of plots 13/8 and 13/9 • C) the inclusion of PPs to safeguard continued operation • D) regulation of any competing use of the Terminal by NZT • Negotiations are ongoing • Insufficient detail in the application to assess whether powers sought are proportionate – require a plot by plot explanation/justification.	Negotiations are ongoing with regards to a side agreement and protective provisions to resolve RBT's concerns. The Applicant's case for compulsory acquisition powers is set out in the Statement of Reasons [APP-024] and other representations made to the examination. The Book of Reference [APP-023], Land Plans [APP-08] and Works Plans [APP-010] read together specify the land requirements on a plot by plot basis. Several meetings have been held between the Applicant and Redcar Bulk Terminal to discuss the technical and commercial requirements related to the Proposed Development, as well as to address the landowner's interests. Engagement between parties is focused on discussing these requirements and clarify key details needed to advance the Side Agreement and the commercial agreement. Negotiations remain ongoing, with the Applicant and RBT actively working to align on critical specifications. RBT's comments on the Protective Provisions are under review by the Applicant to safeguard landowner's assets concerning the Proposed Development. Net Zero Teesside Power and the Applicant shall collaborate and enter into a separate agreement to govern the use of the common areas including the Terminal, ensuring that such use is appropriately regulated and does not interfere with other operational activities. Further discussions are expected to finalise the key terms. The Applicant has now submitted a Change Application into the Examination to remove plots 13/8 and 13/9 from the Order Limits.

6.0 BOC LIMITED

Table 6-1: Response to BOC Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
BOC1	Written Representation [REP2-075]	• BOC are not objecting in principle to the Application • BOC wish for acceptable PP's to be agreed between themselves and the Applicant. • The Book of Reference does not list all plots in which BOC have an interest, but they will supply this detail during PP negotiations. • The corridor is congested and will require multiple crossings of existing services and pipelines. Further clarification is needed on how this is to be navigated. • BOC seek clarification that they will have access to its assets for maintenance, monitoring and emergency works. • In the Issue Specific hearing it was stated that the PP were in progress with BOC, which is incorrect • BOC are concerned that the Applicant is attempting to use another project to deny its PP's	**<u>Summary</u>** 1.1 BOC's solicitors misrepresent the Applicant's position. The Applicant has not stated that BOC is not entitled to specific standalone protective provisions. 1.2 to 1.3 The Applicant included protective provisions at Schedule 12 Part 3 of the dDCO for the protection of third party apparatus owners and operators. These would automatically apply to and benefit BOC. However, BOC's solicitors have intimated that BOC does not wish to agree these and would instead prefer protective provisions based on those included in the Net Zero Teesside DCO at Schedule 12 Part 17 ("**the NZT Part 17 PPs**"). Whilst the Applicant has no objection to this approach as a matter of general principle, the draft protective provisions proposed by BOC's solicitors differ from the NZT Part 17 PPs in a number of material respects. The Applicant has requested an explanation from BOC's solicitors as to the rationale for these changes in order to understand whether there has been any relevant material change of circumstances since the NZT Part 17 PPs were included in the made DCO, but no such explanation has yet been forthcoming. 1.4 The Applicant notes the importance of BOC's operations to the Teesside cluster. The Proposed Development has been designed taking account of BOC's apparatus and operations, and protective provisions for the protection of third party apparatus (including BOC's) were proactively included in the dDCO. 1.5 The Applicant is in the process of reviewing the data provided by BOC and will update the Book of Reference accordingly to ensure all interests have been captured at the next examination deadline (D4). 1.6 Whilst the Applicant notes BOC's preference for protective provisions to be put in place on a plot-by-plot basis, to date BOC's solicitors have not provided draft protective provisions in this form for the Applicant to review, including which specific provisions BOC's solicitors consider should apply to which plot and why.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			Absent the provision of this information by BOC's solicitors, the Applicant considers that it will not in practice be possible to include plot-by-plot protective provisions in the dDCO. **BOC** 2. The Applicant notes the summary provided as to BOC's operations. **BOC's interests in the Application site and Teesside** 3.1 The Applicant notes the statement that the BoR does not currently list all plots in which BOC has an interest. As the Applicant's counsel set out at ISH1, the Applicant has been engaged with BOC for a significant length of time in order to seek confirmation as to the location and type of its apparatus and land interests. Further information in this regard was provided to the Applicant's land agents by BOC's agent on 17 October 2024 listing some 89 additional plots in respect of which BOC asserts an interest. The Applicant is in the process of reviewing the data provided and will update the BoR as appropriate to ensure that all interests have been recorded as needed. Given the volume of the updated dataset and the stage at which it has been provided, the Applicant anticipates that an updated BoR will be available at the next examination deadline (D4). 3.2 to 3.3 The Applicant notes the comments regarding this corridor and the existing services and pipelines therein. The Applicant is considering existing BOC pipelines, CATS pipeline, and the proposed Anglo American York Potash project, being implemented pursuant to the York Potash Harbour Facilities Order 2016 (and the York Potash Harbour Facilities (Amendment) Order 2022) and the Materials Handling Facility and Minerals Transport System Portal (approved under planning permissions Ref: R/2018/0139/VC and R/2014/0626/FFM). The Applicant's detailed design plans will demonstrate the interactions between the proposed development and other existing/proposed services, including that a solution considering all assets is feasible. The Applicant is confident that this will be achieved. This will be shared with BOC during technical engagements. **Statutory and regulatory requirements and other concerns**

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			4.1 to 4.2 The Applicant acknowledges that BOC is subject to statutory and regulatory duties in relation to the management and maintenance of its infrastructure. The Applicant considers that the protective provisions included in the dDCO are suitable and sufficient to ensure that BOC can continue to meet these duties, including through ensuring that appropriate access is available for maintenance, monitoring and emergency works purposes and with respect to the grant of any necessary replacement rights should it be necessary for BOC's rights to be extinguished in order to carry out the Project. Without prejudice to that, the Applicant is content to continue discussions with BOC on alternative protective provisions based on the relevant provisions of the NZT Part 17 PPsif this is BOC's preference As noted above the draft protective provisions provided by BOC's solicitors differ from the NZT Part 17 PPs in several material respects and the Applicant has sought an explanation for these changes. For example, a material change of circumstances on a technical level since the NZT Part 17 PPs were adopted would be reason for the Applicant to consider matters further and look to agree appropriate protective provisions for inclusion in the dDCO or a side agreement, but no such explanation has yet been forthcoming from BOC's solicitors. **<u>Protective provisions</u>** 5.1 The Applicant agrees that the inclusion of appropriate protective provisions in the dDCO to ensure that BOC, and all other apparatus owners and operators, have the benefit of all protections and rights that are reasonably necessary to enable them to repair maintain and operate their apparatus, mitigate relevant health and safety concerns and ensure they can comply with their statutory obligations is important. This is why the dDCO submitted by the Applicant included draft protective provisions for the benefit of third party apparatus owners and operators in Schedule 12 Part 3. 5.2 The Applicant's solicitors provided a copy of the proposed protective provisions included within the dDCO to BOC's solicitors on 24 April 2024. BOC's solicitors intimated that they objected to those provisions. The Applicant's solicitors sent a further email on 25 April 2024 seeking confirmation that BOC wished to replicate the relevant protective provisions from the NZT DCO and, if so, inviting BOC's solicitors to provide a mark-up of those updated to reflect the interactions with the H2Teesside Project. BOC's solicitors replied to state that BOC wished to base the protective provisions on "*the NZT Sembcorp provisions*" i.e. the NZT Part 17 PPs.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			BOC's solicitors provided draft protective provisions on 17 June 2024 and which are reproduced at Appendix 2 of REP2-075 ("**the FF PPs**"). The FF PPs differed in several material respects from the NZT Part 17 PPs and the only rationale for the FF PPs provided by BOC's solicitors was that "*the BOC infrastructure is predominantly within the Sembcorp pipeline corridors. This time we will want stand alone provisions so as to give BOC direct locus rather than via Sembcorp).*" This point is considered below. 5.3 It is correct that the Applicant's counsel intimated at ISH1 on 28 August 2024 that protective provisions were "*in progress with BOC*". The Applicant notes the position in terms of the sharing of draft protective provisions above. 5.4 The draft FF PPs provided by BOC's solicitors have been reviewed in detail by the Applicant's solicitors in collaboration with the Applicant's technical advisors and appointed land agents, and a comprehensive response setting out the Applicant's position was provided to BOC's solicitors in the letter from the Applicant's solicitors dated 11 September 2024. That letter made clear that, as far as the Applicant was aware, the potential interactions between BOC's apparatus and the H2Teesside Project are broadly the same in substance as those between BOC's apparatus and the Net Zero Teesside DCO scheme. Nevertheless, the letter also confirmed that the Applicant remained open to seeking agreement with BOC on reasonable and appropriate protective provisions and any side agreement that may be warranted, and requested that BOC's representatives provide: i. the further information which had been requested by the Applicant's land agents particularising the location and type of BOC's land, rights and apparatus within the DCO order limits and, where relevant, the wider locale; and ii. a reasoned justification as to why any standalone protective provisions included in the present dDCO should differ in substance from the NZT Part 17 PPs. As set out above, further information was provided to the Applicant's land agents by BOC's agent on 17 October 2024 and the Applicant is in the process of reviewing this. BOC's solicitors have not provided an explanation as to why any standalone protective provisions included in the present dDCO should differ in substance from the NZT Part 17 PPs, other than statements about "*significant health and safety risks*" which "*could*" happen, but have not been particularised.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			On the basis of the currently available information, there is nothing to justify the adoption of a different approach to protective provisions in the dDCO compared to the NZT Part 17 PPs insofar as BOC's land, rights and apparatus are concerned. There is nothing to indicate that there has been any material change of circumstances since the NZT DCO was made and, accordingly, there is no reason why the FF PPs should be included in the dDCO. 5.5 As set out above, further information was provided to the Applicant's land agents by BOC's agent on 17 October 2024 and the Applicant is in the process of reviewing this. The Applicant's solicitors have sought an explanation as to whether BOC consider there has been a material change of circumstances compared to the NZT project, so as to warrant a different approach to protective provisions now, but has not received this. 5.6 As will be apparent from the above responses, the Applicant does not seek to exclude standalone protective provisions in favour of BOC from the dDCO, whether by reference to the NZT DCO or otherwise. BOC's solicitors' position is also inconsistent on its face: i. on the one hand implying that the Applicant (quite reasonably) pointing to the precedent set by the NZT Part 17 PPs is somehow inappropriate; ii. on the other hand, BOC seek to rely on protective provisions which they assert are "*precedented for projects such as these*" in putting forward the FF PPs. The Applicant also notes these precedents have not been identified by BOC. The Applicant further notes that the NZT DCO is the most recent example in this region and has interactions with BOC's land, rights and apparatus which are (so far as is material) the same as for the present dDCO. That being the case, in the Applicant's submission the NZT Part 17 PPs are clearly the most directly relevant and recent precedent in terms of what protective provisions should be considered reasonable and appropriate. 5.7 The Applicant's principal position is that the protective provisions included at Schedule 12 Part 3 of the dDCO are suitable and sufficient to ensure that all parts of the BOC infrastructure are adequately protected. BOC would automatically have a direct locus to rely upon those protective provisions as a third party apparatus owner and operator.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			Without prejudice to that, the Applicant does not object as a matter of general principle to including standalone protective provisions based on those contained within the NZT Part 17 PPs in BOC's favour within the dDCO. However, as set out above, the draft FF PPs provided by BOC's solicitors differ in substance from the NZT Part 17 PPs in several material respects and no substantive reasoned explanation has been provided for these differences. The only reason put forward by BOC's solicitors (despite several invitations by the Applicant's solicitors) for this discrepancy is that BOC wishes to have a direct contractual nexus with the Applicant, rather than relying on third parties and third-party approvals to protect its interests. However, under the NZT Part 17 PPs, BOC already has direct locus to rely upon and enforce them as a third party apparatus owner and operator. This would also be the case if protective provisions based on the NZT Part 17 PPs were to be included in the dDCO. BOC's solicitors' argument based on locus is therefore mistaken. As to whether the FF PPs are "*well precedented*", as explained above, the identity of these asserted precedents has not been particularised by BOC's solicitors. The Applicant can provide further representations in due course should these be identified. 5.8 The Applicant is also happy for suitable and appropriate protective provisions to be included in the dDCO or to be secured by way of an agreement. Given BOC's solicitors' statement that a "*direct contractual nexus*" is desired, a contractual side agreement may be more appropriate. **Costs** 6.1 to 6.3 The Applicant submits that this is not a matter which has any relevance to the examination of the dDCO or its merits, but brief explanatory comments are set out below. The Applicant's solicitors have provided BOC's solicitors with an undertaking to reimburse costs and disbursements reasonably and properly incurred in the negotiation and settlement of protective provisions and any applicable side agreement(s). The undertaking is in the usual form for a DCO interested party.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			The Applicant has engaged with BOC's solicitors since the undertaking was issued in relation to the amounts invoiced and the costs which are out with the scope. As far as any land referencing expenses incurred by BOC's solicitors are concerned, it is not usual practice for interested parties to instruct their own land referencing exercises during a DCO examination. Such work relates to advice to BOC on the DCO application and, accordingly, would not fall within the scope of the undertaking. **Conclusion** 7.1 The Applicant does not argue that standalone protective provisions in favour of BOC should not be included, whether in the dDCO or in a side agreement. The Applicant's position is that Schedule 12 Part 3 of the dDCO is already sufficient to protect BOC's interests, but if BOC wishes to base protective provisions on those in the NZT Part 17 PPs instead then the Applicant does not object to this as a matter of general principle. However, the draft FF PPs proposed by BOC's solicitors differ from the NZT Part 17 PPs in several material respects. The Applicant's solicitors have invited them to provide a reasoned explanation for these differences, including by articulating any material change of circumstances, but this has to date not been forthcoming.

7.0 ANGLO AMERICAN

Table 7-1: Response to Anglo AmericanDeadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Anglo1	Written Representation [REP2-074]	Key Project Overlaps • There continues to be a lack of clarity in the Applicant's proposals. At the River Tees Crossing Location, the scope of works are not yet known and as such, it is not possible to determine the potential impacts to Anglo American. • Anglo American is seeking meaningful engagement with respect to the protective provisions and other negotiated arrangement with the Applicant to understand specific implications for Anglo American at each Order Limits interface – broadly, this would include an understanding of: 1. How works relating to the respective projects might be protected at interface points - 2. Where a use of shared corridor or accesses is proposed, and how this interface will be managed; and – 3. Where the Applicant is proposing to enter into land agreements with Anglo American, how and where Anglo American's interests will be preserved. The Applicants Change Request • Anglo American is engaging with the Applicant in the consultation exercise on the detail of the proposed Change Request. Anglo American note that whilst some changes take Anglo American into account, not all fully recognises Anglo American's concerns. For example, the Order Limits continue to overlap with respect to the Bran Sands frontage. From our discussions with the Applicant, it was our understanding that this would no longer be the case. Examination • To date, the following remain outstanding: • Draft HoTs for required land arrangements • Proposed amendments to the dDCO • Protective Provisions and the intended modifications to the YP DCO to populate the blank Schedule in the dDCO. protective provisions for Anglo American should be included in Schedule 12 of the dDCO. • HoTs for a Side Agreement to provide for interface measures • Anglo American requests the opportunity to see drafts of these materials,	Key Project Overlaps 1. River Tees Crossing – The Applicant has now discussed the technical detail of the proposed Tees Crossing with AA in their monthly meetings. The parties have agreed to have continued dialogue on this and share further technical information as and when available. 2. The Applicant has a monthly meeting cadence, as a minimum, where these interfaces are being covered. The Applicant is intending to share its draft of Protective Provisions imminently. With respect to protective provisions negotiations, please see response at Anglo2 below. The Applicant considers that each of the points 1-3 noted by Anglo American can be addressed through the negotiation of appropriate protective provisions. The Applicant's Change Request The Applicant has now submitted a Change Application to the ExA that includes removal of the AGI planned in the Bran Sands corridor. However, the Applicant still needs right over the Bran Sands corridor for its pipelines. The Applicant also needs the Bran Sands frontage in the Order Limits for its planned river crossing. The Applicant is going to discuss this in detail in its next planned meeting w/c 21st Oct. Examination 1. Heads of Terms for Land Agreements – The Applicant has recently issued Anglo American with draft Heads of Terms for their review and comments. It is anticipated that these terms will be discussed at the parties' next meeting. It is acknowledged that Anglo American will not have had a chance to review this and reflect any feedback in their Deadline 3 submission. Amendments to the DCO 2. Please see Applicant's response in lines Anglo4 and Anglo5 below. Status of Negotiations The Applicant has engaged with AA on the H2Teesside Project and their intention to mirror terms agreed with AA on the precedent scheme has been discussed with AA. It is therefore anticipated that the two parties will be able to come to a voluntary agreement where the land rights are mirrored with relative expediency. Where the land requirements of H2Teesside deviate from those prior agreements, the Applicant has addressed these in the recently issued Heads of Terms which are to be agreed by both parties.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		• Anglo American retains the right to review amendments to the scheme and comment further on any subsequently arising issues Status of Negotiations • Anglo American remains concerned that granting H2 Teesside compulsory acquisition powers over certain plots of land would adversely affect the deliverability of its own project. Anglo American is hopeful that negotiated agreements can be reached and acknowledges progress to date. Anglo American confirms receipt of a draft Statement of Common Ground. Comments were provided to its first draft in advance of Deadline 1. The published Statement of Common Ground (SOCG) (Document Reference 9.13/REP1-023) contains details of issues currently under discussion. However Anglo American does not agree that the SOCG reflects discussions to date, which although positive, have not resulted in Anglo American receiving draft documents.	Protective Provisions and Side Agreements 3. Please see the Applicant's response in line Anglo2 below. SOCG – It is the Applicant's understanding that Anglo American agreed with the content of the SoCG and signed the submitted SoCG to reflect this. The Applicant will discuss this with Anglo American to ensure that the parties are aligned on the content of the SoCG. The Applicant has now shared the HoTs for voluntary land agreements with Anglo American and intends to share the draft Protective Provisions imminently. The Applicant undertakes monthly interface meetings with AA and will look to address concerns raised by AA regarding the River Tees Crossing and those regarding the interfaces between the York Potash DCO and the proposed H2Teesside DCO in the Bran Sands area.
Anglo2	Written Representation [REP2-074]	Protective Provisions *"Anglo American has set out its expectations for the agreements and protective provisions within these WR. Anglo American is seeking protective provisions in the dDCO to safeguard the deliverability of the Woodsmith Project. The status of achieving this agreement and other aspects of negotiations is detailed within these WR. Anglo American is seeking meaningful engagement with respect to the protective provisions and other negotiated arrangement with the Applicant to understand specific implications for Anglo American at each Order Limits interface."*	The Applicant is committed to negotiating bespoke protective provisions for the benefit of Anglo American which address concerns raised by Anglo American on the interface with Anglo American's York Potash project, being implemented pursuant to the York Potash Harbour Facilities Order 2016 (and the York Potash Harbour Facilities (Amendment) Order 2022) and the Materials Handling Facility and Minerals Transport System Portal (approved under planning permissions Ref: R/2018/0139/VC and R/2014/0626/FFM). The Applicant's land agent is liaising with Anglo American to agree plans demonstrating the interactions between the proposed development and the York Potash project to inform protective provisions negotiations. The Applicant and Anglo American have agreed the principle that the protective provisions will be based on those agreed by the parties on the Net Zero Teesside project (consented by The Net Zero Teesside Order 2024), with amendments being made to reflect the specific interactions of the Proposed Development with Anglo American's York Potash project and land interests.
Anglo3	Written Representation [REP2-074]	Schedule 3 dDCO *"To date, the following remain outstanding:..* *• Protective Provisions and the intended modifications to the YP DCO to populate the blank Schedule in the dDCO. It is noted that the Applicant has commented that the protective provisions will be included in the blank Schedule 3. This would not be appropriate as in order to trigger article 41 of the dDCO, protective provisions for Anglo American should be included in Schedule 12 of the dDCO. The Applicant has not informed Anglo American as to the intended effect of the blank Schedule 3 and the am*endments to the YP DCO which remains a significant concern"	To provide clarity here, the Applicant intends that protective provisions for the benefit of the Proposed Development will be contained in dDCO Schedule 3 (as changes to the York Potash Harbour Facilities Order 2016) and protective provisions for the benefit of Anglo American in respect of the Proposed Development will be contained in a Schedule at the rear of the dDCO specifically for this purpose, as is the case for other protective provisions included in the dDCO to date. The Applicant is committed to negotiating the proposed content of Schedule 3 of the dDCO with Anglo American as part of reciprocal negotiations on protective provisions for the benefit of both projects. As set out in its response to ExQ1.9.62 [REP2-027] This follows the precedent in The Net Zero Teesside Order 2024 (NZT Order). The principle is

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			that these negotiations will be based on the protective provisions found in Schedule 3 of the NZT Order that has been agreed between the parties, subject to the amendments that are required to reflect the specific interactions between the York Potash Harbour Facilities Order 2016 development and the Proposed Development. The content of the NZT Order provisions were included in the Applicant's Deadline 1 submissions (Net Zero Teesside Order as made [REP1-009]) so that the nature of the type of provisions that will be included can be seen. It can be seen in particular that they contain 'reciprocal' provisions to those contained in the Protective Provisions for Anglo American. As such, the two sets of Protective Provisions need to be seen together, and the Applicant is working to add them to the DCO at the same time, once substantively progressed.
Anglo4	Written Representation [REP2-074]	Applicant's draft DCO submitted at Deadline 1 Anglo American has significant concerns that the powers sought in the dDCO will, unless adequately provided for in the dDCO, be problematic in terms of Anglo American's compliance with the environmental permit for the site at Bran Sands.	The Applicant notes that it did not submit an updated version of the draft DCO at Deadline 1 of the examination and that the rev. 1 version of the dDCO [AS-003] was submitted prior to the start of examination in response to the Examining Authority's Section 51 Advice. The Applicant has since submitted an updated draft DCO at Deadline 2 [REP2-005]. The updated draft DCO contains a new article 48 (interface with Anglo American permit) which makes it clear that carrying out of an authorised activity by the undertaker shall not constitute a breach of, or non-compliance with the Anglo American permit'. The 'Anglo American permit' is defined as 'environmental permit number FB3601GS' and 'authorised activity' is defined as 'any works or activities authorised by this Order, work carried out in connection with the authorised development, or the exercise by the undertaker of functions conferred by this Order'. This has been inserted in response to Anglo American's (AA) concern (paragraph 4.3 of Relevant Representation [RR-010]) that their environmental permit covers land that could be compulsorily acquired by the Applicant using the DCO and if the land is compulsorily acquired, AA would still be responsible for the operation of the permit. The new article 48 ensures that authorised activity undertaken by the undertaker does not constitute a breach of the permit. It is envisaged that protective provisions (following the example in the Net Teesside Order 2024 and to be agreed between the parties) would provide for how the AA is consulted on how the project is built in this area and provide for any access arrangements required for monitoring and for the continued operation of the permit.
Anglo5	Written Representation [REP2-074]	Applicant's draft DCO submitted at Deadline 1 AA raised the following concerns about Schedule 2 (Requirements) to the draft DCO as follows: • Requirement 18 - Construction traffic management plan: Anglo American seeks to be included in 18(f) such that the Applicant is required to engage with it to manage cumulative construction transport impacts. • Requirement 22 - Restoration of land temporarily used for construction: Anglo American seeks to ensure that at points of interface between Anglo American operations and the Proposed	**Requirement 18** – The Applicant refers to its response to ExQ1.9.51 [APP2-027]. This Requirement refers to both Net Zero Teesside and HyGreen, as these are both developments led by bp and therefore the Applicant is more likely to be able to engage in constructive discussions around co-ordination of activities across the various developments. However, to reference other developments in this Requirement would mean that the Applicant would be beholden to other developments and other companies complying with this DCO, which the Applicant would have no control over. The Applicant also considers that, given the results of the ES, there is no criteria to validly determine which developments should or should not be referenced within this Requirement, given the wider development environment within Teesside. The Applicant

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		Scheme, it is consulted as regards scheme of restoration for land used temporarily (including remediation of contamination). Anglo American's role in such consultation will be important in the context of its liabilities under the Environmental Permit. • Requirement 25: Local liaison group: Anglo American considers it vital to be part of the liaison group as an interest party with significant operations in the area. Anglo American therefore seeks to be included in the liaison group which is proposed to include other major operations in the area (being Net Zero Teesside and HyGreen Teesside) as regards matters relating to the Proposed Scheme. • Requirement 28: Decommissioning: Anglo American has a vested interest in ensuring that any decommissioning works do not adversely impact on its operations, and seeks to be consulted under Requirement 28 unless this is otherwise provided for in appropriate Protective Provisions. • Requirement 33: Anglo American is concerned that Requirements for a standalone NSIP should not be discharged via the actions of a separate scheme and should be removed from the dDCO. Proposed additional requirement: To the effect that the authorised works should not be brought into use until such time as a scheme for management and mitigation of noise during operation is consistent with principles of the ES (relevant particularly in the current absence of an assessment of the cumulative environmental effects taking Anglo American's operations into account).	considers it is not appropriate for one consent to seek to manage the impacts and benefits of a large number of other consents. In addition, as the projects are still at an early stage, the Applicant notes that it has not undertaken specific engagement on this issue because its delivery programme and the programmes of the other projects will continue to evolve between now and when the traffic management is required. **Requirement 22** – The Applicant does not consider it appropriate or necessary for AA to be a consultee for this requirement and would seek to allay AA's concerns relating to this issue through use of protective provisions. **Requirement 25** – As an interested party with significant operations in the area the Applicant would welcome AA's participation in the local liaison group. **Requirement 28** – The Applicant does not consider it appropriate or necessary for AA to be a consultee for this requirement and would seek to allay AA's concerns relating to this issue through use of protective provisions. **Requirement 33** – The Applicant refers to its response to ExQ1.9.61 [REP2-027] and the updated draft DCO submitted at Deadline 2 [REP2-005]. Net Zero Teesside and H2Teesside are separate projects, however, due to the nature of their location and their Applicants' corporate relationship with bp, there are also potential overlaps for some elements which require the discharge of requirements (including the creation of a Local liaison group) and the two projects anticipate working closely to deliver these elements together in a joined-up approach. The purpose of Requirement 33 is to enable the relevant planning authority to disapply a requirement in the H2T DCO if it has already been discharged by NZT in its activities in implementing its projects. The idea is that this would prevent the duplication of work of discharging what is effectively the same Requirement twice and so save time and resources for both of the projects and the relevant planning authority. The power in Requirement 33 is limited and constrained by the fact that this can only be done with the relevant planning authority's approval. If the equivalent NZT requirement has been refused or does not cover all the necessary details to discharge the same requirement in H2Teesside, then the relevant planning authority will be able to refuse to allow the requirement to be disapplied and require the undertaker to make an application to discharge the requirement. The Applicant has amended the drafting in the draft DCO submitted at Deadline 2 [REP2-005] to remove the generality of Requirement 33 in the previous version and focus it only on Requirements 3, 10, 25 and 26 where the Applicant considers there is sufficient overlap that the discharge of the Requirement by the Net Zero Teesside project may be sufficient to discharge the equivalent Requirement in the H2Teesside DCO. **Proposed additional requirement** – The Applicant refers to its responses to ExQ1.13.4 [REP2-031]. The ES Chapter 11: Noise and Vibration [PDA-007] concluded there were no likely significant effects for operational sound and so no mitigation is required to ensure no likely significant effects are felt. This is particularly the case given the scarcity of receptors in the area and thus limited scope for affecting health or quality of life. As operational

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			noise will be regulated by the Environment Agency through the environmental permit, duplicate operational controls set via requirement of the DCO are not required.

8.0 SEMBCORP UTILITIES (UK) LIMITED

Table 8-1: Response to Sembcorp Utilities (UK) Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Sembcorp1	Comments on any submissions received at DL1, including LIRs any updated dDCO and the Applicant's draft itinerary for the ASI [REP2-101]	• The Applicant should provide evidence that it considered developing a new multiuser tunnel according to NPS EN1 – "*4.3.15 Applicants are obliged to include in their ES, information about the reasonable alternatives they have studied. This should include an indication of the main reasons for the applicant's choice, taking into account the environmental, social and economic effects and including, where relevant, technical and commercial feasibility*." And the government Guidance on Associated Development "*Associated development should be proportionate to the nature and scale of the principal development. However, this core principle should not be read as excluding associated infrastructure development (such as a network connection) that is on a larger scale than is necessary to serve the principal development if that associated infrastructure provides capacity that is likely to be required for another proposed major infrastructure project.*3"	As explained in ISH1 the DCO application as submitted includes a hydrogen pipeline crossing under the River Tees to meet the operational needs for H2T, defined in Work No. 6 as "a hydrogen distribution network, being works for the transport of hydrogen gas…". If the pipe was to cater for other developments or uses, it would need to be established that this was nevertheless Associated Development (i.e. development associated with the principal development). That would require a direct relationship with the principal development and assessment against the core principles set out in the Government's Guidance on associated development applications for major infrastructure projects (2013).
Sembcorp2	Responses to comments on Relevant Representations [REP2-102]	• Draft protective provisions awaited • Concerns raised over the capacity of the pipeline corridors and the interrelationship of the various DCO projects in the area • Concerns raised over the impact of the Tees crossing on the existing infrastructure and the constraints this could place on future crossings	The Applicant has had productive discussions with Sembcorp on the principles for bespoke protective provisions and continues to progress these discussions. The Applicant's legal and technical teams are progressing draft protective provisions for issue to Sembcorp. The Applicant remains committed to ongoing engagement and will continue to work closely with Sembcorp to ensure that any concerns are addressed adequately through protective provisions and other technical discussions. The Applicant believes its pipeline can be accommodated within the pipeline corridor without unduly impacting the potential for future projects based on the engineering design work and site surveys performed and looks forward to continued discussions with Sembcorp in this regard. The Applicant would refer to its input provided during ISH1 [REP1-008] regarding the Tees Crossing. Each new crossing has incrementally added to the difficulty of future crossings. As such, while all previous crossings have been installed in parallel arrangements, there is no available route for the Project's crossing which avoids intersection with existing crossings. The Project has been designed to overcome the additional complexity involved in its own river crossing caused by existing crossings. Any future crossing would similarly have to account for the complexity caused by existing pipelines. This Project may add an additional layer of complexity but in principle this is not new or unacceptable, and it would not render future crossings impossible.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Sembcorp3	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-103]	• Q1.6.62 - Concerns over interference with access to assets for both SembCorp and its Tenants and potentially prevent future tenants and new customers from maturing • Q1.9.67 - Draft PPs are yet to be issued • Q1.17.1 - Access rights remain a concern	The Applicant acknowledges Sembcorp's concerns regarding potential interference with access to assets for both Sembcorp and its tenants, as well as the potential impact on future tenants and new customers. The Applicant considers that access protections will be addressed through negotiation of Protective Provisions (PPs).
Sembcorp4	Written Representation [REP2-104]	**Part 1 - Safety Concerns** 2.1. Sembcorp is concerned about the safety of those parts of the Applicant's network comprising above-ground hydrogen pipelines and questions whether, fundamentally, this is a safe approach which is ALARP (as defined in paragraph 20.2.5 of Chapter 20 of the ES). 2.2 Issues include greater propensity for leaks, flammability, detection difficulties, explosivity, risk of asphyxiation, temperature control of above ground hydrogen. 2.3 Proximity of above ground pipelines to other hazardous substances in pre-existing pipelines. 2.4 Above ground leakages compared to buried lines. 2.5 Considering ALARP, SembCorp believes that the risks associated with the Applicants proposed pipeline would be significantly reduced by burying the pipeline, rather than routing above ground. 2.6 Sembcorp is concerned by domino effects caused by interactions with existing COMAH facilities in the Wilton International Site. 2.7 The presence of H2 pipes above ground may disproportionately use up capacity on existing pipeline racking due to greater buffers being required to achieve appropriate separation. 2.8 External interference of above ground pipelines is considered as a specific threat to pipeline integrity as indicated in TD/1 with gas pipelines being buried this significantly reduces this risk	2.1. The Applicant considers safety as its number one priority and will use their many years of experience to ensure that H2Teesside is operated in accordance with its operating management system, to prevent harm to people and the environment. The Applicant is following industry norms to identify, confirm and assesses the hazards related to the project, and ensure that there are processes in place to manage these hazards appropriately, during the operation of H2Teesside. Risks that are identified through this process to require the demonstration of ALARP will do so through established processes. 2.2 These issues are noted and are being considered in the design of the H2Teeside plant and pipeline system. 2.3 The Applicant is aware of site-specific risks introduced by the existing assets in Teesside, which includes Major Accident Hazard Pipelines (MAHP), and is aware of the potential for domino effects in the event of a failure. Domino effect, or escalation, will be considered as part of the FEED Phase Quantitative Risk Assessment (QRA). The Applicant will collect information about the existing assets within the pipeline corridor and, if possible, information about the existing site safety plans. The assessment will determine what the increased risk is due to the Hydrogen pipeline. The Applicant will demonstrate to the HSE in the Safety Report that these escalation risks are ALARP. 2.4 Within Teesside, there is limited space for a buried pipeline given the existing aboveground pipeline routes throughout the area. The Applicant proposes to install the hydrogen pipeline above ground where there are existing above ground pipeline corridors and where there is not sufficient space for below ground installation. Buried pipeline sections include: • Teesworks and Seal Sands pipeline from the H2Teesside plant to the Bran Sands Corridor • Greatham Creek pipeline • Transmission and Industrial pipeline to Cowpen Bewley Other pipeline segments will be installed aboveground. As part of engineering design, the Applicant will perform Quantitative Risk Assessment which will consider the additional threats to the pipeline from above ground installation, where applicable, and the failure frequency used in the analysis will be adjusted accordingly. The methodology will follow the HSE Guidance Note RR1186: *Failure rates for above ground major accident hazard pipelines outside above ground installations*.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			Additional risks to be considered are included vandalism, road/rail/aircraft crashes. The methodology for aircrafts follows the HSE Guidance note. 2.5 The Applicant has considered Inherently Safer Design (ISD) to start with and analysis so far has indicated that design falls within the 'Broadly Acceptable' region. Nevertheless, mitigation of risk analysis is being included in the FEED studies to ensure all measures are considered from the hierarchy of controls to ensure an ALARP design. 2.6 The Applicant is engaging with the Competent Authority in relation to COMAH. The Applicant appreciates that the Proposed Development Site is located within an area which has a number of COMAH installations, forming a domino group as described in Regulation 24 of COMAH (See Chapter 20 – APP-073). In the design phase of the Project the risk of domino effects will be considered, and appropriate mitigation measures will be adopted to demonstrate ALARP. 2.7 The project will not take up disproportional space as typical buffers for access and maintenance for pipelines shall be used. This is 1 metre in all directions. The potential escalation impact will be assessed using this distance. If escalation events are found to be a concern, mitigation methods such as increasing pipe wall thickness may be implemented. The majority of existing pipeline corridors are highly congested, however not all assets are in service. 2.8 IGEM/TD/1 Ed. 6 is the primary design code for H2Teesside pipelines, and IGEM/TD/1 Supplement 2 is being applied for the hydrogen lines. During discussions with the Applicant, the Institute of Gas Engineers and Managers (IGEM) recommended that independent professional advice should be sought to confirm the applicability of TD/1 to above ground hydrogen pipelines. The Applicant engaged a competent engineering contractor who are members of IGEM and contributed to the development of IGEM/TD/1. The contractor concluded that IGEM/TD/1 philosophy was applicable for above ground hydrogen pipelines. An appropriate technical meeting has been arranged to discuss this further with Sembcorp.
Sembcorp5	Written Representation [REP2-104]	**Part 2 - Existing Underground River Crossing Assets** 2.9 SembCorp has additional concerns relating to the River Tees crossing and the proximity of the Proposed Development to Tunnel 2 as well as Sembcorp's 24" natural gas pipeline and 8" propane pipeline. 2.10 The methodology of HDD diagonally across existing assets could have adverse impacts on the existing pipelines and tunnels crossing the Tees as all other assets run parallel to each other. 2.11 Concerns about damage inadvertently caused by microbore/HDD method on existing infrastructure through accidental collision, subsidence or vibration. It is not clear to Sembcorp what mitigations and/or separations the	The Applicant is in discussions with Sembcorp relating to the proposed crossing of the River Tees. Further investigations and technical assessments are required before a final crossing methodology can be confirmed. The Applicant is committed to working closely with Sembcorp and other stakeholders to ensure that any potential impacts are thoroughly evaluated and mitigated. 2.9 The Applicant has collected information about existing assets crossing the river from historical records. The Applicant will provide information about all existing assets to its specialist subcontractor for design of the Tees Crossing during FEED phase. The specialist

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		Applicant proposes to prevent such damage, nor how any impacts may be monitored, during and post construction	subcontractor will review the information and design the H2Teesside Tees Crossing appropriately, with suitable crossing techniques and separation distances. 2.10 The crossing angle of existing assets is dictated by land available for construction of the shaft, and available space being taken by existing assets. If there were sufficient space available then the Applicant would have selected a parallel alignment per the philosophy followed by other existing service crossings at this location. Because a parallel alignment is not available, the Applicant proposes to use an appropriate separation distance from other assets considering the selected crossing technology. Typical approach to crossings for pipelines to be at 90-degrees is not applicable as this is a special crossing, and the specific constraints must be considered. Microbored tunnels have been performed in other locations without parallel alignments, for example many tunnels for the London Underground cross services without considering a perpendicular crossing angle. 2.11 The vertical separation distance is currently set at >10m to all assets except the mud return pipeline (0.15m OD) pipeline which is >5m. The Applicant is using a specialist subcontractor to design the Tees Crossing. During the detailed engineering phase, this subcontractor will perform settlement calculations using the known information about soil conditions and existing assets in the area. This calculation will be used to confirm the selected separation distance is suitable. During construction, a settlement monitoring programme will be used to verify that settlement and vibration are within tolerable limits set by the design.

9.0 THE SOUTH TEES GROUP

Table 9-1: Response to The South Tees Group Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
STG1	Notification of wish to attend Accompanied Site Inspection [REP2-109]	• STG was expecting to receive a substantive update to the Statement of Common Ground in advance of Deadline 2, however this was only provided the day before the deadline.	It is acknowledged that the Statement of Common Ground was not provided to STG for review in sufficient time prior to Deadline 2. However, since the draft was issued, the Applicant and STG have had productive discussions on the Statement of Common Ground and this will be submitted at Deadline 3 as a joint submission.
STG2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-110]	• Q1.6.45 - STG retains significant concerns around the scale of the CA powers sought especially around the plots sought by the Applicant in the DCO that are outside the scope of the voluntary agreement. • Q1.6.46 - STG considers that the inclusion of land in the DCO application that was not subject of discussions, and the Applicant's failure to inform STG of the inclusion of the additional land does not comply with the relevant compulsory acquisition guidance. • Q1.9.7 - STG reiterates the position requesting the Applicant either narrows the definition of "permitted preliminary works" or puts in place PP's to ensure works are controlled and co-ordinated. Requirements may be necessary to ensure the Applicant does not carry out material works under the guise of 'permitted works'. • Q1.6.7 - STG notes a number of unregistered plots in the BoR owned by STG and asks what steps have been taken to ascertain the owners of these plots and notify them of the proposed compulsory acquisition. STG requests confirmation that notices have been erected and checked regularly. STG is concerned about the accuracy of the location of the water supply connection works around plot 15/235 as shown in the Land Plans [AS-003]. • Q1.9.12 – STG maintains that Article 2 of "Permitted Preliminary Works" is too broad given that H2T DCO is wider than the equivalent NZT DCO and there is no justification to explain the wider meaning. Permitted Preliminary works will coincide with NZT and other major Teesworks developments and as such may negatively affect them. It is not clear how this overlap will be managed. STG does not understand the scale, timing and location of the activities included in the definition. STG request the applicant narrows the scope of the permitted preliminary works to reflect the definition in the NZT DCO and the Applicant provides more information about the scale, timing and location of the permitted preliminary works well before they begin. A requirement controlling permitted preliminary works may be beneficial.	• Q1.6.45 & 1.6.46 – The Applicant refers to its response to SOCG ID 1 and 9 in 9.9: Statement of Common Ground between H2 Teesside Limited and Teesworks Limited, South Tees Developments Limited and South Tees Development Corporation (together 'South Tees Group') (STG SOCG). The Applicant issued a draft side agreement and protective provisions to STG on 15 October 2024 and is continuing to have regular meetings with STG to progress negotiations. • Q1.9.7 and 1.9.12 – The Applicant refers to its response in Table 3-2 of STG SOCG. Responding to STG's comments about narrowing the definition of permitted preliminary works (PPW) and requesting that they are controlled by a Requirement in the draft DCO (ExQ1.9.7 and 1.9.12), the Applicant has set out its position on these points in its responses to ExQ1.1.8 and Q1.9.6 (in [REP2-019] and [REP2-027] respectively). In summary, the approach to both the structure and wording of the PPW definition has precedent in The Net Zero Teesside Order 2024 and numerous other DCOs, reflects the Applicant's desire to ensure that the project (which is critical national priority infrastructure) can be developed as expeditiously as possible and are focussed on initial works that facilitate main works construction start. The works set out as PPW are de-minimis and have been assessed as such in the Environmental Statement (ES). As such, any overlap would be insignificant. The types of works encompassed within PPW are clearly set out and, in accordance with 5.7.21 of AN15, the DCO does not allow for a range of site preparation works (such as demolition or de-vegetation) to take place before the relevant planning authority has approved measures to protect the environment. For example, under Requirement 4 in Schedule 2 of the draft DCO no part of the authorised development may commence until a Landscape and Biodiversity Management Plan has been submitted and approved by the relevant planning authority. This does not include an exception for PPW and therefore must be discharged before those can take place. There are also controls in Requirement 15 in Schedule 2 where no part of the PPW may be carried out until a PPW Construction Environmental Management Plan for that part has been submitted to and approved by the relevant planning authority (and the plan submitted must be in substantial accordance with the Framework

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		• Q1.6.25 - STG does not believe that the Applicant has appropriately explored rationalisation options for the utility corridors and pipeline routes which are proposed to be acquired. STG suggests alternatives for the Applicant to consider in paragraph 3.11 of its RR [RR-003]. STG and the Applicant have had preliminary discussions regarding the potential for STG to provide easement agreements that would render the compulsory acquisition of some land unnecessary, but an agreement is yet to be reached. The Applicant should evidence what steps it has taken to voluntarily acquire these specific rights. • Q1.9.16 - STG does not believe such wide powers under article 10 are justified, and should only be limited to identified streets within the Order Limits. • Q1.9.31 - STG is concerned that due to the overlapping consents over the same land, Article 39 may enable the Applicant to avoid implementing mitigations or commitments under a particular consent. STG does not understand how the Applicant proposes to deal with the overlapping consents. • Q1.6.42 - STG, as main landowner of this area, requests further information on the Applicant's intended use of the special category land and crown land, including details of how long (if at all) it expects to close these areas. STG also requests justification from the Applicant that the rights in Schedule 8 to the DCO are proportionate and necessary for each open space plot. • Q1.9.47 – STDC should be included as a consultee for both temporary and permanent surface and foul water drainage under Requirement 10.(1) (Surface and Foul Water Drainage). The permanent drainage systems are likely to interface with STG/STDC ownership and STDC requires the opportunity to review compatibility. • Q1.10.5 – STDC confirms the status of various planning applications relating to the 'Foundry' and that it has been agreed between STG and the Applicant that the responsibility for the monitoring will be shared and covered in the Option Agreement. In the near-term following completion of the remediation works, STG shall take on the responsibility for monitoring. Upon taking over the site for construction of the H2Teesside facility the Applicant will take on the responsibility for monitoring. Any remediation works either within the boundaries of the aforementioned applications or beyond these areas, would need to be agreed as part of any subsequent Option Agreement. • Q1.9.35 – Regarding assumed approval of applications made under Article 43 after 6 weeks if the consenting authority has not notified the undertaker of its disapproval - STG maintains the position in paragraph 4.11 of its RR [RR-003], which is an objection to the	CEMP to the extent it is relevant to PPW). The flexibility is constrained by and is contained within these controls, and these are clearly defined in the draft DCO. • Q 1.6.7: The Applicant has undertaken several initiatives to identify the owners of unregistered land. These include issuing targeted letters to parties believed to own the unregistered land, requesting their co-operation in providing relevant information. One of these letters was addressed to South Tees Developments Limited on 02/06/2023. Additionally, unregistered land notices, asking potential land interests to come forward have been erected and monitored simultaneously at different key milestones throughout the DCO submission and examination process. • Q 1.6.25: The Applicant refers to its response to SOCG ID 9 and 10 in the STG SOCG. The Applicant responded to STG's Relevant Representation [RR-003] in 8.4 Applicant's Comments on Relevant Representations and Additional Submissions [REP1-007]. The Applicant is continuing discussions with STG on the negotiation of easements and confirms that easements are being covered in the Option Agreement that is currently being negotiated. • Q1.9.16: Responding to STG's response to ExQ1.9.16 about the powers under article 10, the Applicant refers to its response to ExQ1.9.16 [REP2-027] where justification is provided for the powers sought in article 10 of the draft DCO. The powers sought in Article 10 are sought to allow for the scenario that any other highway works, that are not at this stage known, are required. These may be identified in the future by the highway authority or the undertaker, and it is appropriate that the undertaker can carry them out within the regime imposed by the Order. In addition, the nature of the existing streets could change prior to the commencement of the DCO, which could necessitate the need for alterations to the streets. Such alterations are limited to any street within the Order limits and for the purposes of constructing, operating and maintaining the authorised development. While such a power might appear wide, the consent of the street authority is required in order for this power to be exercised, which the Applicant considers provides the requisite level of input and control. The Applicant is confident that protective provisions can be agreed to allay STG's concerns and ensure powers relating to street works and access works will not harm the operation of the Teesworks site without making amendments to article 10. • Q 1.9.31: – The Applicant refers to its response in Table 3-2 of STG SOCG. Responding to STG's response to ExQ1.9.31 in relation to article 39 of the draft DCO, the Applicant refers to its response to ExQ1.9.30 [REP2-027]. Article 39 provides flexibility for the Applicant to determine the best course of action for the project depending on how another planning permission interfaces with the DCO. If another planning permission affected the ability to construct the associated development as set out in the DCO then the Applicant would have a consenting choice whether to apply to amend the associated development as a change to the

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		deemed approval element (that STG believes should instead be a deemed refusal). STG believes a fee should be payable by the Applicant, covering the consenting body's reasonable costs to process the submission and reach a decision on consent, agreement or approval. STG expects this matter to be covered in protective provisions.	DCO or whether to obtain a separate planning permission for the changed associated development. In addition, it may be that there are existing or future planning permissions which benefit third parties, and these are also catered for by the drafting in Article 39, which ensures that the DCO and those other planning permissions are not legally inconsistent, and where appropriate can both be progressed. It is not the Applicant's intention to rely on this article to avoid implementing essential mitigation or other commitments from a different consent. • Q1.6.42: Paragraphs 9.1.48 to 9.1.63 of the Statement of Reasons [APP-024] provides information about the plots and interests in the Coatham Marsh Open Space Land and the nature of the works forming part of the Proposed Development in that area. The work in that area is Work No. 4 – water supply connection works to provide cooling and make-up water to Work Nos. 1B.1 and 1B.2, comprising up to two water pipelines from the existing water main. The rights set out in Schedule 9 (Land in which new rights etc. may be acquired) of the Draft Development Consent Order [REP2-004] are considered by the Applicant to be proportionate and necessary to enable the Applicant to maintain and protect this infrastructure once it is constructed. Please also refer to the Applicant's response to ExQ1.6.42 [REP2-024]. • Q1.9.47: The Applicant notes that STDC were added as a consultee for Req 10(3) around permanent surface water drainage systems at Deadline 2 [REP2-004]. STDC were already a consultee in the original dDCO submission for temporary surface water drainage systems under Req 10(1). • Q1.10.5: The Applicant is in active technical and commercial discussions regarding remediation and confirms that monitoring forms part of Option Agreement negotiations. • Q 1.9.35: In relation to STG's comment regarding the deemed approval mechanism in Article 43, the Applicant refers to its response in Table 3-2 of the STG SOCG. Article 43(1) of the Draft Development Consent Order sets out the procedure for obtaining consent from a 'consenting authority' in respect of consents and approvals required under the DCO which are not Requirements. There is no provision in the draft DCO for a fee to be paid in relation to this process. This is a process which is distinct from the procedure for the discharge of requirements pursuant to Article 43(3) and Schedule 13 to the draft DCO for a which a fee is payable to the relevant planning authority. The Applicant will discuss the issue further with STG during the next set of discussions.
STG3	Written Representation and Response to Deadline 1 [REP2-111]	• STG welcomes its CTMP consultee role and requests that the Applicant be required to set up the Framework CTMP working group described in its Deadline 1 RR response with STG included as a member.	• In relation to the comment about the Rochdale envelope, the Applicant refers to its response on page 90 of 8.4 Applicant's Comments on Relevant Representations and Additional Submissions [REP1-007] and SOGC ID 6 and 9 of the STG SOCG. • In relation to the query about the overlap, the Applicant refers to its response on pages 89-90 in 8.4 Applicant's Comments on Relevant Representations and Additional Submissions [REP1-007] The Applicant has also submitted a Change

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
		• STG reiterates its assertion from paragraph 2.3.3 of its RR that in order for the Applicant to rely on the Rochdale Envelope principle, more justification and evidence is required. • STG requests information on the overlap between the H2T and NZT projects in and around plots 14/10, 14/11, 14/12, 14/16, 14/17 and 14/24 as shown on sheet 14A of the Land Plans (AS-003) and many plots along the highways to the southeast of the main Teesworks site in which the South Tees Group has interests and how that overlap's impact on the land has been minimised	Application into the Examination that significantly reduces this overlap. The Applicant has explained the reasons for this overlap in its Interrelation Report [REP2-038] submitted at Deadline 2.

10.0 NORTHERN GAS PROCESSING LIMITED

Table 10-1: Response to Northern Gas Processing Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
NGasProcessing1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-088]	• Q1.6.7 - NSMP requests clarification as to why the organisations of NSMP Limited and NSMP Operations Limited are referred to in updated BoR as they have no formal interests in the area affected by the project • Q1.9.67 - dDCO does not contain PPs covering NSMP Entities rights and interests – NSMP Entities are preparing a set of PPs based on those developed for NZT • Q1.17.1 - Concerns over ability to maintain access to the Teesside Gas Processing Plant which NSMP Entities own and operate – should be resolved through appropriate PPs	The NSMP entities were included as a precautionary measure to acknowledge any potential rights. This information originated from a returned Land Interest Questionnaire submitted by TGLP and NGPL, which indicated that NSMP manages their interests. However, following confirmation from NSMP's solicitors that they have no interest in the land, NSMP can now be removed from the Book of Reference. The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination. The Applicant also agrees that the inclusion of appropriate protective provisions in the dDCO would be sufficient to resolve the NSMP Entities' concerns regarding access.
NGasProcessing2	Written Representation [REP2-089]	• NSMP Entities are preparing a set of PPs based on those developed for NZT • Feel that the Applicant should consult with NSMP at an early stage to resolve issues where activities outside the NSMP site, would impact their operation • Request to be consulted on detailed design of specific works, construction traffic management and request a local liaison group is established (to which NSMP should be invited) – same as NZT DCO • NSMP feel their concerns can be resolved through appropriate PPs • NSMP anticipate that if such provisions can be met, they will withdraw from proceedings	The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination, potentially through their inclusion in a side agreement between the parties. In terms of the inclusion of additional requirements in the dDCO, the Applicant is reviewing the scope of those proposed by the NSMP Entities and will propose any appropriate drafting changes to the dDCO in due course. Overall, the Applicant is confident that all relevant outstanding matters raised in the NSMP Entities' representations will be capable of agreement during the remaining course of the examination so as to enable them to withdraw.

11.0 TEESSIDE GAS PROCESSING PLANT LIMITED

Table 11-1: Response to Teesside Gas Processing Plant Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
TGPP1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-107]	• Q1.6.7 - NSMP requests clarification as to why the organisations of NSMP Limited and NSMP Operations Limited are referred to in updated BoR as they have no formal interests in the area affected by the project • Q1.9.67 - dDCO does not contain PPs covering NSMP Entities rights and interests – NSMP Entities are preparing a set of PPs based on those developed for NZT • Q1.17.1 - Concerns over ability to maintain access to the Teesside Gas Processing Plant which NSMP Entities own and operate – should be resolved through appropriate PPs	The NSMP entities were included as a precautionary measure to acknowledge any potential rights. This information originated from a returned Land Interest Questionnaire submitted by TGLP and NGPL, which indicated that NSMP manages their interests. However, following confirmation from NSMP's solicitors that they have no interest in the land, NSMP can now be removed from the Book of Reference. The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination. The Applicant also agrees that the inclusion of appropriate protective provisions in the dDCO would be sufficient to resolve the NSMP Entities' concerns regarding access.
TGPP2	Written Representation [REP2-108]	• NSMP Entities are preparing a set of PPs based on those developed for NZT • Feel that the Applicant should consult with NSMP at an early stage to resolve issues where activities outside the NSMP site, would impact their operation • Request to be consulted on detailed design of specific works, construction traffic management and request a local liaison group is established (to which NSMP should be invited) – same as NZT DCO • NSMP feel their concerns can be resolved through appropriate PPs • NSMP anticipate that if such provisions can be met, they will withdraw from proceedings	The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination, potentially through their inclusion in a side agreement between the parties. In terms of the inclusion of additional requirements in the dDCO, the Applicant is reviewing the scope of those proposed by the NSMP Entities

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			and will propose any appropriate drafting changes to the dDCO in due course. Overall, the Applicant is confident that all relevant outstanding matters raised in the NSMP Entities' representations will be capable of agreement during the remaining course of the examination so as to enable them to withdraw.

12.0 TEESSIDE GAS AND LIQUIDS PROCESSING

Table 122-1: Response to Teesside Gas and Liquids Processing Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
TGLP1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-105]	• Q1.6.7 - NSMP requests clarification as to why the organisations of NSMP Limited and NSMP Operations Limited are referred to in updated BoR as they have no formal interests in the area affected by the project • Q1.9.67 - dDCO does not contain PPs covering NSMP Entities rights and interests – NSMP Entities are preparing a set of PPs based on those developed for NZT • Q1.17.1 - Concerns over ability to maintain access to the Teesside Gas Processing Plant which NSMP Entities own and operate – should be resolved through appropriate PPs	The NSMP entities were included as a precautionary measure to acknowledge any potential rights. This information originated from a returned Land Interest Questionnaire submitted by TGLP and NGPL, which indicated that NSMP manages their interests. However, following confirmation from NSMP's solicitors that they have no interest in the land, NSMP can now be removed from the Book of Reference. The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination. The Applicant also agrees that the inclusion of appropriate protective provisions in the dDCO would be sufficient to resolve the NSMP Entities' concerns regarding access.
TGLP2	Written Representation [REP2-106]	• NSMP Entities are preparing a set of PPs based on those developed for NZT • Feel that the Applicant should consult with NSMP at an early stage to resolve issues where activities outside the NSMP site, would impact their operation • Request to be consulted on detailed design of specific works, construction traffic management and request a local liaison group is established (to which NSMP should be invited) – same as NZT DCO • NSMP feel their concerns can be resolved through appropriate PPs • NSMP anticipate that if such provisions can be met, they will withdraw from proceedings	The Applicant's and the NSMP Entities' solicitors are now in direct discussions regarding the preparation and agreement of appropriate protective provisions. In this regard, the Applicant has accepted the NSMP Entities' proposal to base these on the relevant protective provisions contained within the Net Zero Teesside DCO. A full draft text has been prepared by the Applicant's solicitors and is currently being reviewed by the Applicant's technical team to ensure that these reflect the present proposals, including following the Applicant's most recent change request. The Applicant envisages that this technical check will be completed in early course, following which the draft protective provisions will be shared with the NSMP Entities' solicitors with a view to reaching agreement during the remaining course of the examination, potentially through their inclusion in a side agreement between the parties. In terms of the inclusion of additional requirements in the dDCO, the Applicant is reviewing the scope of those proposed by the NSMP Entities

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			and will propose any appropriate drafting changes to the dDCO in due course. Overall, the Applicant is confident that all relevant outstanding matters raised in the NSMP Entities' representations will be capable of agreement during the remaining course of the examination so as to enable them to withdraw.

13.0 AIR PRODUCTS PLC AND OTHERS

Table 13-1: Response to Air Products Plc and Others Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
AirProducts1	Written Representation [REP2-073]	• AirProducts has a Cat1 or Cat2 interest in 121 plots within the BoR – their ability to maintain and operate existing infrastructure must be preserved when exercising CA or TP powers. • Objects to the proposed CA Powers unless appropriate PPs can be secured for AirProducts and their tenants. • Notes that there has been positive engagement with the Applicant's solicitors • Negotiations on PPs are underway but in early stages so AirProducts are not yet in a position to respond to WQ1.9.67 and identify areas of disagreement for the ExA but will provide updates at future deadlines. • AirProducts will only withdraw its objection when appropriate PPs and APA are reached	The Applicant is currently drafting an asset protection agreement (APA) and protective provisions (PPs) and will issue to Air Products PLC, Air Products (BR) Limited, Air Products Renewable Energy Limited and Air Products Chemicals Teesside Limited as soon as possible. The parties have agreed the principle that this will be based on the APA and PPs negotiated in respect of The Net Zero Teesside Order 2024.

14.0 NATIONAL GRID ELECTRICITY TRANSMISSION PLC

Table 14-1: Response to National Grid Electricity Transmission Plc Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
NGET1	Written Representation [REP2-068]	• Considers current form of Protective Provisions to be materially deficient. (Katie) • Where land rights are to be acquired or held via CA, including temporary acquisition or interference with NGET assets, NGET consent must be acquired before exercising those rights to enable NGET to uphold its statutory obligations. • NGET require PPs to ensure that all of NGET's interests and rights are unaffected by compulsory acquisition, temporary possession and the grant and/or extinguishment of rights, and that appropriate protection is given to NGET's assets and other retained apparatus is maintained during and after construction of the proposed development. • NGET requires to be in control of the plans, methodology and specification for works within 15 metres of any retained apparatus. NGET also require appropriate surety and insurance provisions to back up an uncapped indemnity to protect NGET. • Tower YYJ037 and overhead line – the Authorised Development must not interfere with NGET ability to maintain, repair, replace the tower, as well as maintenance to the YYJ 400kV overhead line. • Saltholme Substation – NGET is currently assessing a number of connection applications for this substation which will require an additional substation with a minimum footprint of 80x280m and potential relocation and realignment of existing infrastructure. The location of the AGI adjacent to the Saltholme Substation is unacceptable as it may sterilise the land required for the anticipated upgrades to the Saltholme substation. • Requires further justification for the location of Works Nos 6A.1 and 6B and the absence of suitable alternative locations. • NGET disagrees with the Applicant's characterisation of both the duration and nature of engagement between the parties and requires further engagement on Protective Provisions.	As NGET's response notes, the Applicant has included protective provisions in the dDCO for the protection of NGET. NGET's legal representatives have proposed changes to the included protective provisions, which are being reviewed by the Applicant, its land agents and its legal representatives. The Applicant anticipates responding imminently to NGET on this matter. It is noted that the protective provisions included in the dDCO for the benefit of NGET require a plan to be submitted for approval by NGET in respect of 'specified works.' 'Specified works' include any of the authorised works which: (a) will or may be situated over, or within 15 metres measured in any direction of any apparatus the removal of which has not been required by the undertaker under paragraph 7(2) or otherwise. (b) may in any way adversely affect any apparatus the removal of which has not been required by the undertaker under paragraph 7(2) or otherwise; and/or (c) includes any of the activities that are referred to in development near overhead lines EN43-8 and HSE's guidance note 6 "Avoidance of Danger from Overhead Lines" Tower YYJ037 and overhead line In addition to the PPs above, good engineering practice will be used for planning construction. It is not the expectation that the Works will interfere with maintenance of the tower or overhead line because the planned works will not block access. Site specific risk assessments shall be used when working near high voltage overhead lines, and the asset owner (NGET) will be notified ahead of any Works that may impact its assets. Saltholme Substation The Applicant was made aware of NGET's potential expansion plans at the Saltholme Substation on 27th June 2024 and has requested further detail from NGET in order to manage the interaction between the parties' two proposed projects. Works Nos 6A.1 and 6B The Applicant notes that the Order limits for the Works No 6B, which include the AGI near Saltholme substation, are 15m from the pylon. This is deemed suitable at this early design phase but is subject to electrical interference calculations and constructability reviews for working near overhead lines. North of the Saltholme Substation, the pipeline route (Works No.6A.1) is parallel to overhead lines and pylons and so an offset of 40m has been applied. This offset is based

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			on National Grid Guidance and will be verified by electrical interference calculations in later design phase. The Applicant has provided NGET with the rationale behind the proposed routing of the Pipeline and demonstrated the local constraints which inhibit relocation of the pipeline and the AGI. Engagement The Applicant has been in correspondence with NGET and their representatives since August 2022. The Applicant has recently provided NGET with a chronology of correspondence to evidence both the duration and nature of the Applicant's engagement between the parties. Following a request for a further meeting, the Applicant has now received a response from NGET and understands that NGET is holding internal meetings prior to meeting again with the Applicant. It is anticipated that the next meeting between the parties will take place prior to the upcoming Hearings.

15.0 NATIONAL GAS TRANSMISSION PLC

Table 1515-1: Response to National Gas Transmission Plc's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
NGT1	Written Representation [REP2-067]	• Requires Protective Provisions to ensure that interests and rights are unaffected by CA powers • Requires all works within the vicinity of NGT apparatus to be subject to protective provisions, for NGT to be in control of the plans and methodology of such works and appropriate surety and insurance provisions to be in place to comply with its duties as a Statutory Undertaker • No response has been provided by the Applicant since July 2024 on the Protective Provisions and they would like to engage on this matter.	As NGT's response notes, the Applicant has included protective provisions in the dDCO for the protection of NGT. NGT's legal representatives have proposed changes to the included protective provisions, which are being reviewed by the Applicant, its land agents and its legal representatives. The Applicant anticipates responding imminently to NGT on this matter.

16.0 INEOS NITRILES (UK) LIMITED

Table 16-1: Response to INEOS Nitriles (UK) Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
INEOS1	Responses to comments on Relevant Representations [REP2-080]	- INEOS looks forward to the Applicant engaging further private treaty negotiations and receiving draft protective provisions.	The Applicant is actively engaging with INEOS Nitriles (UK) Limited to negotiate Heads of Terms for the land agreements required for the Proposed Development. These negotiations are at an advanced stage due to multiple elements of the agreements having precedence set by prior agreements between the two parties. The Applicant remains in regular correspondence and will work further with INEOS to settle any outstanding concerns or deviations from those prior agreements. The Applicant has had meaningful discussions with INEOS Nitriles and has agreed high level principles for protective provisions drafting. The Applicant's solicitors are currently drafting Protective Provisions reflective of these principles to issue to INEOS Nitriles for review and expect to issue these imminently.
INEOS2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-081]	• Q1.6.62 - The access roads around Seal Sands, which provide the main access to INEOS' site will be impacted by the compulsory acquisition of rights or freehold and extinguishment of existing right. • Q1.9.28 – The implications of leaving 'ground strengthening works' in situ, as provided for by Article 32(5)(b) is dependent on greater specificity in relation to the proposed works and precisely what may be left in situ on decommissioning, which we understand has been requested by the ExA.Q1.9.67 - No draft protective provisions have been received from the Applicant to date. • Q1.17.1 - In response to the ExA's request for an update on INEOS' concerns regarding access, INEOS noted that no draft protective provisions have been received from the Applicant to date.	**Q1.6.62 - Inaccessible or Severed Areas of Land** The Applicant can confirm that no areas of land within the INEOS site will be permanently severed or rendered inaccessible as a result of the development. Any temporary impacts will be managed to minimise disruption to operations, and access will be maintained as far as possible. **Q1.9.28 - Clarifications Regarding Article 32(5)(b) and Ground Strengthening Works** The impacts of installing ground strengthening is already accounted for in the ES by assessing the impacts of the construction phase. This article simply requires for such areas to be retained. This would not prevent the Applicant putting in place the commitments it already put in place to ensure that habitats are restored, as per the OLBMP. The Applicant's response to question 1.9.28 in Response to ExQ1 Draft Development Consent Order [REP2-027] provided the following examples of ground strengthening works which may be relevant to the proposed development: • The need to strengthen the ground to accommodate crane pads, to allow cranes to operate safely; and • Works to strengthen the ground to accommodate heavy plant and machinery required for the construction phase **Q1.9.67 - Protective Provisions (PPs)** The Applicant refers to its response to INEOS1 above. Discussions regarding the content of the PPs are ongoing, and the Applicant will continue to engage with INEOS to discuss INEOS' concerns.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			Q1.17.1 - Access Concerns from Interested Parties Please see response to INEOS1 above.

17.0 PD TEESPORT LIMITED

Table 17-1: Response to PD Teesport Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
PDTeesport1	Responses to comments on Relevant Representations [REP2-093]	1. PD Teesport have not yet received any Protective Provisions	The Applicant is finalising draft protective provisions to issue to PD Teesport imminently for review.
PDTeesport2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-094]	2. Q1.6.52 – PDT Represent their tenants interests in terms of access rights and protection of assets and services on their land. A number of these businesses will not be registered as IPs. PDT will liaise with the Applicant and its tenants with regards to the Emergency Access road discussed in PDT's RR. 3. Q1.6.53 -Areas within the Order Limits, such as Tees Dock roundabout to the BOC Middlesborough site, the emergency access road and Riverside ro-ro are problematic to PDT as a Statutory Harbour Authority in the absence of suitable PPs 4. Q1.9.14 – Dis-application. To the extent the Applicant wishes to disapply any of those conditions, it should specify which ones and provide justification in each instance which we will respond to. 5. Q1.6.7 – PDT understands that the BOR is not accurate with respect to the emergency access road. PDT have a lease over Plot 7/3 which is not recorded in the BoR. 6. Q1.6.62 – The emergency access road is leased to PDT from the Crown Estate and others – the leases do not appear to be in the BoR. Other access affected by CA Powers include PDT's access to its land at Redcar Bulk Terminal, in the Seal Sands area and from the Teesdock roundabout. 7. Q1.9.28 -Require greater specificity in the proposed works. 8. Q1.9.67 – Await Protective Provisions 9. Q1.17.1 – Await Protective Provisions and therefore all concerns raised in PDTs RR remain outstanding.	**Q1.6.52, Q1.6.53 –** Please see response above to PDTeesport1. The Applicant is committed to engaging with PD Teesport to resolve access concerns and agree appropriate protective provisions. **Q1.9.14 -** The purpose of article 9(2)(a) and article 9(2)(b) is to disapply certain byelaws, directions and licensing provisions in force pursuant to the Tees and Hartlepools Port Authority Act 1966, Tees and Hartlepool Authority Revision Order 1974 and Tees and Hartlepool Harbour Revision Order 1994 to ensure that the Applicant has sufficient flexibility to build the scheme efficiently and is not restricted by byelaws, directions or licensing requirements that would impose restrictions on its construction, operations and methodologies. The article disapplying these statutory provisions in the Draft Development Consent Order [REP2-004] has precedent in article 9(2) of the The Net Zero Teesside Order 2024 (NZT) where these statutory provisions are disapplied for NZT work numbers 2A (natural gas connection), 6 (CO2 pipeline), 10 (highway improvements) and any works that may be carried out in association with those numbered works. Given the similar location of elements of the H2Teesside Project to elements of NZT, the Applicant included drafting to disapply the same statutory provisions on the basis that this would be required to facilitate the construction and operation of H2Teesside Project as it was for NZT. **Q1.6.7 -–**Please see response to 1.6.62. **Q1.6.62** The Applicant has included PDT's registered lease for title CE118857 on plots 7/5, 7/9 and 7/14 and for title CE118856 on plot 7/18, 7/20. Plot 7/3 is a registered lease under title CE26683 and belongs to Norpipe Oil AS and Norpipe Petroleum UK Limited. The Applicant asks PDT to confirm the registered lease referenced and its location in relation to Order Plots, as only a small section of the emergency access road appears to be registered (plots 7/18, 7/20). Q1.9.28 - The impacts of installing ground strengthening is already accounted for in the ES by assessing the impacts of the construction phase. This article simply requires for such areas to be retained. This would not prevent the Applicant putting in place the

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			commitments it already put in place to ensure that habitats are restored, as per the OLBMP. The Applicant's response to question 1.9.28 in Response to ExQ1 Draft Development Consent Order [REP2-027] provided the following examples of ground strengthening works which may be relevant to the proposed development: • The need to strengthen the ground to accommodate crane pads, to allow cranes to operate safely; and • Works to strengthen the ground to accommodate heavy plant and machinery required for the construction phase **Q1.9.67 -** Please see response above to PDTeesport1. **Q1.17.1 -** Please see response above to PDTeesport1.

18.0 NAVIGATOR TERMINALS LIMITED

Table 18-1: Response to Navigator Terminals Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Navigator1	Responses to comments on Relevant Representations [REP2-086]	• Navigator Terminals concerns are still in place and a private treaty is not yet in place. Navigator would like to be provided with detail in relation to the greater certainty and optionality on the river crossing and aligning timings between the Proposed Development and Navigators own Net Zero project, as well as the draft of the Protective Provisions. • Navigator have not yet received a copy of the Protective Provisions.	For timings, the project schedule has detailed design and construction in 2025 to 2028. Within this, one year (52 weeks) has been allowed for the Tees Crossing. A Project schedule with dependencies shows the Tees Crossing approximately mid-way through the construction phase (2026 and 2027) however this may change as the schedule is refined and start dates or durations of preceding activities is adjusted. The Applicant would look to engage with Navigator on specific timing for construction so as not to impact other planned developments. Draft protective provisions have been issued to Navigator Terminals Seal Sands Limited and Navigator Terminals North Tees Limited for review.
Navigator2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-087]	• Q1.6.62 – Compulsory acquisition powers are being sought by the Applicant over access to Navigator's site and over land through which their pipeline passes and the Applicant has not confirmed that their interests will not be extinguished. • Q1.9.28 – The implications of leaving 'ground strengthening works' in situ, as provided for by Article 32(5)(b) is dependent on greater specificity in relation to the proposed works and precisely what may be left in situ on decommissioning, which we understand has been requested by the ExA.Q1.9.67 - No draft protective provisions have been received from the Applicant to date. • Q1.9.67 – Navigator have not received a copy of the Protective Provisions • Q1.10.4 – Navigators expectation is that any specific operation/site concerns will be addressed by Protective Provisions.	**Q1.6.62** Draft protective provisions have been issued to Navigator Terminals Seal Sands Limited and Navigator Terminals North Tees Limited for review. The Applicant looks forward to progressing negotiations and working with Navigator Terminals to resolve their concerns. **Q1.9.28** The impacts of installing ground strengthening is already accounted for in the ES by assessing the impacts of the construction phase. This article simply requires for such areas to be retained. This would not prevent the Applicant putting in place the commitments it already put in place to ensure that habitats are restored, as per the OLBMP. The Applicant's response to question 1.9.28 in Response to ExQ1 Draft Development Consent Order [REP2-027] provided the following examples of ground strengthening works which may be relevant to the proposed development: • The need to strengthen the ground to accommodate crane pads, to allow cranes to operate safely; and • Works to strengthen the ground to accommodate heavy plant and machinery required for the construction phase Q1.9.67 See above Q1.6.62 response. Q1.10.14 See above 1.6.62 response.

19.0 CF FERTILISERS UK LIMITED

Table 1919-1: Response to CF Fertilisers UK Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
CF1	Responses to comments on Relevant Representations [REP2-076]	• In response to the Applicant's commitment to adhering to safety standards and working collaboratively with CFL and other stakeholders to ensure safety concerns are addressed, CFL noted that it would expect a framework to provide a way to deal with safety concerns. • A clear mechanism for the Applicant to engage with CFL during decommissioning is required. • CFL are unable to yet comment on whether PPs are sufficient to protect CFL's critical infrastructure as CFL has not received the draft protective provisions. • CFL awaits more detailed pipeline designs from the Applicant	The Applicant issued a draft side agreement and protective provisions to CFL on 26 September 2024 and is awaiting CFL's comments on the draft documents. The Applicant is not clear on the framework CFL is seeking to address any safety concerns. The Applicant is willing to discuss this matter as well as any issues regarding the protection of CFL's critical infrastructure. The Applicant will liase directly with CFL to discuss and clarify these requests. The requirement in paragraph 28 of Schedule 2 to the dDCO [REP 2-004] requires the relevant planning authority to approve the decommissioning environmental management plan, which the Applicant considers is appropriate. The Applicant is progressing the pipeline designs and will provide in due course. Refer to drawing 2.17 [REP1-003] for typical elevations of aboveground pipeline sections. Within that drawing, the pipe bridges are representative of the elevated pipe racks within CFL land. The proposed construction technique is lifting of line pipe via small mobile cranes from adjacent roads onto the racks. The Order Limits have been developed to allow space for this operation to take place.
CF2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-077]	• Q1.6.62 – some of the compulsory acquisition rights sought may sever access rights onto CFL's main site – CFL is reviewing PPs • Q1.9.28 – The implications of leaving 'ground strengthening works' in situ, as provided for by Article 32(5)(b) is dependent on greater specificity in relation to the proposed works and precisely what may be left in situ on decommissioning, which we understand has been requested by the ExA • Q1.17.1 – Issues regarding access remain an issue but may be alleviated through PPs which are currently under review.	Q1.6.62 The Applicant has been careful to avoid permanent severance of access across the Project and intends to manage any temporary severance on a case by case basis with the Affected Parties. The Applicant welcomes further discussion with CFL to discuss this in detail. The Applicant looks forward to receiving CFL's comments on the drafted PPs. Q1.9.28 The impacts of installing ground strengthening is already accounted for in the ES by assessing the impacts of the construction phase. This article simply requires for such areas to be retained. This would not prevent the Applicant putting in place the commitments it already put in place to ensure that habitats are restored, as per the OLBMP. The Applicant's response to question 1.9.28 in Response to ExQ1 Draft Development Consent Order [REP2-027] provided the following examples of ground strengthening works which may be relevant to the proposed development: • The need to strengthen the ground to accommodate crane pads, to allow cranes to operate safely; and • Works to strengthen the ground to accommodate heavy plant and machinery required for the construction phase Q1.17.1

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			The Applicant refers to its response to question 1.6.62 above.

20.0 NORTH SEA MIDSTREAM PARTNERS LIMITED

Table 20-1: Response to North Sea Midstream Partners Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
NSMP1	Request for withdrawal of Relevant Representation (RR-029) and written summary of oral submissions (REP1-039) and withdrawal from the Examination. [REP2-090]	• North Sea Midstream Partners Limited wishes to withdraw as an interested party to this examination. As such, it seeks to withdraw its relevant representation (RR-029) and written summary of oral submissions (REP1-039) • North Sea Midstream Partners Limited was initially identified as having property interests which were impacted by the Project in the application book of reference (APP-023). However, we understand North Sea Midstream Partners Limited is not the company which formally holds such interests, and the relevant interests are held by the other NSMP Entities outlined above. As a result, North Sea Midstream Partners Limited considers its participation in this examination is no longer required.	The Applicant acknowledges North Sea Midstream Partners Limited's withdrawal.

21.0 NATURAL ENGLAND

Table 221-1: Response to Natural England's EXA Question Deadline 2 submissions

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
1.2.9	Natural England	Connection Corridor Routing (Water Corridors) Clarification/ Views sought. Paragraph 6.7.10 of ES Chapter 6 (Needs, Alternatives and Design Evolution) [APP-058] refers to two options in terms of effluent management. When will a final decision be made on the option chosen and are NE/ EA satisfied in regard to 'Nutrient Neutrality' and the final methods of disposal currently detailed in both options	WQ/Marine/Ecotox response 20: **Two options exist in terms of effluent management:** If Case 1B were to be progressed (accepting this is unlikely), we would need to understand where the Minimalised Liquid Discharge waste would be disposed of to ensure there would be no impact to the catchment. NE accept that Case 2B is to be taken forward as modelling has shown Nitrogen is unlikely re-enter the estuary. However for Case 2B, two aspects should be considered: impact to the Tees transitional waterbody (high nutrients), where inputs must not cause an increase, and impact on the Tees Bay itself (favourable for nutrients). Although the focus has been on Seal Sands as the sensitive area NE would want to be confident that the new discharge would not impact condition in the Tees Bay. WQ/Marine/Ecotox response 23: **Nutrient Neutrality:** If a project contributes nutrients and these nutrients are mitigated so made nutrient neutral then there will be no remaining nutrient impact to consider in combination. Don't believe that for this specific project NN is triggered, as adverse effects are ruled out via other routes in the HRA where in combination effects do still need to be considered e.g ensure that the combined effluent discharge does not change whether the nutrients end up in the Tees estuary, or whether the combined discharge may cause the Tees Bay to become in unfavourable condition. The WQ modelling report does include the combined component, but NE would welcome clarification of this within the RR response.	WQ/Marine/Ecotox response 20: Case 2B will be taken forward. NE have accepted that modelling has shown that under Case 2B that Nitrogen is unlikely to re-enter the estuary (i.e. Tees Transitional WFD waterbody). In terms of Tees Bay, Appendix 9B: Water Quality Modelling Report (APP-193) shows that when the discharge from the Proposed Development and the adjacent Net Zero Teesside projects are modelled cumulatively, that concentrations of Dissolved Inorganic Nitrogen (DIN) are slightly elevated above background concentrations within Tees Bay but the overall increase in average and maximum pollutant concentrations do not approach EQS values, taking into account the complex tidal currents in this region which can result in pollutants accumulating in shallow water. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative impact of discharges from both sites and therefore the condition of Tees Bay would not be adversely impacted. Full details are given of the modelling outputs in Appendix 9B: Water Quality Modelling Report (APP-193). Please also refer to the Applicant's updated response to NE20. WQ/Marine/Ecotox response 23: It is confirmed that Appendix 9B: Water Quality Modelling Report (APP-193) does include combined modelling of the discharge of process water effluent and surface water runoff, and that this is done for H2Teesside independently and cumulatively with Net Zero Teesside. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative (or combined) impact of discharges from both sites and therefore the condition of Tees Bay would not be adversely impacted.
1.2.10	Natural England	Connection Corridor Routing (Water Corridors) Views sought.	Natural England can confirm that it is Satisfied. - Please refer to representation NE21	Noted, the Applicant welcomes the agreement with Natural England on this issue.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		Are you satisfied in terms of the options under consideration for the disposal of surface water run-off arising from the Proposed Development, as set out in Paragraph 6.7.10 (Third Bullet Point) of ES Chapter 6 (Needs, Alternatives and Design Evolution) [APP-058]?		
1.3.4	Natural England	Views sought. Paragraph 8.3.1 – 8.3.2 of ES Chapter 8 (Air Quality) [APP-060] states that the Study Area for construction dust and construction Non-Road Mobile Machinery emissions has been applied in line with the IAQM guidance 2024 extending: • up to 250 m beyond the Proposed Development Site and 50 m from the construction traffic routes (up to 250 m from the Proposed Development Site entrances), for human health receptors; and • up to 50 m from the Proposed Development Site and construction traffic routes (up to 250 m from the Proposed Development Site entrances) for ecological receptors. The ExA would ask the EA, NE and LAs to confirm whether they consider the Study Area distances assessed by the Applicant and set out above, are appropriate and acceptable in respect of the air quality study areas.	Our updated representations NE10 & NE11 refer to this.	Please refer to the Applicant's updated response in this document.
1.3.5	Natural England	Views sought. Paragraph 8.3.4 of ES Chapter 8 (Air Quality) [APP-060] states the Study Area or the operational Proposed Development point source emissions extends up to 15 kilometres (km) from the emission sources to assess the	1. Natural England confirms that we accept the 15km threshold distance as appropriate for a scheme of this type and scale. 2. No specific comments though it should be noted that 'Loe Hill Pools SSSI''s correct name is Lovell Hill Pools SSSI.	Noted, the Applicant welcomes acceptance of the 15km study area for operational point source emissions. Please see the Applicant's response to 1.3.9 below.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		potential impacts on ecological receptors. This is in line with the EA Risk Assessment Methodology (Defra and EA, 2016, as updated in 2023) but also includes additional sites requested by the Proposed Development biodiversity specialists: • Special Protection Area(s) (SPA), Special Area(s) of Conservation (SAC), Ramsar sites and Sites of Special Scientific Interest (SSSIs) within 15 km of the Proposed Development Site; and • Local Nature Sites (including ancient woodlands, Local Wildlife Sites and National and Local Nature Reserves) within 2 km of the Proposed Development Site. Paragraph 8.3.5 of ES Chapter 8 (Air Quality) [APP-060] lists the additional sites to include the North York Moors SPA and SSSI, the North Cumbria Coast SPA, Durham Coast SAC, Northumbria Coast Ramsar, Cliff Ridge SSSI, Durham Coast SSSI and National Nature Reserve, Hart Bog SSSI, Langbaurgh Ridge SSSI, Loe Hill Pools SSSI, Roseberry Topping SSSI and Saltburn Gill SSSI. Please state whether the EA, NE and LAs, together with any other relevant Authority/ Body: i) considers the Study Area of 15 km to be satisfactory to assess the potential impacts on ecological receptors. ii) have any comments and observations on the additional areas included by the Applicant as the ecological receptors for the Study Area.	3. Please see response to Q1.3.9	

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		iii) have any other observations to make in respect of Paragraph 8.3.5 – 8.3.6 of ES Chapter 8 (Air Quality) [APP-060].		
1.3.9	Natural England	Clarification/ Views sought. Paragraphs 8B.2.14 and 8B.2.15 of ES Appendix 8B (Air Quality - Operational Phase) [APP-191] sets out a list of cumulative developments which are either consented or about to receive planning consent but yet to come into operation and which have potential operational air quality impacts. The details of the cumulative assessment is presented at 8B.11 (Annex B: Cumulative Assessment Inputs and In-Combination Results) of that document. Bearing in mind the above: i) Please confirm whether the LAs, together with any other relevant Authority/ Body, are satisfied with the list of consented, or soon to be consented, cumulative development included in that list. Should any of the Interested Parties (IPs) listed in the question above not be satisfied, please provide full details of those consented or about to be consented development it believes are missing from the list. When providing such details please provide a statement confirming the status of the planning application (ie Planning permission granted, resolution to grant subject to the prior completion of a legal agreement, undetermined, on appeal, etc, as well as details of the planning application, including, but not limited to, the planning application number, a description of and location of the Development, a copy of the planning	i) Natural England has reviewed the list of projects included in the In-Combination Assessment and would like to highlight the following projects which are not included in the assessment. (Format = name, impact pathway, status): Graythorpe Energy Centre, air quality, permit/consent Teesside Brinefields Hydrogen Storage, loss of designated site habitat/species, concept Lighthouse Green Fuels, air quality, preapplication H2NE Blue Hydrogen Facility, air quality, preapplication Flexible Regas Port, air quality, preapplication HyGreen Hydrogen Facility, loss of designated site habitat/species, preapplication British Steel Electric Arc Furnace, air quality, post decision Biffa Redcar Plastics Recycling Facility, air quality, consent Carbon Capture from Existing Waste Facility, air quality, examination. In addition to the list of projects above, Natural England would like to highlight that the proposed development is within the Teesside Freeport Zone and Tees Valley Industrial Cluster. There may be additional projects and aims of these strategic zones which are relevant for the in-combination assessment. Some uncertainty exists over Air Quality impact pathways associated with these omitted projects. and we request that H2T screen the projects in question for operational AQ impacts in combination.	The Applicant has reviewed the list of projects provided by Natural England. The table below provides an update for each development, noting the concerns raised by Natural England here will likely be dealt with by the updated Cumulative Effects Assessment currently being prepared for Deadline 5, as well as a further update to the Report to Inform HRA. This will be prepared by the Applicant for Deadline 5. **Development (Reference)** — **Deadline 3 Update** Graythorpe Energy Centre ((H/2019/0275)): This development was included in the original long list for the cumulative effects assessment as ID95 and scoped out due to the lack of temporal overlap between the two developments. The permit application for the Graythorpe Energy Centre was recently refused[1]. However, in order to ensure a worst case scenario, and in accordance with the PINS Advice Note on cumulative effects, this development will be scoped in to further assessment for the cumulative effects assessment update being prepared for Deadline 5 in case of appeal. Teesside Brinefields Hydrogen Storage: This development does not have any environmental information in the public domain that can be utilised for the purposes of the updated cumulative effects assessment, and therefore it is proposed to not include this development in the cumulative

[1] https://www.gov.uk/government/publications/ts25-2bq-graythorp-energy-limited-environmental-permit-refused-eprzp3307sda001

<table>
<tr><th>Exa question Ref. no.</th><th>IP</th><th>Question</th><th>IP Responses</th><th>Applicant's Response</th></tr>
<tr><td></td><td></td><td>permission granted or resolution to grant planning permission, etc).
ii) Please advise whether the LAs, together with any other
relevant Authority/ Body, have any observations or
comments on the cumulative assessment set out in 8B.11
Annex B (Air Quality - Operational Phase) [APP-191].</td><td></td><td>
<table>
<tr><td></td><td>effects assessment update being prepared for Deadline 5.</td></tr>
<tr><td>Lighthouse Green Fuels (EN010150)</td><td>The development was at the scoping stage when the cut-off date for the cumulative effects assessment accompanying the DCO Application was set. Therefore, at that point in time, there was not enough information available to take forward to a full assessment.

However, the development has since progressed, and will be assessed in the updated Cumulative Assessment to be submitted at Deadline 5.</td></tr>
<tr><td>H2NE Blue Hydrogen Facility</td><td>This development does not have any environmental information in the public domain that can be utilised for the purposes of the updated cumulative effects assessment, and therefore it is proposed to not include this development in the cumulative effects assessment update being prepared.</td></tr>
<tr><td>Teesside Flexible Regas Port (EN040001)</td><td>This development came forward after the cut-off date for the Cumulative Effects Assessment that accompanied the DCO Application [APP-076] and therefore was not included.

This development has now been added to the updated shortlist and will be considered in the updated cumulative effects assessment to be submitted at Deadline 5.</td></tr>
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Exa question Ref. no.	IP	Question	IP Responses	Applicant’s Response	
				Hygreen Hydrogen Facility (R/2023/0179/SCP + R/2024/0271/ESM)	This was not originally included as the application was submitted after the cut-off date for the Cumulative Effects Assessment that accompanied the DCO Application [APP-076] and at that stage only scoping information had been provided. The full TCPA application will now be considered in the updated cumulative effects assessment to be submitted at Deadline 5.
				British Steel Electric Arc Furnace (R/2023/0793/ESM)	This was not originally included as the application was submitted after the cut-off date for the Cumulative Effects Assessment that accompanied the DCO Application [APP-076]. This development has now been added to the updated shortlist and will be assessed in the updated Cumulative Assessment to be submitted at Deadline 5.
				Biffa Redcar Plastics Recycling Facility (R/2022/0290/FFM)	The environmental permit for this project (EPR/GP3947QE) was issued in August 2024 meaning it will become operational in the near future. Therefore, this is not accounted for in the Air Quality baseline data and as such will be assessed as a cumulative development in operation in the cumulative effects assessment update to be submitted at Deadline 5.
				Carbon Capture from Existing Waste Facility, Billingham	This development was considered in the original cumulative effects assessment but determined to be

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
				negligible from an Air Quality perspective because: It is an update from an existing energy recovery facility in Billingham, with amines being the only new pollutants (not emitted by the Proposed Development and emitted in quantities too low to have any perceptible impacts on nitrogen deposition). For pollutants that are also emitted by the Proposed Development (nitrogen oxides and ammonia being the main concern), it was noted that emission levels and stack height were similar between the existing facility and the updated one, with the main difference being a lower temperature in the updated one. This would mean that although maximum impacts might be higher, they will be closer to the site and impacts near the Proposed Development will be lower than with the existing facility. Based on both points above, impacts from the Carbon Capture from Existing Waste Facility were considered negligible. However, this will be reconsidered in the updated Cumulative Assessment to be submitted at Deadline 5.
1.4.8	Natural England	Please confirm that NE is satisfied that the Applicant has identified all relevant European sites and qualifying features in its Report to Inform HRA [AS-016]. If not, confirm which are missing and for what impact pathways.	Satisfied.	Noted.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
1.4.9	Natural England	Clarification/ View sought. Part II of NE's RR [RR-026] states it agrees there would be no adverse effects on integrity for the North Northumberland Coast, Humber Estuary and The Wash and North Norfolk Coast SACs. However, NE26 raises concerns about noise disturbance to seal qualifying features. Can NE confirm if it is satisfied that there is no adverse effects on integrity to these sites. Can NE also confirm if its concerns relate only to noise, ie that it is satisfied by the Applicant's conclusions in [AS-016] on visual disturbance to seal qualifying features.	<u>WQ/Marine/Ecotox response 26:</u> Following a conversation with AECOM, Natural England advises that as long as HDD operations last no longer than 3 weeks in October, and noise abatement barriers reduce noise by 10dB, there is unlikely to be a significant impact on the seals of the Teesmouth and Cleveland Coast SSSI from the HDD works at Greatham Creek. Natural England would welcome securing these mitigations through conditions to any licence granted. NE has received additional information form the applicant on noise assessment at Greatham Creek and some uncertainty remains regarding noise reductions achieved by mitigation measures. Our advice remains that pre-construction monitoring is carried out to assess the behaviour of seals in the area under "normal" conditions. Further monitoring should be carried out during construction to assess the efficacy of mitigation measures. If behaviour indicating disturbance is noted, further mitigation must be put in place. This may include more effective sound barriers, further muffling of machinery. If monitoring shows that disturbance is not occurring, further mitigation is unlikely to be necessary.	The HRA has been amended to address these points as part of the Proposed Change Application see Paragraphs 6.5.15 to 6.5.38 (Section 'Noise and Visual Disturbance – Seals (Construction)')of the updated Report to Inform HRA regarding noise disturbance of seals. The implementation of these barriers is secured through the DCO (via their inclusion in the FECMP). Regarding pre-construction monitoring the Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions. Please refer to the Applicant's updated response to NE26 in this document, where a number of clarifications have been requested. This matter will continue to be discussed with NE through the SoCG.
1.4.10	Natural England	Clarification/ Views sought. Please confirm if Coastal Dune Grasslands (Grey Dunes) is a qualifying feature of the Durham Coast SAC. It does not appear as a qualifying feature on the citation provided in the Applicant's Report to Inform HRA [AS-016], but it has been modelled in the air quality assessment for nutrient nitrogen deposition, as presented in ES Appendix 8B (Air Quality - Operational Phase) [APP-191], Table 8B-31.	Natural England can confirm that coastal grey dune grasslands are not a feature of the Durham Coast SAC. For further information on the SAC please see: European Site Conservation Objectives for Durham Coast SAC - UK0030140 (naturalengland.org.uk)	Noted, the Applicant welcomes agreement with Natural England on this issue.
1.4.11	Natural England	Clarification. In NE's RR [RR-026] (NE1) you advised that project commitments should be logged in a Framework Construction Environmental Management Plan (CEMP) and that mitigation plans for horizontal directional drilling collapse should be secured in the DCO. Can NE explain what	Updated representation reference NE1 refers to this.	Please refer to the Applicant's updated response to NE1 in this document.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		additional measures it considers are needed in the Framework CEMP [APP-043] in this regard, noting that some measures are included under Surface Water (Table 7-2) and Marine Ecology (Table 7-7).		
1.4.12	Natural England	Views sought. In NE's RR [RR-026] (NE4 and NE5), you advise that you do not support the use of 'Waterbird disturbance mitigation toolkit (Institute of Coastal and Estuarine Studies', 2013) as evidence has not been collected in a rigorous manner and it has not been peer reviewed. Can NE advise of any alternative guidance that would be appropriate to support the establishment of thresholds for noise levels for bird disturbance.	Natural England is not aware of any other formal guidance note to follow. Natural England has discussed our concerns regarding the use of the IECS toolkit during a call on 20.8.24, in which we provided ornithological advice on how to assess noise impacts on birds.	The Applicant notes that Natural England Commissioned Report NECR570 (uploaded 30/08/2024) (see Appendix 1 of this document) discusses the effects of noise on waterbirds. This study was designed to fill data gaps for the overwintering period through noise monitoring in key areas across SPA sites in the Solent with the objective of providing data on background noise levels in order to more accurately determine the likely significant effect on birds when responding to anthropogenic noise. This study found that there was no obvious correlation between specific sound frequencies and bird responses. However, the sound pressure level at each frequency was generally above the background noise level. The results showed that birds are more likely to respond to noise disturbance when the sound pressure levels at the location of the birds are at least 20.0 dB(A) above the background noise level. However, the visual nature of the noise disturbance is also likely to cause bird responses. The Applicant has also reviewed the NatureScot Research Report 1283 - Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species (NatureScot, 2022) (see Appendix 2 of this document). This report discusses data gaps, habituation and other factors influencing disturbance distance but does not draw conclusions.
1.4.13	Natural England	Clarification. In NE's RR [RR-026] (NE9, NE10, NE11 and NE16), you requested consideration of additional pollutants as part of the screening of construction phase emissions to air to the Teesmouth and Cleveland Coast SPA and Ramsar site and a mitigation plan (monitoring plan for construction dust). The Applicant screened out this impact pathway for LSEs, specifically for construction traffic based on the results presented in ES Chapter 8 (Air Quality) [APP-060]. Can	AQ/Ornithology/HRA response NE11: **Satisfied** It is accepted that NRMM sources were considered, but were not within 200m of nesting sites (from the site boundary at the theoretical closest points) - assuming the nesting site locations etc are included in the HRA no further assessment for AQ is required. It is also acknowledged that traffic numbers for tree planting/ landscaping would be <1000AADT/ 200AADT HDV and therefore no assessment of traffic air quality impacts arising from these works are necessary. Demolition dust mitigation works within the fCEMP and PPW CEMP are likely to be generic, but as long as justification is provided that there will be no impact on the integrity of the protected sites, it is considered	Please refer to the Applicant's updated response to NE11 and NE12 in this document.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		NE clarify if it considers that this impact pathway should be assessed at the appropriate assessment stage.	appropriate to rely on these as compliance with the CEMPs will form part of the DCO consent. <u>AQ/Ornithology/HRA response NE12:</u> **Not satisfied (Without further info)** It is accepted that the environmental permit will address emissions, including fugitive emissions but this will not cover the entire red line boundary, including e.g. traffic emissions – and the full extent of emissions should be considered in the DCO application, not wait for the environmental permit, as otherwise there cannot be sufficient confidence that there will not be harm to the protected sites. It is acknowledged that further information on ammonia from traffic and operational emissions (as in our RR questions) will be provided, and used to inform updates to the HRA. NE will comment on these when available. Further information should also be provided on the "closed loop" carbon capture process, including the treatment of any amine rich wastes. Any offsite treatment should be noted, and impacts considered. <u>AQ/Ornithology/HRA response NE15:</u> **Satisfied** Assuming the information requested is provided in the updated HRA report, NE would be content with the methodology. We will review the assessment when provided.	
1.4.14	Natural England	Information sought. Can NE provide confirmation of what additional information it requires in relation to the temporal overlap with neighbouring schemes for the purposes of understanding the in combination assessment in [AS-016], including a list of the schemes the information is required for.	We set out at Annex A a Gantt chart indicating the scope for significant 'temporal overlap' for a range of Teesside projects. Relevant information has been gathered in Excel spreadsheet form and is attached separately to the covering email response with our Written Representations. Our response to Q1.3.9 sets out those projects that have not been reflected in the in combination assessment so far. The in combination assessment needs to quantify impacts fully on the SPA classified bird species and assemblage. We advise that consideration is given to the spatial extent of impacts through time and	The Applicant has reviewed the list of additional projects provided by Natural England. All projects identified by Natural England were included in the cumulative effects assessment (and considered in the HRA by extension) that accompanied the DCO Application. Please refer to the Applicant's updated response to NE19 in this document. The Applicant has considered the spatial extent and potential for construction phase overlaps of other developments included in the in combination assessment. The Applicant does not have access to raw bird data from other developments included in the assessment, and

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
			numbers of birds impacted through time for this project alone and other projects in the assessment.	therefore it is not possible for the Applicant to quantify the number of birds affected in combination.
1.5.7	Natural England	Views sought. The Supreme Court has recently (20 June 2024) handed down judgment in the case of R (on the application of Finch on behalf of the Weald Action Group) v Surrey County Council and others. To the Applicant: Following the Supreme Court judgment, please comment on the relevance or otherwise of the above mentioned Supreme Court judgment, especially in regard to your assessment of GHG emissions in ES Chapter 19 (Climate Change) [APP-072]. To IPs: Please comment on the relevance or otherwise of the above mentioned Supreme Court judgment in regard to this Proposed Development.	We have been unable to provide a response to this question by 03/10/24 but aim to provide an answer as soon as we can. Natural England advises that the ExA may wish to seek their own legal advice on this matter.	Noted.
1.9.28	Natural England	Clarification. Article 32 (Temporary use of land for carrying out the authorised development) – Article 32(5)(b) provides and exemption whereby "the undertaker is not to be required to… (b) remove any ground strengthening works which have been placed on the land to facilitate construction of the authorised development." Please define the term 'ground strengthening works' and provide written examples and/ or drawings of what they would be likely to consist of. Additionally the ExA would ask: • The Applicant for an explanation of the potential implications of having to removing 'ground strengthening works' should Article 32(5)(b) be removed. • Interest Parties for their views as to any potential implications of leaving	We propose that affected areas should be considered within the Report to inform HRA, in particular if the ground strengthening is to be permanently retained. Such areas should be quantified and assessed for impacts on the designated site.	The impacts of installing ground strengthening is already accounted for in the ES by assessing the impacts of the construction phase. This article simply requires for such areas to be retained. This would not prevent the Applicant putting in place the commitments it already put in place to ensure that habitats are restored, as per the OLBMP. .

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		such 'ground strengthening works' in situ		
1.10.4	Natural England	IPs Views sought. Can the relevant bodies please confirm whether they have any comments or observations in respect of the Framework CEMP [APP-043]?	A number of our representations refer to the fCEMP as the means for securing mitigation: NE1, NE9, NE11, NE16, NE22, NE23 Further themes and issues may rely on the fCEMP for implementation as and when the updated Report to inform HRA becomes available.	The Applicant has provided updated responses to each representation made (NE1, NE9. NE11, NE16, NE22, NE23) – see [DOC REF]. In response to some of these representations, an updated version of the Framework CEMP was submitted into the Examination at Deadline 2 [REP2-011].
1.10.9	Natural England	Clarification/ Views sought Paragraph 10.5.10 of ES Chapter 10 (Geology, Hydrogeology and Contaminated Land) [APP-062] states that assessment of the significance of impacts will take into account the principles of assessment in the Construction Industry Research and Information Association (CIRIA) Report C552 (2001) and the EA's Guiding Principles for Land Contamination in assessing risks to controlled waters (EA, 2010). It also explains that any such risk-based assessment may indicate the need for mitigation measures additional to those as detailed in the ES. An environmental risk assessment has been submitted at ES Appendix 10C (Contaminated Land Environmental Risk Assessment) [APP-196]. Bearing these documents in mind: i) The Applicant is asked to explain how its risk assessments have taken into account the EA's Guiding Principles for Land Contamination. ii) All relevant IPs are asked to confirm whether they consider the Applicant has used the most up to date and	No comments.	Noted.

Exa question Ref. no.	IP	Question	IP Responses	Applicant's Response
		appropriate approaches for undertaking such risk assessments (ie to controlled waters and human health); and if not to explain what approaches to such risk assessments the Applicant should have followed?		

Table 21-2: Response to Natural England's Relevant Representation Deadline 2 submissions

REF. NO.	NATURAL ENGLAND RELEVANT REPRESENTATION ISSUE	APPLICANT'S RESPONSES	NATURAL ENGLAND'S D2 RESPONSE	APPLICANT'S RESPONSE AT D3 (ITALICISED RESPONSES HAVE ALREADY BEEN SUBMITTED WITH THE CHANGE APPLICATION)
NE1: Risk of HDD Collapse/Leakage of Drilling Fluid to SPA Sites	We note that Paragraph 4.2.2 of the Report to Inform Habitats Regulations Assessment states that 'The Teesmouth and Cleveland Coast SPA and Ramsar are within the boundary of the Proposed Development Site. The Proposed Development has been designed to avoid the direct loss of habitat within the SPA and Ramsar site boundaries through use of HDD. However, direct habitat loss could occur in the event of HDD collapse. The risk of HDD collapse / leakage of drilling fluid was considered in the Secretary of State's HRA for the Net Zero Teesside (Department for Energy Security and Net Zero (DESNZ), 2024) (which is adjacent to the Proposed Development) project following concerns by Natural England raised by NE in Relevant Representation and during Examination. It has therefore also been considered here.' For the Net Zero Teesside project commitments were logged in a framework CEMP [APP-043] to address NE concern regarding direct loss to sites in the event of HDD collapse. NE advise that a similar solution should apply to H2Teesside and be considered within the HRA.	Available soils data, (refer doc NS051-CV-REP-OA1-00008 Preliminary Onshore Ground Investigation for NZT Ground Investigation Report which covers an adjacent HDD crossing ca 85m to the north, but subject to confirmation from the H2T Ground Investigation works and reporting to confirm this assumption) suggests the ground conditions are suitable for current HDD technology giving confidence a successful HDD can be undertaken subject to further GI and detailed design. Methods will be applied, such as using a conductor pipe, to reduce the risk of frac out off-shore as part of standard design. Confirmatory ground investigation is being undertaken later this year to optimise the drilling programme, design and methodology and the selection of drilling fluids to reduce the consequence and probability of a frac-out. The Applicant confirms that water based drilling fluids that are inert in the marine environment will be used during HDD operations to minimise any potential effects on the marine SPA. These will also disperse readily in the marine environment.	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. Natural England are waiting for an updated framework CEMP to reflect 'lessons learned' from the NZT 'frac out' provisions, which is currently being prepared by the Applicant. Pending receipt of the revised fCEMP we would add the following provisions, consistent with our Statement of Common Ground for the NZT project, as follows: *If a frac out were to occur within the designated site, Natural England would expect to be notified and that the clean-up be agreed in consultation with Natural England. This is because in some cases the clean-up itself can create an impact and we would like to avoid this.* *Access routes to the intertidal should be agreed ahead of the use of any equipment (i.e. tractor) mobilising, ensuring sensitive*	*The Framework CEMP was updated at Deadline 2 [REP2-011] to take account of Natural England's Relevant Representation. Reference to a clean-up plan has been added to the list of plans to be produced as part of the Final CEMP (Paragraph 2.3.2 and Table 7-2). This has also been updated in the HRA as part of the Proposed Change Application [EN070009/EXAM/7.3], see Paragraph 6.1.8.* *The specific wording proposed by Natural England has not been included as the Applicant did not have sight of this prior to the submission of the updated Framework CEMP at Deadline 2. However, the principles of what NE are seeking have already been incorporated in the wording proposed. The Proposed Development does not involve access to the intertidal environment.* *In addition, consultation with Natural England regarding HDD operations is already secured in the water REAC table (Table 7-2), contained within the Framework CEMP [REP2-011], as follows:* *"Natural England, and any landowner of land crossed by the HDD, would be consulted on the effectiveness of the proposed measures in reducing effects on designated sites."*

REF. NO.	NATURAL ENGLAND RELEVANT REPRESENTATION ISSUE	APPLICANT'S RESPONSES	NATURAL ENGLAND'S D2 RESPONSE	APPLICANT'S RESPONSE AT D3 (ITALICISED RESPONSES HAVE ALREADY BEEN SUBMITTED WITH THE CHANGE APPLICATION)
		All of these measures are inherently taken into account in designing and delivering a robust HDD irrespective of the designation status of the surface environment. Natural England, confirmed during NZT Examination their agreement that there is unlikely to be a significant effect from HDD collapse for the NZT HDD work. However, they did request that a 'clean-up plan' is produced in the very unlikely event that a collapse did occur. The contractor will also undertake analysis to identify key parameters to be monitored during installation and subsequently monitor the drilling operations to ensure parameters remain within safe operating envelope. A review of the works for the NZT HDD will be undertaken to assess the effectiveness of site procedures and whether any 'lessons learned' would be beneficial to the H2T HDD. Given these integral elements of HDD design and delivery it is not considered that an adverse effect on integrity would arise due to HDD collapse and associated SPA habitat loss. The Applicant will introduce a commitment to produce a 'clean-up plan' and to learn the lessons from NZT within the Framework CEMP [APP-043]. This plan will be (or has been) discussed with Natural England and will be incorporated into an updated Framework CEMP at Deadline 2.	*features are not impacted.* Regarding soils (Soil resources and Best and Most Versatile land) we can confirm that we do not anticipate the HDD part of the scheme resulting in material impacts on soils resources.	
NE2: Impact Assessment on Birds	Natural England notes that in the Report to Inform a Habitats Regulations Assessment the Applicant has ruled out Adverse Effect On Integrity (AEOI) or SPA bird species (which are either designation features alone or part of the waterbird assemblage) based on their numbers for each sector and what percentage of the SPA population this represents. Natural England does	Impacts upon birds have been assessed on a field by field basis due to the complexity of the project, extent of the development boundary and the expected duration of the programme of works and in acknowledgement that works are not likely to occur across all parts of the Proposed Development simultaneously. The	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. Natural England are waiting for an updated Report to inform HRA to reflect a	*The Ornithology Supplementary Baseline Report [EN070009/EXAM/6.2.13AA] has been submitted alongside the Proposed Change Application [EN070009/EXAM/7.3].* *The Report to Inform HRA [EN070009/APP/5.10] has been updated alongside the Proposed Change*

REF. NO.	NATURAL ENGLAND RELEVANT REPRESENTATION ISSUE	APPLICANT'S RESPONSES	NATURAL ENGLAND'S D2 RESPONSE	APPLICANT'S RESPONSE AT D3 (ITALICISED RESPONSES HAVE ALREADY BEEN SUBMITTED WITH THE CHANGE APPLICATION)
	not agree with this approach to ruling out AEOI on SPA species. Natural England advises that the impacts on individual bird species are assessed for the project site as a whole rather then on a sector-by-sector basis. This should be presented for different stages of the project (taking account of when multiple activities are likely to occur at the same time) as well as for the project as a whole. In the current reports data are presented for individual species. These data should also be combined to provide a 'waterbird total' in analyses (to enable better understanding of impacts on the >20K waterbird feature). See NE Issue Refs 03 to 08 for additional information that is required to assess the impact on SPA/Ramsar features .	approach chosen was considered to be the most appropriate way of identifying the peak counts of qualifying bird species in specific locations which could be impacted. The Applicant has not added up the peak counts of birds for the Proposed Development as a whole, as the Proposed Development Site covers a large area, and birds will use different locations at different times throughout the day, week, month and year and in response to changing tidal state, weather conditions and other environmental factors not under control of the Applicant. Thus, the Applicant considers that sufficient conservatism is built in to the assessment by considering the peak counts that are spatially relevant to the extent of the Proposed Development, recorded from multiple sources of data, and the frequency of occurrence of a given species at a given location. Adding up the peak counts of birds for the whole Site would inflate the number of birds considered in the assessment of disturbance of any particular activity. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination.	review of the bird survey data. This is currently being prepared by the Applicant. In addition we anticipate the need for an explicit consideration of the scheme's work phases in order to assess satisfactorily the potential for impacts on the SPA's classified bird species.	*Application with the updated bird survey results and to reflect the changes to the scheme design outlined in the Change Application Report [EN070009/EXAM/7.3].* *The Applicant will discuss consideration of the Proposed Development's expected work phases further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*
NE3: Functionally Linked Land (FLL)	SPAs are classified for rare and vulnerable birds. Many of these sites are designated for mobile species that may also rely on areas outside of the site boundary (referred to as 'functionally linked land' (FLL)). 'Functional linkage' refers to the role or 'function' that land or sea beyond the boundary of a European site might fulfil in terms of ecologically supporting the populations for which the site was designated or classified. Such land is therefore 'linked' to the European site in question because it provides an important role in maintaining or restoring the population of	The baseline report describes in some detail where birds were recorded roosting and/or were already known to roost, and went on to identify key locations for SPA species and the function of those locations. The limitation with any set of data is that each bird count is a point in time or snapshot of numbers and activity . However, the data presented are sufficiently robust for the Applicant to be confident about where roosting occurs and by which species. In particular, the	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. Natural England understands that bird survey data is available to address this point. The Report to inform HRA should be revised accordingly.	*The Ornithology Supplementary Baseline Report [EN070009/EXAM/6.2.13AA] has been submitted alongside the Proposed Change Application [EN070009/EXAM/7.3] and the Report to Inform HRA [EN070009/APP/5.10] has been updated to reflect this.* *Section 13-3 of ES chapter 13 (Ornithology) stated that survey areas were identified:* *to cover all potential functionally linked land up to approximately 500m from the Proposed Development*

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	qualifying species at favourable conservation status. These supporting habitats may be used by SPA bird populations or some individuals of the population for some or all of the time. These supporting habitats can play an essential role in maintaining SPA species populations, and proposals affecting them may therefore have the potential to affect the designated site. FLL is to be lost during the construction of the main site and connection corridor. It is unclear what losses of FLL are to be temporary or permanent, and what the specific function of the land to be lost serves to SPA birds (i.e. foraging or roosting habitat). We advise that the losses of FLL are quantified by type (permanent or temporary) and function (roosting, foraging etc) for birds. In addition, further information on the phasing of works and how much functionally linked land will be unavailable to birds at any one time during the construction and operational phases should be provided, and how long it will be until any temporary losses will be restored and functional for bird use again. We note that some mitigation for avoidance of disturbance impacts to SPA birds during the construction of specific sectors of the connection corridor is the timing for these works to occur outside the overwintering period. Natural England generally supports this measure, however it is unclear when the land will be restored and by when it will be functional again i.e. to provide the sector-specific use to birds that it did previously. This includes sectors 18, G4, B4, B5 and B6. We advise that further information is provided on the timescales for restoration.	Applicant built the recording of bird activity through coded metrics into the baseline surveys precisely for this reason. The OLBMP confirms that habitats that would be temporarily lost or damaged during construction would be reinstated on a like-for-like basis. There will be no temporary habitat losses during the operational phase. The time required for habitats to reach target condition is considered to be the same as the timescales used in the DEFRA metric. However, habitats will be available for birds to use for foraging before they reach target condition. Birds will be able to use areas of bare ground to forage once excavations are backfilled. Given that much of the temporary habitat loss will be linear (where pipelines will be installed), the original habitat type will remain available on either side of the construction area so functionality will be retained. Furthermore, RSPB indicated during consultation in November 2023 that its habitat restoration goals across Cowpen Bewley included breaking up of the soils in some areas to improve habitat for foraging birds, which supports the notion that the areas of bare ground left temporarily by pipeline installation across several areas of existing grassland would not be detrimental to the utility of these broad areas of habitat for foraging SPA birds. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.		*and set out the underlying reasons for identifying these areas as functionally linked to the SPA; and* *to take account of other areas where ornithological features may be affected by the proposed development* *The baseline report provides supporting information that clearly identifies bird roosts. All other areas surveyed in which SPA birds were recorded (other than breeding SPA bird locations, which are discussed under NE11) principally support foraging birds, although occurrences of occasional roosting by individuals or small parties of birds cannot be ruled out at any location. The location of roosts and breeding locations of SPA birds maps closely to the extent of the SPA and adjacent habitats across Seal Sands and the North Tees Marshes north of the river and this is where the surveys identify the vast majority of functionally linked land that overlaps the Proposed Development.* *The Applicant has reviewed the information in the baseline report and ES Chapter 13 and agree that, while this is not explicitly stated, essentially all of the habitats surveyed north of the River Tees that lie outside of the SPA boundary have been regarded in our assessments as functionally linked land and the results of the bird surveys carried out by AECOM corroborate this.* *The Applicant will discuss consideration of the Proposed Development's expected work phases further with NE, including restoration, and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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NE4: Use of IECS 2013 'Waterbird disturbance mitigation toolkit'	Natural England does not support the use of IECS 2013 'Waterbird disturbance mitigation toolkit' as we do not consider the evidence to have been collected in a rigorous way, and the results have not been peer reviewed. Therefore, any assessment that relies on the toolkit may be inaccurate. Paragraph 4.2.23 of the Report to inform Habitats Regulations Assessment [APP-040] references the IECS toolkit and the thresholds for noise levels for bird disturbance. We advocate a precautionary approach to assessing disturbance to waterbirds, and advise that further work is required to inform impacts on SPA bird populations (see comments in key issue ref NE5 below).	Paragraphs 4.2.23 and 4.2.24 of the report to inform HRA [APP-040] make reference to literature where noise disturbance thresholds are discussed. The IECS waterbird mitigation toolkit states '*generic guidelines at present are precautionary for consenting requirements and employ an approach distance to 300 m and a low noise threshold figure of 55 dB (possibly based upon research by Wintermans in 1991 which recorded no effect on shooting or roosting waders where noise levels did not exceed 55 dB. E.g. a level where no effect occurred rather than a threshold where effect commenced*). *A 70 dB noise threshold has however been developed over a period of years, based upon published data as well as findings from primary observations (e.g. Cutts and Allen, 1999, Cutts, Phelps & Burdon, 2008 and Cutts and Hemmingway, 2010).*' Paragraph 4.2.26 notes that as part of discussions involving the adjacent Net Zero Teesside Project, Natural England officers advised that a 70 dB metric was appropriate to use for impact assessment regarding the Teesmouth and Cleveland Coast SPA / Ramsar and hence this approach was also applied here. Additionally, for this project, the Applicant also considered the potential change in baseline noise. A change in noise levels of 3 dB at locations where predicted noise levels will exceed 55 dB has been used to screen the potential for LSE within this HRA. 3 dB is the smallest change in noise that can be perceived as a change; it is not a damage or impact threshold but merely identifies the need for further consideration as there is a considerable difference between a sound being perceptible and it being disturbing.	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. Please refer to NE5 below for more detailed explanation of the approach needed to measure and assess noise arising from the project.	*Please refer to the Applicant's response to NE5 below.*

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		Therefore, the Applicant considers that potential noise impacts have been assessed robustly.		
NE5: Noise Impact Assessment	Natural England notes that the noise modelling figures presented only includes average noise levels for the construction and operational phases of the development and there is little reference to the existing noise environment. In order to inform assessment of the potential impacts on SPA birds from noise disturbance it is essential to understand changes from the baseline noise environment and also the magnitude and frequency of occurrence of impulsive noise (such as that produced by percussive piling) at bird receptors. We therefore advise that change in noise levels as well as absolute noise levels are presented for all areas which SPA birds utilise (functionally linked land and SPA habitat) and that impulsive noise is also quantified. LAmax (fast) and LApeak are useful metrics to describe impulsive noise. We note that the Applicant has outlined mitigation for noise impacts in the form of noise barriers, noise abatement measures and timings of works. Natural England is generally supportive of these types of mitigation for noise impacts associated with construction, however it is unknown if such measures will be sufficient without a better understanding of changes to the noise environment and phasing of work across the whole development. We note in Paragraph 6.5.6 of the Report to Inform Habitats Regulations Assessment [APP-040] that 'It has been assumed that installation of noise barriers will result in a 10 dB reduction in noise levels'. It is unclear if the noise modelling levels presented in the ES include the 10dB reduction associated with the mitigation or not. This needs to be clarified. We advise that figures on noise levels are presented both without and then with mitigation in order to allow for an assessment of whether the	A change in noise levels of 3 dB at locations where predicted noise levels will exceed 55 dB has been used to screen the potential for LSE within the HRA. Baseline sound survey data is provided in Table 4-3 within the report to inform HRA [APP-040]. As it is not possible to model baseline noise as contour plans, so the nearest noise monitoring locations representative of the area have been used when assessing the baseline. The LAeq2 values presented combine all measurements taken in each time period (day/night). The LAF Max level is the maximum sound level with 'A' frequency weighting and Fast Time weighting during the measurement period. Figures 7 to 10 within the report to inform HRA [APP-040] show predicted noise levels in the absence of mitigation and a reduction of 10 dB can be achieved with mitigation. The Main Site has been subject to disturbance for a number of years with works including the demolition of the former buildings and structures and site remediation. Habituation to noise was discussed within the NZT HRA when agreeing appropriate noise disturbance thresholds. Construction of the River Tees HDD crossing is estimated to take approximately 50 weeks. Acoustic barriers and visual screening are proposed to mitigate the effects of noise and visual disturbance	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. When assessing noise disturbance thresholds, it is imperative to note the type of measurement, otherwise the decibel level is somewhat meaningless. The appropriate threshold is a 55-70 db LAmax. Measurement of a maximum level is necessary to assess the loud bangs and impulsive noise that can disturb non-breeding waterbirds during construction and operation. If not clarified, the level stated is likely to be an average, which could mask potentially damaging effects of noise on birds.	*Please see the further detail on this point provided in the text following this table.* *The Applicant will discuss consideration of the scheme's work phases further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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	mitigation is sufficient, or if there will be residual effects. We also note that in several paragraphs of the Report to Inform Habitats Regulations Assessment [APP-040] that the Applicant states that birds on or adjacent to the development site will already be habituated to noise and visual disturbance (e.g. 6.5.25, 6.6.0, Table E-1). Natural England does not agree with this statement and advises that if noise levels are assessed to impact on SPA bird populations that avoidance or mitigation measures should be provided. Natural England also note that the location for the pipeline crossing of the Tees is a critical area for waterbirds. Natural England advise that further assessment of noise impacts to birds across the 50 week programme is undertaken to ensure that the timings of noisy works is designed to minimise impacts. For instance, the timing of the above-ground component of the works should be outlined. Mitigation opportunities such as timing noisy works during less sensitive periods within this long work programme and/or to specific sides of the river should be appraised.	during this time. Due to the duration of proposed works and a detailed construction programme not being available until post-consent, it is not possible to use timings to minimise disturbance and impacts have been assessed based upon on a worst case scenario, works taking place across the full 50 week programme. As per Section 6.5 of the Report to Inform HRA [APP-040], noise disturbance at the Teesmouth and Cleveland Coast SPA was scoped into Appropriate Assessment. A suite of measures designed to reduce noise have been proposed in the Framework CEMP [APP-043], these are listed at Paragraph 6.5.4. With the mitigation measures in place, a conclusion of no adverse effect on integrity at this location could be drawn. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination		
NE6: Visual Screening	Natural England notes that screening is proposed (Paragraphs 13.7.1 and 13.7.2 describe relevant locations) to mitigate visual disturbance. Impacts of visual disturbance on SPA birds may be compounded by other factors, such as noise disturbance. The interaction between different factors can be complex and depends on aspects such as the proximity of the disturbance events to the receptor, sightlines from the receptor, etc. The areas proposed for visual screening may therefore need to be modified/expanded following the further analysis of noise and other impacts requested in NE refs NE7 & NE8.	The visual and noise assessments have been undertaken on a worst case scenario based upon available information at the time of undertaking the assessment. These assessments have subsequently been used to inform the HRA [APP-040] and the need for any mitigation accounting for the interaction between different factors, e.g. the proposed location of noise barriers also accounts for visual considerations. The Applicant will discuss the need for any amendments to the visual screening proposals with NE as part of its discussions	At this stage, Natural England's position remains as set out in our Relevant Representations. Note that this representation is linked with NE7 and NE8 due to the cumulative effects of visual and noise impacts pathways.	*Indicative locations for screening have been provided in Figure 14a and 14b within the Report to Inform HRA [EN070009/APP/5.10]. These locations will be updated when further detailed assessments are undertaken, if required.* *The sound/noise reduction caused by a barrier depends on two factors, the path difference of the sound wave as it travels over the barrier compared with the direct transmission to the receiver, and the frequency content of the sound. A broad rule of thumb for sound/noise barriers is that where the sound/noise source is totally obscured from the receiver position, an approximate 10 dB reduction in sound level can be achieved at the*

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		on the wider issues set out in rows 7 and 8 below.		*receiver. Where the sound/noise source is partially obscured such that the top of the source is just visible to the receiver over the barrier, a 5 dB reduction in sound/noise level can be achieved at the receiver.* *The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*
NE7: Quantification of operational visual disturbance sources	Natural England notes that visual disturbance during operation has been screened out as no Likely Significant Effect (LSE) due to habituation. Natural England do not agree with this approach because there are very few instances where habituation with no negative impacts occurs. In most cases of apparent habituation birds are still suffering negative impacts, such as elevated stress levels or reduced foraging rates from increased vigilance. Natural England also note that there is no reference to potential activities along the pipeline corridor during operation, such as inspection visits and maintenance. Natural England request that likely sources of visual disturbance during operation are better quantified and that a robust analysis of impacts is undertaken. This analysis would inform whether any mitigation is required.	The land within and surrounding the Main Site has been subject to anthropogenic disturbance historically as it was the site of the former Redcar Steel Works. There are ongoing industrial activities within Teesworks including demolition and site remediation activities and movement of materials and machinery. As such, the bird assemblage in this area is likely to be habituated (to some extent) to the industrial landscape and activity. Disturbance within the Main Site will be limited once the Proposed Development becomes operational. Typical activities will include the arrival and departure of site staff; the average daily operational traffic will comprise fewer than 15 Heavy Goods Vehicles (HGVs) and approximately 50 light vehicles during regular operations. Some external lighting would be required to ensure that the Hydrogen Production Facility can operate safely at all times. It would be at the appropriate luminance required to provide safe working conditions. Lighting would be designed, positioned and directed to prevent or minimise light disturbance to sensitive receptors (human and ecological) and low-energy fittings would be used where possible. As such, visual disturbance during	At this stage, Natural England's position remains as set out in our Relevant Representations.	*The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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		operation is anticipated to be lower than that historically or currently experienced within the site. Operational requirements in the pipeline corridor will be limited, requiring arrival by LGV and walkover visual inspection. Plant or equipment would, in the main, not be required, but there may be isolated incidents where unplanned/emergency repair is required where they may be necessary. Such isolated activities would not lead to likely significant effects. An additional consideration relevant to the operation of the Main Site is that habitats immediately adjacent to it are sand dunes containing dune ponds, all but one of which are choked with swamp vegetation and therefore unsuitable for SPA birds. The remaining habitats within much of the dune system are also topographically "enclosed" and therefore suboptimal for most SPA birds, which is reflected in the baseline survey and desk study data presented to support the HRA. The dune system physically separates the main site from the open habitats of Coatham Sands and Bran Sands Bay, which are more readily used by SPA birds. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination		
NE8: Sightlines from the Blast Furnace Pool	It appears that the new hydrogen production facility will reduce sightlines from the Blast Furnace Pool (sector 3a) and the area will become less 'open'. This could have a number of negative impacts on waterbirds ranging from increased vigilance when using the pool and increased	There is currently little evidence that this pool or any part of the dune system in the vicinity of the Proposed Development is used in any more than an occasional way by SPA birds, although it is likely to be targeted for measures to improve SPA	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. The applicant has undertaken to	*It is noted that the changes to Main Site elevations considered under Change 7 would not make any change to the conclusions with regards to visual disturbance in the Report to Inform HRA.*

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	predation risk to direct avoidance of the pool. These impacts have not been adequately addressed in the assessment.	condition by NE in attempts to reverse this. Across all of the high and low tide surveys of this sector (which collectively number 24) 4 SPA species occurred and none of them occurred more than twice, nor did any occur in numbers significant in the context of the SPA populations. Sightlines may be reduced to the south-west by the Proposed Development, an area that has previously accommodated infrastructure and buildings albeit not of the same specification or layout. Sightlines to the north (Coatham Sands) and west (Bran Sands Bay) will not be affected.	review the building layout and to illustrate the vertical scale of the main site buildings in relation to Blast Furnace Pool to inform assessment of the scheme's impacts.	*Until recently, significant steelworks structures and conveyors occupied the Main Site, resulting in a lack of sight lines for many years prior. If any sight lines have opened up, this was a recent development that has only occurred in the last few months due to the ongoing demolition of structures on the Main Site by STDC.* *The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*
NE9: Construction Dust Assessment and Monitoring	Without mitigation there could be a potential significant/ adverse effect on the Teesmouth and Cleveland Coast SSSI/SPA/Ramsar, as a result of construction dust. The applicant indicates standard mitigation would be sufficient to reduce this to non-significant – though assessment of the efficacy of each of the measures is not provided. Similar approaches are provided for operation (e.g. travel management) and decommissioning. For example, with reference to para 6.6.38 of the HRA, is unclear exactly which measures in the DEMP would reduce the air quality impacts at Teesmouth SPA/ Ramsar – and whether they could prevent any otherwise adverse effects on the qualifying features. A more robust assessment should be provided, with a commitment to monitoring.	The FCEMP includes mitigation measures relating to potential dust impacts within Table 7-1. The proposed good practice dust control measures selected originate from the 'high risk' site guidance published by the Institute for Air Quality Management. The control measures were selected based on decades of successful adoption at UK construction sites with the primary aim of minimising emissions at source and thereby minimising the transfer of dust beyond the site boundary. It is assumed that the same measures would be applied as part of the DEMP at decommissioning. All measures deployed to limit dust beyond the boundary of the construction area would protect the Teesmouth & Cleveland Coast SPA/SAC/SSSI as they are proven measures to protect human health and would therefore also protect ecological receptors (which are less sensitive). Table 9-1 within the Framework CEMP [APP-043] contains a commitment to monitor dust during earth moving activities. This table will be reviewed and updated in the Final	At this stage, Natural England's position remains as set out in our Relevant Representations. Without mitigation there could be a potential significant/ adverse effect on the Teesmouth and Cleveland Coast SSSI/SPA/Ramsar Site, as a result of construction dust. It is accepted that standard dust management techniques are generally effective at minimising dust beyond the site boundary. However, as the protected sites are very close/ adjacent to the site boundary, it is not accepted that measures designed for protection of human health would automatically protect sensitive ecosystems, given the different mechanisms of impact and the differential proximity. Demolition dust mitigation works within the fCEMP and PPW CEMP are likely to be generic, but as long as justification is provided that there will be no impact on the integrity of the protected sites, it is considered appropriate to rely on these as	*Human receptors are generally more sensitive to dust than ecosystems because of particulates in atmosphere that can be breathed into the lungs. In contrast, for ecosystems the main concern of dust is coating of vegetation (i.e. much larger than the particles that can be breathed into the lungs). Therefore, measures that will control dust emissions to such an extent that small particulate release is minimised will certainly be sufficient to prevent significant dust coating of vegetation.* *It is noted that the Framework CEMP [REP2-011] at Section 9 sets out that one of the main aims of the monitoring regime to be included in the Final CEMP is vegetation protection.* *Noting the above, and the commitment to consult with Natural England on the effectiveness of any proposed measures (including monitoring) in reducing effects on designated sites (see Table 7-2 of the Framework CEMP [REP2-011]), the Applicant considers this matter to be closed.*

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		CEMP once construction details have been fully defined.	compliance with the CEMPs will form part of the DCO consent. As well as the mitigation, monitoring of dust is proposed/ committed in Table 9.1 of the Framework CEMP. Therefore it is accepted that construction dust would not result in an AEOI to the Teesmouth protected sites as long as ecological receptors are included in the monitoring scheme and there is a mechanism to ensure any dust beyond the site boundary is mitigated (by cessation of works in that area if necessary).	
NE10: Ammonia emissions from vehicle and Acid Deposition	Ammonia emissions have not been considered within the assessment of construction traffic (and traffic in the in-combination aspect for operational consideration). Ammonia is a pollutant in its own right, and also a component of nitrogen deposition (Ndep). Para 8.3.22 in the Air Quality (AQ) ES chapter indicates the traffic assessments consider NOx (and Particulate Matter - PM) and this is used to calculate Ndep. However, Ndep levels in the assessment will be lower than reality as they do not include the ammonia component. Acid deposition is also not considered for the traffic assessments (though it is for the operational assessment). Para 8.3.21 notes SO2 will be emitted from traffic but is not considered further as relevant AQ objectives are not exceeded and concentrations will be low. However, SO2 is an important component of acidifying pollution alongside NOx, and can locally be important even if its concentration does not exceed its critical level. Without this information it is not possible to conclude there would be no adverse effect on the integrity (AEOI) of the Teesmouth and Cleveland Coast SPA/Ramsar. The assessment should model ammonia emissions from vehicles. Further information on this is available FAQ 143 – Assessment of Ammonia | LAQM (defra.gov.uk). Ammonia levels should be	It is noted that FAQ 143 confirms there is currently no agreed guidance for the assessment of road traffic ammonia emissions or statutory criteria for establishing the need for such an assessment. Defra and NE are at an early stage in developing this guidance. In discussion with NE, construction traffic air quality modelling will be updated using the CREAM emissions database to account for ammonia emissions and acid deposition from traffic as part of the updating the Report to Inform HRA. Although it is expected that the contribution will not be material, the calculations will be reported for completeness. Note that the only SPA/Ramsar interest features of concern regarding atmospheric pollutants are the nesting terns and nesting avocet. According to APIS even the nesting terns and avocet are not sensitive to NOx, acid deposition or ammonia in atmosphere. Therefore, for the SPA/Ramsar the only pollutant that needs exploring is nitrogen deposition at the avocet/tern nesting locations. Moreover,	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. It is noted and welcomed that ammonia concentrations will be reported and included in the updated Report to Inform the HRA. It is understood that CREAM will be updated late Summer 2024 so the version used should be noted. Comments on tern and avocet locations are noted and accepted, but the arguments for the broad habitat structure rather than subtle changes in botanical composition being relevant should be included clearly in the summary table. Natural England agrees that the assessment of construction traffic emissions should be introduced earlier for clarity.	*The HRA has been amended to address these points alongside the Proposed Change Application - see paragraph 4.2.85 onwards and 4.3.6 onwards.* *Further details on the assessment of cumulative road traffic emissions impacts using the NAE001 Methodology are included in Annex G of the updated HRA.*

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	given as a concentration and compared against the relevant critical level for the qualifying features (where relevant) and should be included in the calculation of Ndep levels. Acid deposition (including any sulphur input) should also be considered in the assessment.	for avocet the impacts of N deposition are as likely to be positive as negative according to APIS. While ammonia will contribute to nitrogen deposition, it should be noted, as per paragraph 4.2.94 of the HRA, 'Moreover, there are no tern or avocet nesting locations within 200 m of the affected roads' [the only European site relevant to traffic emissions being Teesmouth & Cleveland Coast SPA]. The traffic routes are entirely to the east of the Main Site (via A66 and A174) whereas the nesting areas are all west of the Main Site. Based on data from INCA, the main nest areas are a minimum of 2.9km west of the Main Site (for avocet) and 2.8km west of the Main Site (for little tern). The nearest historic location (South Gare) is a little closer, 1.7km from the Main Site, but there has been no successful nesting there since before 2018. Additionally, paragraph 4.3.3 in the operational emissions section of the Report to Inform HRA [APP-040] explains why acid and ammonia are not considered for Teesmouth & Cleveland Coast SPA. The interest features are not sensitive to acid deposition according to APIS. While their habitats may be sensitive to ammonia, the nesting terns and avocet of the SPA/Ramsar will only be affected by changes in broad habitat structure rather than by relatively subtle changes in botanical composition. This rationale was also included in the HRA for the granted Net Zero Teesside DCO, and Natural England expressed no disagreement. This section on operational traffic emissions		

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		applies equally to construction emissions and can be introduced earlier for clarity.		
NE11: Construction Emissions	It is not clear that all sources of construction pollutants have been considered in the construction emission section. These include: 1) Construction emissions from non-road mobile machinery (NRMM) such as generators on the main site or in the 7 construction compounds or for access/ highway works. Para 8.3.2 in the AQ chapter indicates the study area for this source was 50 m from the Proposed Development Site (250 m from the Proposed Development Site entrances). Teesmouth and Cleveland Coast SPA and Ramsar Site are within 50m but were scoped out of the assessment (para 8.3.19). Depending on the fuel type to be used, NRMM could emit NOx, SO2 and ammonia, resulting in acid deposition and nitrogen deposition to nearby habitats including at Teeesmouth and Cleveland Coast SPA and Ramsar Site. It is not clear that 50m is a sufficient distance to disperse to negligible levels – so evidence should be provided why this distance is used – or modelling undertaken to cover a wider area. 2) Construction emissions from traffic on internal roads/ haul roads – it is not clear if emissions from the main site include these (for ecological receptors within 200m of the site boundary including Teesmouth and Cleveland Coast SPA and Ramsar Site) – See NE10. 3) Emissions associated with landscaping around Cowpen Bewley Open Space replacement have not been considered. Para 4.8.3 indicates traffic impacts are expected to be minimal and below thresholds – but this is not confirmed.	1)The assessment has taken into account the presence of designated ecological sites and distance to them from the application site boundary using the methods proposed by the Institute for Air Quality Management referenced within the assessment. It is noted that actual works and associated emissions from NRMM are transient and the location of emissions move around the site. Consequently the site boundary is the theoretical closest distance between any emission and a receptor and is a conservative approach. Moreover, these sources are mainly within the main construction site which is more than 200 m away from tern and avocet nesting areas. 2)The assessment considers the movement of road going vehicles at the site boundary and on the public highway. Trucks that only operate onsite (NRMM) are not considered separately, see 1) with respect to distances. 3)The minimal amount of works required (mainly tree planting) means that traffic flows associated with landscaping around Cowpen Bewley Open Space replacement will be significantly below assessment thresholds. 4)Demolition and clearance works prior to main works will be controlled by the measures included in the FCEMP. Works undertaken prior to main works are listed in Chapter 5 (5.3.7) as Permitted Preliminary works and will be subject to a	No significant impacts are anticipated for the international designated sites listed. It is accepted that NRMM sources were considered, but were not within 200m of nesting sites (from the site boundary at the theoretical closest points) - assuming the nesting site locations etc are included in the HRA no further assessment for AQ is required. It is also acknowledged that traffic numbers for tree planting/ landscaping would be <1000AADT/ 200AADT HDV and therefore no assessment of traffic air quality impacts arising from these works are necessary. Demolition dust mitigation works within the fCEMP and PPW CEMP are likely to be generic, but as long as justification is provided that there will be no impact on the integrity of the protected sites, it is considered appropriate to rely on these as compliance with the CEMPs will form part of the DCO consent	*The locations of tern and avocet nest sites were provided in table 13A-5 of the ornithology baseline report, as supplied by INCA. Further locations were recorded during AECOM surveys and are described in the report narrative, and these map fairly closely to some of the INCA locations. Mapping can be provided to Natural England if considered helpful.* Please also refer to the Applicant's updated response to NE8 above.

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	4) Emissions (dust) from demolition and site clearance which would take place before the main works. Clarification that impacts will be subject to their own assessment and mitigation of impacts is required. See NE9. Without this information it is not possible to conclude there would be no AEOI on the Teesmouth and Cleveland Coast SPA/Ramsar.	PPW CEMP (5.3.120). The fCEMP [APP-043] includes mitigation measures relating to potential dust impacts within Table 7-1.		
NE12: Sources of Operational Pollutants	It is not clear that all sources of operational pollutants, as outlined in Chapter 4 of the ES [APP-056] have been considered in the operational emission section (EN070009 – 000239). In particular, sources of ammonia appear to have been missed (as well as not having been considered in the traffic assessment and excluded from the assessment of the auxiliary boiler emissions – AQ chapter para 8.4.7) which could underestimate impacts of this pollutant alone and its contribution to Ndep. These potential sources include: 1) Various effluent treatments (for example –bio-treatment plant, effluent treatment plant). Venting (or diversion to flare?) of some gases is assumed to be necessary. The biotreatment plant in particular is considered likely to emit ammonia as it is used to treat process condensate to reduce nitrogen concentration, using nitrification and denitrification (para 4.3.10). 2) Pipework (venting, fugitive emissions from valves and flanges etc). It is assumed emissions would be largely CO2, H2, N2, O2 and methane (so not of direct relevance to the designated sites AQ assessment, although potential explosion/ fire risk, and in some cases greenhouse gases) and reactive emissions would be limited, but this should be clarified.	Natural England's observations about the likely release points for substances such as carbon dioxide, hydrogen, oxygen, and nitrogen gases are correct; however these emissions are not directly relevant to the designated sites' air quality assessment since this is confined to assessment of NOx, ammonia, nitrogen deposition and acid deposition in line with guidance. Through the Environmental Permit application process, the Environment Agency will address the issue of total emissions on a mass balance basis, with any fugitive emissions included within those calculations. This assessment assumes that the total mass of emissions will be released to the air at the stated release locations, providing a conservative basis for evaluation. Further information will be provided to NE regarding operational traffic flows and combined impacts of ammonia emissions from road traffic and onsite operational plant and will be incorporated into updates to the Report to Inform HRA. All other potential emissions have been assessed or screened out of the impact assessment as insignificant based on release rates and locations.	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. It is accepted that the environmental permit will address emissions, including fugitive emissions but this will not cover the entire red line boundary, including e.g. traffic emissions – and the full extent of emissions should be considered in the DCO application, not wait for the environmental permit, as otherwise there cannot be sufficient confidence that there will not be harm to the protected sites. It is acknowledged that further information on ammonia from traffic and operational emissions (as in our RR questions) will be provided, and used to inform updates to the HRA. NE will comment on these when available. Further information should also be provided on the "closed loop" carbon capture process, including the treatment of any amine rich wastes. Any offsite treatment should be noted, and impacts considered.	*The HRA has been amended to address points in relation to traffic as part of the Proposed Change Application [EN070009/EXAM/7.3] see Paragraphs 4.3.6 to 4.3.14 and 6.6.2 to 6.6.9 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding atmospheric pollution.* *The carbon capture system to be installed on the hydrogen production facility is closed loop, meaning that the amines and associated degradation products are kept in a closed system and not discharged to atmosphere. The amine solution is recycled through a reclaimer system and returned for reuse. This is possible in chemical production processes such as the hydrogen production process, but is not possible in, for example, post combustion carbon capture on a power station, since the flue gas from the power station has to eventually be discharged to atmosphere and therefore can carry some amine and amine degradation products entrained in that flue gas. There is therefore no emission of amine and amine degradation products to atmosphere during normal operation. Any amine wastes that could arise are therefore minimal.* *It is noted that the Air Quality chapter of the ES (APP-060) (whose conclusions are not changed by the updates set out in the Change Application Report [EN070009/EXAM/7.3]) considers all emissions arising from the Proposed Development in the operational phase. While the non-Nitrogen and Acid deposition figures are only presented for Human Health, they lead to a conclusion of negligible adverse effects. As such, all*

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	3) Amine emissions are usually a byproduct of carbon capture systems. It is accepted that this process may avoid these by having a novel closed system (e.g. Para 8.3.35). Further information on this is required – including clarification of treatment of (presumably amine-rich) waste materials and how any fugitive gasses would be dealt with. 4) Dedicated vent stack – for venting CO_2 from the carbon capture units in contingency situations (para 4.3.6) – it is not clear if this could include venting of gases arising from the amine solvent or other pollutants. 5) Chemical storage – in particular, storage of the amine-based solvent used to absorb CO_2 produced by the H_2 production process, and aqueous ammonia imported by tanker (para 4.3.10). Other chemicals listed in para 4.7.4 of the ES should also be considered. 6) Air Separation Unit (or alternative O_2 and N_2 supply lines)– assumed emissions of N_2, O_2 or H_2, though reactions could occur resulting in emissions of NO_x or NH_3. 7) Indirect emissions – including emissions arising from any "waste" removed from the site, including amine-based waste from the amine based solvent used in the Carbon Capture process (eg segregated drain system?), or waste from the pre-treatment of natural gas to remove sulphur species. Emissions may occur from these off-site, even if outwith the direct control of the applicant/environmental permit. 8) Emissions from the 4-yearly major overhaul – although emissions would be temporary (over 28 days) and infrequent, there will be substantially	Amines associated with the carbon capture facility are not released to atmosphere – this is a closed loop process unlike that used for carbon capture from combustion sources such as power stations and EfW plants.		*relevant emissions have been presented to allow for full consideration of effects at this DCO stage.* *The ES Traffic and Transport Chapter (APP-068) concludes that operational traffic movements are expected to be very low, which given the conclusions in respect of construction, means no likely significant emission related effects to ecological receptors would arise as they are below the screening threshold for further assessment. This includes in relation to periodic maintenance periods.*

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	higher operational emissions for their duration, particularly in terms of traffic. This should be accounted for in the assessment. 9) Clarification of operational traffic including 4-yearly maintenance) - these have been excluded from the assessment as they fell below the Annualised Average Daily Traffic (AADT) thresholds. The applicant should clarify that this is the case when applied in-combination with other traffic from in-combination projects/plans as well as the project alone. The implication of traffic associated with the 4-yearly maintenance should also be considered. Without this information it is not possible to conclude there would be no AEOI on the Teesmouth and Cleveland Coast SPA/Ramsar.			
NE13: Stack Height Determination	The Rochdale Envelope included a minimum stack height (para Clarification of the sensitivity testing undertaken should be provided to NE 4.6.5). It is understood that a lower stack will result in lesser dispersion so potentially higher concentrations/ deposition at affected protected sites. Clarification that testing of alternative stack heights was undertaken to ensure that greater dispersion from a taller stack (up to the maximum) would not impact additional sites further from the site should be provided.	The stack height determination has considered the likely impacts on human health and all designated ecological sites within the study area, within and at the upper and lower bounds of the Rochdale Envelope. Please refer to Section 8B.7 of Appendix 8B: Air Quality – Operational Phase of the ES [APP-191].	Following discussion with the applicant NE accepts that the approach used is acceptable to establish a reasonable worst case in terms of the stack height, and that relevant ecological sites were considered.	*Following discussions with Natural England this matter is now considered to be concluded.*
NE14: Cumulative and combined effects	Para 8.3.33 in the Air Quality Chapter [APP-060] indicates that potential cumulative traffic emissions from the construction of the Proposed Development as well as the contribution from traffic associated with other committed schemes in the area, is reflected in the 2026 scenario. Further information about the traffic model should be provided – for example whether it includes allocations in the Local Plan and is therefore a worst case. It is not clear what search	TEMPRO has been used to include for Local Plan sites along with the combined impact from other cumulative sites as set out in Table 15A-42 of the Transport Assessment. As per the Applicant's responses to NE10 and NE12, traffic contributions for all traffic scenarios (operational traffic flows and combined impacts of ammonia emissions from road traffic and onsite operational	At this stage, Natural England's position remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. We await a revised Report to Inform HRA.	*The HRA has been amended as part of the Proposed Change Application see Paragraphs 4.3.6 to 4.3.14 and 6.6.2 to 6.6.9 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding atmospheric pollution.* *The in-combination assessment has been reviewed and updated in the Report to Inform HRA [EN070009/APP/5.10] to provide updates on Hygreen, York Potash and Teesside Flexible Regas Port.*

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	terms were used in establishing the long list of other plans/ projects included in Chapter 23 [APP-076] (e.g. para 23.3.14) - for example, no agricultural developments appear to have been listed in Appendix 23A [APP-221] which could have a local impact on Ndep or ammonia concentrations. The approach to identifying in-combination projects relevant to the HRA is also unclear. For example, it seems the in-combination assessment for traffic includes only other vehicle emissions, and not emissions from the (point) sources outlined in Chapter 23 of the ES [APP-076]. In addition, some projects are not included in the in-combination assessment in the HRA (Table 5.1) as their individual assessments did not highlight significant impacts at European sites. However, at screening the requirement is to assess whether several non-significant impacts could add up to a significant one.	plant) will be included for completeness within the in-combination assessment, forming part of the update to the Report to Inform HRA. Operational traffic movements are significantly lower than construction traffic movements for the Proposed Development. Therefore, it is expected that the contribution will not be material. The general contribution of agriculture to N deposition is captured through the use of background contribution to deposition rates. The planning regime does not provide a useful basis for understanding how individual farm operations and associated emissions to air, might vary year to year. A standard approach to assessing cumulative and combined effects has been undertaken, considering sources with the potential to be considered cumulatively based on location, emissions profiles and where appropriate emissions estimates or data exist, considering the developments identified through the ES cumulative process. The Applicant will undertake a review of the in-combination assessment to determine if there is a need to include any projects that have been dismissed on the basis that their own HRA identified no in-combination effects. This will be included in the anticipated update to the HRA, alongside other updates to the in-combination assessment to account for the on-going work to update the ES cumulative assessment [APP-076].		*The Applicant will review the list of additional projects provided by Natural England at D2. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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NE15: Approach to HRA (Air Quality)	Relevant habitat types/qualifying features and their associated critical loads (and critical levels for NOx, SOx and ammonia) should be provided for each site/receptor. Para 8.3.63 of Chapter 8: Air Quality [APP-060] indicates that "the impact of point source emissions on ecological receptors, through deposition of nutrient nitrogen or acidity, can be evaluated using the Environment Agency and Natural England's threshold for insignificance criterion of 1% of the long-term objective." It must be noted that Natural England requires this threshold to be an in-combination one (if the project alone does not meet it). It also applies to critical levels as well as critical loads for Ndep and acidity. The screening/ LSE stage should follow the approach to assessment laid out in NE's AQ guidance NEA001. If the process contribution from a project alone exceeds 1%, there is an LSE and appropriate assessment is required. This does not depend on background or PEC. These considerations and ecological considerations about the sensitivity of qualifying features are relevant, but should be addressed in the appropriate assessment as LSE cannot be excluded. If a project generates <1% alone, an in-combination assessment is required to see if 1% is exceeded in-combination prior to being able to conclude no LSE. At present the information provided in the HRA does not give sufficient information to be able to exclude AEOI. NE disagrees with the conclusion that there is no LSE arising from construction or operational NOx or Ndep at Teesmouth and Cleveland Coast SPA/Ramsar. It would also be helpful to follow the HRA process to include a table (relating to the assessment undertaken in Chapter 8 [APP-060]) outlining modelling results for each phase (construction/ operation), designated site, and project alone/ in-combination results. At present, reference has to be made to the appendices of Chapter 8 [APP-060].	Relevant habitat types, qualifying features, and their associated critical loads (and critical levels for NOx, SOx, and ammonia) for each site and receptor will be clarified. The methodology applied for the Report to inform Habitats Regulations Assessment [APP-040] for H2Teesside, including the assessment of whether the critical level for NOx would be exceeded in the LSE section, aligns with the approach used for the Net Zero Teesside HRA. It also reflects the fact that according to APIS the only SPA/Ramsar interest features of concern regarding atmospheric pollutants are the nesting terns and nesting avocet which are not sensitive to NOx, acid deposition or ammonia. Therefore, for the SPA/Ramsar the only pollutant that needs exploring is nitrogen deposition at the avocet/tern nesting locations. The project air quality modelling has forecast the effects 'alone' (Table 8B-29 to 8B-32) and 'in combination' (Tables 8B-40 to 8B-43) as presented in ES Appendix 8B (Air Quality). Updates will be made to the Report to inform Habitats Regulations Assessment [APP-040] to ensure that factors beyond whether the 1% of the critical level and load metric is exceeded alone or in combination are addressed in the appropriate assessment. However, it should be noted that for the only pollutant to which the key interest features of Teesmouth & Cleveland Coast SPA/Ramsar is designated (nitrogen deposition on the nesting terns and avocet) an LSE from operational nitrogen deposition in combination with other projects and plans has been identified at Teesmouth & Cleveland Coast SPA/Ramsar, which was taken forward to Appropriate	Discussions with the Applicant are ongoing on this matter. Assuming the information requested is provided in the updated HRA report, NE would be content with the methodology. We will review the assessment when provided.	*The HRA has been amended to address these points as part of the Proposed Change Application see Paragraphs 4.2.85 to 4.2.90, 4.3.6 to 4.3.14 and 6.6.2 to 6.6.9 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding atmospheric pollution. Further details on the assessment of cumulative road traffic emissions impacts using the NAE001 Methodology are included in Annex G of the updated HRA.*

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		Assessment in the Report to inform Habitats Regulations Assessment [APP-040], where other factors were discussed to inform the conclusion of no adverse effect on integrity. This will be reviewed and expanded upon in the update to the HRA. Additionally, supplementary air quality data including the in-combination traffic and operational plant emissions will be provided once available, as referred to in NE10 above.		
NE16: Construction Dust Assessment and Monitoring	Without mitigation there could be a potential significant/ adverse effect on the Teesmouth and Cleveland Coast SSSI/SPA/Ramsar, as a result of construction dust. The applicant indicates standard mitigation would be sufficient to reduce this to non-significant – though assessment of the efficacy of each of the measures is not provided. Similar approaches are provided for operation (e.g. travel management) and decommissioning. For example, para 6.6.38 of the HRA is unclear exactly which measures in the DEMP would reduce the air quality impacts at Teesmouth SPA/ Ramsar – and whether it could prevent any otherwise adverse effects on the qualifying features. A more robust assessment should be provided, with a commitment to monitoring.	Please see responses provided under NE Ref 9	At this stage, Natural England's position remains as set out in our Relevant Representations.	*Please refer to our response under NE9 above.*
NE17: Nitrogen Deposition (Ndep)	Para 12.6.16 in the ES Ch12 [APP-064] indicates that historic nitrogen deposition (Ndep) levels were higher than at present, and have declined. Although trends in NOx (as shown on APIS) have declined since 2015 – levels of Ndep have varied, with an overall limited decrease since 2015 while ammonia has increased dramatically. It is therefore not possible to indicate that pollution levels are declining, and the proposed	With regard to the SSSI, paragraph 12.6.16 shows that 'in combination' nitrogen deposition is forecast to be 13.89 kgN/ha/yr, whereas N deposition in 2003 was up to 14.77 kgN/ha/yr. Therefore a net improvement in nitrogen deposition is forecast and nitrogen deposition rates are forecast to be materially lower than they were when the habitat in question	At this stage, Natural England's position broadly remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter.	*The HRA has been amended as part of the Proposed Change Application see Paragraphs 4.3.6 to 4.3.14 and 6.6.2 to 6.6.9 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding atmospheric pollution. The HRA concludes no AEOI via Atmospheric pollution at Operation.* *With respect to little tern nesting locations, it is not clear if the plan supplied by Natural England is intended to*

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	development will not reverse this trend. The proposed development in-combination with other plans and projects, could delay any recovery. Section 6.6.3 in the HRA indicates that terns are sensitive to nitrogen deposition. Natural England agree that increases in nitrogen deposition can make nesting areas unsuitable for terns by promoting vegetation growth (in general terns favour sparsely vegetated areas to nest in). One historic site (around an area called 'the Ducky') is considered to have changed so much (from natural hydrodynamic changes) that it is no longer suitable for nesting, but other former nest sites around South Gare remain viable. Natural England also advise that there are a number of actions that could be taken to improve opportunities for nesting along this stretch of the coast (e.g. management of recreational disturbance). The addition of further Ndep may undermine the suitability of nest sites along the coast and therefore attempts to improve conditions. Overall, it is considered there is insufficient information at present to be able to exclude an adverse effect on the terns or avocets.	established at a time when there were industrial emissions in the area that have since ceased. This same argument presented in Chapter 12 [APP-064] was also submitted to the consented Net Zero Teesside DCO and was taken into consideration in the decision to consent the project. With regard to Teesmouth & Cleveland Coast SPA (as opposed to the SSSI), the point the Applicant is making is that despite the very elevated N deposition rates the nesting locations are nonetheless extremely sparsely vegetated. That indicates that N deposition is in practice having little effect on vegetation encroachment and therefore the small increase due to this project or in combination won't affect it. This identical argument was accepted by Natural England for the NZT DCO. Nonetheless, this will be revisited as the assessment presented in the HRA was very precautionary. The submitted HRA used the boundary of the SPA as the assessment location rather than the actual location of the nesting terns and avocet, which are much further from the Main Site (c. 2.8km west). As such nitrogen deposition to these areas is much lower than was reported in the submitted HRA. At these nearest tern/avocet nest locations (used since 2018) operational 'in combination' nitrogen deposition is modelled to be below 1% of the critical load. This will be added to the HRA. The reference to the historic nesting location at South Gare will be checked and confirmed but even this is 1.7km from the Main Site. Furthermore, while the historic	Although the points made relating to historic nitrogen levels are relevant, it must be recognised that levels are still above the critical load, and therefore the protected site is at risk of harm – even if historic levels were higher. The decline of <1kgN/ha/yr over 20 years indicates levels are still high with no rapid decline in nitrogen levels, and in-combination projects in the Teesside area coming forward are a risk to this slow decline. It is accepted that the impact of air pollution on the SPA will depend on the impacts on the bird qualifying features – largely as a result of ensuring vegetation encroachment does not adversely affect the nest sites. This argument can be made in the appropriate assessment, alongside the consideration of historic nesting locations as proposed. NE will review the updated shadow HRA when available. The location of the qualifying features of the SPA are relevant in establishing whether the conservation objectives are undermined. An in combination PC of <1% is sufficient to conclude no LSE and therefore no AEOI. We attach separately a map illustrating breeding site record for lt terns [*sic*] close to the main site to inform the applicant's updated air quality modelling and Report to inform HRA.	*show only little tern colony locations, or if it shows the locations of other species as well. The Applicant would also draw attention to the extent of the SPA shown on the plan, which appears to be based on the SPA boundary prior to the reclassification of the SPA that was adopted in 2020. If the plan is intended to show only little tern breeding locations, then the Applicant would question the validity some of the records. Little tern breed on open shorelines close to high tide mark. Some of the locations shown in Natural England's plan include inland areas such as Brinefields and Saltholme RSPB Reserve Pools north of the River Tees, where common tern and avocet are known to breed but there are no reliable records of breeding little tern, and where breeding habitats for this species are not found.* *It is also noted that, while in theory Coatham Sands provides suitable breeding habitat, the breeding site provided by Natural England at this location may be an error. The majority of publicly available historic breeding records for little tern are available from INCA, who were involved in the monitoring of little tern nests across Teesside and the publication of reports setting out historic and current breeding records (e.g. Bell and Leakey, 2019). None of those reports include records of breeding anywhere across Coatham Sands since around 1995, and this has been confirmed in recent correspondence with INCA. The baseline reported submitted by the Applicant was based on data from BTO WeBS, INCA and RSPB, none of which identified nesting at Coatham Sands or at any inland locations.* *Furthermore, studies commissioned by Natural England to inform the updates made to the extent of the SPA that were adopted in 2020 included the determination of foraging ranges from nest sites for terns, including little tern. This included shore and boat-based monitoring of tern activity based upon the identification of active nest sites. That study was based on the location of the breeding colony at Crimdon Dene and the Departmental Brief for the reclassification of the SPA states "Virtually*

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		occurrence of nesting on South Gare is well known and described in the supporting baseline report to the ES, the Cleveland Little Tern Report 2019 (Bell and Leakey, 2019) describes the availability of suitable nesting habitat on South Gare as "severely limited".		*all breeding birds are currently located at Crimdon Dene, north of Hartlepool. The feeding grounds of the little terns that nest at Crimdon Dene lie predominantly in marine areas within 5 km alongshore of the colony and within 3.5 km offshore" (Natural England, 2018).* *Taking all of the above into account the cumulative evidence base is contrary to some of Natural England's suggested breeding locations for little tern, including at Coatham Sands and these were clearly not the basis for the delineation of the SPA boundary in its current form. However, regardless of any of the narrative provided above, the Applicant does not regard breeding records from 2005 as sufficiently contemporary to inform a robust impact assessment or HRA.*
NE18: Operational Emission of amine and amine degradation products	It is noted that in the AQ ES 'There will be no emissions to air of amines and amine degradation products during normal operation, as the carbon dioxide capture process is a closed loop system.' However, further specific information is required to describe how this is so, including a clear diagram including all inputs (solid/liquid/gas), outputs (solid, liquid.gas) and byproducts (solid/Liquid/gas) of intermediary processes. Furthermore, information is required on contaminant release during planned maintenance, planned venting, flare emissions, as well as the potential for release of contaminant via unplanned venting or flare release. These contaminant substances are alluded to in the ES Proposed Development document, and include, but are not limited to: amine; phosphates; morpholine; activated MDEA (aMDEA) – an amine used in syngas production; carbohydrazide; aqueous ammonia; water treatment chemicals (including sulphuric acid, sodium hypochlorite and bromine); corrosion inhibitor; scale inhibitor; cleaning chemicals and lubricating oils. To enable ecotoxicological assessments of the impacts of these contaminants via air deposition or water all	A clear diagram presenting the carbon dioxide capture process including all inputs and byproducts will be provided to Natural England – this will include information relating to contaminants (to confirm that there is expected to be no contaminant release to air). Process Condensate is expected to contain only one contaminant which is subject to an Environmental Quality Standard (EQS) in coastal waters, ammonia, which is limited through the Dissolved Inorganic Nitrogen (DIN) EQS. The Process condensate will be treated by a denitrification plant prior to being combined with other site water supply streams and used in on-site processes. The combined site process effluent will then be treated further (additional denitrification) and the final treated effluent discharged to Tees Bay will contain 15 mg/l N as DIN, with other forms of nitrogen converted to nitrogen gas for atmospheric release. This was outlined in ES Volume III Appendix 9B Water Quality Modelling Report [APP-193]. This impact of process (and surface water)	Discussions with the Applicant are ongoing on this matter. It is understood by NE that the modelling done shows rapid dilution of pollutants in vicinity of the discharge points. This results in no further requirement for the modelling of contaminants partitioning into sediment. If the current assessment excludes the possibility of build-up of discharged toxic substances in sediments in the vicinity of the discharge point concerns are resolved. If not, further evidence should be presented to demonstrate no accumulation of toxic substances in sediments in the vicinity of discharge points.	The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative impact of discharges from both sites and therefore the condition of Tees Bay would not be adversely impacted. The discharged substances would be rapidly dispersed and would not be expected to build up in the sediment based on the nature of the substances. Modelling of contaminants portioning into sediment is therefore not required. Full details are given of the modelling outputs in Appendix 9B: Water Quality Modelling Report (APP-193).

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	routes into the environment should be considered and whilst the technologies to be used remain still to be determined, these emissions should be estimated according to the Rochdale Principles. Clarity is required regarding how Process condensate is treated. The WQ ES, section 9.5.80 states ammonia (NH3), methanol (CH3OH), carbon dioxide (CO2), methane (CH4) and H2 need removal before discharged, yet section 9.5.81 states process water will not be discharged but reused. Please clarify the route and final destination of the removed contaminants, ammonia (NH3), methanol (CH3OH), carbon dioxide (CO2), methane (CH4) and H2. The WQ ES section 9.5.87 treated wastewater method Case 2B table 9-20 provides indicative effluent quality following treatment at discharge with further information provided in Appendix 9B: Water Quality Modelling Report [APP-193]. The values for chromium, copper, nickel and zinc all indicate exceedance of the EQS. This discharge with toxic metals contained within a reduced volume of river water are highly likely to result in ecotoxicological impacts for wildlife within the zone of influence of the discharge point. Please provide further information and detail as to how these impacts have been assessed, and mitigated against, with regards to exceedance of EQS at point source of discharge and ecotoxicological impact.	discharge from H2Teesside in isolation and cumulatively with NZT has been assessed through a water quality modelling exercise (near field and far field water quality modelling) reported in that Appendix. Table 9B-4 in ES Volume III Appendix 9B Water Quality Modelling Report [APP-193] gives the estimated wastewater discharge concentrations of contaminants in the final effluent from the effluent treatment plant. Average concentrations of DIN, fluoranthene, PFOS, polyaromatic hydrocarbons, cadmium, chromium, lead, zinc, copper, iron and diazinon may be discharged at concentrations exceeding the average annual EQS in coastal waters in the absence of effluent dilution by surface water runoff. Similarly, maximum effluent concentrations of benzo(b)-fluoranthene, benzo(g.h.i)-perylene, benzo(k)-fluoranthene, lead and mercury may exceed the Maximum Allowable Concentration (MAC) in coastal waters. With the exception of DIN, the source of all substances discharged at concentrations exceeding EQS values is the River Tees raw water that we will abstract for use in the process – none of these substances are expected to be generated by the H2Teesside processes which only act to concentrate River Tees water. Table 9B-4 shows that the addition of surface water runoff would be expected to dilute final effluent pollutant concentrations such that only average concentrations of DIN, PFOS, polyaromatic hydrocarbons, chromium (VI) and lead would exceed the EQS values in the final discharged wastewater. Similarly, only maximum concentrations of		

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		benzo(g,h,i)-perylene and lead would exceed MAC EQS values. Effective volume flux calculations have been carried out in accordance with Environment Agency methods and show that only DIN and polyaromatic hydrocarbons will be discharged from the Main Site above the allowable volume flux value, although lead is also discharged above the allowable volume flux value when also taking account of NZT discharges. Effective volume flux calculations cannot be carried out for benzo(g,h,i)-perylene or PFOS because ambient concentrations of these substances already exceed EQS values due to other point source and diffuse pollution sources to Tees Bay, however as stated above, these pollutants are not generated by the Proposed Development. The final list of substances taken forward for detailed water quality modelling was therefore DIN, polyaromatic hydrocarbons, lead, benzo(g,h,i)-perylene and PFOS. The near field and far field modelling show that the impact of the H2Teesside Main Site process effluent discharge is small for all polluting substances at all stages of the tidal cycle, with chemical contaminants diluted to below the EQS within a very short distance of the outfall. The cumulative impact of discharges from the Main Site and NZT sites is larger but mixing zones are still limited to the immediate vicinity of the outfall. Average and maximum pollutant concentrations outside the immediate vicinity of the outfall do not approach EQS values, taking into account the complex tidal currents in this region which can result in pollutants accumulating		

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		in shallow water. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative impact of discharges from both sites. The Environment Agency will carry out an environmental assessment including operational emissions as part of the determination of the site Environmental Permit application. Natural England will be consulted and kept informed as part of this process.		
NE19: Update in-combination assessment	We advise that the developments scoped in for potential impacts in-combination in Table 5-1 of the Report to Inform Habitats Regulations [APP-040] is comprehensive, in terms of inclusion of the correct types of development. We also note that Table 7-1 details the projects taken to Appropriate Assessment stage and the potential for in-combination effects with H2 Teesside. Further information is required from the Applicant for a number of thematic areas including ornithology, water quality and air quality, and we note that there is a temporal overlap between H2Teesside and a number of the neighbouring schemes which should be considered within the in-combination assessment. Without this information NE do not yet fully understand the impacts of H2Teesside on the designated site. We advise that the in-combination assessment is updated once this outstanding information is received, as this may impact the overall conclusion of the assessment.	Chapter 23 of the ES [APP-076] identifies the long and short lists of developments considered for their potential to have cumulative and combined effects with the Proposed Development. Table 5-1 summarises the plans and projects which have been considered within this HRA and whether there is potential for LSE upon the European designated sites in combination with the Proposed Development. The potential for all aspects of the Plans and Projects to have in combination effects has been considered. This includes ornithology, water quality, air quality and temporal overlaps. Where the potential for in-combination effects has been identified, those projects have been taken forward to Appropriate Assessment. Table 7-1 within the Appropriate Assessment summarises the plans and projects with the Potential for 'in-combination' Effect with the Proposed Development and any residual effects identified after mitigation is applied. The Applicant would like further clarification from Natural England on the	At this stage, Natural England's position remains as set out in our Relevant Representations. We note the applicant and ExA's request (relevant ExA Q ref) for clarification on the information we seek. Natural England offers a copy of construction phase overlap in Gantt chart format for context at Annex A Further information sought = Boundaries of schemes with temporal overlap (construction phase) relative to SPA/Ramsar Site – Reason – To illustrate proximity Consideration of bird spp records (breeding, roosting and feeding locations) relative to scheme works phases Consideration of impact pathways and resulting impacts through time for relevant schemes – to include numbers of birds likely to	*The HRA has been amended as part of the Proposed Change Application. The in-combination assessment has been reviewed and updated to provide updates on Hygreen, York Potash and Teesside Flexible Regas Port.* *Please also refer to the Applicants response to NE3.* *The Applicant will review the list of additional projects provided by Natural England at D2. The Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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		additional information they require to inform the in-combination assessment to help inform the anticipated update to the HRA, which will include updates to the in-combination assessment to account for the on-going work to update the ES cumulative assessment.	be affected by the project alone and in combination.	
NE20: Water quality and nutrient neutrality	(EN070009/APP/5.13) Table 4.1 Nutrient Neutrality screening under Process water states that "Off-site transport of Minimalised Liquid Discharge waste from the ETP. This would contain 710 mg/l TN or 2.8 kgTN/hr (Case 1B). Minimalised Liquid Discharge waste will be treated in a manner consistent with nutrient neutrality requirements by either a) denitrification and discharge of resultant effluent within the habitats site catchment or b) discharging outside of the habitats site catchment." NE requests further information on what level reduction would be applied for option a) to ensure that liquid discharge waste would be nutrient neutral. If nutrients are to be reduced via denitrification treatment, the reduction and subsequent load of nutrients that would be discharged into the habitats site must be understood before this can confidently be screened out of the Nutrient Neutrality assessment. The same also applies to section 3.5.3 for other wastewater streams (cooling tower blowdown and demineralisation plant rejects).	The Applicant has now determined that Case 1B - Minimalised Liquid Waste from the ETP is to be discounted, and that Case 2B (discharge of effluent to Tees Bay via the NZT outfall) will be progressed.	Discussions with the Applicant are ongoing on this matter. If Case 1B were to be progressed (accepting this is unlikely), we would need to understand where the Minimalised Liquid Discharge waste would be disposed of to ensure there would be no impact to the catchment. NE accept that Case 2B is to be taken forward as modelling has shown Nitrogen is unlikely re-enter the estuary. However for Case 2B, two aspects should be considered: impact to the Tees transitional waterbody (high nutrients), where inputs must not cause an increase, and impact on the Tees Bay itself (favourable for nutrients). Although the focus has been on Seal Sands as the sensitive area NE would want to be confident that the new discharge would not impact condition in the Tees Bay. The modelling data shows that the mixing is sufficient to protect against this, but it would be helpful to explain in the Relevant Representations response.	Case 1B is to be discounted as the applicant is not pursuing this option. ~~Should any change from this occur and there was a requirement to revisit Case 1B, then further details and assessment of nutrient neutrality would be provided to the examination, although this is not anticipated to be the case.~~ With regard to Case 2B, Appendix 9B: Water Quality Modelling Report (APP-193) shows that when the discharge from the Proposed Development and the adjacent Net Zero Teesside projects are modelled cumulatively, that concentrations of Dissolved Inorganic Nitrogen (DIN) are slightly elevated above background concentrations within Tees Bay but the overall increase in average and maximum pollutant concentrations do not approach EQS values, taking into account the complex tidal currents in this region which can result in pollutants accumulating in shallow water. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the cumulative impact of discharges from both sites and therefore the condition of Tees Bay would not be adversely impacted. Full details are given of the modelling outputs in Appendix 9B: Water Quality Modelling Report (APP-193).
NE21: Water quality and EIA evidence base	Chapter 9: Surface Water, Flood Risk and Water Resources [APP-061], section 9.4.70 states that "No formal monitoring of harmful algal blooms is	The monitoring of opportunistic macroalgae in the Tees Estuary transitional waterbody (including the Seal Sands area)	We have had discussions with the Applicant on this matter and concluded that no significant	Noted, the Applicant welcomes agreement with Natural England on this issue.

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	carried out within the lower River Tees or coastal water bodies although the Tees WFD water body which covers the lower reaches of the estuary is classified as having 'Good' phytoplankton status despite Seal Sands being recognised as a sensitive eutrophic area." The Environment Agency undertakes regular monitoring of opportunistic macroalgae in the Tees Estuary transitional waterbody (including the Seal Sands area) as this is the ecological element expected to be most responsive to elevated nutrients in this waterbody. This is reported under the 'macroalgae' WFD indicator, and this data is used by NE to inform the condition assessment for nutrients in the site and 'restore' conservation objective. This monitoring data should be considered when accounting for potential adverse impacts to the Tees Estuary area of the designated sites. E.g. in accounting for surface water quality and marine ecology impacts during construction.	is noted, along with the fact that this informs the macroalgae WFD element and Natural England's condition assessment for nutrients in the site and 'restore' conservation objective. Nevertheless, the Water Framework Directive Assessment [APP-048] has considered the macroalgae WFD element in the Tees transitional water body, and the assessment demonstrates that there would be no deterioration or prevention in future improvement in this element (as well as all other WFD elements) in the Tees water body as a result of the Proposed Development. Where macroalgae was referred to in paragraph 9.4.70 of the baseline of ES Vol I Chapter 9: Surface Water, Flood Risk and Water Resources [APP-061], this was part of an overview of marine ecology that is used to support the determination of receptor importance. On the basis of the baseline information as a whole, both the River Tees (Tees transitional WFD water body) and Tees Bay (Tees Coastal WFD water body) have been given the highest receptor importance available for the water quality and resources assessment, which is 'Very high importance' (see Table 9-17). However, it should be noted that Chapter 9 does not assess impacts to marine ecological receptors which are considered in Chapter ES Vol I Chapter 14: Marine Ecology [APP-067] and also in the Water Framework Directive Assessment [APP-048], as mentioned above. To reiterate, the WFD assessment reports no deterioration from current WFD status (including macroalgae), and appropriate mitigation is included in the proposed development design to ensure that this is	impacts are anticipated for the international designated sites listed. This is based on the following written response: *"The monitoring of opportunistic macroalgae in the Tees Estuary transitional waterbody (including the Seal Sands area) is noted, along with the fact that this informs the macroalgae WFD element and Natural England's condition assessment for nutrients in the site and 'restore' conservation objective. Nevertheless, the Water Framework Directive Assessment (APP-048) has considered the macroalgae WFD element in the Tees transitional water body, and the assessment demonstrates that there would be no deterioration or prevention in future improvement in this element (as well as all other WFD elements) in the Tees water body as a result of the Proposed Development."* *Where macroalgae was referred to in paragraph 9.4.70 of the baseline of ES Vol I Chapter 9 Surface Water, Flood Risk and Water Resources (APP-061), this was part of an overview of marine ecology that is used to support the determination of receptor importance. On the basis of the baseline information as a whole, both the River Tees (Tees transitional WFD water body) and Tees Bay (Tees Coastal WFD water body) have been given the highest receptor importance available for the water quality and resources assessment, which is 'Very high importance' (see Table 9-17). However, it should be noted that Chapter 9 does not assess impacts to marine ecological receptors which are considered in Chapter ES Vol I Chapter 14 Marine Ecology (APP-067) and also in the*	

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		the case, for instance through appropriate treatment of potential effluent to ensure that no additional nutrients would enter the Tees Estuary.	*Water Framework Directive Assessment (APP-048), as mentioned above. To reiterate, the WFD assessment reports no deterioration from current WFD status (including macroalgae), and appropriate mitigation is included in the proposed development design to ensure that this is the case, for instance through appropriate treatment of potential effluent to ensure that no additional nutrients would enter the Tees Estuary."*	
NE22: Water Quality Surface water run off impacts	Although the Tees Coastal waterbody is good status for nutrients, the Tees and Cleveland Coast SPA/Ramsar Site are considered 'unfavourable' for nutrients due to high DIN concentrations in the Tees Estuary, and are considered at risk of eutrophication, and sensitive to nutrient loading. The area of concern is the Tees Estuary (in particular the Seal Sands area). The potential impacts identified during construction (notably mobilisation of sediment and release of contaminants affecting water quality, etc.) in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2) are considered to be temporary and short-term impacts to water quality. However, NE request that an estimation of the scale of these impacts, and further explanation as to why they would be considered a short-term/negligible impact would be beneficial i.e. assurance that contaminants would not be retained in sediment in the estuary or within the system due to limited mixing, thus impacting the condition of the protected sites. Negative impacts from increased scour and sedimentation to intertidal sedimentary habitats as a result of increased runoff should also be considered to ensure no adverse impacts to supporting SPA habitat.	The potential impacts identified during construction in Chapter 9: Surface Water, Flood Risk and Water Resources [APP-061] are considered to be temporary and short-term impacts to water quality given the mitigation that has been outlined for all various aspects of the construction phase. An overview of the construction mitigation measures for managing construction site runoff, chemical spillage risk, construction dewatering and crossings of watercourses (by HDD or open-cut approaches) are outlined in Section 9.5 of Chapter 9: Surface Water, Flood Risk and Water Resources [APP-061], as well as in the Framework Construction Environmental Management Plan [APP-043] and in further detail in the Outline Water Management Plan [APP-045]. These documents provide mitigation measures developed from good practice industry guidance, and the Outline Water Management Plan [APP-045] includes water quality monitoring requirements for water bodies during the pre-construction and construction phases. There is relatively limited requirement across the Proposed Development for direct in-channel works to watercourses which would have the greatest associated	We have had discussions with the Applicant on this matter. No significant impacts are anticipated for the international designated sites listed. This is based on the following written response: *"The potential impacts identified during construction in Chapter 9 Surface Water, Flood Risk and Water Resources (APP-061) are considered to be temporary and short-term impacts to water quality given the mitigation that has been outlined for the construction phase. An overview of the construction mitigation measures for managing construction site runoff, chemical spillage risk, construction dewatering and crossings of watercourses (by HDD or open-cut approaches) are outlined in Section 9.5 of Chapter 9 Surface Water, Flood Risk and Water Resources [APP-061], as well as in the Framework Construction Environmental Management Plan [APP-043] and in further detail in the Outline Water Management Plan [APP-045]. These documents provide mitigation measures developed from good practice industry guidance, and the Outline*	Noted, the Applicant welcomes agreement with Natural England on this issue.

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		risk of sediment and/or contaminant mobilisation. The assessment indicated that direct works to watercourses (for pipeline installation) would only be required for the Hydrogen Pipeline Crossings of Holme Fleet (NZ 49241 23828) , an unnamed tributary north of Seal Sands Road (NZ 51091 23758), an unnamed ephemeral watercourse (tributary of Greatham Creek, NZ 51110 24822) and an unnamed tributary of Holme Fleet (NZ 48649 24325) and are therefore relatively minor in scale in the context of the wider development. The closest of these crossings is over 350 m from the SPA/Ramsar site and involves the crossing of a minor watercourse (ephemeral tributary of Greatham Creek). Given mitigation measures adopted during these works (including damming, overpumping or fluming to create a dry working environment and employing sediment capturing methodologies such as silt fences) then it would not be expected that there would be any sediment or contaminant mobilisation significant enough to affect the downstream Teesmouth and Cleveland Coast SPA/Ramsar site. While there is a requirement for HDD crossing below The Tees and Greatham Creek, there would be no direct works to the estuary. The methodology of the HDD drilling, or other trenchless techniques, will include measures to minimise the risk to the environment, as set out in the Framework CEMP [APP-043]. For HDD methods, the risk that drilling muds can 'break out' into watercourses leading to pollution (known as 'hydraulic fracture' or	*Water Management Plan [APP-045] includes water quality monitoring requirements for water bodies during the pre-construction and construction phases.* *There is relatively limited requirement across the Proposed Development for direct in-channel works to watercourses which would have the greatest associated risk of sediment and/or contaminant mobilisation. The assessment indicated that direct works to watercourses (for pipeline installation) would only be required for the Hydrogen Pipeline Crossings of Holme Fleet (NZ 49241 23828), an unnamed tributary north of Seal Sands Road (NZ 51091 23758), an unnamed ephemeral watercourse (tributary of Greatham Creek, NZ 51110 24822) and an unnamed tributary of Holme Fleet (NZ 48649 24325). Given mitigation measures adopted during these works (including damming, overpumping or fluming to create a dry working environment and employing sediment capturing methodologies such as silt fences) then it would not be expected that there would be any sediment or contaminant mobilisation significant enough to affect the downstream Teesmouth and Cleveland Coast SPA/Ramsar site.* *While there is a requirement for HDD crossing below The Tees and Greatham Creek, there would be no direct works to the estuary. The methodology of the HDD drilling, or other trenchless techniques, will include measures to minimise the risk to the environment, as set out in the Framework CEMP [APP-043]. For HDD methods, the risk that drilling muds can 'break out' into watercourses leading to pollution (known as 'hydraulic fracture' or 'frac-out' event) will be*	

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		'frac-out' event) will be mitigated by adoption a site-specific Hydraulic Fracture Risk Assessment (secured within the Framework CEMP [APP-043]) that will be developed prior to construction following further investigation of specific ground conditions at the crossing locations, and appropriate mitigation developed in line with best construction practice. The entry and exit pits of the HDD crossings across the River Tees and Greatham Creek are above MHWS. Plans demonstrating this have been provided to Natural England. A slight adverse impact (not significant) on water quality in Tees Estuary was identified in Chapter 9: Surface Water, Flood Risk and Water Resources [APP-061], but this is a worst case and based on negligible impacts having been predicted. Given that this is a very high importance receptor this leads to a slight adverse effect based on the assessment methodology (outlined in Chapter 9 Surface Water, Flood Risk and Water Resources [APP-061]) but is not significant. Furthermore, there is not considered potential for increased scour and sedimentation to intertidal sedimentary habitats based on the mitigation measures outlined above and the lack of direct works to these habitat areas.	*mitigated by adoption a site-specific Hydraulic Fracture Risk Assessment (secured within the Framework CEMP) that will be developed prior to construction following further investigation of specific ground conditions at the crossing locations, and appropriate mitigation developed in line with best construction practice.* *A slight adverse impact (not significant) on water quality in Tees Estuary was identified in Chapter 9 Surface Water, Flood Risk and Water Resources (APP-061), but this is a worst case and based on negligible impacts having been predicted. Given that this is a very high importance receptor this leads to a slight adverse effect based on the assessment methodology (outlined in Chapter 9 Surface Water, Flood Risk and Water Resources (APP-061)) but is not significant. Furthermore, there is not considered potential for increased scour and sedimentation to intertidal sedimentary habitats based on the mitigation measures outlined above and the lack of direct works to these habitat areas."*	
NE23: Water quality discharged effluent	Water quality modelling (ES Volume III, EN070009/APP/6.4) indicates that for dissolved inorganic nitrogen (DIN) discharged effluent from the main site to the Tees Bay are diluted to below the Environmental Quality Standard (EQS) (0.252	It has been demonstrated within ES Volume III Appendix 9B Water Quality Modelling Report [APP-193] and the Water Framework Directive Assessment [APP-048] that the discharge of DIN from	Discussions with the Applicant are ongoing on this matter. If a project contributes nutrients and these nutrients are mitigated so made nutrient	It is confirmed that Appendix 9B: Water Quality Modelling Report (APP-193) includes combined modelling of the discharge of process water effluent and surface water runoff, and that this is done for

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	mg/l as calculated in accordance with WFD standards for moderate status) within a short distance, and thus should not render the condition of the protected site unfavourable for nutrients. The cumulative impact of discharges from both the main site and the Net Zero Teesside (NZT) sites is larger, however pollutants are diluted to below the (EQS) value within a short distance and therefore similarly should not impact condition of water quality in the protected site. The maximum increase in concentration recorded was 0.017mg/l for DIN which is not sufficient to breach EQS values thus rendering the site unfavourable. However, this is dependent on denitrification treatment prior to discharge to reduce 15mg/l. Caveat - this reduction limit should consider the permit limits once calculated and agreed, this limit may need to be reconsidered to ensure that discharged concentrations remain suitable so as not to allow exceedance. The modelling for the proposed development indicates that for Case 2B (screened in for Nutrient Neutrality assessment) discharges from the proposed NZT outfall would not be carried into the estuary by the tides, and therefore would not contribute nutrients to the designated sites, thus no impact to condition is expected. Plate 9B-20 (from document 6.4.10) presents the average increase in DIN concentrations from H2Teesside and Net Zero Teesside combined. We note that the increase in DIN concentrations above background levels for the Net Zero Teesside project alone was presented for the Net Zero Teesside examination (see Figure 6.2 EN010103-002322-NZT DCO 9.36 - Nutrient Nitrogen Briefing Paper Clean Oct 2022 (D9).pdf (planninginspectorate.gov.uk)) using a similar plot, which suggested that discharges may be carried into the estuary via tides. To facilitate a clear understanding of the possible increases in DIN concentrations resulting from the H2Teesside	H2Teesside and NZT (both alone and in-combination) would not breach EQS that would change WFD status in terms of DIN, particularly when considered at the WFD water body scale or the scale of the Teesmouth and Cleveland Coast SPA/Ramsar site. As such, the discharge would not cause any part of the Teesmouth and Cleveland Coast SPA/Ramsar site to become unfavourable with regard to nutrients. Within the NZT DCO Examination, NZT committed to a nutrient neutral development secured via Requirement 37 of their DCO. The primary option for achieving this is anticipated to be through onsite treatment plant (Net Zero Teesside, ES Vol III Appendix 25A Commitments Register Clean Oct 2022 (Document reference 6.4.49)). The modelling of DIN mixing carried out for the NZT DCO did not take account of this onsite treatment and therefore the plots previously provided for NZT are no longer representative of the proposals for that site. Revised modelling of the NZT site, in isolation and reflecting the updated design progress for the project, is understood to be currently ongoing. The cumulative modelling in ES Volume III Appendix 9B Water Quality Modelling Report [APP-193] for H2Teesside therefore illustrates an example of the type of concentrations that could be expected from NZT following on-site treatment. As outlined above, the cumulative discharge would not breach the EQS or change WFD status in terms of DIN. The modelling for the H2Teesside site will be updated to reflect the final design parameters for both the NZT site and the H2Teesside site at the	neutral, then there will be no remaining nutrient impact to consider in combination. We do not believe that for this specific project Nutrient Neutrality is triggered, as adverse effects are ruled out via other routes in the Report to inform HRA where in combination effects do still need to be considered e.g. to ensure that the combined effluent discharge does not change whether the nutrients end up in the Tees estuary, or whether the combined discharge may cause the Tees Bay to become in unfavourable condition. The Water Quality modelling report does include the combined component, but Natural England would welcome clarification of this within the Relevant Representations response.	H2Teesside independently <u>and</u> cumulatively with Net Zero Teesside. The near field and far field modelling results show that there is no significant impact on water quality in Tees Bay due to the <u>cumulative</u> (or combined) impact of discharges from both projects and therefore the condition of Tees Bay would not be adversely impacted.

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	and Net Zero Teesside outfall, NE advise that the model outputs showing the total maximum increase in DIN is presented (using similar plume plotting) for H2Teesside and Net Zero Teesside alone and in combination. It is important that all increases in DIN are presented, even small increases (Plate 9B-20 does not map increases <0.004 mg/l).	appropriate stage and for the application for a discharge permit to Tees Bay.		
NE24: Impact of acid deposition	Acid deposition exceeds 1% of the acid critical load at North York Moors in-combination so should be considered in the appropriate assessment. (Table 8B-43). These issues could be resolved in a final version of the shadow HRA document. Further discussion with NE may confirm requirements.	However, paragraph 4.3.8 of the submitted HRA makes it clear that the contribution of H2Teesside to the in combination impact is effectively zero for nitrogen and the same is true for acid. Review of ES Appendix 8B [APP-191] Tables 8B-31 and 8B-32 shows that the contribution of H2Teesside is less than 0.01kgN/ha/yr for nitrogen (i.e. too small to show in the model) and less than 0.000 for acid).	At this stage, Natural England's position remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter. NE will review the revised Report to inform HRA when available. In principle, there is no lower level at which a project may not result in an in-combination impact to a protected site. However, given the distance and differential impacts from other in-combination projects, it is accepted that the impact could be negligible in practice – subject to review of the revised shadow HRA.	*The HRA has been amended to address this point as part of the Proposed Change Application see Paragraphs 4.3.13 to 4.3.15 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding acid deposition.* *While the 'in combination' impact on North York Moors SAC/SPA exceeds 1% of the critical load, the contribution of H2T is less than 0.001% i.e. effectively zero. As such it is considered reasonable to dismiss the contribution of H2T to the modelled in combination impact as imperceptible.*
NE25: Impact of Nitrogen deposition on qualifying species	It is not clear why a critical load of 10kgN/ha/yr is used for Durham Coast, when APIS indicates the most sensitive habitat type (Coastal dune grasslands (grey dunes) - acid type) has a lower critical load of 5kgN/ha/yr. Therefore, it would seem precautionary to include this site in the appropriate assessment and justify why use of the calcareous grassland critical load is considered appropriate. In addition, these levels do not include any contribution from ammonia. Therefore it is unclear at present whether the applicant is correct to conclude no LSE at these sites for Ndep in-combination. The justification around location of nesting terms may be relevant (HRA para 4.3.9) but it should be made in the	Durham Coast SAC doesn't have any dune grasslands as it is a cliff site. This is why the 5 kgN/ha/yr critical load would not be appropriate for this SAC. The cliffs are magnesian limestone and flushed with calcareous water (Durham Coast - Special Areas of Conservation (jncc.gov.uk)), and therefore the cliff vegetation is calcareous.	Natural England's position has changed from that set out in our Relevant Representations. We have had discussions with the Applicant on this matter. Grey sand dunes do not form a feature of the Durham Coast SAC. Natural England Accepts the use of the 10kg N/Ha/Yr critical load value for XYZ habitat accordingly.	*Noted, the Applicant welcomes agreement with Natural England on this issue.*

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	appropriate assessment rather than at the screening stage. These issues could be resolved in a final version of the shadow HRA document. Further discussion with NE may confirm requirements.			
NE26: Noise disturbance - Seals	Report to inform HRA [APP-040] - Section 6.5.20 The report notes that Permanent Threshold Shifts (PTS) and Temporary Threshold Shifts (TTS) are 34 and 154 dB in air. NE confirms that TTS for seals is 134 dB and PTS is 154. Furthermore, NE advise that these are injury thresholds and that disturbance can occur at levels lower than these. Table 6-7At model locations 1 and 2 (south-east and south-west corners of seal sands intertidal area) SEL totals are expected to be 127 dB and 125 dB respectively. These levels are close to the TTS threshold. NE require the cumulative noise level from ambient noise plus main site construction and compound plus pipeline construction at model location 1. NE advise that even if the TTS threshold is not reached, there may still be a disturbance effect from the noise. 6.5.23 The document states that HDD works at Greatham Creek may affect seal movement NE advise that further mitigation is required to further reduce the disturbance effect and impacts on seal movements. 6.5.24 The document states that during the 10 weeks of HDD works at Greathem Creek, seals disturbed from Greatham Creek are expected to haul-out on Seal Sands. NE queries the justification for this on two counts: • Will there be enough space on Seal Sands – that area is used by other individuals? • Will the seals from upstream of Greatham Creek be able to get to Seal Sands?	Please refer to Appendix 2: Technical Note in response to Natural England's Relevant Representation (NE26). The information provided concludes that considering the very limited potential for disturbance to seals during the works, the noise from the pipeline construction is not considered to result in a barrier to seal movement between Greatham Creek and Seal Sands. Therefore, a pre-construction monitoring plan is not considered appropriate. The mitigation recommended is considered sufficient to reducing any noise produced during construction to below ambient (as per the updated noise modelling), even without considering the avoidance of the most sensitive period for seals at Seal Sands.	Discussions with the Applicant are ongoing on this matter. Following a conversation with AECOM, Natural England advises that provided HDD operations last no longer than 3 weeks in October, and noise abatement barriers reduce noise by 10dB, there is unlikely to be a significant impact on the seal population of the Teesmouth and Cleveland Coast SSSI from the HDD works at Greatham Creek. Natural England would welcome securing these mitigations through conditions to any licence granted. Natural England's advice remains that pre-construction monitoring is carried out to assess the behaviour of seals in the area under "normal" conditions. Further monitoring should be carried out during construction to assess the efficacy of mitigation measures. If behaviour indicating disturbance is noted, further mitigation must be put in place. This may include more effective sound barriers further muffling of machinery. If monitoring shows that disturbance is not occurring, further mitigation is unlikely to be necessary.,	*The HRA has been amended to address these points as part of the Proposed Change Application see Paragraphs 6.5.15 to 6.5.38 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding noise disturbance of seals.* *Regarding pre-construction monitoring the Applicant will discuss this further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.*

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	NE is concerned that the noise from the HDD works will present a barrier to seals moving down the creek and out to sea and the Seal Sands haul-out. The applicant needs to consider any barrier effect as that would seriously impact any individual that are "trapped" upstream of the HDD works. NE advise that further mitigation is required to ensure there is no barrier effect from the noise of HDD at Greatham Creek. 6.5.27 The document recognises that disturbance may occur at Greatham Creek during the important moulting and breeding season. 6.5.28 The applicant has committed to using noise abatement barriers at Greatham Creek. NE welcome this commitment but require further confidence that these will be a suitable and sufficient mitigation. NE advise that pre-construction monitoring is carried out to assess the behaviour of seals in the area under "normal" conditions. Further monitoring should be carried out during construction to assess the efficacy of mitigation measures. If behaviour indicating disturbance is noted, further mitigation must be put in place. This may include more effective sound barriers, further muffling of machinery. If monitoring shows that disturbance is not occurring, further mitigation is unlikely to be necessary.			
NE27: River Tweed SAC and Tweed Estuary SAC	NE have been unable to fully consider this potential impact pathway. NE will include commentary and advice on this impact pathway within our submission at the next deadline.	This is noted thank you. However, the River Tweed SAC and Tweed Estuary SAC are over 130 km away from the project. Given that there are no underwater sound effects in the marine environment which could	At the relevant representations stage of consultation Natural England was unable to comment in detail on this theme.	The Applicant welcomes agreement from Natural England that adverse effects on the integrity of these Habitats Sites can be ruled out subject to mitigation being secured as part of the DCO.

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Impact on Atlantic salmon and sea lamprey (C and O)		extend outside of the River Tees, there is considered to be no potential to effect River and Sea Lamprey designated as part of the River Tweed, even if they were passing this location when migrating to the river. These species have been identified as being present within the River Tees, however, there is considered to be no significant effect to these species from the proposed works.	Update: For consultations for the River Tees, we include information on Salmonids of the Tweed, such as the Atlantic salmon, as they use the estuary and spawn upstream during their annual migrations. Noise and/or sediment can create a barrier to movement. For works occurring between 1st May and 30th November activities should therefore be restricted to daylight hours only, i.e., between dawn and dusk. This is to avoid activity occurring at peak migration periods (i.e., at night) during annual Salmonid migrations. We note the 50 week duration of HDD works for the Tees crossing and understand from dialogue with the Applicant that this represents a period of continuous drilling. This will overlap with the 1 May – 30 November period. Having considered the mitigation measures referenced in the Report to Inform HRA (tables E4 R.Tweed SAC and E5 Tweed Estuary SAC) Natural England agrees that adverse effects on the integrity of these Habitats Sites can be ruled out subject to suitable mitigation being secured as part of the DCO.	Tables E-4 and E-5 (EN070009/APP/5.10) describe a suite of mitigation measures to limit any visual disturbance of migratory fish. Standard working hours will be implemented as much as possible to reduce working in hours of darkness and therefore reduce the requirement for artificial lighting. When extended working hours are required, the design measures included within the Indicative Lighting Strategy (Construction) (EN070009/APP/5.12) are to be implemented, reducing light glare or spill into the marine environment, including directing light away from the estuary. A warm white light colour will also be used, which is considered less intrusive for ecological receptors. Construction working hours are secured by Requirement 19 of the dDCO. Measures relating to the limiting of any light spill or glare are secured by Requirement 15 of the dDCO and the production of a Final Construction Environmental Management Plan. As part of this, a Final Lighting Strategy (Construction) will be produced prior to construction of the Proposed Development. This final lighting strategy will be produced in accordance with the indicative strategy produced as part of the DCO Application [APP-046]. Therefore, the Applicant considers all mitigation currently proposed for the Habitat Sites discussed are adequately secured in the dDCO.
NE28: Consideration of ammonia and acid deposition in the traffic assessment	As considered for International sites For our advice see NE Ref 10	Response will be included under NE Ref 10. Do note in particular, however, that Teesmouth & Cleveland Coast SPA/Ramsar and SSSI should be considered separately due to their different vulnerabilities. The SSSI is designated for its dune habitat which is located north of the Main Site and is sensitive to nitrogen, acidity, ammonia,	Discussions with the Applicant are ongoing on this matter. It is noted and welcomed that ammonia concentrations will be reported and included in the updated SSSI assessment. It is understood that CREAM will be updated late Summer 2024 so the version used should be noted. Comments on tern and avocet locations are noted and accepted, but the	See the Applicant's updated response to NE10 above. The HRA has been amended to address these points as part of the Proposed Change Application see Paragraphs 4.2.85 to 4.2.90, 4.3.6 to 4.3.15 and 6.6.3 to 6.6.9 of the updated Report to Inform HRA regarding atmospheric

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		NOx. In contrast, the only SPA/Ramsar interest features of concern regarding air quality (aside from dust) are the nesting terns and nesting avocet (source: APIS). According to APIS even the nesting terns and avocet are not sensitive to NOx, acid deposition or ammonia in atmosphere and nitrogen deposition is as likely to be positive for the avocets as negative. Inclusion of ammonia in the traffic assessment would increase nitrogen deposition at the SSSI, but only temporarily to a small extent during construction. Operational traffic movements will not materially be within 200m of the SSSI.	arguments for the broad habitat structure rather than subtle changes in botanical composition being relevant should be included clearly in the summary table. NE agrees that the assessment of construction traffic emissions should be introduced earlier for clarity.	pollution, the conclusions equally apply to the Teesmouth & Cleveland Coast SSSI. Further details on the assessment of cumulative road traffic emissions impacts using the NAE001 Methodology are included in Annex G of the updated HRA.
NE29: Scope of Pollutants considered in the construction and operational assessments	As considered for International sites For our advice see NE Refs 11 &12	Response will be included under NE Ref 11 & 12.	No significant impacts are anticipated for the national designated sites listed. It is accepted that NRMM sources were considered, but were not within 200m of nesting sites (from the site boundary at the theoretical closest points) - assuming the nesting site locations etc are included in the ES no further assessment for AQ is required. It is also acknowledged that traffic numbers for tree planting/ landscaping would be <1000AADT/ 200AADT HDV and therefore no assessment of traffic air quality impacts arising from these works are necessary. Demolition dust mitigation works within the FCEMP and PPW CEMP are likely to be generic, but as long as justification is provided that there will be no impact on the integrity of the protected sites, it is considered appropriate to rely on these as compliance with the CEMPs will form part of the DCO consent.	See the Applicant's updated response to NE11 above.
NE31: Impact of	The same issues as raised for international sites would apply. Please see NE Refs 11 &12.	ES Appendix 8B shows that In combination acid deposition at Hart Bog SSSI is 0.005	At this stage, Natural England's position broadly remains as set out in our Relevant	*The HRA has been amended as part of the Proposed Change Application submitted on 16th October 2024. See*

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pollutants at SSSIs including SSSIs underlying European designations	In addition, acid deposition exceeded 1% of the acid critical load at Hart Bog SSSI so should be considered. (Table 8B-43). Furthermore, Natural England do not agree with the statement in section 12.6.16 about Teesmouth and Cleveland Coast SSSI that 'The calcareous dune habitat has thus developed and persisted in close proximity to an operational steel works and other industrial facilities when nitrogen deposition rates were considerably higher than the lower critical load of 10 kgN/ha/yr.' This statement suggests that the dune system is of recent origin, which is not the case. It also fails to recognise that damage is likely to be occurring under the current levels of nitrogen deposition (that exceed the critical load for calcareous dune habitat). Although the SSSI was notified at a time when nitrogen deposition levels exceeded the critical load for sand dune habitat, this does not mean that damage was not and is not still occurring. Natural England do not therefore consider that assessment demonstrates no damage to Teesmouth and Cleveland Coast SSSI.	keq which is over 1% of the critical load, and PEC is exceeded. However, the contribution of H2Teesside is 0.000 i.e. effectively zero at the distance at which Hart Bog is situated. With regard to the Teesmouth and Cleveland Coast SSSI, paragraph 12.6.16 shows that 'in combination' nitrogen deposition is forecast to be 13.89 kgN/ha/yr, whereas N deposition in 2003 was up to 14.77 kgN/ha/yr. Therefore, a net improvement in nitrogen deposition is forecast and nitrogen deposition rates are forecast to be materially lower than they were when the habitat in question established. While the dune system is not 'new' , the habitat structure has extensively changed due to slag deposition and movement from at least the 1940s to the early 2000s. In these decades N deposition will have been higher than it is now due to much higher NOx emissions (and was certainly higher in 2003 than it is now according to APIS). For example, UK N deposition reduced from 465 kt N in 1990 to 278 kt N in 2017 (Tomlinson *et al*, 2021)[2]. This identical argument was submitted into the Examination for the consented Net Zero Teesside DCO to enable no likely significant effects to be reported for this site. Given it was accepted by the Examining Authority/Secretary of State for that DCO it would be inconsistent to take a different approach for this DCO.	Representations. Discussions with the Applicant are ongoing on this matter. Update on NE17 (above) refers Comments are as for NE24 - it is accepted that the contribution of H2Teesside to an in-combination impact of >1% may be negligible, but this argument requires to be made in the shadow HRA. The comments on Ndep at the SSSI are the same as for NE17 – the site is still exceeding its critical load, and the proposed development is adding to this. There has been a <1kgN/ha/yr decline in Ndep over approximately 20 years, and the applicant would need to justify that the proposed development would not undermine any environmental improvement in recent years.	*Paragraphs 4.3.6 to 4.3.14 and 6.6.2 to 6.6.9 of the updated Report to Inform HRA [EN070009/APP/5.10] regarding atmospheric pollution.* *The Change Application report [EN070009/EXAM/7.3] concludes that no likely significant effect will arise on Teesmouth & Cleveland Coast SSSI, based on the negligible contribution of the proposed project, the fact that nitrogen deposition is modelled to remain below historic levels (thus denoting a net improvement even when cumulative deposition is considered), and the fact that much of the dune interest developed when pollution levels were higher than at present.*

[2] Tomlinson, S. J., Carnell, E. J., Dore, A. J., Dragosits, U. (2021). *Nitrogen deposition in the UK at 1 km resolution from 1990 to 2017.* Earth System Science Data, 13(10), 4677 – 4692.

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NE32: Bat Survey Effort	Following review of the information within the document 'H2_Teeside_NSIP_BatSurvey_BaselineH2Teesside Project Environmental Statement Volume III – Appendices Appendix 12C: Bat Survey Report [APP-203] Natural England has concerns with respect to survey constraints during Preliminary Roost Assessment activities on trees within the Cowpen Bewley Woodland Park area. Based on the possible constraints due to limited access and viewing from ground level (as stated in the Preliminary Roost Assessment section 12C.4.5-12C.4.6), and considering that section 12C.4.19 states at least seven species (common pipistrelle, soprano pipistrelle, Myotis sp., noctule bat, Nathusius' pipistrelle, Leisler's bat and brown long-eared bat) that are all frequently associated with roosting in trees, Natural England would likely require further consideration of these constraints as they relate to survey effort. Ideally, given that the trees discussed were indicated to have a degree of bat roosting suitability/potential as assessed from ground level, and given that view to these trees was restricted, these trees would need to be climbed to allow inspection for roosting bats or potential roost features (PRFs) if they are to be removed during works. If this is not possible due to access issues or any other appropriate reason, further justification and evidence could perhaps be gained through emergence surveys to support the wider impact assessment, and to provide greater confidence that said trees are unlikely to support roosting bats.	Three trees within Cowpen Bewley Woodland Park were assessed as having 'low' suitability for roosting bats based upon their size and age. Limitations were noted during the ground level assessment (which was completed from within the Country Park), namely limited access and visibility due to dense vegetation and scrub. The trees are located on the boundary of the Northern Gas Network (NGN) substation which could not be accessed at the time of survey. The trees were assessed as low suitability (with reference to the Bat Conservation Trust's good practice guidelines in place at the time of survey (Colins, 2016). Access was granted to undertake a ground level bat roost assessment from within the NGN substation on the 13th August 2024. The ground level assessment was undertaken by a Natural England Level 2 bat survey licence holder qualified in tree climbing and aerial rescue. Trees were inspected using binoculars from within the NGN substation and then from within the country park. The previous assessment of 'low' suitability is considered correct. With reference to the current BCT guidelines, the trees were assessed as PRF-I. It is not safe to climb and inspect these trees due to the presence of dense scrub and proximity to the NGN substation. To complete emergence surveys effectively, surveyors would need to be positioned within the country park and the NGN substation. Electronic equipment, camaras and mobile phones are not permitted within the NGN substation for safety reasons. Therefore, emergence surveys cannot be completed.	At this stage, Natural England's comments in our relevant representation still stands. Due to the presence of bats detected during the activity surveys, the knowledge that these species are known to roost in trees, and in the absence of being able to fully inspect the trees from the ground Natural England would expect further justification and evidence as to their unsuitability. As the trees are unsafe to climb and given the access limitations described, evidence could be gained through emergence surveys to support the assessment that they are unlikely to support roosting bats. Discussions with the Applicant are ongoing on this matter.	The recording of foraging and commuting bats during bat activity surveys does not indicate that bats are roosting within the tree at NGR NZ 47893 25047. Bats forage over a wide area, with common pipistrelle and soprano pipistrelle having core sustenance zones of 2 and 3 km (radius) respectively. The Applicant makes reference to Table 7.1 within the Bat Conservation Trust's *Bat Surveys for Professional Ecologists, Good Practice Guidelines* (Collins, 2023), which states that for low suitability or PRFI trees, no further survey is required. As outlined in our previous response, the need for removal of any of these three trees is not yet confirmed and may not be required. If the trees are identified for removal at detailed design stage, it is proposed that precautionary soft felling methods will be followed; this mitigation measure has been incorporated into the updated Framework CEMP to be submitted at Deadline 3. This approach is considered proportionate for a low suitability or PRF-I tree.

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		If the trees are identified for removal at detailed design stage, it is recommended that precautionary soft felling methods are followed (this mitigation measure will be incorporated into the updated Framework CEMP to be submitted at Deadline 2). This approach is considered proportionate for a low suitability or PRF-I tree.		
NE33: Water Vole Survey Effort	In certain circumstances one survey visit may be sufficient to assess the impacts of the proposed development to water voles. These circumstances typically apply when: 1) The presence of water voles is confirmed during the first survey visit and a precautionary approach to mitigation can be applied; and, 2) When the habitat is of very low suitability to water voles that there is a ow likelihood of water voles being present in the surrounding area (up 2km). In both scenarios it is advisable to do a second survey visit prior to the development works proceeding. It should be noted that absence of water voles cannot be determined from a field survey visit outside of the optimal window for surveying water voles (April-September). Any surveys conducted outside of the optimal window and where 'absence' has been recorded should be repeated during the optimal window prior to the development works proceeding. To inform a licence application Natural England would expect sufficient surveys to have been conducted to allow for a robust assessment of the impacts to water voles and their habitat. Two surveys (conducted at either end of the season) are considered industry best practice and should be routinely used to inform licence applications. Natural England were not able to review the	A desk study and field surveys have been conducted to inform the Proposed Development. During the 2023 field surveys, limitations were encountered due to the presence of nesting birds in areas to the north of Greatham Creek, Holme Fleet, and Belasis Beck. These areas were subsequently surveyed later in the season to avoid disturbing the nesting birds. The Proposed Development has been designed to minimise potential impacts on watercourses and water voles wherever possible. This includes implementing buffer zones to protect suitable habitats. Water bodies to the north of Greatham Creek will be avoided through the use of Horizontal Directional Drilling (HDD). Impacts on ditches within the Brinefields (Sabic) will be mitigated by using existing access tracks and applying buffer zones around the ditches. Belasis Beck was surveyed in 2022 for the NZT development, with evidence of water voles, such as latrines and feeding remains, being recorded. Although the 2023 survey of Belasis Beck was limited due to nesting birds, feeding remains were still recorded, indicating the presence of water voles. Similarly, feeding remains at Holme Fleet suggest the presence of water voles in this watercourse.	At this stage, Natural England acknowledges that impacts to water voles and their habitat will be avoided wherever possible and welcomes the inclusion of pre-construction surveys will be conducted. Natural England's comment regarding the level of survey that is required to inform a licence plication (should one be required) still stands. Discussions with the Applicant are ongoing on this matter.	Post-consent, the Applicant proposes to complete update water vole surveys in 2025 in areas where nesting birds were a limitation. This would inform any licence application if required. The Applicant will consult Natural England if nesting birds present a continuing constraint to water vole surveys to agree a suitable approach to inform a licence (should one be required).

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	survey results fully as the figures within Appendix 12F [APP-206] appear to have been redacted.	As works will not commence on site until Q4 2025 , updated water vole surveys are proposed to inform the final mitigation requirements, including the need for a development licence. This is secured via the Framework CEMP [APP-043]. Following these updated surveys, a water vole impact avoidance strategy will be prepared if required. This document will outline all measures and supervision required to ensure legislative compliance during the construction of the Proposed Development. The Applicant has provided the figures contained within Appendix 12F [APP-206] to Natural England.		
NE34: BNG Update	The Environment Act 2021 includes NSIPs in the requirement for BNG. The biodiversity gain objective for NSIPs is defined as at least a 10% increase in the pre-development biodiversity value of the on-site habitat. It's the intention that BNG should apply to all terrestrial NSIPs accepted for examination from November 2025. This includes the intertidal zone but excludes the subtidal zone. Although BNG is not yet a mandatory requirement for NSIPs, we strongly recommend that net gain provision is secured through this development. This will reflect the important role NSIPs must play in delivering the government's environmental targets. Early engagement with Natural England on BNG proposals will help maximise outcomes and reduce risks. The biodiversity baseline should include all land contained within the site's red line boundary and proposals can be iteratively refined over time and throughout detailed design.	The Applicant has not submitted a BNG report/assessment with its development consent application due to reasons outlined in paragraphs 6.2.115 (complexities of infrastructure projects and their interaction with the BNG metric), 6.2.116 (complex temporary land requirements for the connection corridor), and 6.2.117 (active remediation following the demolition of the former Redcar Steelworks, which forms the future baseline of the main site) of the Planning Statement (EN070009/APP/5.2). Despite this, and in recognition of the policy imperatives of EN-1, the Applicant is committed to fully mitigating the ecological impacts of the Proposed Development and, where possible within the constraints of the proposed Order Limits and the Main Site, delivering enhancements.	At this stage, Natural England's position remains as set out in our Relevant Representations. Discussions with the Applicant are ongoing on this matter.	Please see the Applicant's response to FWQ 1.4.16 (REP2-022).

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	We encourage developers to develop their BNG proposals in adherence with well-established BNG principles. To encourage best practice, we can also direct developers to the following: • BS 8683:2021 Process for designing and implementing Biodiversity Net Gain • CIEEM/IEMA/CIRI - A good practice principles (2016) and guidance (2019). We recommend that developers use the latest version of the Defra biodiversity metric to calculate BNG (currently version 4.0) and adhere to the rules and principles set out within the metric guidance. Biodiversity gains should be secured for a minimum of 30 years and be subject to adaptive management and monitoring. BNG plans should be secured by a suitably worded requirement in the DCO.	Provisions related to the Planning Act 2008 for Development Consent Orders (DCOs) are not expected to come into force until at least November 2025 and discussions are still on-going between industry, DEFRA and NE to the appropriate approach to BNG calculations for DCO projects – it should not be assumed that the TCPA approach is required to be followed. Nonetheless, the Applicant is committed to ensuring no net loss as a minimum.		
NE35: Soils and best and most versatile agricultural land	Whilst NE accepts that there is no mitigation for the permanent loss of agricultural land due to permanent development, appropriate mitigation to prevent the potential loss of BMV land, including the restoration of disturbed land to the baseline ALC Grade, should be set out in the assessment. This would require a detailed ALC survey of the pipeline routes to inform appropriate restoration. For all areas of agricultural land subject to temporary and permanent loss, in which Post-1988 ALC survey information is not available, an ALC survey should be undertaken. The colours used in the mapping so far are not the standard ALC colours. These should be updated to reflect the appropriate colours for each ALC grade. It is recognised that a large proportion of the agricultural land affected by the development will experience temporary land loss or disturbance and will be restored to the baseline ALC grade (largely as a result of the pipeline and cable trenching). In order to both	BMV land across the Proposed Development boundary is limited, with the majority of the Main Site and Connection Corridors classified as Urban and Non-Agricultural. A small portion of the Hydrogen Pipeline Corridor north of the River Tees has land classified as Grade 3, 4 and 5. As a worst case scenario Grade 3 land, at the Cowpen Bewley Replacement Land, is assumed to be Grade 3a, making it BMV land for the purposes of the assessment presented in Chapter 10: Geology, Hydrogeology and Contaminated Land [APP-062]. Taking into account the above, the Applicant does not propose to undertake supplementary ALC surveys of the Proposed Development Site at this time.	At this stage, Natural England's position remains as set out in our Relevant Representations.	The Applicant will continue to discuss this matter with NE through the SoCG between the two parties. In addition, the Applicant recognises this commitment to an update of the Framework CEMP was missed in the Deadline 2 update. Therefore, a revised version of the Framework CEMP has been prepared at Deadline 3 [EN070009/APP/5.12] to incorporate this commitment.

REF. NO.	NATURAL ENGLAND RELEVANT REPRESENTATION ISSUE	APPLICANT'S RESPONSES	NATURAL ENGLAND'S D2 RESPONSE	APPLICANT'S RESPONSE AT D3 (ITALICISED RESPONSES HAVE ALREADY BEEN SUBMITTED WITH THE CHANGE APPLICATION)
	retain the long term potential of this land and to safeguard all soil resources as part of the overall sustainability of the whole development, it is important that the soil is able to retain as many of its many important functions and services (ecosystem services) as possible. This can be achieved through careful soil management and appropriate, beneficial soil re-use, with consideration of how adverse impacts on soils and their functions can be avoided or minimised. Para 10.5.19. Natural England welcome the consideration of soil handling however this should be expanded in an Soils Management Plan (SMP), and based on the site-specific soil properties. The soil information presented (Figure 10-1 [APP-110]), should include the mapped soil associations. The information will provide an indication of the soils' resilience to handling and therefore inform appropriate soil handling and storage. The SMP should include the restoration criteria for all land to be returned to agricultural use, including the ALC grade and soil properties. A soil balance should be prepared to identify the surplus of different soil types across the Site and identify opportunities for the sustainable re-use of this resource on site. H2Teesside should use an appropriately experienced soil specialist to advise on, and supervise, soil handling, including identifying when soils are dry enough to be handled and how to make the best use of the different soils on site. All soils should only be handled in a dry and friable condition, and it is expected that soil handling will be confined to the drier summer period to minimise risk of soil damage.	However, the Applicant recognises the need for careful soil management and handling. The Framework CEMP [APP-043] will be amended to include the production of a Soils Management Plan (SMP), included as part of the Final CEMP, produced prior to construction. Figure 10-1 [APP-110] is for artificial geology/made ground only. Figure 10-19 [APP-137] will be updated to include the correct colours for each ALC grade at Deadline 2.		
NE36: Other valuable and sensitive	NE notes that the proposed scheme does not involve direct impacts upon the England Coast Path (ECP) but that due to the main site's proximity it has been concluded that mitigation of impacts on walkers' experience of the route is not	A likely significant effect was recorded in Chapter 13: Landscape and Visual Impact of the ES [APP-069], and therefore the scope for further mitigation measures, such as screen planting, was considered for	At this stage, Natural England's position remains as set out in our Relevant Representations.	Table 16-7: Viewpoint Assessment within Chapter 13: Landscape and Visual Impact [APP-069] assesses the effects of the Proposed Development on recreational users of the England Coast Path at Viewpoint 7. The viewpoint is located approximately 1.3 km to the east of

REF. NO.	NATURAL ENGLAND RELEVANT REPRESENTATION ISSUE	APPLICANT'S RESPONSES	NATURAL ENGLAND'S D2 RESPONSE	APPLICANT'S RESPONSE AT D3 (ITALICISED RESPONSES HAVE ALREADY BEEN SUBMITTED WITH THE CHANGE APPLICATION)
habitats and species, landscapes and access routes	possible. We draw the Examining Authority's attention to two very recent projects in the area providing relevant context and scope for dialogue to identify how mitigation measures might be chosen and delivered. These comprise the 'Regreening the King Chares III England Coast Path' project and the 'Reframing the Tees' Landscape Architecture project. Both provide a range of recommendations that will support suitable dialogue. We attach a copy of each report for reference.	Viewpoint 7 (England Coast Path). However, it was concluded that due to the combination of operational constraints, development proximity, and scale of the Proposed Development there is no opportunity to deliver additional mitigation to reduce the significant visual effects for Viewpoint 7, at the time the ES was submitted. However, the Applicant welcomes the further information provided by Natural England and will take this into consideration.		the Main Site and set within the context of a coastal dune system and Cleveland Golf Links. Due to the low-lying landscape and limited existing vegetation within the coastal landscape, views of existing infrastructure and large-scale industry influence views across the horizon and middle-distance. The assessment concluded that additional mitigation is unlikely to reduce the significance of any effects due to the size and scale of the Proposed Development, together with its position in relation to cumulative developments (NZT). The Outline Landscape and Biodiversity Management Plan (LBMP) [APP-039] sets out the proposed strategy to mitigate the effects of the Proposed Development and outlines the landscape and biodiversity avoidance, restoration, enhancement and management measures. Figure 1 (Sheet 8 of 11) of the Outline LBMP illustrates the locations where appropriate landscape planting on the margins of the main site and AGI are proposed includes the regeneration of the open mosaic habitat on the periphery of the Main Site, providing positive integration into the landscape. Although no further mitigation is provided in relation to this aspect, the Applicant is considering environmental enhancements in Teesside for the benefit of environment and society.

NE5: Additional detail

On a general note LAmax and LAeq indices are used to characterise and quantify different aspects of a given sound event, over the time period of interest. A LAmax (maximum A-weighted Sound Pressure Level) corresponds with the loudest single sound level one would hear during the sound event or time period of interest, such as the loudest bang, or passing vehicle-engine noise. On the other hand, a LAeq (A-weighted equivalent continuous sound pressure level) is akin to the "average" sound level over the sound event or time period of interest. It accounts for all of the sound (i.e. the fluctuating highs and lows, including the LAmax sound event) during that time, and represents, in a single number, the "average" level of sound. The use of LApeak noise levels are not so commonly used in assessment of environmental noise.

With respect to assessment of construction noise from the Proposed Development, noise modelling has been undertaken with respect to the noise prediction methodology contained in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites.

In accordance with BS 5228 (in relation to noise impacts on humans), construction noise is described as a continuous equivalent A-weighted sound pressure level (LAeq T,) where 'T' equals the time period under assessment (i.e. = typically 12 hours, 4 hours or 8 hours depending on whether the day, evening or night- time period is being assessed respectively)

Therefore the noise contours presented in Figures 7 to 12 of the HRA show the predicted LAeq T, levels, as stated in the Figure legend(s) 'without' mitigation. Noise contours have not been provided 'with' mitigation as the final location of the construction plant and proposed barriers are not yet confirmed.

BS 5228 does not contain a database of LAmax noise levels from construction plant (save for a small number of vehicle pass-by noise levels), therefore it is not possible to predict the LAmax levels during the different construction activities across the various sites within the Proposed Development. There is also no general empirical relationships between LAmax and LAeq, T, as stated under BS 5228 section 8.5 "Noise control from piling sites", which could allow an extrapolation of LAmax noise levels at the SPA bird locations.

The Applicant will discuss consideration of the scheme's work phases further with NE and progress will be reported within the SoCG over the course of the Examination. Any updates needed to the HRA will form part of these discussions.

22.0 STOCKTON-ON-TEES BOROUGH COUNCIL

Table 222-1: Response to Stockton-on-Tees Borough Council's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
[AS-033]	- Responses to the Examining Authority's First Written Questions (ExQ1)	Q1.7.4 – Tees Archaeology consider the non-designated WWII anti-landing glider posts and ridge and furrow surrounding Cowpen Bewley to be of high and medium heritage value respectively and propose mitigation measures to address these. Q1.7.6 – Tees Archaeology do not consider that Requirements 13 'Archaeology' and 15 'CEMP' are sufficient to secure cultural heritage mitigation. Also request that "intrusive archaeological surveys" are included in the definition of permitted preliminary works. Q1.7.7 – Tees Archaeology concerned over implementation of protocol for unknown archaeological deposits encountered during construction Q1.9.16 – STBC consider that article 10 'Power to alter layout of streets' should be more precise Q1.9.31 – further information is sought on article 39 'Planning permission etc.' of the dDCO and its implications Q1.9.52 – more clarification on start-up and shutdown periods Q1.9.70 – the five days periods specified in Schedule 13 'Procedure for discharge of requirements of the dDCO are not considered reasonable Q1.13.10 – working outside hours should be for critical work not due to time limits on deadlines and advanced warning should be given Q1.13.11 – no information in Framework CEMP on how noise complaints will be rectified Q1.14.17 – STBC would recommend engagement of Stockton Employment and Training Hub for future recruitment needs Q1.14.20 – status of discussions on Cowpen Bewley Woodland Park replacement land and how the process to agree and secure the layout of the land.	Q1.7.4 The Applicant acknowledges Tees Archaeology's comments in relation to the non-designated WWII anti-landing glider posts and ridge and furrow surrounding Cowpen Bewley. Mitigation measures to protect heritage assets are secured via Requirements 13 and 15 of the draft DCO [REP2-004]. Q1.7.6 The Applicant does not consider that an Archaeological Management Strategy is required and that the measures already secured via Requirements 13 and 15 of the draft Development Consent Order [REP2-005] are sufficient to secure cultural heritage mitigation and protect the archaeological and cultural heritage assets in this location. The Applicant would also refer to the response to ExQ1.7.5 of the Response to ExQ1 Cultural Heritage [REP2-025] which sets out more detail about how the mitigation is secured. The definition of permitted preliminary works, as drafted in the Draft Development Consent Order (reference EN070009/APP/4.1), specifically includes 'archaeological investigations', which inherently covers intrusive archaeological surveys. Q1.7.7 Archaeological matters will be addressed through of a programme of archaeological evaluation and mitigation to be set out in Site-Specific Written Scheme of Investigations to be prepared and approved by the Local Planning Authorities prior to construction. Q1.9.16 The Applicant would refer to its response to Q1.9.16 submitted at Deadline 2. While the power sought might appear wide, the consent of the street authority is required in order for the power to be exercised, which the Applicant considers provides the requisite level of input and control. The implications of not including such a provision are that the undertaker would not have the power to alter the layout of streets and which is necessary in order to deliver the Proposed Development. This would then require a separate Section 278 agreement to be entered into with the relevant highway authority outside of the Order regime, which could lead to a delay in the implementation of the Proposed Development and is contrary to the 'one-stop shop' approach to powers and consents enabled by the PA 2008. Q1.9.31

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			Article 39 sets out that it will not be a breached of the Order if development is carried out or used within the Order Limits in accordance with any planning permission granted under Section 57 of the Town and Country Planning Act 1990 (the 'TCPA 1990'). The relates to both existing and future planning permission granted by the TCPA 1990. The effect of article 39 is explained at paragraphs 3.7.2 to 3.7.4 of the Explanatory Memorandum [APP-028]. Q1.9.52 The Applicant has provided further clarification on this matter in its response to Q1.9.52 submitted at Deadline 2. In order that the dDCO is more consistent with the terminology in the Framework CEMP, the Applicant amended Requirement 19(4)(a) at Deadline 2 so that instead of "start-up" and "shut-down" periods the reference is made to "mobilisation and de-mobilisation periods". Q1.9.70 The Applicant would refer to its response to Q1.9.69 submitted at Deadline 2. Schedule 13 of the dDCO sets out the same procedure as approved by the Secretary of State for the Net Zero Teesside Order 2024 and which apply to two out of three of the relevant planning authorities relevant to H2Teesside, including STBC. As a result, the timeframes set out have precedent and have been considered to be reasonable by the SoS. Q1.13.10 The Applicant would refer to its response to Q1.13.10 submitted at Deadline 2. Requirement 19 of the dDCO requires the undertaker to obtain the prior approval of the relevant local authority for such works. Q1.13.11 The Applicant notes STBC's comments. It will be for the relevant EPC Contractor to set out in the Final CEMP(s) submitted for approval the procedure for how complaints will be investigated and rectified. The Framework CEMP [REP2-011] Table 7.4 includes 'noise complaints should be monitored reported to the EPC contractor and immediately investigated. These complaint swill be kept in a log book available on request.' Q1.14.17 Requirement 26 of the dDCO commits the Applicant to agreeing an Employment, Skills and Training Plan with the relevant planning authority, which includes STBC, to promote skills and training development opportunities for local residents during construction. The Applicant is committed to working with STBC and other bodies and agencies to develop that plan. Q1.14.20

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			As confirmed by STBC, discussions are ongoing with regard to the replacement land. The Applicant's response to Q1.14.20 at Deadline 2 confirms that the layout of the land is secured through article 29 of the dDCO. The draft SoCG between the Applicant and STBC [REP2-040] submitted at Deadline 2 sets out the latest position on the replacement land.

23.0 KELLAS MIDSTREAM LIMITED AND CATS NORTH SEA LIMITED

Table 23-1: Response to Kellas Midstream Limited and CATS North Sea Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
Kellas1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-082]	• Q1.9.67 - Request for Protective Provisions – preferred form attached as Appendix 1 to this document	The Applicant notes that the protective provisions included at Schedule 12 Part 3 of the dDCO already apply for the benefit of Kellas and CNSL as an owner and operator of apparatus. The Applicant has reviewed the preferred form of protective provisions supplied by Kellas and CNSL's solicitors, as attached to their submission. It is noted that these are broadly similar to the protective provisions incorporated into the Net Zero Teesside DCO, but there are a number of differences on certain points of detail and scope. Whilst the Applicant is not in principle opposed to reaching agreement on an alternative form of protective provisions compared to the Net Zero Teesside DCO – whether in Kellas and CNSL's preferred form or some other form – no specific explanation has yet been provided by Kellas and CNSL as to the underlying reason for these proposed changes. Subject to such explanation being forthcoming, the Applicant is confident that suitable protective provisions can be agreed between the parties during the remaining course of the examination.

24.0 WARD HADAWAY LLP ON BEHALF OF NORTHUMBRIAN WATER LIMITED

Table 24-1: Response to Ward Hadaway LLP on behalf of Northumbrian Water Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
REP2-092	Responses to the Examining Authority's First Written Questions (ExQ1) and Letter of Objection	• Q1.15.1 - Agreement yet to be reached for water supply to Proposed Development during operation. • Q1.6.44 - No PPs yet agreed • Q1.9.67 - NWL unable to agree to PPs in Part 1 of Schedule 12 of the Draft Order • NWL invite the Applicant to make contact to resolve any outstanding matters as soon as possible.	Q1.15.1 The Applicant has agreed with NWL to have a dedicated techno-commercial discussion about NWL regarding water supply shortly. Q1.6.44 and Q1.9.67 The Applicant understands from recent correspondence on 17th October 2024 that Ward Hadaway are in the process of drafting Protective Provisions and the Applicant's legal representatives will be in receipt of these shortly. The Applicant acknowledges Northumbrian Water Limited submissions but disagrees with the suggestion that there has not been any contact between the Applicant and NWL. The Applicant has held three meetings and exchanged multiple emails with various members of the NWL team since June 2024, with the latest meeting prior to NWL's submission being on 23rd September 2024. The Applicant has fostered a good working relationship with NWL, promptly responding to queries or meeting requests, and are awaiting an Impact Assessment Report from NWL in order to ascertain the protections required for their assets within the Order Limits. The Applicant held a further meeting with NWL and Ward Hadaway on 17th October 2024 and feel that both parties are now aligned on the next steps and it was confirmed that NWL has not been and is not waiting on any further information from the Applicant.

25.0 LIGHTHOUSE GREEN FUELS LIMITED

Table 255-1: Response to Lighthouse Green Fuels Limited's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
LGF1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-084]	• Strongly supports the project in principle. • To the extent that the Applicant seeks powers in the draft DCO to either (a) compulsorily acquire land (including subsurface) or rights or (b) to extinguish, suspend or override existing rights, the maintenance, operation and development of LGF's infrastructure must be preserved. LGF also require confirmation that infrastructure, which are currently or may in the future be owned or used by us, including those owned or controlled by Air Products plc, will not be impacted by the proposals. LGF objects to the proposed powers of compulsory acquisition over land in which it has an interest unless adequate protection in the form of an **asset protection agreement or protective provisions** can be agreed. • Interaction between H2T and LGF Project – TV1 &Tv2 Sites, access on Riverside Road and Huntsman Drive • AGI location – LGF have suggested alternative located closer to Linkline Corridor • Request for further collaboration on Construction Traffic Management Plan, Construction Environmental Management Plan, Framework Construction Workers Travel Plan, and the Framework Construction Traffic Management Plan • Request for collaboration on cumulative environmental effects assessments and any potential opportunities for natural and social capital or net gain	The Applicant welcomes Lighthouse Green Fuel's (LGF's) support in principle for the Proposed Development. The Applicant is currently seeking a meeting with LGF and their legal representatives to initiate discussions on LGF's requirements for Protective Provisions, as well as the interactions between the Proposed Development and the LGF DCO. AGI Location - The Applicant acknowledges their discussions with LGF on the location of the AGI and will continue to collaborate with LGF to find a mutually beneficial solution. The Applicant wishes to work towards reaching agreements with LGF based on the proposed AGI location. Where required (depending on the works and location) a copy of each detailed Final CTMP(s), CWTP(s) and CEMP(s) will be provided to affected parties relevant to that part of the Proposed Development at least one month before the relevant works are anticipated to commence. The Applicant will discuss directly with LGF the CTMP collaboration point and where it is best capture, the Applicant's DCO or the LGF DCO. The Cumulative Effects Assessment is currently being updated by the Applicant and will be submitted into the Examination at Deadline 5. The Scoping Report submitted by LGF is included in this Cumulative Assessment (as Development ID: 8). However, it is acknowledged that Statutory Consultation was undertaken by LGF between 16 May 2024 and 20 June 2024, after submission of the H2Teesside DCO application. Therefore, the PEIR published as part of that consultation will be taken into account by the Applicant in its update to its cumulative assessment proposed for Deadline 5. It should be noted that the methodology for the Cumulative Assessment is primarily based upon guidance contained within the Planning Inspectorate's Advice Note on cumulative effects assessments. The information collected to inform the Cumulative Effects Assessment is restricted to information publicly available to ensure a transparent and accurate assessment. The Applicant is exploring opportunities for biodiversity enhancements in the wider Teesside area off-site from the proposed Order Limits and is working with stakeholders to develop proposals in this regard. The Applicant will provide an update on this in due course.

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
LGF2	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-084]	• Q1.6.7 - No inaccuracies identified in the BoR but seeks further clarification regarding CA of plot 11/56. • Q1.6.62 - Keen to continue discussions around the AGI Location and proposed CA of plot 9/16. • Q1.8.5 - LGF disagree with the statement asserting that there is no construction overlap at page 126 of the ES Appendix 23D (Stage 4 - Assessment of Cumulative and Combined Effects) [APP-224] • Q1.9.12 - Comfortable with the scope of the definition for permitted preliminary works provided APA or PPs agreed and in place. • Q1.9.53 - Request representation within the local liaison group to respond to issues arising from cumulative impacts. • Q1.9.67 - Yet to receive first draft of PPs or APA. • Q1.10.1 - Ground investigations to be covered by Protective Provisions • Q1.10.9 - Will require further risk assessments/permits for any works within LGF RLB • Q1.17.1 - Requires further discussion around accesses and impact on existing or required accesses for the LGF Project	Q1.6.7 The Applicant is seeking permanent acquisition over plot 11/56 in order to. build a shaft head for the proposed river crossing. Q1.6.62 The Applicant is in contact with LFG regarding the AGI location and is looking forward to further discussions with LGF on this. Q1.8.5 Development ID8 is currently in its pre-application stage (application expected in March 2025). Development ID8 in Appendix 23B is stated to have an overlap in temporal scope (during construction) and in Appendix 23C it is identified to have an overlap in temporal scope saying: *"Y – potential overlap of construction periods (construction due to last four years starting shortly after determination of the DCO and discharge of pre-commencement requirements)."* The text in Table 23D-9 which states that ID8 has no construction overlap is an error. However, the development was scoped out of a construction phase assessment due to the development being at the scoping stage, and insufficient information being present to inform any cumulative assessment. The Applicant still considers this judgement to be valid. Q1.9.12 The Applicant is currently seeking a meeting with LGF and their legal representatives to initiate discussions on LGF's requirements for Protective Provisions, as well as the interactions between the Proposed Development and the LGF DCO. Q1.9.53 The Applicant will discuss this directly with LGF taking into account project development timelines and interactions. Q1.9.67 Please see response to Q1.9.12 above.Q1.10.1 At present, none of the planned ground investigations impact LGF or their existing assets but the Applicant will seek to provide protection for LGF in respect of any GI works that do through Protective Provisions negotiations. Q1.10.9

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			The Applicant notes LGF's requirement for additional risk assessments and permits for works within the LGF's ownership, occupancy or red line boundary. Site specific risk assessments will be performed prior to any work taking place. As noted in Section 5 Construction Programme and Management, "Hot works including welding and preparations for joint coating will need to be managed through a suitable agreed permit process considering other apparatus in the area." This permit process will be developed considering the LGF RLB and other asset owners in the area to be fit for purpose, noting the high potential hazard from both existing assets and proposed projects from not just hot works and from other works in congested areas such as lifting or intrusive ground work. Q1.17.1 The Applicant acknowledges LGF's comments and will seek to agree appropriate access protections through Protective Provisions negotiations.

26.0 ENVIRONMENT AGENCY

Table 26-1: Response to Environment Agency's EXA Question Deadline 2 submissions

EXA QUESTION REF. NO.	IP	QUESTION	IP RESPONSES	APPLICANT'S RESPONSE
1.1.7	Environment Agency	Clarification/ Views sought The Examining Authority (ExA) notes the use of Amine products within the proposed Carbon Capture element of the Proposed Development and would ask: i) By what mechanisms are the use of Amine products controlled (ie do they form part of the Environmental Permit (EP) controls? ii) Should the control of Amine products be dealt with through the Development Consent Order (DCO)?	Amine products will be controlled by the Environmental Permitting Regulations (EPR) permit. These controls cover the delivery of these products onto site, the bulk storage and bunding of relevant tanks, venting and fugitive emissions from storage, pipeline delivery into the Carbon Capture Plant (CCP) and its use to capture CO2, and eventually the abatement of emissions and the monitoring of emissions from the CCP.	Noted, the Applicant has provided relevant details regarding the use of amines for carbon capture within the Environmental Permit application.
1.3.4	Environment Agency	Views sought. Paragraph 8.3.1 – 8.3.2 of ES Chapter 8 (Air Quality) [APP-060] states that the Study Area for construction dust and construction Non-Road Mobile Machinery emissions has been applied in line with the IAQM guidance 2024 extending: • up to 250 m beyond the Proposed Development Site and 50 m from the construction traffic routes (up to 250 m from the Proposed Development Site entrances), for human health receptors; and • up to 50 m from the Proposed Development Site and construction traffic routes (up to 250 m from the Proposed Development Site entrances) for ecological receptors. The ExA would ask the EA, NE and LAs to confirm whether they consider the Study	The Applicant is required to comply with the Emission Limit Values contained within the Non-Road Mobile Machinery (Type-Approval and Emission of Gaseous and Particulate Pollutants) Regulations 2018, during the construction and operation phases, limiting emissions to air.	NRMM used on site will comply with all applicable regulations, including the Non-Road Mobile Machinery (Type-Approval and Emission of Gaseous and Particulate Pollutants) Regulations 2018. This commitment has been included in the updated Framework CEMP submitted at Deadline 3 and will be discussed with the Environment Agency as part of ongoing discussions regarding the Environmental Permit.

EXA QUESTION REF. NO.	IP	QUESTION	IP RESPONSES	APPLICANT'S RESPONSE
		Area distances assessed by the Applicant and set out above, are appropriate and acceptable in respect of the air quality study areas.		
1.3.7	Environment Agency	Views sought. It is stated in paragraph 8.3.10 of ES Chapter 8 (Air Quality) [APP-060] that there may be a period following opening of Phase 1 where Phase 1 will be operational and Phase 2 in construction. There may be construction traffic pollutant emissions from Phase 2 construction at the same time as operation point source emissions from Phase 1 with two different types of emissions sources (road traffic emissions typically extending up to 200 m from the source with emissions released near ground level whilst operational emissions are released over a broader area, from height). This means, that typically, the greatest pollutant contributions at receptors in the Study Area will be very different for the two emission types. For completeness, the predicted contributions at receptors that may experience impacts from both sources have been combined to demonstrate the total pollutant contribution from the two emission sources. It is noted that this is a very precautionary approach as it combines the peak construction traffic pollutant contributions with the combined pollutant contributions from Phase 1 and 2 operations. Bearing the above in mind, please confirm whether the EA and LAs,	Emissions from the operational plant will be regulated under the EPR permit.	Noted, the Applicant's Environmental Permit Application contains the relevant Air Dispersion Assessment of the Operational Impacts.

EXA QUESTION REF. NO.	IP	QUESTION	IP RESPONSES	APPLICANT'S RESPONSE
		together with any other relevant Authority/ Body: i) Agree with the approach adopted by the Applicant in paragraphs 8.3.9-8.3.10 of ES Chapter 8 (Air Quality) [APP-060]. ii) Have any comments or observations in relation to the assessment methodology adopted by the Applicant in ES Chapter 8 (Air Quality) [APP060] and the Applicant's conclusions on the impacts and LSE set out in Paragraph 8.6 of the same document.		
1.14.3	Environment Agency	Clarification/ Views sought. Table 20-2: Responses to the Statutory Consultation Feedback of ES Chapter 20 (Major Accidents and Disasters) [APP-073] sets out the EAs response where they noted several other issues and concerns, including in relation to the Preliminary Environmental Information Report (PEIR) missing a list of proposed dangerous chemicals and a proposed inventory. In response the Applicant has stated that a provisional chemical list is provided in ES Chapter 21 (sic) (Major Accidents and Disasters), but does not actually direct the reader to that list. It is assumed that the Applicant is referring to Table 20-4 of ES Chapter 20 (Major Accidents and Disasters) [APP-073]. Can the Applicant confirm the above assumption is correct? Does the EA consider that the Applicant's response in Table 20-4 of the above mentioned Chapter of the ES is adequate and can it confirm whether or not the other issues and concerns raised	A list of dangerous substances has been provided. However, it is noted that some substances have not been decided upon by the applicant at this point. We would expect these to be identified during an application to the HSE and the local authority for a Hazardous Substance Consent.	Yes, this assumption is correct. The provisional chemical list is available in ES Chapter 20: Major Accidents and Disasters [APP-073], in Table 20-4.

EXA QUESTION REF. NO.	IP	QUESTION	IP RESPONSES	APPLICANT'S RESPONSE
		by them, as referred to in Table 20-2 have been addressed?		

Table 2626-2: Response to Environment Agency's Relevant Representation Deadline 2 submissions

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
EA1: FRA	Issue: Some of the areas highlighted as compounds are located within flood zone 2 and 3. Impact: Additional mitigation maybe required to ensure these are not at risk of flooding or increase flood risk elsewhere. Suggested solution: The FRA should be updated to include an assessment of the flood risks associated with the compound areas, and appropriate mitigation.	Whilst the FRA indicates that compounds are to be located in flood zone 1 where possible, where compounds can only be located in flood zones 2 and 3 for operational reasons (e.g. minimising vehicle movements, safe and efficient movement of labour and materials to work locations), mitigation measures are presented in the following documents: Flood Risk Assessment [APP-192, Section 9.A.9], ES Chapter 9 Surface Water, Flood Risk and Water Resources [APP-061, Section 9.5] and the Framework CEMP [APP-043]. The Framework CEMP [APP-043] includes a requirement for an Emergency Response Plan and a Flood Risk Management Action Plan (produced as part of the Final CEMP(s). The construction compounds are of temporary nature and management of flood risk is a common requirement of construction contractors and their supply chains, the detail of which are proposed to be controlled within Requirement 11 (see above). As such, we do not consider an update to the FRA is required.	We accept that temporary compounds will only be located within Flood Zone (FZ) 3 where operationally required. Although the compounds are 'temporary' in nature, what is classed as temporary is variable. We would therefore expect the applicant to consider mitigation and management of flood risk for any temporary compounds within FZ3 and FZ2, and/or within 16m of any tidal statutory main river. Mitigation should reflect the duration of operation and the size of the compound, in order to ensure there is no increase in flood risk on and off site. If mitigation for the temporary compounds is not being considered within the Flood Risk Assessment (FRA) specifically, the applicant should update the FRA to indicate where this associated flood risk is being considered, and where this assessment can be found. Once finalised locations of the temporary compounds are agreed, we wish to review copies of the Flood Risk Management Action Plan, and final Construction Environment Management Plan (CEMP).	Temporary compound duration is nominally 2 years for the satellite compounds, 3 years for the main site. Once the precise location of the temporary compounds within Flood Zone 2 and Flood Zone 3 are finalised mitigation requirements will be considered on a site-by-site basis. Any mitigation measures will be outlined in the details to be provided pursuant to Requirements 11 and 15 of the DCO. Examples of the type of mitigation measures that could be employed include header drains or drainage ditches around the edge of the compound, storm drains through the site, bunds and grading of the site to be on a slope.
EA2: Pipeline Design and Construction	Issue: There is inadequate evidence that demonstrates that all of the proposed infrastructure, in particular the	As defined in Paragraph A.6.27 of the FRA [APP-192] the Proposed Development is classified as 'Essential Infrastructure' in line with NPPF Annex	If the development is classed as essential infrastructure, this needs to be consistently reflected throughout the DCO documents.	Infrastructure built as part of the Proposed Development will be designed to remain operational during flood events.

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
	pipeline corridors and critical plant equipment in flood zone 3 will remain safe in times of a flood. Impact: There is a risk that elements of the proposed development will not be safe for its lifetime. Suggested solution: Highly vulnerable infrastructure is not acceptable within flood zone 3. They must be classed as 'essential infrastructure' and should be designed and constructed to remain operational and safe in times of flood. This means that equipment necessary for its operational would need to remain dry. We would expect a 1 in 200 year, plus an allowance for climate change, including a 600mm freeboard to be used as the design flood level. The 600mm freeboard accounts for any uncertainty in modelled flood levels, as well as for the presence of any floating debris caught within flood flows, which could damage the pipelines. The applicant should identify all critical plant equipment in flood zone 3 including both new and existing above ground infrastructure, and include mitigation measures that allow them to remain safe and operational for the lifetime of the development. Evidence should be provided in the FRA demonstrating how the design of existing pipelines in flood zone 3 are 1) flood resilient, 2) if they can currently withstand floodwaters as stated in section 9A.9.27 of the FRA CIRIA Report C688 'Flood Resilience and Resistance for Critical Infrastructure' (CIRIA, 2010), and 3) if the existing infrastructure in flood zone 3 will be altered/refurbished to meet this standard of protection for the lifetime of the development. Confirmation is also required on whether the crossing at the River Tees is below ground, above ground or both. There is reference to both types of crossing in different documents.	3: Flood Risk Vulnerability Classification. Essential Infrastructure is defined as "Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood". Due to the connections required and the infrastructure needing to be connected to, some pipelines and infrastructure will be required to be developed in areas identified as Flood Zone 2 or 3. However, largely this proposed infrastructure will be underground; those elements that aren't (e.g. Above Ground Installations) are typically unmanned and access is normally only required for planned maintenance which can be scheduled to avoid any flood risk events. Details regarding watercourse crossings are provided in Section 9.5 of ES Chapter 9 Surface Water, Flood Risk and Water Resources [APP061] and confirms the crossing of the River Tees and Greatham Creek (and adjacent water features at Seal Sands) will be underground via trenchless technologies (Horizontal Direction Drilling (HDD) or Micro Bored Tunnelling (MBT)). The use of trenchless technologies avoids any direct impact to the estuary or creek bed. For the purposes of assessment the worst case depth below the bed is assumed to be 10 m. For the Tees Crossing this is expected to be in the range of 40 to 50 m depth but will be determined following the Ground Investigation at the detailed design phase. No element of the Proposed Development is classed as Highly Vulnerable infrastructure – in contrast, the nature of the proposed development has low vulnerability, being underground or designed to be exposed to the elements. Locations where further detailed	For example, Appendix 9A: Flood Risk Assessment, section (9A.6.41 confirms that all essential infrastructure will be developed within FZ3A. However, it fails to state whether it will remain operational in times of a flood, which is one of the criteria as per Table 2 of the Planning Practice Guidance. Additionally, section 9A.9.26 refers to 'recovery time' from a major flood event, yet there should be no need for recovery time as the plant should remain operational if classed as essential infrastructure. Document APP-093 (Drawings 6.3.15 ES Vol II Figure 5-2 Indicative Pipeline Routings) confirms the Tees is trenchless, in line with your response. However, this drawing indicates many of the pipeline routings are overground. Some of these overground pipeline routings are within FZ3. For example South of the Tees towards Dabholm Gut as well as towards Saltholme Brine Reservoir and the Holme Fleet. Where these above ground pipeline corridors are classed as essential infrastructure and are within FZ3, they are required to remain safe and operational in times of flood and must not impede water flows. This means that equipment necessary for its operation would need to remain dry. *The applicant will need to provide evidence that the above ground infrastructure within FZ3 can remain dry for the lifetime of the development using 1 in 200 year, plus an allowance for climate change, including a 600mm freeboard to be used as the design flood level.* The applicant should also provide evidence which demonstrates existing above ground	Critical plant equipment in the Main Plant, Pipeline corridors and AGIs will be identified as required to be protected from flooding and appropriate flood mitigation will be included in the design. CIRIA guidance (C688) shall be used. For example, electrical equipment will be elevated above design flood levels and/or located within bunds. Recovery time includes time to assess potential impact from flooding which is not limited to loss of containment. Pipelines or equipment can remain operational but must be assessed for corrosion or water damage which, if not maintained, may lead to further consequences. Recovery time includes taking equipment down for maintenance following an event (flooding or otherwise) which may have compromised equipment performance and which should be checked as part of best practice. It also includes maintaining or rebuilding flood defences (e.g. bunds) if required to ensure they are to the original specification and their integrity has not been compromised Above ground pipelines will be assessed for flotation, and if susceptible, appropriate restraints will be put in place to make the design flood resistant. Impeding flood water is applicable to river floods but not overland flooding which is the majority of the pipeline route. There are many existing aboveground pipelines in these corridors therefore the proposed design will not benefit from higher elevations to avoid impeding water if other pipelines will block the path. New pipeline constructed for the Proposed Development will be built in line with the CIRIA guidance.

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
		design is required is proposed to be managed through the process of Protected Provisions and Requirement 11 (see response to EA 18 below). Existing above ground pipelines including those in the Linkline corridor are appropriately designed, protected and maintained in accordance with pipeline design standards and legislative requirements.	pipelines meet design standards to be flood resilient and will be maintained in accordance with pipeline design standards and legislative requirements.	The Applicant can confirm that the design flood level is as-per the quoted amount. Where existing above ground pipelines are under the control of a third party the Applicant cannot demonstrate that the pipelines meet design standards. In the case of the existing buried natural gas pipeline which is under the control of a third party the Applicant will check the integrity status of the pipeline.
EA3: Temporary Construction and enabling works (flood risk)	Issue: The Applicant has described several temporary construction and enabling works such as but not limited to temporary storage in the floodplain, open-trench channels and trenchless channels, directional drilling under the tees, utilising existing culverts andoverbridges. However, these have not been adequately considered within the FRA. Impact: Potential increase of flood risk from the temporary construction and enabling works. Suggested solution: Temporary works and enabling works in flood zone 3 need to be assessed and considered in the FRA. The FRA should demonstrate the use of operational controls and/or mitigation measures throughout the construction phase, and minimise flood risk in areas at high-risk of flooding. Furthermore, it is vital there are no adverse impacts to the EA's flood defence assets along Greatham Creek.	Mitigation measures are presented in the following documents: Flood Risk Assessment [APP-192, Section 9.A.9], ES Chapter 9 Surface Water, Flood Risk and Water Resources [APP-061, Section 9.5] and the Framework CEMP [APP-043]. Mitigation measures specific to maintaining the integrity of flood defences, including Greatham Creek, are provided within the aforementioned documents. Further, defining specific mitigation measures at this stage will limit opportunities for refinement and optimisation relating to temporary construction activities and enabling works, whereas the Protective Provisions and Requirement 11 permit approaches to be refined and evolve whilst protecting the environment, development and others from increased flood risk. As a result of these mitigation measures, the Applicant does not consider an update to the FRA is needed	We are satisfied with the proposed approach. The FRA should be updated stating that flood risk surrounding temporary and enabling works are being considered, and reference which documents these assessments can be found. We can review construction methods through a final CEMP and/or through the protective provisions regime if agreed.	The FRA does not need to be updated, as detailed mitigation measures are not yet known and will be determined pursuant to the Protective Provisions and Requirements.
EA4: Figure 9B-9: Salinity Data and Tees Bay	Issue: The legend for figure 9B-9 is incomplete. Impact: It is difficult to understand the figures shown. Suggested solution: The figure should be updated with a completed legend.	Thank you for raising this, we have provided an amended figure for consideration by the EA.	We are unable to find the amended figure. Therefore are unable to comment further on this point.	The updated plate has been appended to this response (see Appendix 3 of this document). The Applicant awaits feedback from the Environment Agency.

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
EA5: Water Quality Modelling	Issue: Cormix files for modelling have not been provided. Impact: We are unable to undertake a full model review until the Cormix files have been provided. Suggested solution: Applicant to provide the Cormix files.	Cormix files have been provided to the EA on 11 September 2024 to facilitate a full model review.	We have reviewed the Cormix files provided by the Applicant, and are satisfied that relevant dilution is happening, and that excess temperatures are not a concern.	Noted
EA6: Table 9B-10: Effective Volume Flux Calculations	Issue: Effective Volume Flux (EVF) values for Polyaromatic Hydrocarbons and Cadmium are given as 4.5 and 24 (Polyaromatic Hydrocarbons) and 0.002 and 0.01 (Cadmium) in the report. However, we expected the values to be 5.0 and 30.6 for Polyaromatic Hydrocarbons and 0.02 and 0.1 for Cadmium. Impact: Potential methodology error. Suggested solution: The Applicant should provide clarification on the calculations and methodology used for Polyaromatic Hydrocarbons and Cadmium.	There is a typing error in the effective volume flux calculations for cadmium - the values should be 0.02 and 0.1. This does not have any impact on the modelling or conclusions of the report in respect of this parameter. The effective volume flux calculations have been checked for polyaromatic hydrocarbons and no error has been found so we are unsure why the difference in values is arising. However, this has no impact on the modelling or conclusions of the report for this parameter.	We accept the typing error for cadmium and agree that there is no impact on modelling or conclusions of the report for this parameter. We recognise there is a difference in the effective volume flux calculated by the EA and the applicant. However, it is noted that the conclusions are still the same. No further action is required on this matter.	Noted
EA7: Figure 9B-15	Issue: It is unclear what the green shading in Figure 9B15 represents. Impact: It is unclear if this indicates material entering the bay area. Suggested solution: Applicant to provide a description of the green shading and if material is entering the bay area.	The green shading shows the mixing patterns in Tees Bay over the entire model run. It was provided to show how dissolved substances move through the Bay, it does not relate to any specific concentration of any specific substance. It shows that water and dissolved substances can move between the Bay and the Estuary, but the following results show that any contaminants from the H2Teesside outfall will be diluted to below EQS values well before that point.	Our review of the cormix files demonstrate that the dilution is satisfactory.	Noted.
EA8: Benzo(g, h, i)- perylene, pages 56- 57	Issue: Benzo(g,h,i)-perylene increase is above Environmental Quality Standards (EQS) for scenario 5. The report also states that this will have no significant impact on water quality. However, no explanation of how this conclusion was formed and the reasoning behind it has been provided.	Report should read scenarios 1, 2, 3 and 4. Scenarios 5 and 6 were renamed as 3 and 4 at a late stage and are occasionally referred to as scenarios 5 and 6 in error on pages 55 and 57. Concentrations of benzo(g,h,i)perylene are limited to using MAC EQS values only and this parameter has been modelled in the far field as set out in Table 9B-18 (scenario 3 = scenario 5).	We recognise that the discharged effluent will contain river water contaminants that are concentrated within the process effluent. Therefore, given that the MAC EQS is already breached, we accept that an EQS proxy of 5% above ambient to assess the significance of the discharge is an appropriate threshold. Although we can see	The maximum ambient benzo(g,h,i)perylene is 1.4ng/l based on sample location D in the report, giving a 5% threshold for mapping of mixing zones of 0.07ng/l above ambient. This equates to an absolute concentration of 0.147ng/l at the edge of the mixing zone. The maximum benzo(g,h,i)perylene concentration modelled in Tees Bay under Scenario 3 is

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	Impact: Benzo(g,h,i)-perylene is over Environmental quality Standards EQS. Suggested solution: Further evidence should be provided regarding why benzo(g,h,i)-perylene increase is above EQS and how the conclusions were made.	The MAC EQS for benzo(g,h,i)perylene is already breached within Tees Bay so an appropriate threshold above background concentrations has been used to establish the area over which water quality impacts may be seen for this parameter. The results in Plate 9B-21 shows that discharges from H2Teesside will be rapidly diluted by water in Tees Bay under scenario 3 (5) and will only increase concentrations of this substance over an extremely limited area in the immediate vicinity of the discharge point and in the deepest waters. For this reason, the impact on receiving water quality is considered to be Not Significant.	from plate 9B-21 that the wider area of Tees Bay is not affected, clarification is required on the maximum percentage above ambient that is achieved under scenario 3.	0.195ng/l. This is approximately the same as the maximum ambient concentration recorded at sample location B.
EA17: Schedule 12 Protective Provisions	Issue: The supporting documents indicate that the Applicant wishes to disapply some EA consents/permits. Furthermore, it is unclear which permits/consents the Applicant seeks to disapply. Impact: We are unable to disapply any EA consents/ permits at present. Suggested Solution: Further discussions between the Applicant and the EA to be undertaken.	The consents sought to be disapplied by the draft DCO are set out in article 9 of the draft DCO and from an EA perspective, include Flood Risk Activity Permits and Water Resources Act 1991 byelaws. The Applicant recognises that the EA will need to be comfortable with the Protective Provisions regime that has been put in place in the alternative for these consents. Draft Protective Provisions have been included in the draft DCO, which are based on what the Applicant understands to be the EA's preferred form, adapted to this application.	The applicant should not apply for both protective provisions and flood risk activity permits, and should only progress down one route or the other. If the applicant wishes to disapply the Flood Risk Activity Permit, we require further details on the specific flood risk activities proposed as part of this work to determine their risk category. The list of generic flood risk activities covered under EPR regulations is available within Chapter 2 Table 1.1 Application Charge Table (Page 33-37), The Environment Agency (Environmental Permitting and Abstraction Licensing) (England) Charging Scheme 2022: version 1.4 (publishing.service.gov.uk).	The Applicant has not sought to apply for both protective provisions and FRAPs – it has sought to disapply the latter. The Applicant will discuss with the EA to ascertain the information it is exactly seeking through the SoCG – the information it has provided with the DCO Application is commensurate with other DCOs where disapplication has been agreed by the EA.
EA18: Requirement 11 – flood risk	Issue: We note the inclusion of Requirement 11. However, it is unclear what the purpose of this Requirement is and why it has been included in the draft DCO. Impact: Lack of clarity regarding this Requirement.	With a planned construction period in excess of 5 years and a sector that is evolving and adapting to innovative ways of working, Requirement 11 has been proposed to facilitate opportunity for the proposed works, permanent and temporary (and associated flood risk measures) to be further refined by the Contractor, in order to avoid stifling opportunities for innovation and reduced carbon in delivery as temporary works and	The principle of this requirement is welcomed. Engagement is ongoing between the EA and applicant regarding this requirement.	The Environment Agency's response is noted. The Applicant will continue engagement with the Environment Agency through the SoCG [REP1-013].

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
	Suggested Solution: We are unable to agree to this Requirement and would welcome further discussions with the Applicant.	construction methodologies evolve. Requirement 11, along with the Protective Provisions (see above) ensures retention of control of the approval process to protect the environment, development and others from increased flood risk. The Applicant is engaging in further discussion on this matter with the EA.		
EA19: Opportunity to secure environmental enhancements	It is acknowledged and welcomed that the applicant has undertaken initial discussions with the EA on opportunities for habitat enhancement that contribute to achievement of Water Environment (Water Framework Directive) Regulations objectives in the Tees estuary area. In particular, we recommend that such measures include the identification and delivery of measures to mitigate the ongoing ecological impacts of recent and historical physical modifications to the Tees Estuary, Tees Coastal and other waterbodies designated as heavily physically modified. Other opportunities for environmental enhancement include: The EA's Tees Tidelands programme of projects, wider partner led projects, and the Natural England led Tees Estuary Nature Recovery Partnership are both developing and implementing works to expand and enhance natural habitats in the Tees Estuary area.There is an opportunity to restore tidal influence to approximately 1ha of agricultural land currently defended by an EA maintained flood embankment adjacent to Cowpen Bewley Woodland Park. If the locations of the applicant's proposed mitigation is the same or proximate then multiple benefits could be achieved through a collaborative approach. There are also further opportunities to work with land managers to facilitate their entry into the Environmental Land Management Scheme to install a buffer zone between current agricultural use and both the Cowpen Bewley Woodland Park and the Claxton Beck watercourse, providing both habitat and nutrient reduction benefits. The applicant should contact the EA to discuss the potential to secure environmental enhancement through the incorporation of intertidal habitat restoration adjacent to Cowpen Bewley Woodland Park.	The Applicant will engage in further discussion on this matter with the EA.	Engagement is ongoing between the EA and applicant.	The Environment Agency's response is noted. The Applicant will continue engagement with the Environment Agency through the SoCG [REP1-013].

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
EA22: Land Contamination	We note that South Tees Development Corporation are responsible for remediation of the main development site prior to this development proposal beginning. The documents submitted recommend that ground investigation should be undertaken followed by a Detailed Quantitative Risk Assessment (DQRA) where necessary. This should identify where remediation is required and to what standard, following best practise guidance.The applicant may not be aware that a site adjacent to a section of the proposed pipeline corridor (NGR NZ 51767 24084) is currently being investigated under Part 2A of the Environmental Protection Act 1990. The site was previously known as Seal Sands Chemicals Company (SSC). The site is heavily impacted by previous chemical manufacturing on site which disposed of waste to land which has gone on to impact shallow groundwater. The EA are investigating this site on behalf of Stockton-on Tees Borough Council. Additional information can be sought from the Local Authority. 6.3.9 ES Vol II Figure 4-4 Hydrogen Pipeline Corridor [APP-087] shows the hydrogen pipeline corridor within this area to be 'overground and underground pipelines' along the eastern edge of the site being investigated. It may therefore be appropriate to undertake ground investigation within this area, as detailed within Table 7-3: Chapter 10: Geology, Hydrogeology and Contaminated Land [APP-062]	Noted.	Our previous advice regarding land contamination in our relevant representations included an error, incorrectly referring to Table 7-3. This sentence has been corrected below: *'It may therefore be appropriate to undertake ground investigation within this area, as detailed within Section 10.5.8: Chapter 10: Geology, Hydrogeology and Contaminated Land [APP-062]'*	Noted.
EA23: Disapplication of Flood Risk Activity Permit (FRAP)	Consent must be obtained from the EA if the applicant wishes to disapply the FRAP. We are unable to agree to disapply FRAP requirements if we are not satisfied that the necessary protective provisions are secured through the DCO. The applicant should ensure adequate information is provided to enable our determination of what is being proposed and the level of risk to the environment.	The Applicant recognises that the EA will need to be comfortable with the Protective Provisions regime that has been put in place in the alternative for these consents. Draft Protective Provisions have been included in the draft DCO [AS-013], which are based on what the Applicant understands to be the EA's preferred form, adapted to this application. The Applicant would welcome further discussion on this matter with the EA. The Applicant considers that sufficient information has been provided in the Application documentation for the EA to understand what is being proposed and the level of risk to the environment, which is commensurate with the level of detail accepted by the EA on many DCOs	We require further information from the applicant on this matter. Please refer to comments for EA17: Schedule 12 Protective Provisions.	The Applicant awaits comment from the EA on the draft Protective Provisions it has included in the draft DCO.

Ref. no.	Environment Agency Relevant Representation Issue	APPLICANT'S Responses	Environment Agency's D2 Response	Applicant's Response
		to date. The Applicant is engaging in further discussion on this matter with the EA.		

27.0 REDCAR AND CLEVELAND BOROUGH COUNCIL

Table 27-1: Response to Redcar and Cleveland Borough Council's Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
RCBC1	Responses to the Examining Authority's First Written Questions (ExQ1) [REP2-044]	Q1.5.3 – it should not be assumed that GHG emissions from existing landfill sites would be minimal; a more robust calculation of GHG associated with maintenance should be adopted Q1.9.51 – the dDCO does not reflect the potential impacts on traffic if major developments other than NZT, H2T and Hygreen are consented 1.10.1 - if the proposal intends to use pile foundations then a pile risk assessment will be needed to prevent preferential pathways of pollution to groundwater. Q1.14.13 - NZT is also set to start construction in early 2025 – concern is will Tees Valley be able to provide the volume of construction workers required for major projects starting around the same time. Need to have training opportunities in place now for local residents to up skill to access the future construction jobs. Happy to work the applicant, TVCA and Teesworks Skills Academy on this. Q1.17.9 - route 4 via the A174 should be the primary route for all construction traffic. Traffic movements can predominantly be limited to the Trunk Road and internally to Teesworks and Wilton sites.	Q1.5.3 The Ground Investigation (GI) will assess the presence of any ground gases along the proposed pipeline route. The findings will inform the design of the pipeline to ensure effective measures are implemented to prevent any potential risks associated with gas migration. Ongoing GI work is in progress, and the results, which will guide the final design and risk mitigation strategies, will be available in due course. Q1.9.51 The Applicant notes RCBC's comments but does not agree that the Requirement 18 of the dDCO should be amended to refer to "any other major development interest as may be agreed with the LPA." As set out in the Applicant's response to ExA Q1.9.51 [REP2-027], Requirement 18 refers to both Net Zero Teesside and HyGreen, and as these are both developments led by bp, the Applicant is more likely to be able to engage in constructive discussions around co-ordination of activities between the Proposed Development and those developments. To reference other developments in Requirement 18 would mean the Applicant being beholden to other developments and other companies complying with the H2Teesside DCO, which the Applicant would have no control over. Further to the above, the Applicant considers that, given the results of the ES, there is no criteria to validly determine which developments should or should not be referenced within Requirement 18, given the wider development environment on Teesside. The Applicant considers it is not appropriate for one consent to seek to manage the impacts and benefits of a large number of other consents. In addition, as all the developments are still at an early stage, the Applicant has not undertaken specific engagement on this issue because its delivery programme and the programmes of the other development will continue to evolve between now and when the traffic management is required. That traffic management will be controlled by the Construction Traffic Management Plan submitted pursuant to Requirement 18 at the relevant point in time. Q1.10.1 A piling risk assessment will be undertaken and its recommendations followed – this is secured by Requirement 21 in Schedule 2 to the Draft DCO. Paragraph (1) prevents commencement of development (other than permitted preliminary works) "until a written piling and penetrative foundation design method statement, informed by a risk

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
			assessment" has been submitted and approved, and paragraph (2) secures compliance with the approved method statement. Q1.14.13 The Applicant has provided clarification on construction worker numbers in its response to ExA Q1.14.13 [REP2-032]. While RCBC's comments are noted, there is still a significant degree of uncertainty over the timing and sequencing of the construction of various developments within Tees Valley, while a number are yet to receive consent. As mentioned above, there is scope for the Applicant to engage in discussions with other bp led developments such as NZT and HyGreen on construction related matters. Furthermore, Requirement 26 of the dDCO commits the Applicant to agreeing an Employment, Skills and Training Plan with RCBC to promote skills and training development opportunities for local residents during construction. The Applicant is committed to working with RCBC, TVCA and other bodies and agencies to develop that plan. Q1.17.9 ES Figure 15-4 [APP-164] shows a number of proposed construction access routes for the Proposed Development, including Route 4. Paragraph 15.6.4 of ES Chapter 15 confirms that it has been assumed that all construction compounds to the south of the River Tees (within Redcar and Cleveland) will be accessed via the A1085 Trunk Road/Teesworks Steel House Gate roundabout. Route 4 via the A174 could be considered as the primary route for construction traffic; however, this decision is influenced by the varied destinations of HGVs. At present, it is assumed the traffic is evenly split, with 50% of HGVs using the A174 (Route 4) and the remaining 50% using the A66 (Route 1), based on whether they are heading northbound or southbound on the A19. For HGVs travelling north on the A19, Route 1 via the A66 offers a quicker option compared to using the A174 and then proceeding north. If greater use of Route 4 via the A174 is required, further assessment will be incorporated into the Final Construction Traffic Management Plan (CTMP) to ensure the route's suitability for accommodating the increased traffic volume.

28.0 VENATOR MATERIALS (UK) LIMITED

Table 28-1: Response to Venator Materials (UK) Limited Deadline 2 submissions

REFERENCE	SOURCE DOCUMENT(S)	IP ISSUE/ THEME	APPLICANT RESPONSE
REP1-051	Written Representation	With reference to the Examining Authority's Initial Assessment of Principal Issues, Venator's representation focusses on Compulsory Acquisition and Temporary Possession; more specifically: Article III. The need for and amount of land, rights and powers sought to be compulsorily acquired and whether the intended use for the plots is clear; Article IV. Whether the temporary possession powers sought are justified and proportionate; Article V. Whether there is a compelling case in the public interest for the compulsory acquisition of the land, rights and powers sought and justify interference with Human Rights and would accord with the Equality Act 2010; and Article VI. Whether all reasonable alternatives to compulsory acquisition and temporary possession have been fully explored. Article VII. Venator continues to be in commercial discussions with the Applicant to enable delivery of hydrogen to the Venator Greatham Works and therefore supports the principle of the Project. Article VIII. Venator remains concerned over the impact of the pipeline routing preventing their ability to extend their operations in the future.	The Applicant welcomes Venator's support in principle for the Proposed Development and confirms the parties are engaged in commercial discussions for the delivery of hydrogen to Venator Greatham Works. The Works Plans [REP-2003] outline the works that are proposed on each lot and the Land Plans [AS-003] outline the rights that are sought over each plot. Sections 5-7 of the Statement of Reasons [APP-024] outline the compulsory acquisition powers sought, the need for compulsory acquisition of land and rights and the justification for the use of powers of compulsory acquisition (please also see the Applicant's responses to ExQ1.6.33, 1.6.34, 1.6.35 and 1.6.36 in 8.11.6 Response to ExQ1 Compulsory Acquisition and Temporary Possession [REP2-024]). The Applicant has addressed the Equality Act 2010 in its response to question 1.6.37 in Response to ExQ1 Compulsory Acquisition and Temporary Possession [REP2-024]. Paragraphs 6.1.32-6.1.48 [APP-024] outline the consideration of alternatives. Specifically in relation to the corridor, paragraph 1.1.41 **[APP-024]** states that *The Applicant has considered a number of alternatives in relation to the Hydrogen Distribution Network and Connection Corridor Routings. These have been refined and flexibility has been retained where design and landowner / stakeholder negotiations are progressing.* This is demonstrated in the Change Application Report and its Appendices (Document Refs. 7.3 & 7.4) submitted on 17th October 2024 which, following discussions with Venator, seeks to change the Red Line Boundary by further reducing optionality in Venator's non-operational land to the south of Greatham Works The Order Limits contained within the Change Application reflect only what is required in order for the Proposed Development to deliver hydrogen to Venator's Greatham Works taking into account where Applicant is with its design development and the need for flexibility at certain locations. The Applicant has issued a draft side agreement and protective provisions for the protection of Venator's assets and is continuing to engage with Venator.

APPENDIX 1: NATURAL ENGLAND COMMISSIONED REPORT NECR570

Noise Disturbance – Baseline Level Monitoring in the Solent

September 2024

Natural England Commissioned Report NECR570

About Natural England

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Further Information

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Report details

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Foreword

Natural England commissioned background noise level and bird disturbance surveys across key sites in the Solent in order to fill in the current data gap on noise levels for Solent SPA sites. These sites were picked as they combine significant overwintering sites and anthropogenic activity.

The surveys provide new information on the levels of background noise experienced at these sites, the kinds of activities generating noise and the amount and kind of disturbance to overwintering birds.

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

Background

The Solent coastline hosts thriving harbours, ports and other coastal industry, meaning there is a high volume of activity interacting with the marine environment. The majority of this activity creates a level of noise that can lead to the disturbance and displacement of Special Protection Area (SPA) bird features. The SPAs in the Solent area with marine components are the Solent and Southampton Water SPA, Portsmouth Harbour SPA, Chichester and Langstone Harbours SPA and Solent and Dorset Coast SPA.

In this report, noise monitoring results from both long-term and short-term monitoring during the overwintering period in key areas across SPA sites in the Solent are presented with the objective of providing data on background noise levels as well as to provide some understanding of the likely triggers for bird responses to anthropogenic noise in the area.

Nine areas of high activity have been identified. These areas are hotspots for anthropogenic activity and cross over with key areas of designated SPA. These areas are therefore used as the main sites for the background noise surveys, and are representative of the Solent as a whole.

Results

The sound index used to represent the background noise levels is the L_{A90} which describes the sound level which is exceeded for 90% of the measurement period. Typically, the daytime background noise levels in the nine study areas range between L_{A90} 43.0 dB(A) to 49.0 dB(A) with the exception of one location within the area of Chichester and Langstone Harbours SPA where the daytime background noise level is 69.0 dB(A).

The results from the short-term noise monitoring show that birds are more likely to respond to noise disturbance when the sound pressure levels at the location of the birds are at least 20.0 dB(A) above the typical background noise level. However, the visual nature of any noise disturbance is also likely to cause responses from the birds.

Furthermore, the study of the 1/3 octave frequency data from the short-term noise monitoring indicates that there is no obvious correlation between frequencies and bird responses. However, the sound pressure level at each frequency is generally above the background noise level measured during the short-term monitoring.

Contents

Introduction

The Solent coastline hosts thriving harbours, ports and other coastal industry, meaning there is a high volume of activity interacting with the marine environment. The majority of this activity creates a level of noise that can lead to the disturbance and displacement of Special Protection Area (SPA) bird features. The SPAs in the Solent area with marine components are the Solent and Southampton Water SPA, Portsmouth Harbour SPA, Chichester and Langstone Harbours SPA and Solent and Dorset Coast SPA.

In particular, most birds are sensitive to above water noise. This pressure relates to any anthropogenic loud noise made onshore or offshore by construction, vehicles, vessels, tourism, mining, blasting etc. that may disturb birds and reduce time spent in feeding, resting or breeding areas.

Above water noise is benchmarked as the introduction of airborne noise above background levels, however there is currently a lack of data on what background noise levels are. Therefore, assessing the risk of an activity disturbing birds through the introduction of above water noise has proven difficult.

This work has been designed to fill this data gap for the overwintering period through noise monitoring in key areas across SPA sites in the Solent with the objective of providing data on background noise levels in order to more accurately determine the likely significant effect on birds when responding to anthropogenic noise.

Nine areas of high activity have been identified. These areas are hotspots for anthropogenic activity and cross over with key areas of designated SPAs. These areas are therefore used as the main sites for the background noise surveys, and are representative of the Solent as a whole.

Methodology

Long-term Baseline Noise Monitoring

A monitoring survey was undertaken to characterise baseline ambient noise levels currently experienced on site at nine SPA locations. Equipment used during the survey included:

Rion NL-52	Environmental Noise Analyser	s/n	253701
Rion NL-52	Environmental Noise Analyser	s/n	710312
Rion NL-52	Environmental Noise Analyser	s/n	732146
Rion NL-52	Environmental Noise Analyser	s/n	264488
Rion NC-75	Sound Calibrator	s/n	35270131

The measurement equipment was checked against the appropriate calibrator at the beginning and end of the measurements, in accordance with recommended practice, a drift of up to ±0.5 dB was observed. The accuracy of the calibrators can be traced to National Physical Laboratory Standards, calibration certificates for which are available on request. Measurements were taken in general accordance with BS 7445-1:2003: Description and Measurement of Environmental Noise – Guide to quantities and procedures.

The baseline monitoring survey was undertaken monthly from October 2023 to February 2024 at the nine SPA locations presented in Table 1 and illustrated in Figure 1 below with measurements being made unattended in 5-minute intervals over a minimum of 72-hour period at each site per month.

Table 1. Long-term Unattended Noise Monitoring Locations

Location	Reference	Coordinates British National Grid (Easting,Northing)	Special Protection Area (SPA)
1 Lymington	LT1	433383.14,95070.70	Solent and Southampton Water
2 Hythe	LT2	442935.31,107644.40	Solent and Southampton Water Solent and Dorset Coast

Location	Reference	Coordinates British National Grid (Easting,Northing)	Special Protection Area (SPA)
3 River Itchen	LT3	444259.88,112777.77	Solent and Southampton Water Solent and Dorset Coast
4 Hook Lake	LT4	448904.58,105111.98	Solent and Southampton Water Solent and Dorset Coast
5 Thorness Bay	LT5a*	445488.10,93354.31 (From October 2023 to December 2023)	Solent and Southampton Water Solent and Dorset Coast
	LT5b*	445509.09,93382.04 (From January 2024 to February 2024)	
6 Ryde	LT6	459691.96,92883.16	Solent and Southampton Water Solent and Dorset Coast
7 Portchester	LT7	462552.29,104714.33	Solent and Dorset Coast Portsmouth Harbour
8 Farlington Marshes	LT8	468514.18,104717.59	Chichester and Langstone Harbours
9 Emsworth	LT9a*	474774.54,105282.06 (October 2023)	Chichester and Langstone Harbours
	LT9b*	475296.67,105229.62 (From November 2023 to February 2024)	

Note: * There are two long-term monitoring locations for 5Thorness Bay and 9Emsworth. The relocation at 5Thorness Bay was due to the purpose of securing the noise monitoring device to a more secure structure such as an existing fence whilst at 9Emsworth, the noise monitoring device was relocated from a public land to a private land for security purposes.

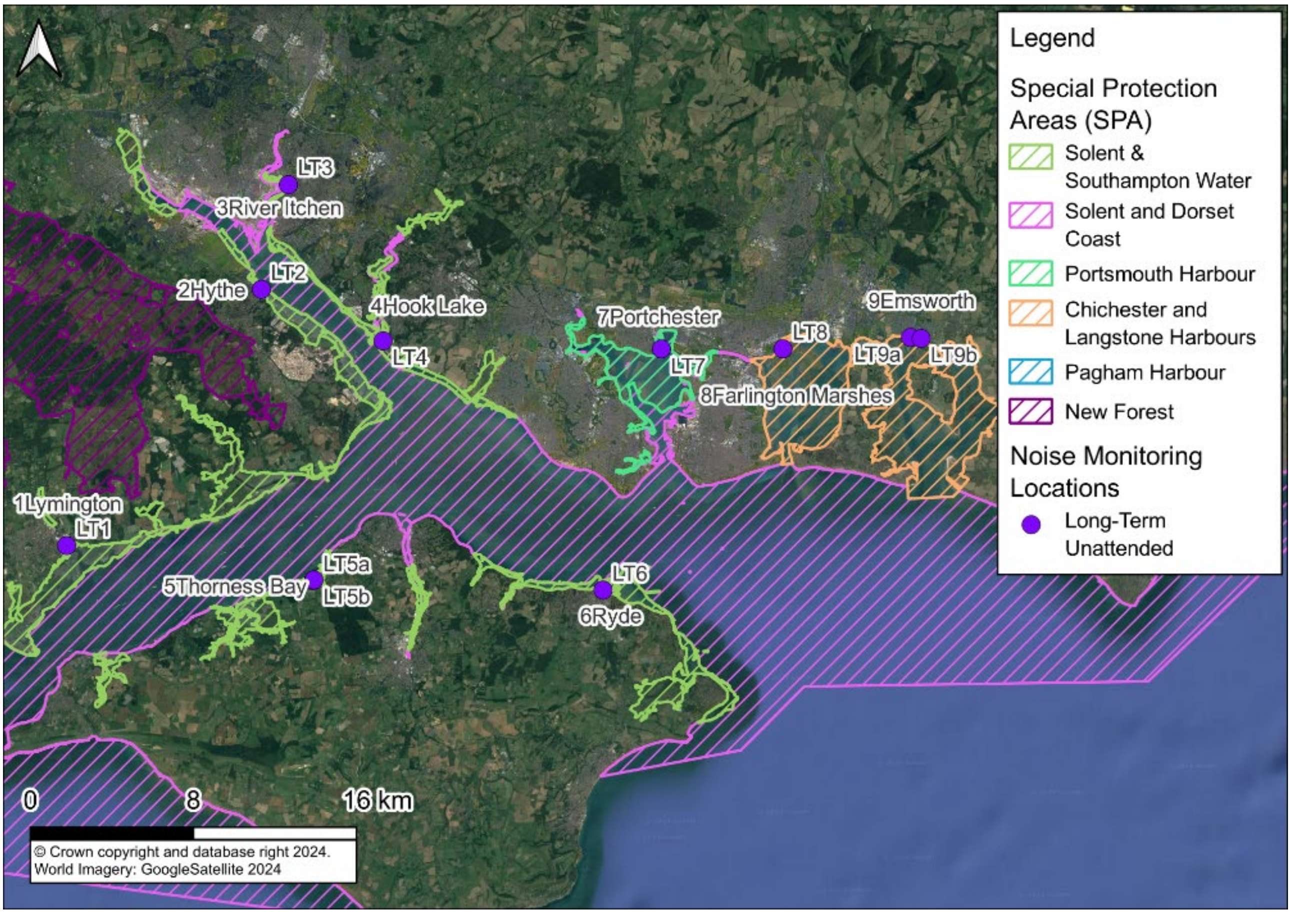

Figure 1. Long-term Unattended Noise Monitoring Locations

Data Analysis

The collected data per measurement period were divided into daytime hours (07:00 – 23:00) and night-time hours (23:00 – 07:00) to reflect the operational hours of anthropogenic activities. The local weather conditions for the duration of measurement were established using Weather Underground, an online resource which provides real-time and historical weather information. Where appropriate due to periods of heavy rain or high wind speeds, data was omitted from analysis.

Background noise levels are usually described using the L_{A90} index (i.e. the sound level exceeded for 90% of the measurement period). This sound index was chosen to represent the background noise levels in the areas studied and the modal L_{A90} sound level of each 5-minute measurement is used to represent the overall background noise levels during the daytime and night-time periods.

Limitations

The following measurement periods were required to be omitted due to equipment failure as a result of poor weather conditions or unsuitable weather conditions to set up the equipment.

October 2023 – 5Thorness Bay*, 6Ryde

November 2023 – 6Ryde

January 2024 – 1Lymington, 2Hythe, 3River Itchen, 4Hook Lake

February 2024 – 2Hythe, 7Portchester, 8Farlington Marshes, 9Emsworth

Note: * The monitoring survey was done twice in November to compensate for the lack of October data.

All locations were monitored for a period of at least four months except for 2Hythe and 6Ryde due to meter failures during both October and November long-term surveys at 6Ryde and during February long-term survey at 2Hythe.

Short-term Noise Monitoring

Short-term noise monitoring was undertaken to coincide with the long-term unattended baseline noise monitoring in order to observe the bird species present, their behaviour and any responses to anthropogenic noise in the area. Observations were made during high, low, rising and falling tides. Equipment used during the survey included:

Rion NL-52	Environmental Noise Analyser	s/n	1043466
Rion NC-75	Sound Calibrator	s/n	35270131

Up to three observation positions near to the long-term noise meter were chosen to maximise the likelihood of observing bird species. Bird count and species identification within an approximate range of 500m were undertaken using binoculars and a telescope for a total of three times during the observation period.

The short-term noise meter was set up to measure the sound levels in 1/3 octave bands and 1-second intervals over a minimum period of 2 hours during the daylight hours. Observations of any anthropogenic noise were noted to include the source of noise, time of the noise event, whether the disturbance is also visual in nature, estimated sound pressure level at the measurement position, and the distance of noise source to the birds being observed as well as the measurement position. The respective distances between the noise source and the location of the bird and the measurement position are estimated using the map on the Survey123 application used. Bird responses to the anthropogenic noise were categorised as one of the following:

0 – no response

1 – freeze/stress response

2 – staying at site but moving away from noise

3 – flight response with settlement within 100m

4 – flight response with settlement beyond 100m

Data Analysis

The background noise levels observed during the 2-hour measurement period is established by calculating the 10th percentile of the L_{Aeq} sound level, showing the sound level exceeded for 90% of the time. This is verified against the measured long-term background noise levels.

Where any bird response was noted during the survey, the sound pressure level at the meter location is used to estimate the sound pressure level at the location of the bird using the relationship below as referenced in The Little Red Book of Acoustics written by R Watson and O Downey.

$$\mathbf{L_2 = L_1 + 20 \log_{10} (r_2/r_1)}$$

$L_{(n)}$ is the sound pressure level at a location and $r_{(n)}$ is the distance from the noise source to the location. In this case, ‘1’ refers to the monitoring location and ‘2’ refers to the location of the bird.

Similar to the above, the loudest instantaneous noise levels L_{AFmax} which correspond to the noise events where bird responses were observed are also estimated at the location of the bird.

Results

Background Noise Levels

The results of the daytime and night-time background noise level monitoring at the nine SPA locations are presented in Figure 2 and Figure 3 below.

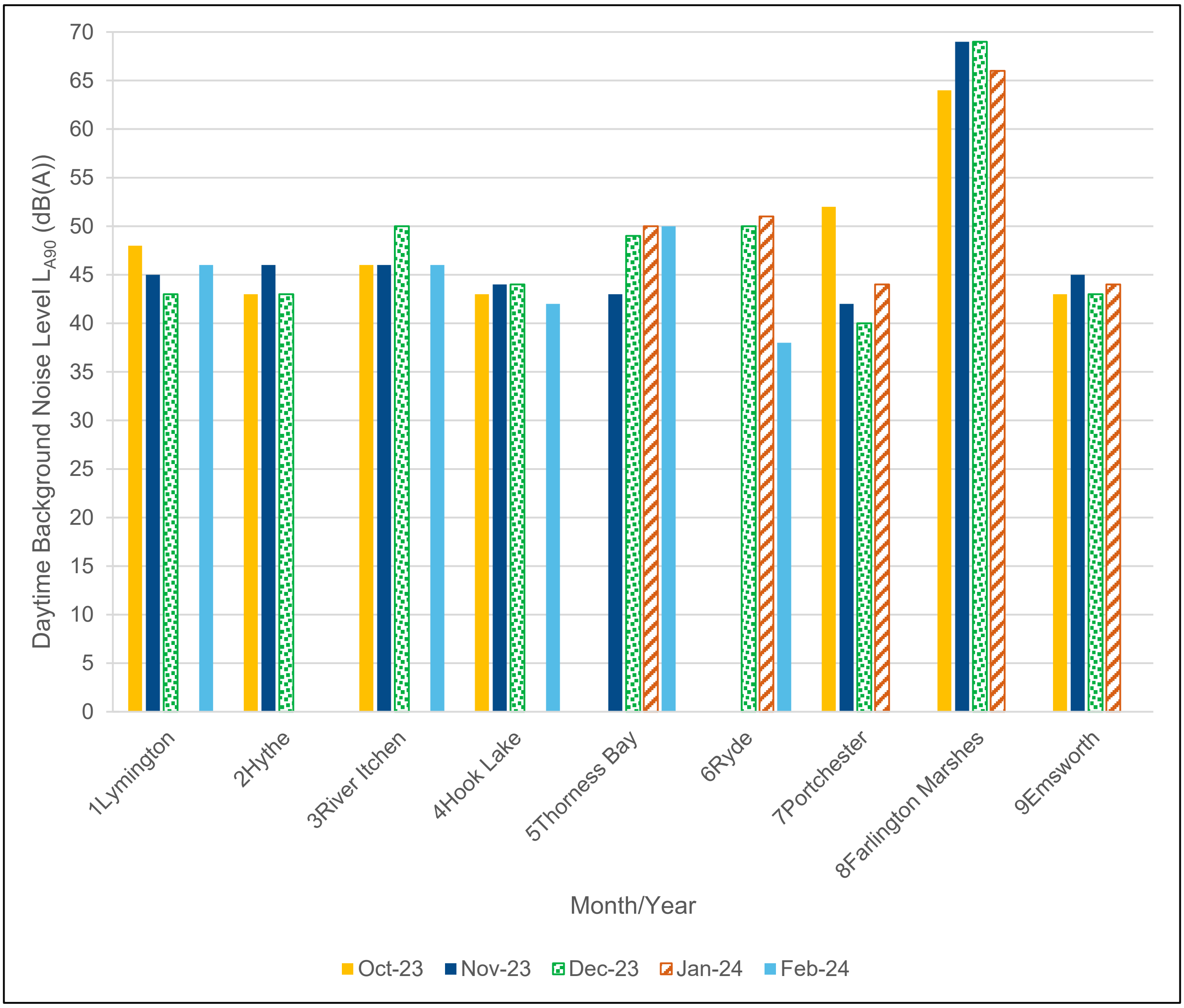

Figure 2. Daytime Background Noise Level L_{A90} in dB(A)

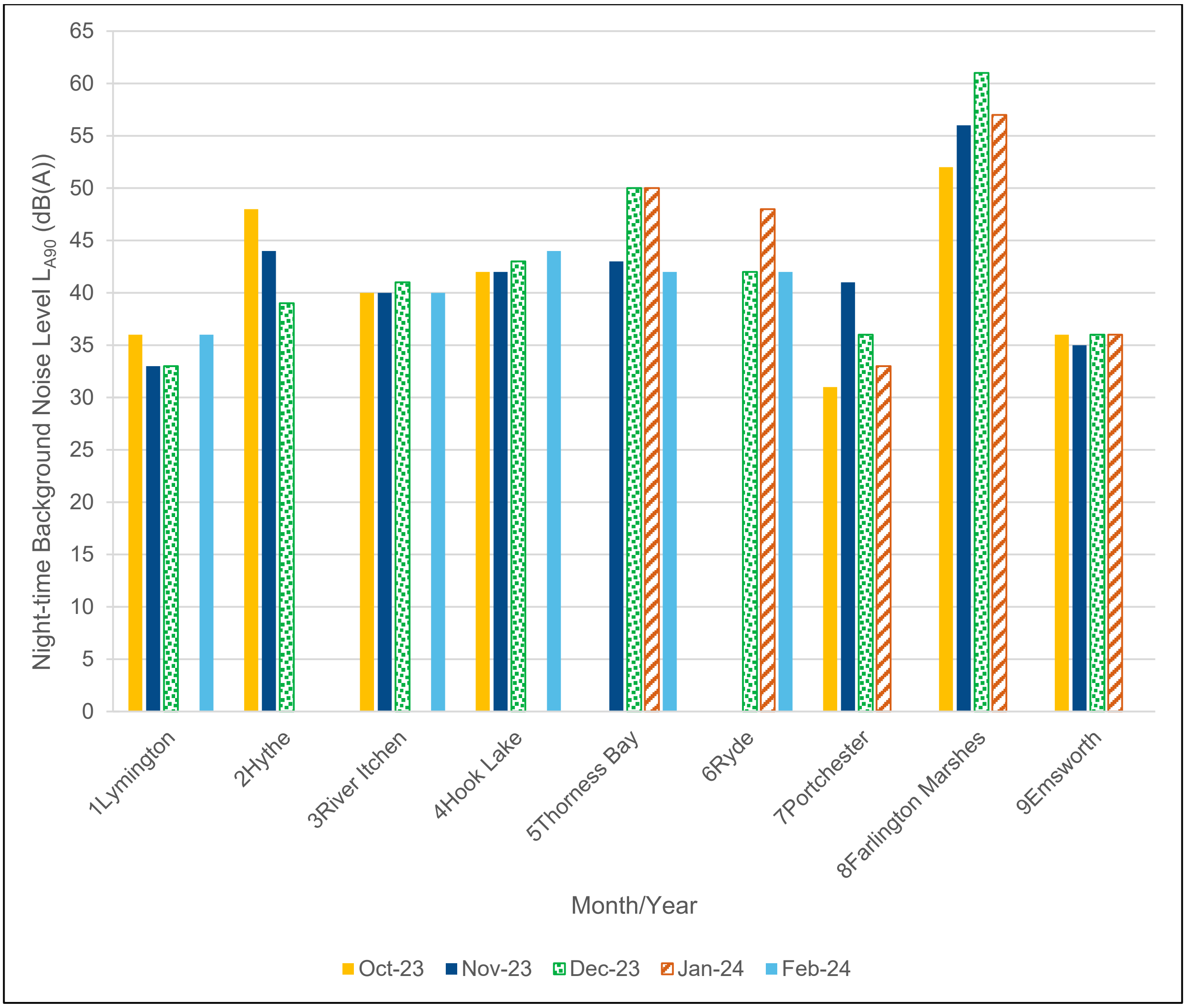

Figure 3. Night-time Background Noise Level L_{A90} in dB(A)

The background noise levels during the daytime vary from month to month by up to 5.0 dB(A) at all locations except for 5Thorness Bay, 6Ryde and 7Portchester where the differences are in the range of 7.0 to 13.0 dB(A).

For the night-time, the background noise levels vary from month to month by up to 3.0 dB(A) at locations 1Lymington, 3River Itchen, 4Hook Lake, 9Emsworth whilst the other locations vary by up to 10.0 dB(A).

Figure 4 below presents the overall average daytime and night-time background noise levels across the entire monitoring period for each location.

Figure 4 Overall Average Background Noise Levels Across the Whole Monitoring Period

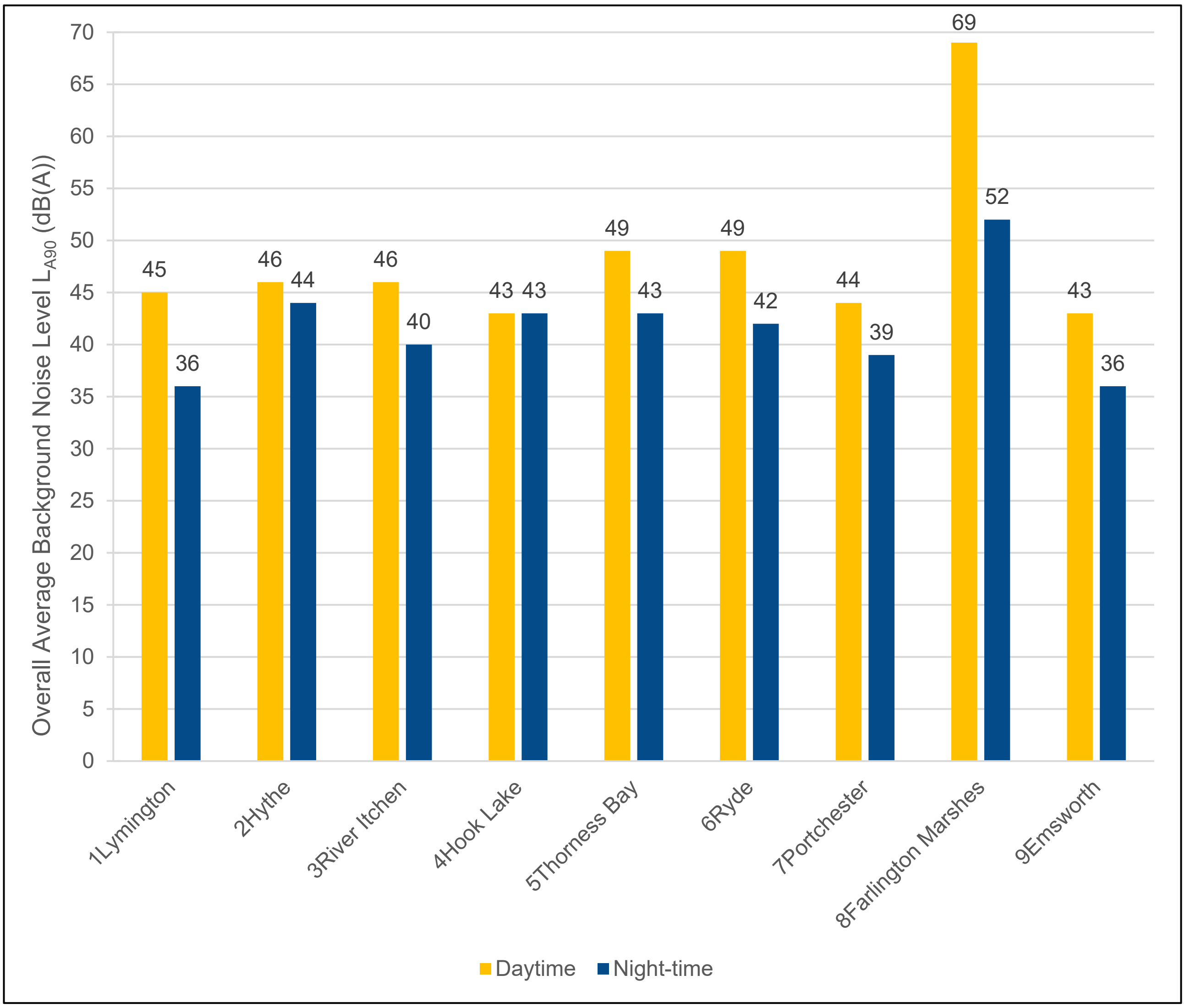

Figure 5. Overall Average Background Noise Levels Across the Whole Monitoring Period

Each location was measured for the following duration.

1Lymington – 449 daytime hours, 232 night-time hours

2Hythe – 273 daytime hours, 144 night-time hours

3River Itchen – 425 daytime hours, 213 night-time hours

4Hook Lake – 448 daytime hours, 232 night-time hours

5Thorness Bay – 469 daytime hours, 232 night-time hours

6Ryde – 318 daytime hours, 153 night-time hours

7Portchester – 425 daytime hours, 214 night-time hours

8Farlington Marshes – 427 daytime hours, 216 night-time hours

9Emsworth – 425 daytime hours, 216 night-time hours

Generally, the overall average daytime background noise levels at all locations are between 43.0 dB(A) to 49.0 dB(A) with the exception of location 8Farlington Marshes where the overall average daytime background noise level is 69.0 dB(A).

Similarly, the overall average night-time background noise levels generally range from 36.0 dB(A) to 44.0 dB(A) at all locations except 8Farlington Marshes where the overall average night-time background noise level is 52.0 dB(A).

Bird Response

Where there were bird responses observed during the short-term noise monitoring survey, the noise events which triggered the response are analysed in Table 2 below. The analysis includes the type of response from the birds as well as the estimated sound pressure level (SPL) and L_{Amax} levels caused by the noise event at the location of the bird.

The common names of the birds identified throughout the survey along with their species codes are listed in Appendix A: Bird Species Code of this report whilst the results for the short-term noise monitoring survey are presented by location in Appendix B: Short-term Noise Monitoring Results along with figures to show the locations of the disturbance and bird responses with respect to the measurement positions.

Table 2. Analysis of Bird Responses

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
2 Hythe 11/10/23	13:58:05 Loud horn from yard (audible but not visible)	4	1 HG (25% of HG observed)	42	67.5	71.6	21.5
3 River Itchen 18/10/23	08:40:23 Airplane passing overhead (audible and visible)	1	1 MS (5% of MS observed)	4000	76.5	78.6	30.5
3 River Itchen 18/10/23	08:53:08 Train passing (audible and visible)	3	1 H. (100% of H. observed)	31	73.1	74.0	27.1

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
6 Ryde 01/11/23	10:17:53 Hovercraft (audible and visible)	4	75 BG (20% of BG observed)	79	74.0	74.9	25.0
6 Ryde 01/11/23	10:46:09 Hovercraft (audible and visible)	4	65 BG (17% of BG observed)	135	79.3	80.5	30.3
6 Ryde 10/11/23	08:44:07 Hovercraft (audible and visible)	4	40 BG (38% of BG observed)	260	75.7	76.5	26.7
6 Ryde 10/11/23	09:16:50 Hovercraft	4	5 BG	174	73.1	73.6	24.1

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
	(audible and visible)		(8% of BG observed)				
6 Ryde 10/11/23	09:44:59 Hovercraft (audible and visible)	4	9 BG (15% of BG observed)	85	85.4	86.4	36.4
6 Ryde 10/11/23	09:44:59 Hovercraft (audible and visible)	3	35 BG (60% of BG observed)	294	74.6	75.6	25.6
6 Ryde 08/01/24	09:39:20 Hovercraft (audible and visible)	3	2 BH (3% of BH observed)	91	77.3	77.9	28.3

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
7 Portchester 17/11/23	14:03:24 Boat leaving the harbour and loud noise from the industrial site (audible and visual)	4	200 BG (91% of BG observed)	313	64.7	67.6	20.7
7 Portchester 17/11/23	14:03:24 Boat leaving the harbour and loud noise from the industrial site (audible and visible)	4	75 TT (75% of TT observed)	194	68.9	71.8	24.9

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
7 Portchester 19/01/24	10:41:09 Boat leaving the harbour (audible and visible)	3	2 BH (66% of BH observed)	93	58.3	59.0	14.3
7 Portchester 19/01/24	10:48:49 Metal works (audible but not visible)	4	1 CU (33% of CU observed)	222	65.7	69.2	21.7
9 Emsworth 23/10/23	11:23:02 People walking into the beach (audible and visible)	3	22 BH (23% of BH observed)	42	54.3	55.6	11.3

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
9 Emsworth 23/10/23	11:23:02 People walking into the beach (audible and visible)	4	6 RK (15% of RK observed)	74	49.4	50.7	6.4
9 Emsworth 23/10/23	11:23:02 People walking into the beach (audible and visible)	4	8 OC (57% of OC observed)	93	47.4	48.7	4.4
9 Emsworth 23/10/23	11:23:02 People walking into the beach (audible and visible)	4	2 DN (4% of DN observed)	98	46.9	48.2	3.9

Location and Survey Date	Time and Description of Noise Event	Bird Response*	Number of Birds / Species / % of Birds Disturbed	Distance of Birds from Noise Source (m)	SPL at Bird Location (dB(A))	L_{Amax} at Bird Location (dB(A))	SPL minus Overall Average Daytime Background Noise Level
9 Emsworth 17/11/23	10:44:10 Small motor boat in the channel (audible and visible)	3	3 BG (1% of BG observed)	58	67.6	68.5	24.6
9 Emsworth 16/01/24	14:33:30 Airplane passing overhead (audible and visible)	1	1 CO (11% of CO observed)	4027	52.0	53.2	9.0

Note: * Bird responses are categorised as 0 – no response, 1 – freeze/stress response, 2 – staying at site but moving away from noise, 3 – flight response with settlement within 100m, 4 – flight response with settlement beyond 100m.

Bird responses were only observed at locations 2Hythe, 3River Itchen, 6Ryde, 7Portchester and 9Emsworth with SPL from the noise events at the location of the birds estimated to be in the range of 46.9 – 85.4 dB(A). These bird responses were from 11 species out of the 51 species observed throughout the attended short-term monitoring. Most of the responses observed were also from Brent Goose (BG).

Although loud noise events (SPL between 30.0 dB(A) to 79.7 dB(A) at the location of the birds) caused by anthropogenic activities were observed at the other locations, no bird responses were noted.

Furthermore, the noise events which triggered bird responses include horns from vehicles, airplanes and helicopters passing overhead, trains passing, metal works, industrial noise, boats and hovercrafts, and people walking/talking. These are mostly also visual in nature. It should also be noted that all of the observed bird responses at the location 6Ryde were triggered by frequent hovercrafts.

The range of estimated L_{Amax} levels at the location of the birds for the noise events which resulted in bird responses is between 48.2 – 86.4 dB(A). However, it should be noted that no bird responses were observed for other perceptible noise events with similar estimated L_{Amax} levels in the range of 32.2 – 81.2 dB(A) at the location of the birds.

The estimated L_{Amax} levels which triggered bird responses are similar (within +0.5 to 4.1 dB(A)) to their corresponding estimated SPL.

Discussion

The Solent coastline hosts thriving harbours, ports and other coastal industry, meaning there is a high volume of activity interacting with the marine environment. The majority of this activity creates a level of above water noise that can lead to the disturbance and displacement of Special Protection Area (SPA) bird features and thus result in reduced time spent in feeding, resting or breeding areas within the SPA.

Above water noise is benchmarked as the introduction of airborne noise above background levels, however there is currently a lack of data on what background noise levels are. Therefore, assessing the risk of an activity disturbing birds through the introduction of above water noise has proven difficult.

This work has been designed to fill this data gap through noise monitoring in key areas across SPA sites in the Solent with the objective of providing data on background noise levels during the overwintering period in order to more accurately determine the likely significant effect on birds when responding to anthropogenic noise.

Background Noise Levels

The results of the long-term noise monitoring show that the overall average background noise levels at all locations are between 43.0 dB(A) to 49.0 dB(A) during the daytime and 36.0 dB(A) to 44.0 dB(A) during the night-time. However, higher overall average background noise levels (69.0 dB(A) daytime and 52.0 dB(A) night-time) at 8Farlington Marshes were recorded.

The long-term noise monitoring location LT8 at 8Farlington Marshes is approximately 120m south of the major road, A27. Based on strategic noise mapping data for road sources published by Extrium, the noise levels from road traffic at the monitoring location are predicted to be between 65.0 – 69.9 dB $L_{Aeq,16hours}$ during the daytime and between 60.0 – 64.9 dB $L_{Aeq,8hours}$ during the night-time. Other monitoring locations are at least 500m from any major roads. In the case of LT6 in 6Ryde, the main road A3055 (approximately 110m south of LT6) is considerably less noisy than the road A27 adjacent to LT8. As such, the noise contribution from road traffic is highly likely to be the reason for the higher background noise levels measured at LT8.

Despite higher background noise levels, at least 29 bird species, both breeding and non-breeding, were observed in the area during attended monitoring in 8Farlington Marshes. However, further and/or longer monitoring is likely required to determine if the birds are affected by the anthropogenic noise in the area.

Comparison of Observed Noise Events to Background Noise Levels

The results presented in this report indicate that bird responses typically occur when the sound pressure level at the location of the birds is at least 20.0 dB(A) higher than the typical background noise level $L_{A90,16hours(daytime)}$. This is relatively comparable to the study on laying hens by J. L. Campo, M. G. Gil and S. G. Dávila (2005) which showed that hens were found to be more stressed and fearful when exposed to higher sound levels (90 dB) for 60 minutes which consisted of background noises plus truck, train and aircraft noises compared to the control group which was exposed to only background noise levels at 65 dB.

However, this is unlikely to be the main factor for the bird responses observed during the attended noise monitoring as several of the bird responses noted at the location 9Emsworth were triggered by people walking into the beach where the sound pressure levels at the locations of the birds are estimated to be only 3.9 dB(A) to 11.3 dB(A) above the daytime background noise level. This response is likely to have been triggered by the visual nature of the disturbance rather than noise.

Furthermore, the bird responses observed at 9Emsworth from airplane passing overhead and at 7Portchester from a boat leaving the harbour showed a difference between the sound pressure levels and background noise levels of only 9.0 dB(A) and 14.3 dB(A) respectively.

In a study of brent geese and human disturbance, Owens (1977) suggested that larger birds with slow wingbeats such as Great Black-backed Gulls (GB) are also liable to causing flight responses in brent geese and intensity of responses to aircraft may be partly due to the visual resemblance of aircrafts to large birds. This could be the trigger to the bird response observed at 9Emsworth mentioned above.

At 6Ryde, three noise events from hovercrafts which resulted in a difference of more than 20.0 dB(A) between sound pressure levels at the locations of the birds and the background noise level showed no response. However, bird responses were observed for subsequent noise events from hovercrafts within the same survey period.

Most of the bird responses observed particularly at 6Ryde were also from brent geese. This might suggest that brent geese are more sensitive to noise events, but it is more likely that the brent geese were loafing on the water closer to the noise sources such as hovercrafts compared to other species including waders which were foraging along the shoreline.

Furthermore, the type of responses observed were mainly flight responses with two freeze responses due to airplanes overhead. It is highly likely that other freeze responses were not immediately noticeable compared to the flight responses and thus were missed out. It is nearly impossible for the surveyor alone to analyse whether a bird is showing a freeze response to a noise event when simultaneously observing 100s of birds of different species in the survey area. As such, for any future works, it may be beneficial to also record the birds and analysing the data by playing back the recording.

Sound Level Threshold to Trigger Bird Response

J. R. Barber et al. (2009) suggested that animal responses to anthropogenic noise are likely to depend on the intensity of perceived threats rather than on the intensity or level of noise. This may apply to most of the observations made during the attended surveys but particularly in the case of the bird responses observed from people walking into the beach at 9Emsworth.

J. R. Barber et al. (2009) also stated that animal responses may begin to appear at exposure levels of 55 – 60 dB when these levels are restricted to relatively small areas close to the noise sources. However, the results presented in this report do not necessarily present a strong correlation to support this considering that several noise events observed (hovercrafts, metal works and horns from a vehicle) with sound levels L_{Aeq} and L_{Amax} above 60 dB did not trigger any bird responses whilst two noise events observed (airplane passing overhead and people walking into the beach) with L_{Aeq} and L_{Amax} levels below 55 dB did trigger bird responses.

1/3 Octave Band Analysis of Noise Events

In a study on the effects of highway and urban noise on birds conducted by R. J. Dooling et al. (2019), it is suggested that anthropogenic noise can affect birds' abilities to detect prey, assess their acoustic environments and communicate with other birds. If the noise includes enough energy in the bird's region of best hearing or dominant frequency, at close distances, the noise can have a significant impact on how well the birds can hear their species-specific vocalisations. This in turn may cause behavioural and/or physiological responses from the birds.

This is also shown in a study by Rheindt (2003) which consisted of population assessments in an oak-beech forest close to a motorway where it was concluded that bird species with higher-pitched vocalisations or songs with dominant frequencies well above the typical frequencies of traffic noise (up to 1 kHz) were less susceptible to noise pollution. Rheindt also stated that most bird vocalisations, in contrast, are in the range of 2 kHz to 9 kHz.

The 1/3 octave frequency data for each noise event which triggered a bird response shows no obvious correlation between specific frequencies and bird response. However, the sound pressure level of the noise event at each frequency is generally above the background noise level measured during the attended short-term monitoring. Figure 5 and Figure 6 below present the 1/3 octave frequency data as examples for the noise events recorded which resulted in bird responses at the locations 6Ryde and 7Portchester.

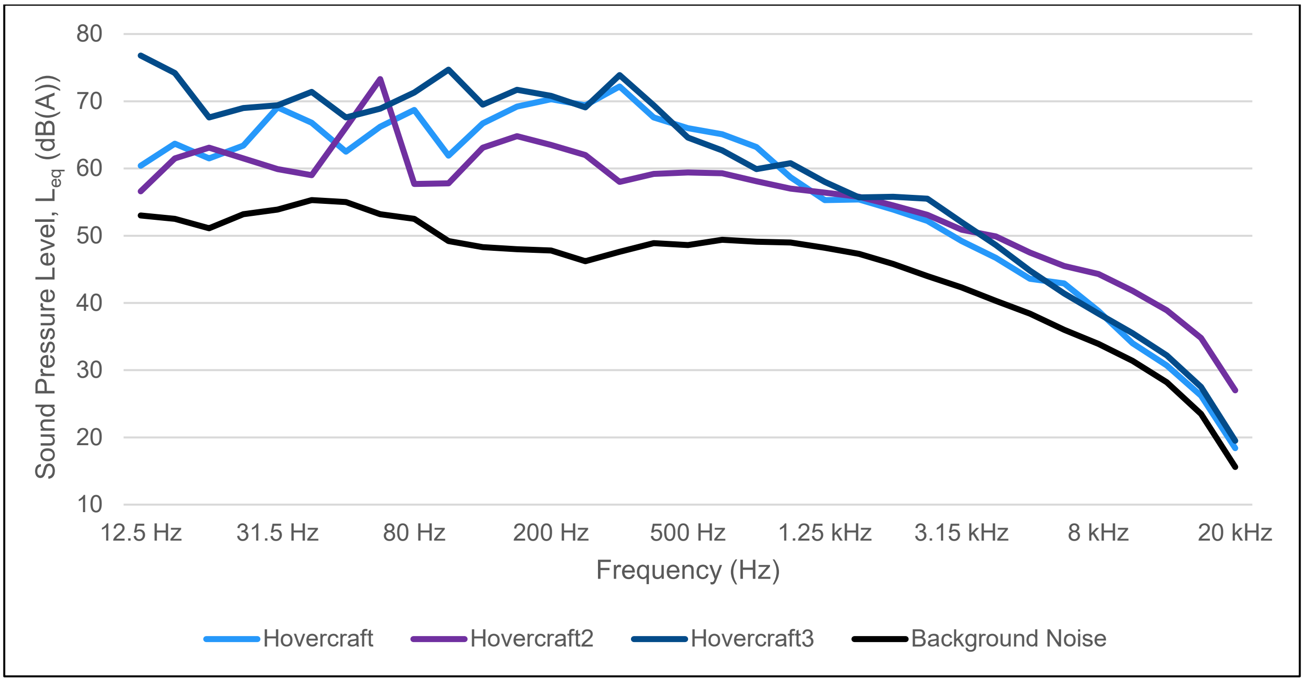

Figure 6. 1/3 Octave Frequency Sound Pressure Level L_{eq} for Noise Events on 10th November 2023 at the Location 6Ryde

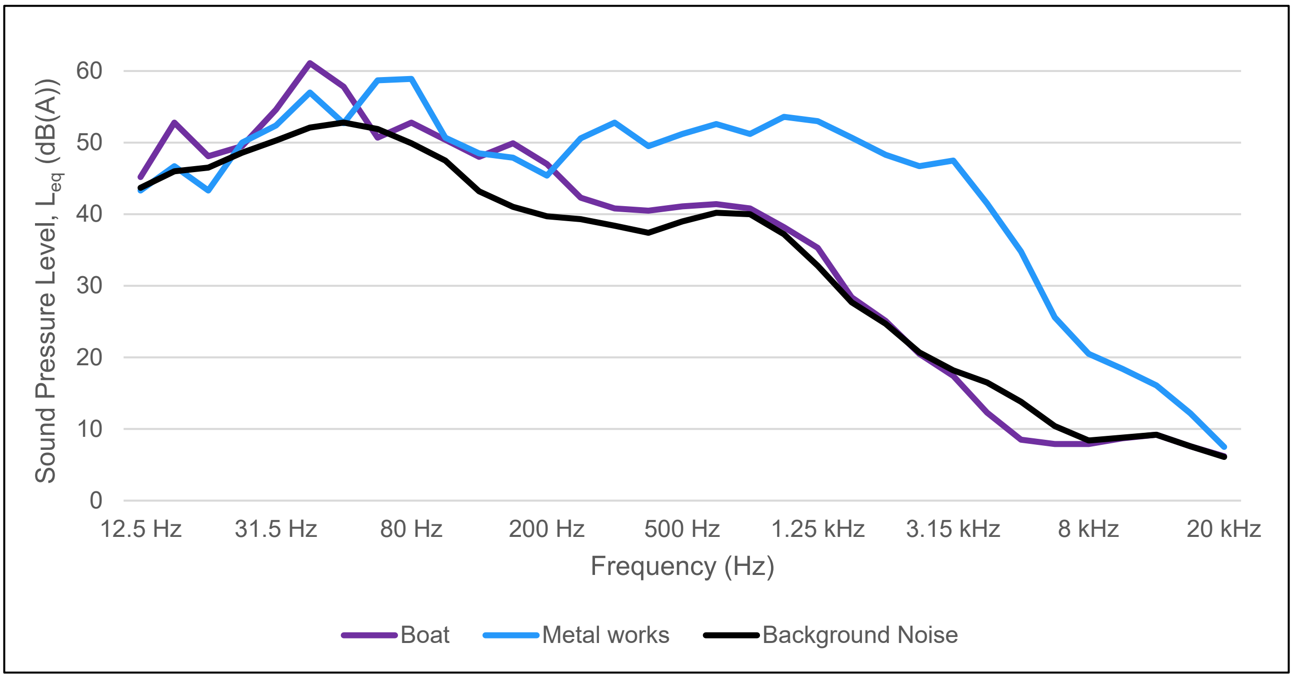

Figure 7. 1/3 Octave Frequency Sound Pressure Level L_{eq} for Noise Events on 19th January 2024 at the Location 7Portchester

Figure 7 below present further visualisation of the 1/3 octave frequency data (from 12.5 Hz to 20 kHz) for all noise events which triggered bird responses.

Location	Species	Noise Event	Leq (dB)																																
			12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
LT6	75 BG	Hovercraft	59	59	56	57	58	56	56	57	56	53	50	54	56	50	51	53	53	54	54	53	53	52	49	47	46	45	43	41	37	34	28	21	12
LT6	65 BG	Hovercraft	74	75	71	68	67	65	66	63	70	75	67	69	69	65	66	64	62	60	62	60	59	57	55	53	51	49	47	45	42	39	36	30	22
LT6	40 BG	Hovercraft	60	64	62	63	69	67	63	66	69	62	67	69	70	69	72	68	66	65	63	59	55	55	54	52	49	47	44	43	39	34	31	26	18
LT6	5 BG	Hovercraft	57	62	63	62	60	59	66	73	58	58	63	65	64	62	58	59	59	59	58	57	56	56	55	53	51	50	48	46	44	42	39	35	27
LT6	9 BG	Hovercraft	77	74	68	69	69	71	68	69	71	75	70	72	71	69	74	69	65	63	60	61	58	56	56	56	52	49	45	41	38	36	32	28	20
LT6	35 BG	Hovercraft	77	74	68	69	69	71	68	69	71	75	70	72	71	69	74	69	65	63	60	61	58	56	56	56	52	49	45	41	38	36	32	28	20
LT7	200 BG	Boat leaving the harbour and noise from the industrial estate	47	49	45	46	49	49	48	51	50	53	50	47	44	44	44	48	50	50	50	50	51	54	53	52	54	49	45	37	25	18	15	12	8
LT9b	3 BG	Small motor boat in the channel	50	55	52	54	53	54	61	56	56	53	51	50	44	44	45	43	39	41	41	40	36	32	27	22	16	13	12	13	10	9	10	8	6
LT6	2 BH	Hovercraft	76	73	73	71	74	70	70	68	70	73	68	69	72	68	67	62	59	57	57	59	56	55	53	52	50	48	46	44	42	39	36	32	25
LT7	2 BH	Boat leaving the harbour	45	53	48	50	55	61	58	51	53	50	48	50	47	42	41	41	41	41	41	38	35	28	25	21	17	12	9	8	8	9	9	8	6
LT9a	22 BH	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT7	75 TT	Boat leaving the harbour and noise from the industrial estate	47	49	45	46	49	49	48	51	50	53	50	47	44	44	44	48	50	50	50	50	51	54	53	52	54	49	45	37	25	18	15	12	8
LT7	1 CU	Metal works	43	47	43	50	52	57	53	59	59	51	49	48	45	51	53	50	51	53	51	54	53	51	48	47	48	42	35	26	21	18	16	12	8
LT9a	6 RK	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9a	8 OC	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9a	2 DN	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9b	1 CO	Airplane passing overhead	47	50	51	48	48	50	47	61	66	45	45	49	55	50	49	43	42	39	41	41	41	39	35	32	28	26	26	24	23	19	17	13	9
LT2	1 HG	Loud horn from yard	51	46	47	51	53	54	51	50	49	49	51	52	45	53	51	52	50	52	48	49	47	44	37	35	31	26	19	16	14	14	11	9	6
LT3	1 MS	Airplane passing overhead	61	59	61	62	65	62	61	59	56	61	68	70	68	61	69	64	66	64	62	65	64	63	65	66	70	62	59	64	48	34	21	13	8
LT3	1 H.	Train passing	49	54	51	54	55	52	55	53	52	50	46	43	41	41	42	41	41	42	42	44	43	42	41	40	39	38	36	34	32	30	27	23	15

Location	Species	Noise Event	Lmax (dB)																																
			12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
LT6	75 BG	Hovercraft	61	62	59	61	61	58	59	59	59	56	53	57	59	52	52	54	57	57	55	55	55	53	50	47	47	47	45	42	39	35	28	22	13
LT6	65 BG	Hovercraft	81	79	74	71	70	67	70	65	71	77	69	71	72	66	69	66	63	62	64	62	60	59	56	53	53	50	48	46	44	41	37	32	23
LT6	40 BG	Hovercraft	64	66	65	68	71	69	66	68	72	63	69	72	73	71	76	69	67	67	65	60	56	57	55	53	51	48	44	44	40	35	32	27	20
LT6	5 BG	Hovercraft	64	65	67	64	63	62	70	75	60	61	65	67	65	65	60	60	60	61	60	58	57	57	56	55	53	52	49	47	46	43	41	37	29
LT6	9 BG	Hovercraft	82	78	72	72	73	74	71	71	74	77	72	75	73	71	77	71	67	65	62	63	60	58	58	57	53	50	46	42	39	36	34	28	20
LT6	35 BG	Hovercraft	82	78	72	72	73	74	71	71	74	77	72	75	73	71	77	71	67	65	62	63	60	58	58	57	53	50	46	42	39	36	34	28	20
LT7	200 BG	Boat leaving the harbour and noise from the industrial estate	50	52	49	51	52	53	52	56	53	55	52	48	46	46	45	50	51	52	52	52	53	57	56	55	58	53	48	40	27	20	19	15	12
LT9b	3 BG	Small motor boat in the channel	53	58	55	58	56	58	63	60	61	56	54	51	46	45	46	45	41	44	43	41	36	33	30	24	20	14	14	15	11	10	10	8	7
LT6	2 BH	Hovercraft	87	87	84	88	81	84	80	78	74	73	69	64	61	56	57	54	54	54	54	54	51	50	51	49	49	46	44	43	40	38	35	31	23
LT7	2 BH	Boat leaving the harbour	48	57	51	54	58	63	60	54	55	53	50	51	49	44	42	42	42	43	42	39	37	30	26	23	19	14	9	9	9	9	10	8	7
LT9a	22 BH	People walking into the beach	69	59	58	61	60	55	48	47	45	45	43	37	35	34	35	34	34	36	36	37	35	33	31	27	23	21	19	18	16	13	12	10	7
LT7	75 TT	Boat leaving the harbour and noise from the industrial estate	50	52	49	51	52	53	52	56	53	55	52	48	46	46	45	50	51	52	52	52	53	57	56	55	58	53	48	40	27	20	19	15	12
LT7	1 CU	Metal works	48	49	51	54	55	59	55	61	61	53	52	53	50	55	58	54	54	57	55	57	58	54	51	51	52	46	39	31	29	26	23	19	11
LT9a	6 RK	People walking into the beach	69	59	58	61	60	55	48	47	45	45	43	37	35	34	35	34	34	36	36	37	35	33	31	27	23	21	19	18	16	13	12	10	7
LT9a	8 OC	People walking into the beach	69	59	58	61	60	55	48	47	45	45	43	37	35	34	35	34	34	36	36	37	35	33	31	27	23	21	19	18	16	13	12	10	7
LT9a	2 DN	People walking into the beach	69	59	58	61	60	55	48	47	45	45	43	37	35	34	35	34	34	36	36	37	35	33	31	27	23	21	19	18	16	13	12	10	7
LT9b	1 CO	Airplane passing overhead	50	53	54	53	51	53	50	63	68	46	48	51	57	52	51	44	44	41	43	43	43	41	39	37	34	34	31	30	30	26	24	19	13
LT2	1 HG	Loud horn from yard	54	51	50	53	57	57	55	52	52	51	53	54	47	56	54	54	52	57	53	56	53	49	42	39	39	31	23	19	21	20	17	10	7
LT3	1 MS	Airplane passing overhead	65	62	65	65	68	64	66	62	58	65	69	72	70	63	72	66	69	67	64	67	67	66	67	69	72	65	62	68	51	37	22	13	9
LT3	1 H.	Train passing	55	57	54	57	60	54	58	57	54	52	47	45	43	42	44	45	43	44	44	45	44	44	42	41	40	40	38	35	33	31	29	25	16

Highest dB — Lowest dB

Figure 8. 1/3 Octave Frequency L_{eq} (top) and L_{max} (bottom) for All Noise Events with Bird Responses

The events above are grouped by the species triggered as responses that are frequency dependent would also likely be species dependent due to vocalisations being species-specific. However, no obvious correlation can be seen between specific frequencies to bird responses observed during the short-term noise monitoring and majority of the noise events have low dominant frequencies (below 200 Hz).

As such, it is unlikely that these bird responses were caused by any specific frequencies, particularly as most bird vocalisations, and their dominant frequencies, are in the much higher frequency range.

Conclusion

Typically, the daytime background noise levels range between 43.0 dB(A) to 49.0 dB(A) at all monitoring locations with the exception of one location – Farlington Marshes within the area of Chichester and Langstone Harbours SPA – where the daytime background noise level is 69.0 dB(A) due to the location's proximity to a major road.

In addition to this, short-term attended noise monitoring was undertaken to coincide with the long-term monitoring. During the short-term noise monitoring, observations of anthropogenic noise and any bird responses as a result of the noise were made. The sound pressure levels which triggered the bird responses were estimated in order to gain some understanding of the reason for the response.

The results show that birds are more likely to respond to noise disturbance when the sound pressure levels at the location of the birds are at least 20.0 dB(A) above the typical background noise level. However, the visual nature of any noise disturbance is also likely to cause responses from the birds.

The findings of this study will help to determine the impacts of anthropogenic noise on overwintering birds in the Solent; a key challenge given the national and international significance of these populations. It has also identified areas of future work to continue addressing this challenge (see below).

Recommendations

1. The results of the noise monitoring presented in this report are collected between October and February (winter season). A longer period of monitoring, both unattended long-term for background noise as well as attended short-term, is recommended to monitor any changes in background noise levels due to changing seasons (and therefore activities such as tourism) in order to provide a clearer conclusion to this study.
2. No perceptible noise events or bird responses were observed at 8Farlington Marshes throughout the monitoring period but longer monitoring and/or a different monitoring location which is further from the major road A27 may be beneficial to understand if

birds in the area respond to noise disturbance in a similar way to the other locations within the Solent.

3. This study may be expanded to look at the dominant frequencies in species-specific vocalisations of the birds in the SPA in order to establish if bird responses were triggered by specific frequencies. The species-specific vocalisations found in the SPA could also be compared to the same species in other varied areas to determine if changes in the dominant frequencies have occurred as was shown in a study of nine tropical bird species in Brazil conducted by Tolentino et al. in 2018.
4. A study on visual disturbance may also be beneficial to understand the impact of human activities on the behaviour and responses from the SPA bird features, particularly during the hotter months where there is likely to be a higher level of tourism.

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Glossary

dB – Sound levels from any source can be measured in frequency bands in order to provide detailed information about the spectral content of the noise, i.e. whether it is high-pitched, low-pitched, or with no distinct tonal character. These measurements are usually undertaken in octave or third octave frequency bands. If these values are summed logarithmically, a single dB figure is obtained. This is usually not very helpful as it simply describes the total amount of acoustic energy measured and does not take any account of the ear's ability to hear certain frequencies more readily than others.

dB(A) – A-weighted sound level. The dB(A) figure is obtained by subtracting an appropriate correction, which represents the variation in the ear's ability to hear different frequencies, from the individual octave or third octave band values, before summing them logarithmically. The single dB(A) value provides a good representation of how loud a sound is.

L_{Aeq} – Equivalent continuous sound pressure level. Since almost all sounds vary or fluctuate with time it is helpful, instead of having an instantaneous value to describe the noise event, to have an average of the total acoustic energy experienced over its duration.

L_{AFmax} – Loudest instantaneous noise level with 'A' frequency weighting and fast time weighting. This is usually the loudest 125 milliseconds measured during any given period of time.

L_n - Another method of describing, with a single value, a noise level which varies over a given time period is, instead of considering the average amount of acoustic energy, to consider the length of time for which a particular noise level is exceeded. L_{A90} is the noise level exceeded for 90% of the measurement period and is the usual descriptor for underlying background noise.

Appendix A: Bird Species Code

The table below lists the bird species code identified throughout the short-term noise monitoring survey.

Table A1. Bird Species Code

Bird Common Name	Code	Bird Common Name	Code	Bird Common Name	Code
Avocet	AV	**Greenshank**	GK	**Osprey**	OP
Black-headed Gull	BH	**Grey Heron**	H.	**Oystercatcher**	OC
Black-tailed Godwit	BW	**Grey Plover**	GV	**Pintail**	PT
Blue Tit	BT	**Herring Gull**	HG	**Red-breasted Merganser**	RM
Brent Goose	BG	**Kingfisher**	KF	**Redshank**	RK
Canada Goose	CG	**Knot**	KN	**Reed Bunting**	RB
Common Gull	CM	**Lapwing**	L.	**Ringed Plover**	RP
Coot	CO	**Lesser Black-backed Gull**	LB	**Sanderling**	SS
Cormorant	CA	**Little Egret**	ET	**Sandwich Tern**	TE
Curlew	CU	**Little Grebe**	LG	**Shag**	SA

Bird Common Name	Code	Bird Common Name	Code	Bird Common Name	Code
Dunlin	DN	**Little Ringed Plover**	LP	**Shelduck**	SU
Gadwall	GA	**Long-billed Dowitcher**	LD	**Shoveler**	SV
Gannet	GX	**Long-tailed Duck**	LN	**Stone-curlew**	TN
Goosander	GD	**Mallard**	MA	**Teal**	T.
Great Black-backed Gull	GB	**Mediterranean Gull**	MU	**Turnstone**	TT
Great Crested Grebe	GG	**Moorhen**	MH	**White Tailed Sea Eagle**	-
Great Northern Diver	ND	**Mute Swan**	MS	**Wigeon**	WN

Appendix B: Short-term Noise Monitoring Results

1Lymington

Table B1. Short-term Noise Monitoring Results for Location 1Lymington

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
11/10/2023 10:48 – 12:50	High	48.0	46.0	BH - 2, CA - 3, ET - 1, MS - 1, RK - 60	Ferry, boat scraping down slipway (audible and visible)	No Response
				CA - 3, CG - 13, ET - 1, MS - 6, RK - 60		
				RK - 60, MS - 5, BW - 5, ET - 1		
24/10/2023 12:55 – 14:56	Low	45.0	48.3	DN - 102, RK - 33, MS - 21, ET - 2, HG - 4, BH - 17, TT - 15, CU - 5, SU - 14, L. - 15, GB - 1	Ferry sounded horn, machinery on boats, airplane flying over	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				GV - 1, DN 87, RK - 6, OC - 9, BH - 4, MS - 7, SU - 11, BG - 6, ET - 1, TT - 8, CU - 5	(audible and visible)	
				DN - 430, TT - 35, RK - 15, BH - 34, HG - 12, SU - 15, BG - 46, CU - 10, L. - 8, MS - 9, CA - 1		
13/12/2023 12:00 – 14:00	Falling	43.0	45.8	BH - 12, MS - 9, HG - 4, CG - 6, ET - 1, BG - 6	Barge going past (audible and visible)	No Response
				BG - 6, CG - 4, CA - 1, MS - 16, BH - 5, HG - 2, CG - 4		
				BG - 37, MS - 18, SU - 3, ET - 1, DN - 23, HG - 15, BH - 8, CA - 1, CG - 4, CU - 9		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
26/02/2024 08:47 – 10:47	Rising	46.0	50.6	WN - 16, SU - 13, BH - 12, HG - 38, RK - 22, BG - 45, MS - 5, OC - 2, CU - 2, GB - 1	No noise events observed (not audible and not visible)	No Response
				WN - 25, SU - 15, BH - 33, HG - 40, RK - 17, BG - 150, MS - 4, OC - 5, CU - 2, GB - 3, White-tailed Eagle - 1		
				WN - 25, SU - 14, BH - 44, HG - 31, MS - 4, OC - 6, CU - 2, GB - 3, ET - 1 White-tailed Eagle - 1		

Figure B1. Map of Location 1Lymington

2Hythe

Table B2. Short-term Noise Monitoring Results for Location 2Hythe

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
11/10/2023 13:44 – 15:44	Falling	43.0	44.7	HG - 4, TT - 11, BH - 9, GB - 2, CA - 4, ET - 1 TT - 7, HG - 4, BH - 4, GB - 2, CA - 4, CU - 6, OC -3 CU - 1, HG - 4, BH - 2, CA - 5, GG - 1	Loud horn from yard approximately 42m from the bird (audible but not visible)	Flight response with settlement beyond 100m
24/11/2023 09:15 – 11:15	High	46.0	47.6	GG - 1, BH - 6, HG - 12, CA - 1, GB - 1 BH - 22, HG - 4 RP - 33, BH - 12, HG - 2, GB - 1, CA - 1	Plane overhead and large vehicles driving past (audible and visible)	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
13/12/2023 08:00 – 09:22	Rising	43.0	51.6	BH - 17, HG - 4, GB - 1, CA - 1 BH - 13, GH - 5, GB - 1, CA - 1 BH - 12, HG - 3, GB - 1	Vehicles driving past, ATV, drilling equipment (audible and visible)	No Response
22/02/2024 14:17 – 16:17	Low	No data due to meter failure	49.1	HG - 15, BH - 12, DN - 19, RP - 10 HG - 22, BH - 5, OC - 1, CU - 1, GB - 1, RK - 2, CA - 2 HG - 14, BH - 8, BG - 5, OC - 2	No noise events observed (not audible and not visible)	No Response

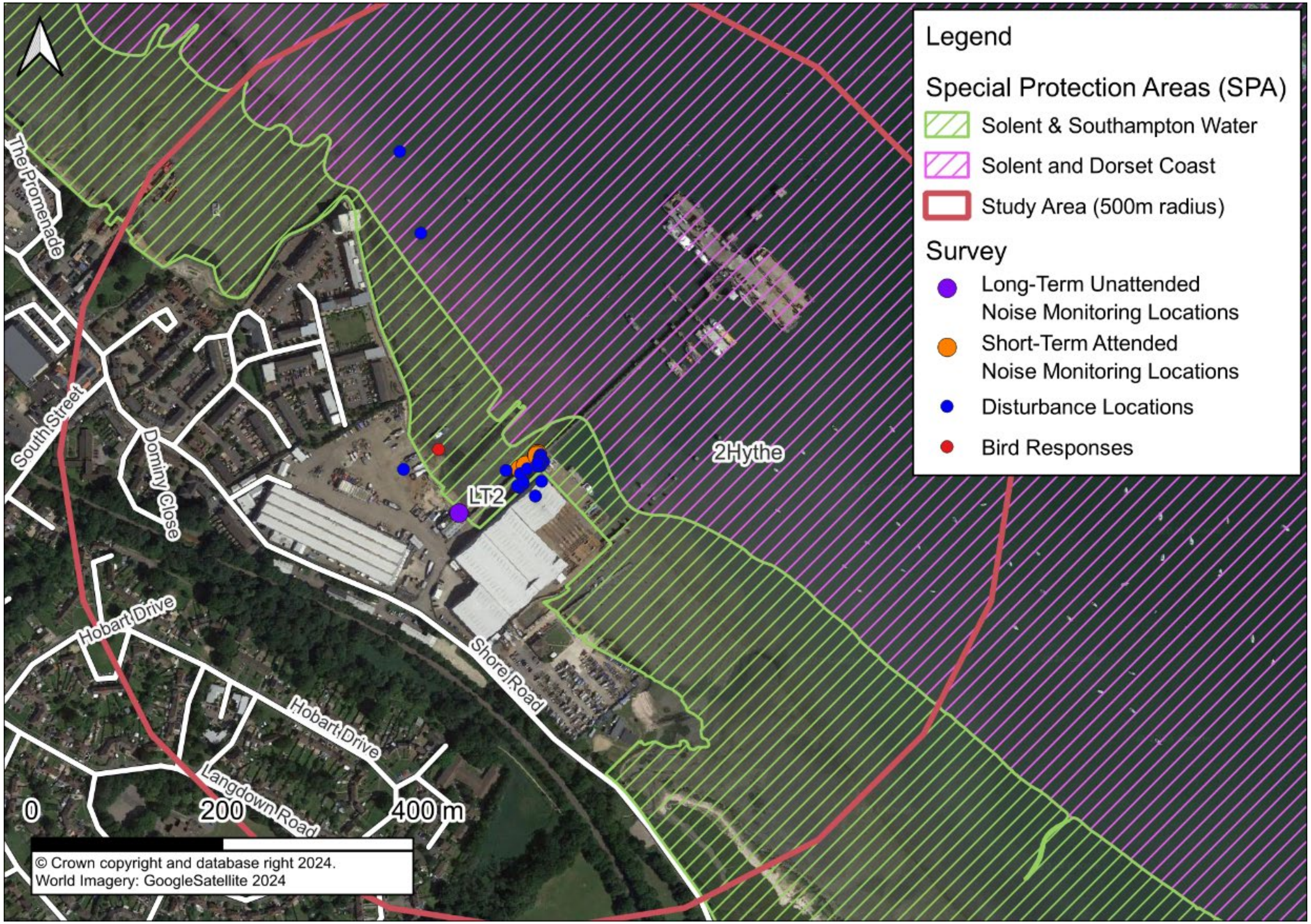

Figure B2. Map of Location 2Hythe

3River Itchen

Table B3. Short-term Noise Monitoring Results for Location 3River Itchen

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
18/10/2023 08:15 – 10:18	Rising	46.0	44.9	BH - 79, OC - 5, RK - 4, CU - 2, MA - 14, HG - 8, MS - 17 BH - 57, MS - 19, CM - 1, HG - 6, ET - 1, RK - 5, OC - 7, CU - 2 MS - 21, MA - 31, BH - 43, CM - 1, HG - 5, KF - 1, ET - 4, H. - 1, RK - 5, OC - 8, CU - 2, MH - 2, CA - 1, GG - 1	Airplane passing overhead, approximately 4000m above and train passing, approximately 31m from birds (audible and visible)	Freeze/ stress response and flight response with settlement within 100m
23/11/2023	High	46.0	49.0	KF - 1, GG - 1, MA - 6, MS - 33, BH - 60	Plane overhead	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
08:48 – 10:48				BH - 83, MS - 37, HG - 5, GB - 1	(audible and visible)	
				MS - 56, BH - 86, HG - 9, GG - 1, OC - 14, CU - 1, MA - 27		
14/12/2023 13:31 – 15:31	Falling	50.0	48.3	MS - 38, BH - 13, HG - 2, MA - 4	Plane overhead, crashing noise from work yard and train passing (audible and visible)	No Response
				MS - 36, BH - 23, WN - 2, OC - 1, MA - 4, RK - 1		
				MS - 40, BH - 220, MA - 9, WN - 2, OC - 12, RK - 4, HG - 19		
20/02/2024 13:04 – 15:05	Low	46.0	52.0	BH - 430, HG - 4, CM - 7, OC - 16, CU - 1, MH - 1, MS - 4, CA - 1	Metal works	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				BH - 405, HG - 6, CM - 7, OC - 19, CU - 3, MS - 4, CA - 3	(audible but not visible)	
				BH - 450, HG - 6, CM - 4, OC - 13, CU - 5, MH - 1, MS - 6, CA - 1, H. - 1, BG - 5		

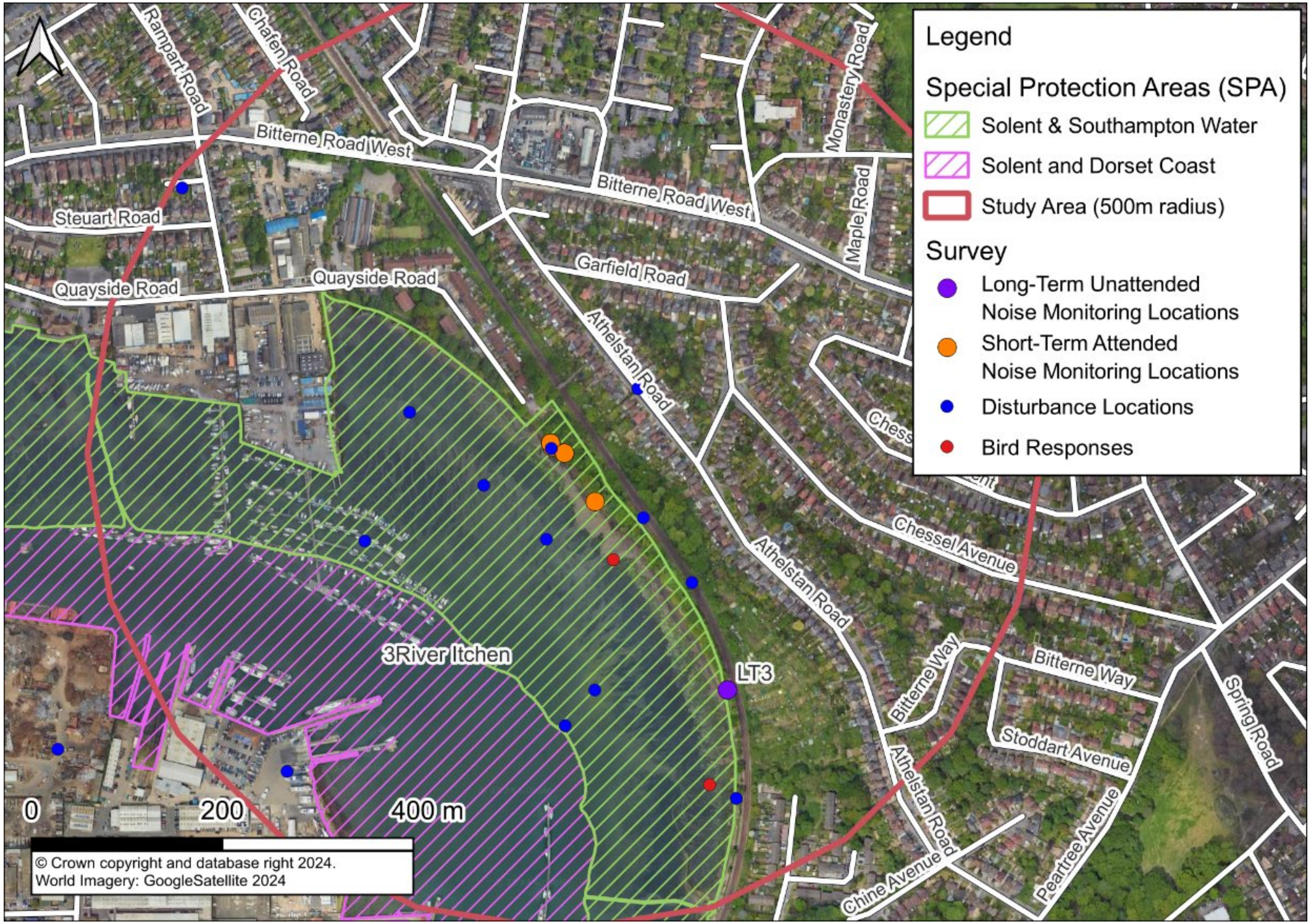

Figure B3. Map of Location 3River Itchen

4Hook Lake

Table B4. Short-term Noise Monitoring Results for Location 4Hook Lake

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
12/10/2023 12:00 – 14:00	High	43.0	50.5	CU - 1, BH - 1, DN - 1, LG - 1	No noise events observed (not audible and not visible)	No Response
				DN - 9, ET - 1, BH - 1		
				WN - 8, BH - 5, DN - 8		
23/11/2023 11:34 – 13:36	Falling	44.0	50.0	BG - 68, OC - 30, CU - 5, RK - 3, WN - 104, BH - 45, MU - 1, CM - 1, TN - 4, DN - 2	No noise events observed (not audible and not visible)	No Response
				OC - 26, CU - 4, BG - 35, WN - 47, BH - 18, HG - 4, CM - 1		
				BG - 55, OC - 25, CU - 4, DN - 76, GG - 2, TE - 1,		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				WN - 53, CM - 2, BH - 12, RK - 1		
18/12/2023 10:04 – 12:05	Rising	44.0	48.4	WN - 59, CU - 3, TE - 6, BG - 49, OC - 30, TT - 1	No noise events observed (not audible and not visible)	No Response
				OC - 36, BG - 112, KF - 1, CU - 3, WN - 74		
				BG - 64, WN - 45, OC - 33, ND - 1, GG - 2, RK - 2		
23/02/2024 14:45 – 16:45	Low	42.0	40.5	WN - 36, OC - 33, BG - 130, HG - 29, BH - 21, GA - 2, CU - 4, SV - 2	Dog barking (audible and visible)	No Response
				DN - 45, BG - 50, WN - 28, OC - 21, HG - 32, BH - 13, CU - 2		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				OC - 4, BG - 3, WN - 19, HG - 12, BH - 2		

Figure B4. Map of Location 4Hook Lake

5Thorness Bay

Table B5. Short-term Noise Monitoring Results for Location 5Thorness Bay

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
01/11/2023 12:12 – 14:13	High	43.0	55.9	BH - 27 BH - 34, TT - 16, DN - 18, ET - 1 BH - 27, HG - 1	No noise events observed (not audible and not visible)	No Response
10/11/2023 11:40 – 13:40	Falling	43.0	54.7	BH - 1, MU - 2 BG - 17, BH - 15, MU - 6, CU - 1, OC - 2, HG - 4, ET - 1 CU - 7, BG - 32, HG - 10, BH - 9, MU - 5	No noise events observed (not audible and not visible)	No Response
22/12/2023	Rising	49.0	53.4	HG - 2, BH - 8, OC - 3, CU - 1	Dog barking	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
14:35 – 16:36				BH - 8, HG - 3, RM - 2, OC - 2, GB - 1	(audible and visible)	
				CU - 2, BG - 5		
08/01/2024 11:48 – 13:50	Low	50.0	44.2	RM - 6, BH - 46, HG - 1, OC - 8, GX - 1, CU - 1, CA - 1, BG - 5	No noise events observed (not audible and not visible)	No Response
				RM - 2, BH - 41, HG - 7, OC - 3, GX - 3, CU - 2, BG - 14		
				BH - 27, HG - 8, OC - 3, CU - 4, BG - 32		
14/02/2024 14:21 – 16:21	High	50.0	54.7	BG - 36, TT - 7	No noise events observed	No Response
				BG - 32, TT - 7		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				TT - 7	(not audible and not visible)	

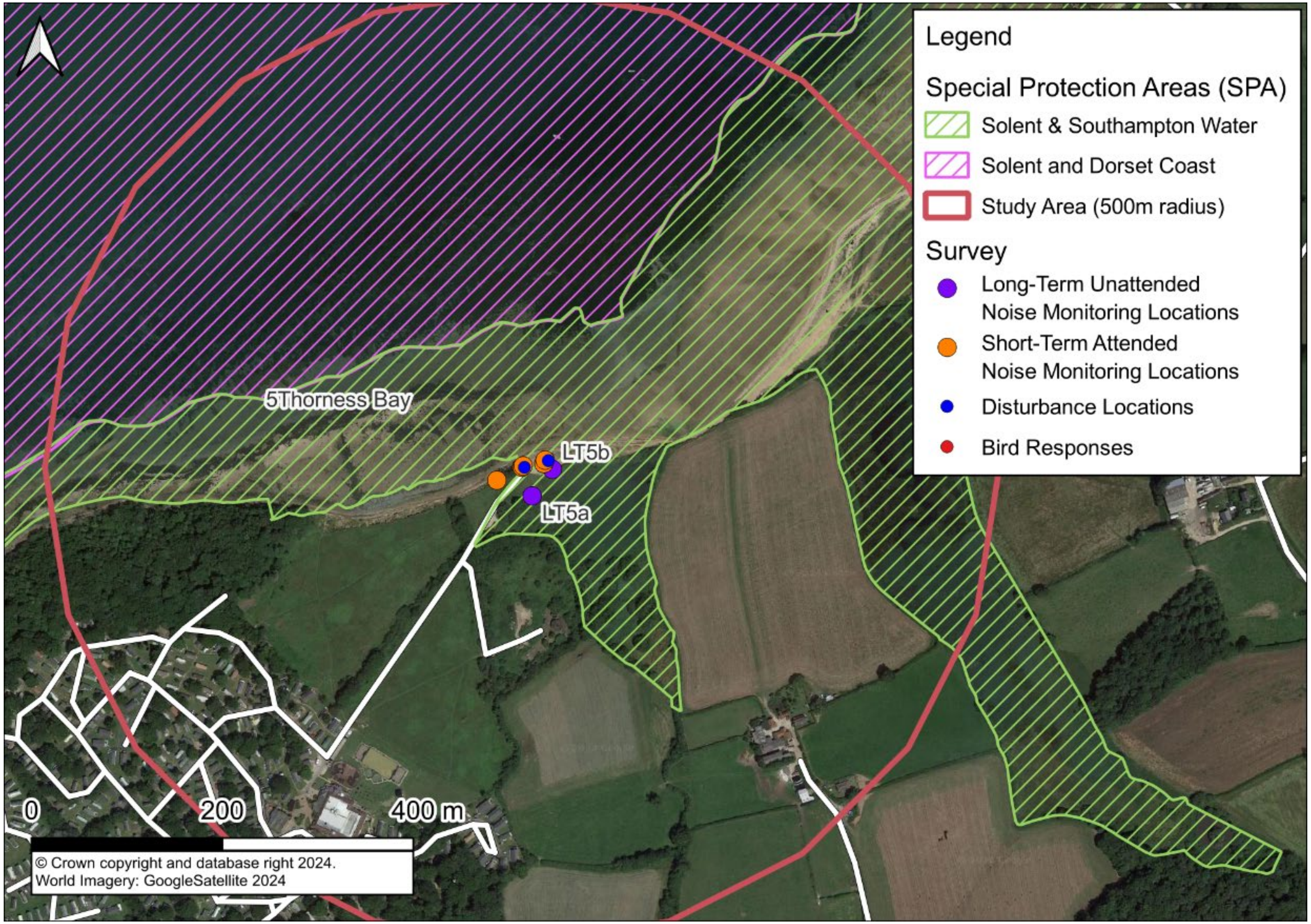

Figure B5. Map of Location 5Thorness Bay

6Ryde

Table B6. Short-term Noise Monitoring Results for Location 6Ryde

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
01/11/2023 09:00 – 11:00	Rising	No data due to meter failure	49.9	MS - 17, BH - 85, GB - 3, CM - 1, HG - 10, BG - 590, OC - 2, CU - 1	Hovercraft approximately 79m and 135m from the birds (audible and visible)	Flight response with settlement beyond 100m
				MS - 6, HG - 3, BG - 372, CA - 2, MU - 1		
				BG - 245, MS - 2		
10/11/2023 08:25 – 10:25	High	No data due to meter failure	58.0	BG - 103, BH - 5, HG - 2	Hovercraft approximately 85m to 294m from the birds (audible and visible)	Flight response with settlement within/ beyond 100m
				BG - 58, BH - 5, MS - 2		
				BG - 35, HG - 2, GB - 1, MS - 2		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
22/12/2023 11:35 – 13:36	Low	50.0	53.4	BH - 72, MU - 7, HG - 27, OC - 29, SA - 59, GB - 4, BG - 18	Train passing (audible and visible)	No Response
				BH - 103, MU - 11, HG - 32, OC - 34, SA - 43, GB - 6, BG - 25, RP - 7, CU - 2		
				BH - 41, MU - 2, HG - 30, OC - 21, SA - 36, GB - 4, BG - 45		
08/01/2024 09:06 – 11:06	Falling	51.0	57.6	BH - 63, HG - 6, SS - 3	Hovercraft approximately 91m from the birds (audible and visible)	Flight response with settlement within 100m
				SS - 25, BH - 47, HG - 5, CM - 2, MU - 2		
				SS - 46, RP - 6, OC - 10, HG - 13, BH - 23		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
14/02/2024 10:10 – 13:10	Rising	38.0	48.6	BH - 17, HG - 12, TT - 3, OC - 8	Hovercraft and road vehicles passing by (audible and visible)	No Response
				BH - 12, LB - 1, GB - 1, HG - 1, SS - 10, OC - 1		
				SS - 6, RP - 2, HG - 3, BH - 21		

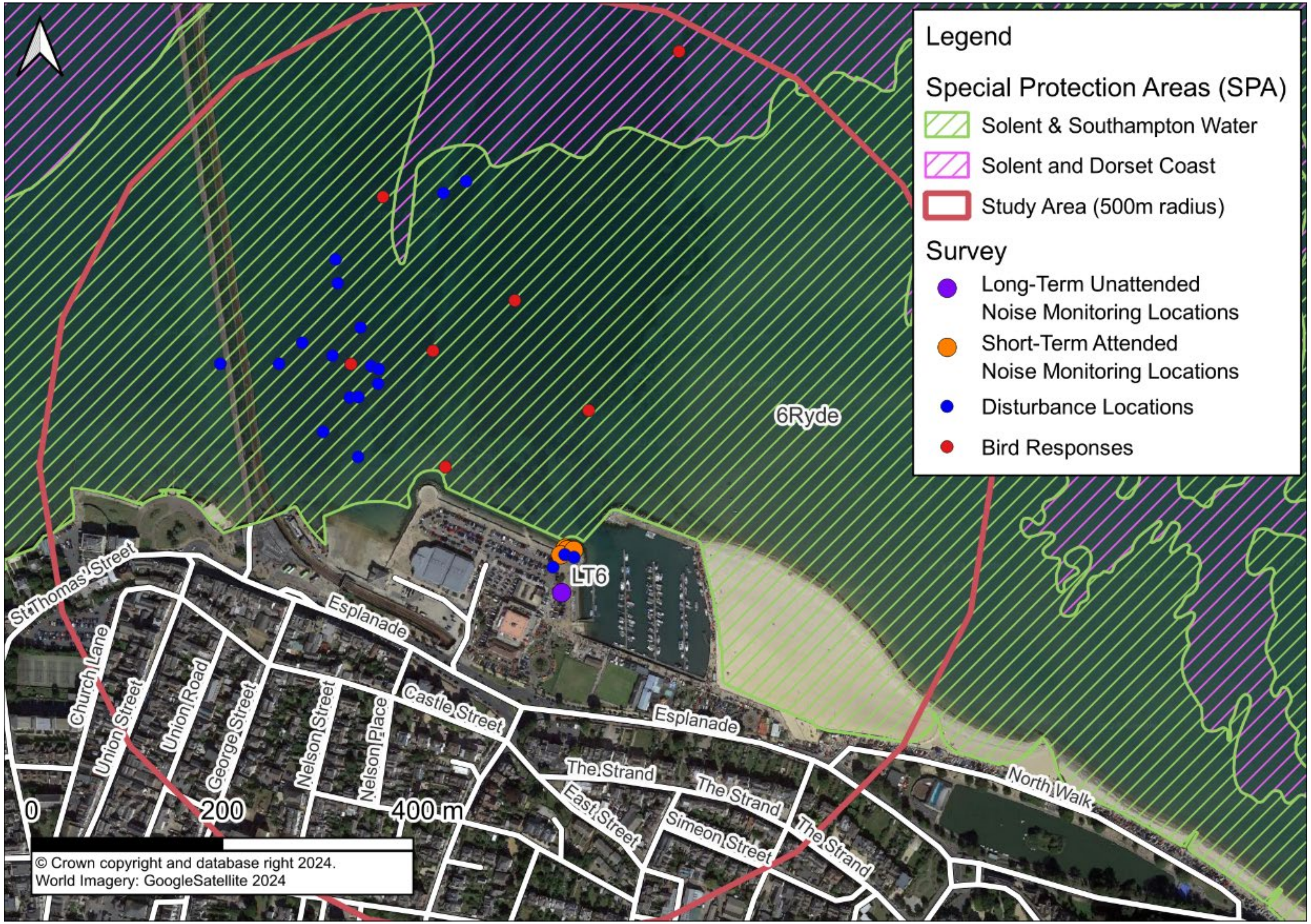

Figure B6. Map of Location 6Ryde

7Portchester

Table B7. Short-term Noise Monitoring Results for Location 7Portchester

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
19/10/2023 10:15 – 12:15	Rising	52.0	43.0	BH - 26, HG - 8, H. - 1, ET - 4, CU - 4, BG - 3, TT - 1, RK - 22, OC - 2	No noise events observed (not audible and not visible)	No Response
				RK - 62, ET - 4, BH - 35, CU - 5, HG - 8, OC - 3, MA - 5		
				RK - 156, TT - 5, CU - 3, BH - 11, ET - 2, BW - 2, MA - 6, HG - 2		
17/11/2023 12:48 – 14:53	High	42.0	41.8	BG - 147, RK - 30, TT - 81, GG - 2, CM - 21, HG - 10, BH - 2, TE - 1, RM - 1, CA - 2, ND - 1, LN - 1	Boat leaving the harbour and loud noise from the industrial site	Flight response with settlement beyond 100m

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				BG - 218, RK -18, HG - 2, CM - 4, TE - 2, TT - 99, DN - 1, GG - 4, RM - 1	(audible and visible)	
				RK - 123, BG - 6, MA - 8, TT - 85		
08/12/2023 09:11 – 11:26	Falling	40.0	43.8	TN - 25, BH - 16, GG - 6, RM - 4, BG - 117, RK - 85, DN - 6, H. - 1, CA - 5, CM - 8	Horn from ship (audible but not visible)	No Response
				RK - 132, TT - 35, DN - 162, GG - 4, CM - 8, BH - 12, BG - 36, H. - 1, MS - 1, CA - 4, CU - 1, OC - 1		
				RK - 102, TT - 46, DN - 121, GG - 4, CM - 8, BH - 30, HG - 3, BG - 24, H. - 1,		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				MS - 1, CA - 4, CU - 2, OC - 1		
19/01/2024 10:04 – 12:04	Low	44.0	46.5	DN - 112, RK - 7, CU - 3, BG - 2, LD - 1, BW - 1, HG - 4, BH - 3, GB - 1	Boat leaving the harbour and metal works (audible and visible)	Flight response with settlement within/ beyond 100m
				DN - 153, RK - 16, RM - 1, BH - 7, CU - 1		
				DN - 143, BG - 2, RK - 19, CU - 2, BH - 7, LD - 1, GG - 2, BT - 13		

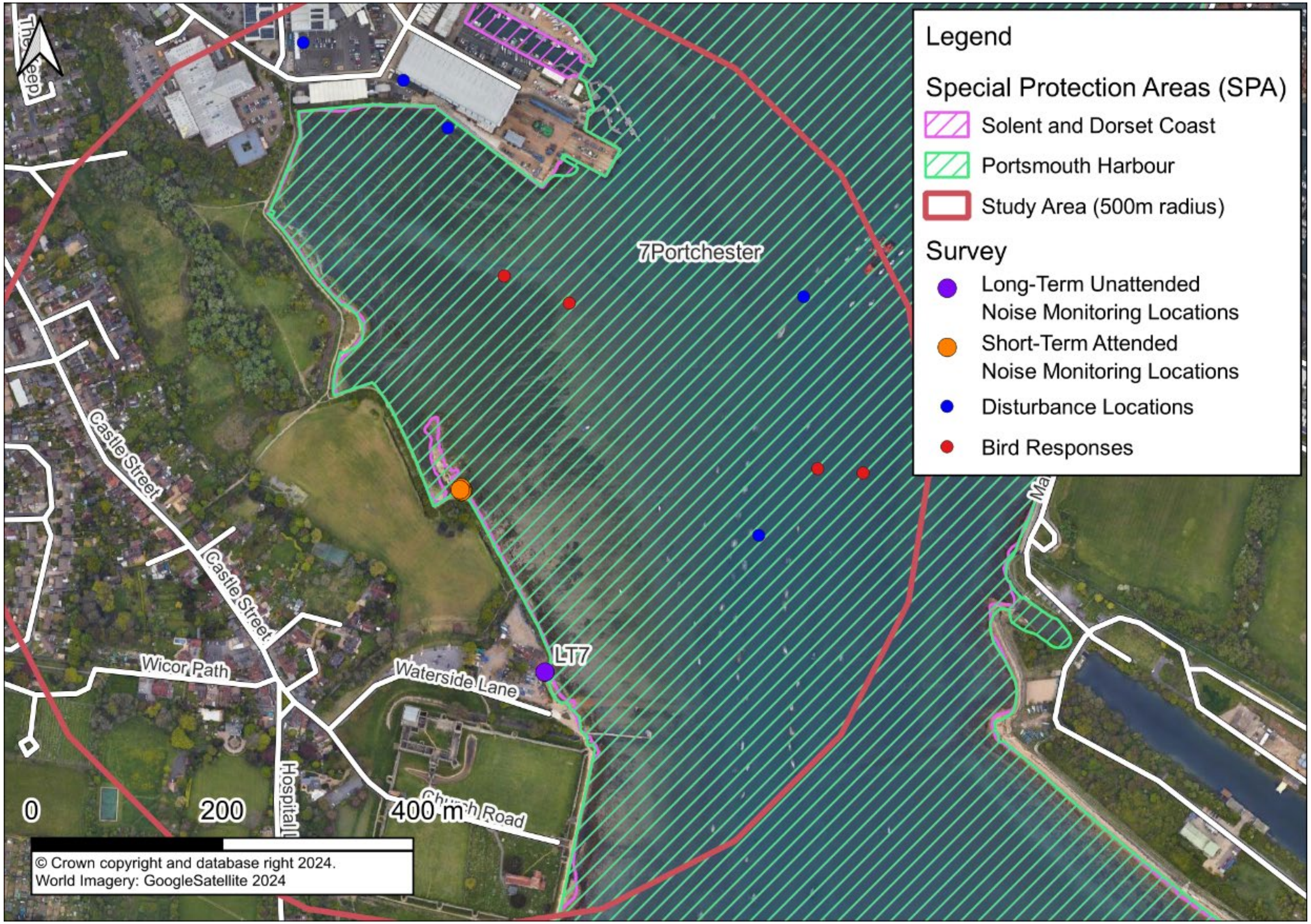

Figure B7. Map of Location 7Portchester

8Farlington Marshes

Table B8. Short-term Noise Monitoring Results for Location 8Farlington Marshes

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
19/10/2023 13:32 – 15:30	High	64.0	50.0	MS - 3, MH - 4, ET - 1, BH - 19, L. - 2, CG - 25, SU - 1	No noise events observed (not audible and not visible)	No Response
				MS - 3, MH - 2, SU - 4, ET - 12, H. - 2, L. - 4, CG - 34, BH - 6, MA - 1, BG - 9		
				ET - 3, MS - 3, BG - 14, GG - 3, BH - 22, OP - 1, HG - 4, SU - 5, L. - 1		
20/11/2023	Rising	69.0	63.8	PT - 18, WN - 35, BG - 168, CU - 7, OC - 5, RK - 17, GV - 1, DN - 520, L. - 38,	No noise events observed	No Response

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
12:59 – 15:03				CM - 55, HG - 5, BH - 19, RP - 4, AV - 8, T. – 12	(not audible and not visible)	
				BG – 110, PT – 8, CM – 11, BH – 44, RK – 42, OC – 10, AV -15, WN – 26, CU – 3, GK – 1, T. - 4, GV - 1, DN - 65		
				BG - 57, GV - 4, DN - 1, RP - 9, OC - 9		
08/12/2023 12:25 – 14:26	Low	69.0	61.9	BG - 67, BH - 85, CM - 5, CU - 2, OC - 2, RK - 3, L. – 16, AV – 5	No noise events observed (not audible and not visible)	No Response
				BG – 21, BH – 54, HG – 4, CM – 43, CU – 2, OC – 9, RK – 3, L. - 103		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				BG - 12, BH - 67, HG - 4, CM - 48, CU - 4, OC - 13, RK - 4, L. - 106		
19/01/2024 07:37 – 09:37	Falling	66.0	63.0	BG - 322, L. - 11, RK - 5, OC - 2, TE - 23, PT - 5, MA - 7, CM - 21, BH - 27, DN - 5, GX - 2, AV - 17, CU - 1	No noise events observed (not audible and not visible)	No Response
				DN - 179, BG - 37, RK - 11, OC - 13, TE - 54, PT – 29, L. - 68, MA - 9, GX - 6, CU - 1, BA - 1		
				DN - 186, L. - 48, RK - 8, TT - 3, TE - 9, CU - 1, BH - 12, CM - 6		

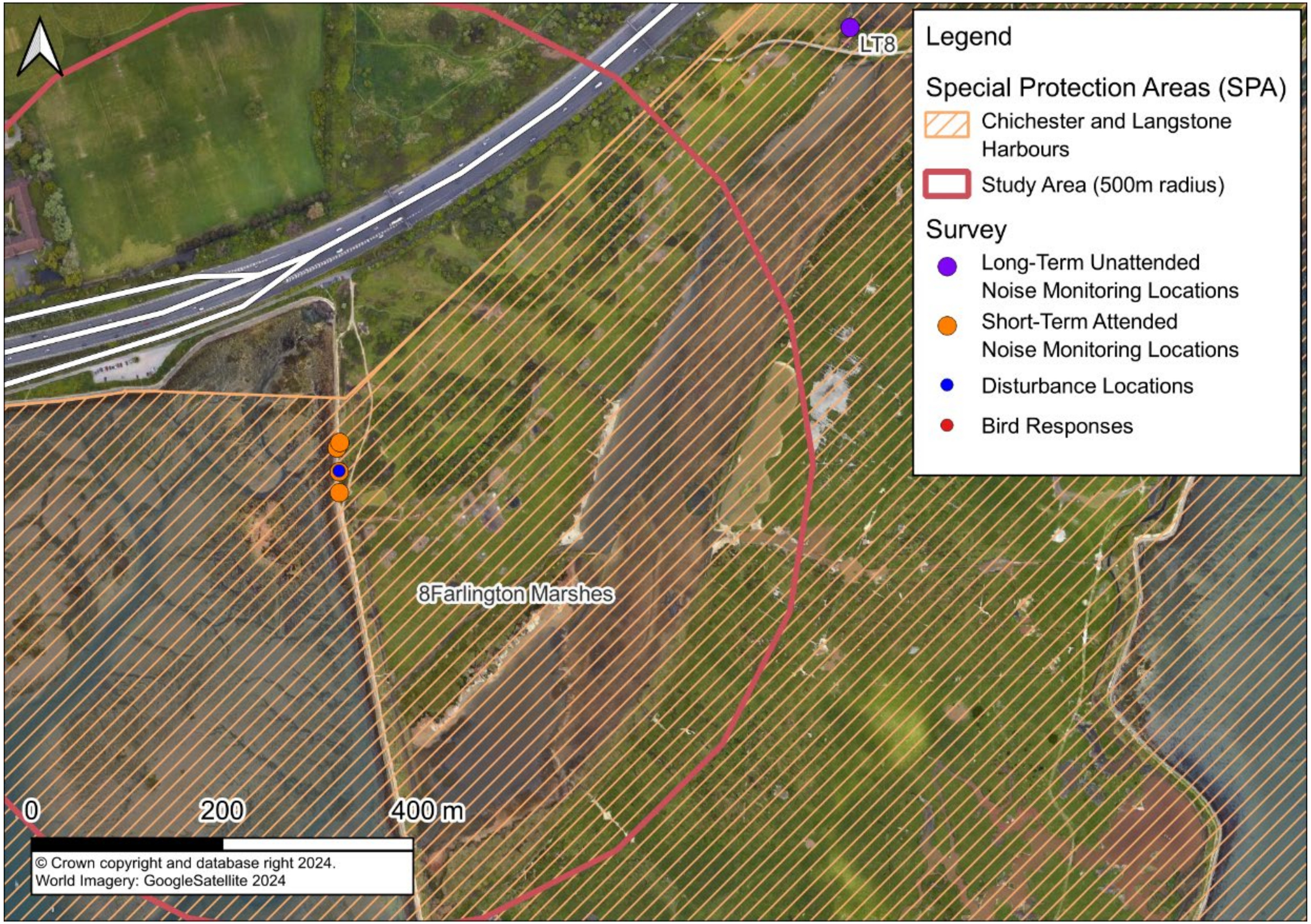

Figure B8. Map of Location 8Farlington Marshes

9Emsworth

Table B9. Short-term Noise Monitoring Results for Location 9Emsworth

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
23/10/2023 09:31 – 11:31	Falling	43.0	37.8	BH - 39, HG - 6, WN - 30, GG - 1, OC - 6, MA - 5, TT - 1 BH - 83, CM - 1, HG - 14, RK - 17, TT - 2, OC - 7, GK - 1, CU - 4, BW - 9, BG - 12, ET - 10, H. - 5, GV - 2, DN - 3 BH - 94, HG - 9, BW - 134, CU - 12, RK - 38, OC - 14, TT - 9, CM - 1, GV - 2, DN - 43	People walking into the beach (audible and visible)	Flight response with settlement within/ beyond 100m
17/11/2023 09:28 – 11:30	Rising	45.0	45.7	CU - 7, RK - 65, TT - 11, DN - 51, GV - 7, OC - 12, BH - 73, MA - 8, WN - 21, BG - 224, HG - 1	Small motor boat in the channel	Flight response with settlement within 100m

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				OC - 9, CU - 4, RK - 3, HG - 1, BH - 2, BG - 314, RM - 2, SU - 8, WN - 22, GV - 3, GB - 1, LG - 1	(audible and visible)	
				OC - 10, BG - 135		
07/12/2023 11:40 – 13:42	Low	43.0	41.6	DN - 257, WN - 18, RB - 1, GG - 1, GV - 2, CU - 3, OC - 8, BG - 208, RK - 65, BH - 75, HG - 6, CM - 1, LP - 5	Car driving off (audible and visible)	No response
				BG - 223, DN - 217, RP - 1, RM - 3, GG - 3, RK - 42, OC - 10, KF - 1, WN - 30, GA - 3, MA - 7, TT - 9, RK - 38, CU - 6		
				BG - 196, RP - 2, RK - 41, DN - 179, KN - 4, RM - 11,		

Date of Attended Survey / Start Time – End Time	Tide	Daytime Background Noise Level L_{A90} (dB(A))		Bird Count	Nature of Disturbance	Bird Response
		Monthly Long-term	Short-term			
				GG - 3, LG - 3, GV - 7, L. - 5, CU - 6, BH - 44, HG - 16		
16/01/2024 14:09 – 16:09	High	44.0	37.2	WN - 93, CO - 9, BH - 7, HG - 3, RM - 1, GD - 1, CM - 1, TT - 14	Airplane and helicopter passing overhead (audible and visible)	Freeze/ stress response
				CO - 6, WN - 35, MA - 4, BH - 18, HG - 6, TT - 5		
				WN - 4, BH - 5, MA - 5		

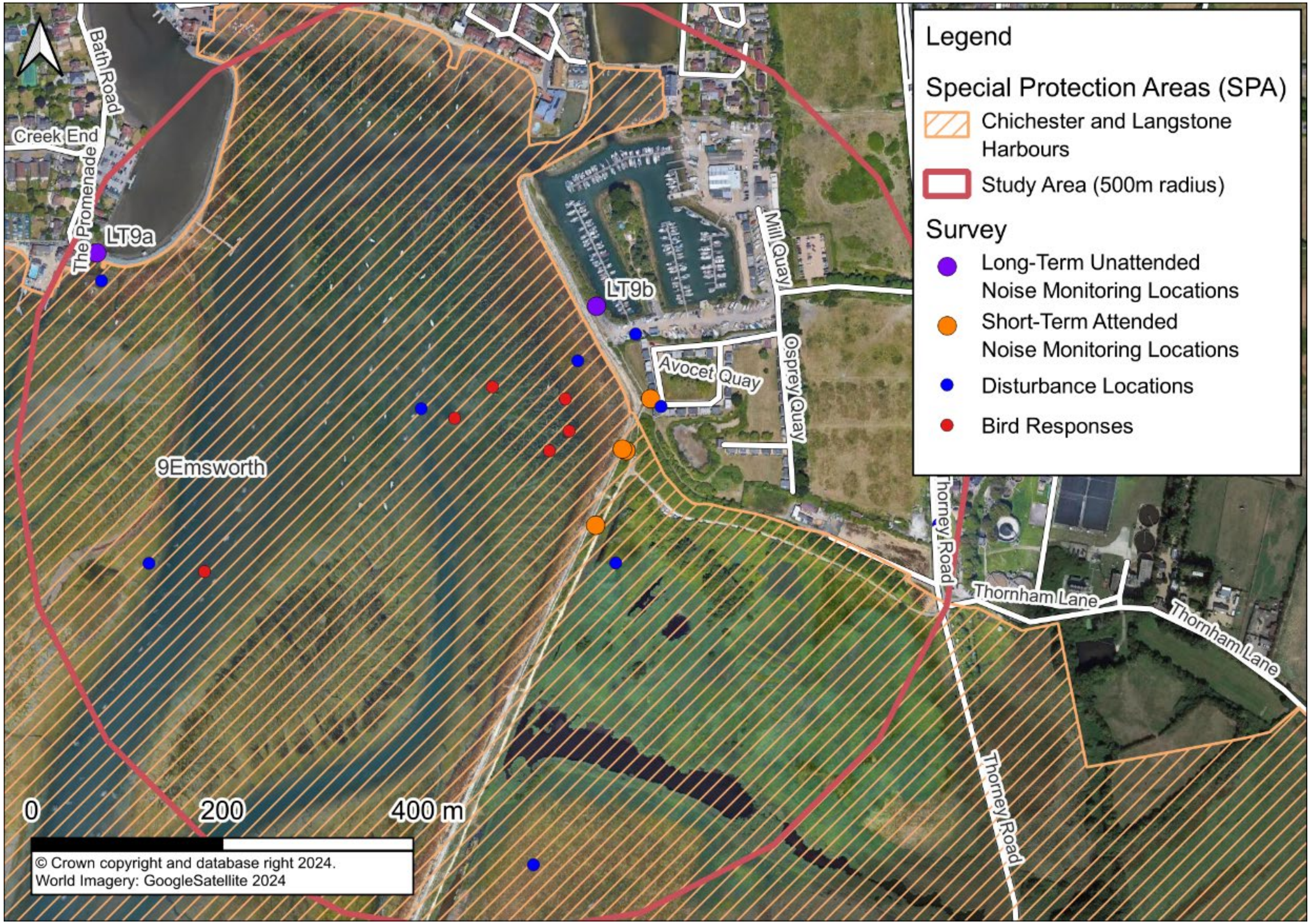

Figure B9. Map of Location 9Emsworth

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APPENDIX 2: NATURESCOT RESEARCH REPORT 1283

NatureScot Research Report 1283 - Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species

Year of publication: 2022

Authors: Goodship, N.M. and Furness, R.W. (MacArthur Green)

Cite as: Goodship, N.M. and Furness, R.W. (MacArthur Green) Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species. NatureScot Research Report 1283.

Contents

Keywords

Human disturbance; bird behaviour; Flight Initiation Distance; Alert Distance; Minimum Approach Distance; Buffer zones.

Background

Since 2007, Scottish Natural Heritage (now NatureScot) have referred to bird disturbance distance information presented in Ruddock and Whitfield (2007) to provide advice and guidance relating to casework involving human disturbance and protected bird species present in Scotland. However, since the 2007 publication, new disturbance response information in relation to human activity has become available. The aim of the current report is to update disturbance distances for species presented in Ruddock and Whitfield (2007) as well as to provide disturbance distance information for a range of additional protected bird species that regularly feature in Environmental Impact Assessments (EIAs) but were not included in Ruddock and Whitfield (2007).

NatureScot commissioned MacArthur Green to undertake a literature review to identify distances at which disturbance could be caused by human related activities to a number of protected UK bird species present in Scotland during the breeding and nonbreeding seasons. All potential sources of human disturbance referenced in the literature were included in the review. Bird disturbance distances were recorded in a wide range of environments including inland sites (e.g. uplands, lowlands, inland waterbodies and streams), coastline (e.g. shoreline, intertidal areas and nearshore waters) as well as offshore areas (including islands and offshore waters). The literature was searched for disturbance distances that were measured in terms of Alert Distance (AD), Flight Initiation Distance (FID) and Minimum Approach Distance (MAD), and for qualitative evidence on bird disturbance. The disturbance distances were collated into a Bird Disturbance Response (BDR) database for 65 bird species that were selected by NatureScot. This report provides an account for each species summarising: quantitative information available in terms of AD/FID and MAD, recommended protection buffer distances, the likely sensitivity of each species to human disturbance activities and the quality of information available.

Main findings

- Wild bird disturbance distances caused by a wide range of human related activities are presented for a total of 65 bird species.
- Recommended buffer zones are provided for each species.
- A total of 23 out of 65 protected bird species were assessed as having a high or a medium to high sensitivity to disturbance from human related activities. EIAs in relation to human activity and development will require greatest consideration to potential disturbance impacts for these species with high sensitivity to disturbance, and to apply appropriate mitigation in areas where these species are likely to be present.
- A total of 31 out of 65 species were assessed as having a medium sensitivity to disturbance from human related activities. This means that these species may tolerate some disturbance caused by human related activities, but the extent of disturbance caused to individual birds could depend on a wide range of factors including levels of habituation to disturbance.
- Few species (11 out of 65) were considered to have a low or a low to medium sensitivity to human disturbance. It is important to note that all bird species assessed in this review (including high, medium and low sensitivity species) are likely to vary in their response to human related disturbance in different areas depending on habituation to disturbance and other factors. Therefore, each assessment for future EIAs needs to be on a site-specific basis, taking account where possible of local circumstances that may influence bird sensitivity.
- A number of data gaps in the bird disturbance distance database are identified in this report and recommendations are provided for future research to fill these gaps.

Acknowledgements

We would like to thank NatureScot, especially Jen Graham, Dr Andy Douse and Andrew Stevenson for the clear guidance on interim drafts of this report. We also thank Dr Larry Griffin for his personal observations included for common scoter and Simon Cohen for his observations included for purple sandpiper.

Abbreviations

Alert Distance (AD)

Bird Disturbance Response (BDR)

Environmental Impact Assessment (EIA)

Flight Initiation Distance (FID)

Intergovernmental Panel on Climate Change (IPCC)

Special Protection Area (SPA)

Introduction

Scottish Natural Heritage (hereafter referred to by its operating name ‘NatureScot’) commissioned MacArthur Green to undertake a literature review to provide a list of disturbance distances caused by human related activities for a selected range of protected bird species. This report updates disturbance distance information presented in Ruddock and Whitfield (2007) which has underpinned NatureScot advice and guidance relating to disturbance. Since 2007, new disturbance response information in relation to human activity has become available for a range of protected bird species present in Scotland; the latest data (published up to summer 2021) are included in the current report. In addition, the current report includes a range of additional protected bird species that regularly feature in Environmental Impact Assessments (EIAs) but were not covered in Ruddock and Whitfield (2007).

This report follows a similar format to the **NatureScot research report 1096** that provided information on the effects of disturbance caused by seaweed hand-harvesting on protected marine and coastal bird species (Goodship and Furness, 2019). Similar to the 2019 report, the current review first created a Bird Disturbance Response (BDR) database providing distances at which disturbance to birds could be caused by human related activities. For each species, the current review summarises disturbance distances in the BDR database and makes suggestions for buffer zones; the overall sensitivity of each species to human disturbance is estimated and the level of confidence in these conclusions within a Scottish context is provided. Knowledge gaps identified during the review process are also presented in this report. Recommendations for potential future monitoring programmes and research are provided with a focus on filling these gaps.

Potential impact pathways causing bird disturbance

A wide range of human activity including recreational pursuits and commercial activity may disturb protected bird species (for examples of types of human disturbance, see The Bird Disturbance Response database section

In the UK, some form of human disturbance occurs in most environments where wild bird species are present during the breeding and nonbreeding seasons. These environments include: inland sites (including uplands, lowlands, inland waterbodies and streams), coastal sites (including the shoreline, intertidal areas and nearshore waters) as well as offshore areas (including islands and offshore waters).

The impact of a human disturbance event (e.g. a pedestrian walking across a moorland, a motorboat out at sea, etc) may directly affect bird behaviour (e.g. disrupting foraging activity while the bird alarm calls, or forcing the bird to fly away from the source of disturbance, etc). This change in behaviour brought about by the disturbance event may mean that birds are disturbed from their initial activity and/or are displaced from their initial chosen location. The effect of disturbance and displacement on birds may change their energy intake/expenditure, alter their breeding success and ultimately impact their survival; some of these changes include, but are not limited to, the following:

- Changes to breeding location, timing of breeding, breeding strategy and success;
- Changes to foraging location, time spent foraging, food source, energy intake and daily energy budgets;
- Changes to roosting location and time spent at rest; and
- Changes to migration routes, stop-over locations and seasonal energy expenditure.

In addition, human disturbance may also indirectly affect bird behaviour through habitat alteration (for example habitat loss though development or agricultural practices) and/or alteration of predator numbers.

Habituation and other factors influencing disturbance distance

This review provides a guide to indicate which species are likely to be disturbed by human activities. However, it is important to keep in mind that a great many factors influence disturbance responses of birds. Even species that are considered to have a low sensitivity to human disturbance (see Assessing sensitivity to disturbance section) may be disturbed in some areas at certain times of the year and more sensitive species will also vary in their disturbance response depending upon the specific situation at the time of the disturbance event. Therefore, each study assessing bird disturbance needs to be on a site-specific basis, taking into account the context.

It is important to note that all bird species assessed in this review are, to some degree, likely to habituate to disturbance and are therefore likely to vary in their response to human disturbance in different areas. If birds are present in a highly disturbed area, then it is likely that these birds will show a high degree of habituation to disturbance and tolerate a shorter disturbance distance (Keller, 1989; Baudains and Lloyd, 2007; Ellenberg *et al*., 2009; Ross *et al*., 2015; Vincze *et al*., 2016). Similarly, if a site is secluded where there is little general disturbance, then birds are more likely to react to human presence at a greater distance (e.g. Bötsch *et al*. 2018; Samia *et al*. 2017). Habituation may be prevented in some locations depending on other factors, such as where birds are exposed to shooting. For example, goosanders *Mergus merganser* can become habituated to people in protected locations such as Hogganfield Loch Local Nature Reserve in Glasgow, where they will feed on grain and bread provided by people and will come within a few metres of people there, and on the River Kelvin, Glasgow, where they will tolerate people walking past them within a few tens of metres (Bob Furness, pers. obs.). In contrast, goosanders on salmon rivers where there has been sustained shooting of goosanders to protect fish stocks, such as the Tweed, will immediately fly away when a person appears over 100m away (Bob Furness, pers. obs.).

The distance at which a bird moves away from a source of human disturbance is often quantified as a Flight Initiation Distance (FID) and this can be understood in terms of a behavioural response involving a trade-off between avoidance of predation risk and acquiring sufficient resources, such as food. Climatic variation is one of the many factors that influence responses to disturbance (Díaz *et al*. 2021); one important factor relevant in Scotland appears to be the effect of cold weather/starvation affecting the behaviour of shorebirds and waterfowl in winter. It is well understood that these birds allow people to approach much more closely under extreme cold weather conditions, because the trade-off between predation risk (represented by an approaching person) and starvation risk (caused by freezing weather preventing foraging) has been altered by extreme cold weather conditions. It should therefore be noted that birds may in adverse conditions be less able to show the 'luxury' of alert behaviour or flight initiation in response to disturbance, although, paradoxically, the impact of disturbance under such severe conditions may be greatly increased. Díaz *et al*. (2021) showed that FIDs of a sample of 229 bird species decreased with increasing temperature and rainfall, which they interpret as demonstrating that FID responds to foraging success (the assumption being that for the bird species studied the foraging success declines with increasing temperature and rainfall). They also found that FIDs were influenced by urbanisation, by latitude, and by bird body mass. Urbanisation has also been shown to strongly reduce FIDs of birds in other studies (e.g. Carlen *et al*., 2021; Charutha *et al*., 2021; Nyatanga *et al*., 2021).

Other factors that may influence disturbance responses of birds include, but are not limited to the following: predation risk, FIDs being shorter in locations with fewer predators (Díaz *et al*., 2021), bird population trend (Díaz *et al*., 2021), what the source of disturbance is (Lethlean *et al*., 2017); species of the focal bird in the study (Blumstein, 2006); individual character of the focal bird, flock size and species construction in which the focal bird is present (Mori *et al*., 2001); the size of the focal bird (Blumstein *et al*., 2004; Mikula *et al*., 2018; Díaz *et al*., 2021), behaviour of the focal bird at the time it is disturbed (Liley *et al*., 2011; Liley and Fearnley, 2012; Lilleyman *et al*., 2016), energetic requirements of the focal bird (Gill *et al*., 2001; Beale and Monaghan, 2004), seasonal constraints (Mikula *et al*., 2018), whether the source of disturbance is visual or acoustic or both and whether the source of disturbance is novel to the focal bird (McLeod *et al*., 2013), disease status of the focal bird (Møller, 2008a), exposure of the birds to hunting pressures (Madsen, 1998a,b; Gnanapragasam *et al*., 2021); to mention just a few.

Weston *et al*. (2021) compared FIDs of African and Australian birds. Controlling for phylogeny, they found smaller FIDs among African species than Australian species when comparing residents, but not migrants. They concluded that resident African birds are more tolerant of humans, perhaps in relation to the history of cohabitation between humans and birds.

In addition, it should be recognised that birds learn to respond in an appropriate way to perceived risks from human activities. For example, whooper swans *Cygnus cygnus* at Hogganfield Loch accept food from people, but recognise that a bird ringer carrying a pole with a hook represents a threat worth avoiding and remain further away under those circumstances (Bernie Zonfrillo, pers. comm.). Eider ducks *Somateria mollissima,* learn the sound of the engine of the powerboat used to chase them away from mussel farms, and move away in anticipation of being chased when they hear the approaching engine noise underwater, but ignore other underwater noises (Ross, 2000). The subtle changes in behaviour of birds as a consequence of learning will alter responses to human disturbance of local populations with specific histories of interacting with people.

Definition of disturbance response (AD/FID)

There are three ways disturbance responses are typically measured, as defined below. As part of the literature review process, evidence of these three responses for each species was collated, where it was available.

AD: Alert Distance (AD) is defined as the distance at which a bird or group of birds starts to show alert behaviour (e.g. head up, alarm calling, staring at the source of disturbance, aggressive display, chicks startled, crouching or flattening on the nest etc) rather than sleeping, foraging or preening behaviour when approached by a disturbance agent (such as a person, or powerboat) (Livezey *et al*., 2016).

FID: Flight Initiation Distance (FID) is defined as the distance at which a bird or group of birds starts to escape (by walking away, running away, swimming away, taking flight, or diving) when approached by a disturbance agent (such as a person, or powerboat). This distance is assumed to reflect the trade-off between costs of escape (energetic costs of flight plus loss of food intake during the period of disturbance) and the risk associated with staying put (inferred predation risk) (Mikula *et al*., 2018).

MAD: Minimum Approach Distance (MAD) is defined as the minimum distance at which humans should be separated from wildlife to avoid any disturbance to the behaviour of the wildlife (Livezey *et al*., 2016). This distance should be such that the wildlife does not show an alert response to the presence of human activity and does not show flight initiation. Estimates of MAD can therefore be informed by measurement of AD and/or FID. MAD is commonly referred to as a buffer distance which can be determined by management, based on evidence from observed behaviour of birds.

Buffer zone: Buffer zone is defined in this report as a range of buffer distances that can be used to protect birds from human disturbance.

Although the above definitions are convenient for quantification of bird responses to human disturbance, it should be recognised that bird heart rate may be increased by exposure to human disturbance before alert behaviour or flight initiation responses are evident. Increased heart rate and increased levels of stress hormones have physiological costs and so disturbance may have subtle impacts even on birds that are not clearly showing behavioural responses to disturbance.

Buffer Zones

We were asked by NatureScot to recommend buffer zones for each study species and have done so. However, we emphasise that whereas AD and FID measurements are empirical data collected using agreed scientific methods, estimates of buffer zones must be based on policy decisions. Those should, of course, be evidence-based, but need also to consider a wide range of other aspects such as site-specific context, conservation status and importance of the focal population, and other pressures and threats affecting the population. Therefore, the estimates of buffer zones we suggest should be seen as indicative and not fixed limits that would be appropriate in all situations.

It is considered beyond the scope of this report to provide buffer zones for individual disturbance activities. For the majority of species the data isn't available to support such conclusions for the following reasons:

1) There often isn't enough data in a consistent format for any one activity type in a season to be able to confidently state a buffer range;

2) For species which do have a relatively large number of AD/FID records, disturbance distances within a species recorded in different studies can vary widely for a large number of reasons. It may often be the case that the source of activity isn't always the main factor determining the distance at which a bird responds to disturbance;

3) Following from this, there can be a large overlap in the range of disturbance distances recorded for different activities, this makes it very difficult to set a meaningful buffer zone for individual activities;

Due to the reasons listed above, providing individual buffer zones for different activities wasn't possible, however an attempt has been made to suggest a generalised buffer for the breeding season and/or non-breeding season for each species.

For species where it is possible to do so (e.g. Mallard), some text has been added to the species section to say what the highest FID/AD was recorded for different types of activity.

Bird species potentially affected by human disturbance

The 65 bird species that are the focus of this report are those which NatureScot identified could potentially be disturbed by humans on breeding and/or nonbreeding grounds in Scotland and give rise to conservation concerns as a result. The full list of species is presented in Table 1. These species are designated under the Birds Directive (EC Directive on the conservation of wild birds 2009/147) Article 4.1, listed in Annex 1 as being rare or vulnerable, as well as those birds listed under Article 4.2 as being regularly occurring migratory species. These bird species are afforded protection within Natura 2000 sites (including Special Protection Areas (SPAs). All wild bird species in the UK are also protected under the Wildlife and Countryside Act (W&CA) (1981), as amended by the Nature Conservation (Scotland) Act 2004. Some sensitive species are listed on Schedule 1 of the Act and receive enhanced protection against disturbance during the breeding season. Birds listed under Schedule 1A of the Act may not be intentionally or recklessly harassed at any time in the year (e.g. including at roost sites) and the nests of birds listed under Schedule A1 of the Act are protected all though the year, even when not in use (SNH, 2014).

The scientific name along with the common name of each focal species is listed in Table 1; these names are also repeated at the start of each species account. Protected bird groups which may potentially be disturbed by human activities and which are covered in this report include: swans and geese (family *Anatidae*), ducks (family *Anatidae*), grouse (family *Tetraonidae*), divers and grebes (families *Gaviidae* and *Podicipedidae*), diurnal raptors (families *Accipitridae* and *Falconidae*), waders (families *Charadriidae,Haematopodidae, Phalaropidae* and *Scolopacidae*), terns (family *Sternidae*), owls (family *Strigidae and Tytonidae*) and some other species (families *Caprimulgidae, Coraciiformes*, *Fringillidae, Paridae and Rallidae*). These family groups include both breeding and nonbreeding UK species.

Data gaps

This review has identified that, for some species, there is a lack of quantitative information available on AD and FID values. Some of these species with missing quantitative disturbance distance data have been assessed to have a medium or high sensitivity to disturbance through non-quantitative studies. The species listed below have one or fewer AD/FID records from human disturbance in the BDR database. These species therefore represent a data gap for studies (see Recommendations for further research section) investigating the impacts of human activity on bird disturbance:

- White-fronted goose, *Anser albifrons* (one FID pedestrian record);
- Bean goose, *Anser fabalis* (one FID pedestrian record);
- Greater scaup, *Aythya marila* (no AD/FID records);
- Common scoter, *Melanitta nigra* (no AD/FID pedestrian records);
- Slavonian grebe, *Podiceps auratus* (no AD/FID pedestrian records during the breeding season);
- White-tailed eagle, *Haliaeetus albicilla* (no AD/FID pedestrian records);
- Red kite, *Milvus* (no AD/FID pedestrian records);
- Marsh harrier, *Circus aeruginosus* (one FID pedestrian record);
- Hen harrier, *Circus cyaneus* (no AD/FID pedestrian records);
- Honey buzzard, *Pernis apivorus* (one FID pedestrian record);
- Hobby, *Falco subbuteo* (no AD/FID pedestrian records);
- Peregrine falcon, *Falco peregrinus* (no AD/FID pedestrian records);
- Merlin, *Falco columbarius* (one FID pedestrian record);
- Purple sandpiper, *Calidris maritima* (no AD/FID records);
- Red-necked phalarope, *Phalaropus lobatus* (no AD/FID records);
- Little tern, *Sternula albifrons* (no AD/FID records);
- Sandwich tern, *Thalasseus sandvicensis* (no AD/FID records);
- Arctic tern, *Sterna paradisaea* (one FID pedestrian record);
- Short-eared owl, *Asio flammeus* (no AD/FID pedestrian records);
- Tawny owl, *Strix aluco* (one FID pedestrian record);
- Barn owl, *Tyto alba* (no AD/FID pedestrian records);
- Corncrake, *Crex* (one FID pedestrian record); and
- Nightjar, *Caprimulgus europaeus* (one FID pedestrian record).

Study aims

The aim of this study was to collate AD and FID responses of a range of protected bird species to human disturbance, relative to recreation and other activities in Scotland. The outputs of this project will be used by NatureScot to provide advice and guidance to inform decisions on applications relating to disturbance.

The key objective was to carry out a thorough review of literature relating to disturbance responses of the species listed in Table 1 and compile the information into a database. The current report provides a compilation of species accounts which summarise the information held within the database. We encourage the updating of the database as further data become available.

Methods

The Bird Disturbance Response database

A summary of how the BDR database was constructed is provided below, for a full description, please see **NatureScot Research Report 1096** (Goodship and Furness, 2019).

A literature search for information on quantitative disturbance response distances measured worldwide in terms of ADs, FIDs and MADs of focal UK protected bird species was extracted from academic scientific publications as well as ‘grey literature’ reports monitoring disturbance distances. Data were obtained not only from Scottish/UK studies but also from other European and worldwide studies (including those taking place in North America, Australia, Asia and Africa) that had been translated into English.

Studies recording AD/FID and MAD distances during the breeding and nonbreeding season that were included in the BDR database included the following sources of human disturbance:

Sources of human disturbance

- Recreational pedestrian disturbance (e.g. walking, running, cycling, climbing, horse riding, bait digging, egg collecting and hunting);
- Recreational use of nearshore waters (e.g. both motorised and non-motorised watercraft including kayak, jet skis, motorboats, yachts);
- Working vessels (e.g. commercial ferries, fishing vessels, tankers, cruise ships, offshore wind-farm vessels);
- Animal disturbance (e.g. cattle and dogs);
- Agricultural disturbance (e.g. tractors and 4x4 vehicles); and
- Aircraft and drone disturbance.

The BDR database quantitative studies are summarised for each species in the species accounts (see Results – Species accounts section).

Twenty-four (mostly non-UK) species were included in the BDR database as “stand-in species” to supply additional quantitative data for 16 UK species with little available quantitative data. Stand-in species belong to the same family and have similar ecologies compared with their UK counterparts; the following species were included:

Stand in species

- Tundra swan, *Cygnus columbianus* (standing in for whooper swan);
- Tule greater white-fronted goose, *Anser albifrons elgasi* (standing in for Greenland white-fronted goose);
- Brent goose, *Branta bernicla* (standing in for barnacle goose);
- Australasian shoveler, *Anas rhynchotis* (standing in for Northern shoveler);
- Pochard, *Aythya farina* and tufted duck, *Aythya fuligula* (standing in for scaup);
- Great crested grebe, *Podiceps cristatus* (standing in for Slavonian grebe);
- Bald eagle, *Haliaeetus leucocephalus* and African fish eagle, *Haliaeetus vocifer* (standing in for white-tailed eagle);
- Black kite, *Milvus migrans* (standing in for red kite);
- African marsh harrier, *Circus ranivorus* (standing in for marsh harrier);
- Rough-legged buzzard, *Buteo lagopus* (standing in for common buzzard);
- Lesser kestrel, *Falco naumanni* (standing in for kestrel);
- Prairie falcon, *Falco mexicanus* (standing in for peregrine falcon);
- Least tern, *Sterna antillarum* (standing in for little tern);
- Barred owl, *Strix variata* (standing in for tawny owl);
- Azure kingfisher, *Ceyx azureus* and Malachite kingfisher, *Alcedo cristata* (standing in for European kingfisher);
- Willow tit, *Parus montanus*; marsh tit, *Parus palustris*; blue tit, *Parus caeruleus*; coal tit, *Periparus ater* and great tit, *Parus major* (standing in for crested tit); and
- Parrot crossbill, *Loxia pytyopsittacus* (standing in for common crossbill and Scottish crossbill).

Due to small available data sample size and close ecological similarity, two species, common crossbill *Loxia curvirostra* and Scottish crossbill *L. scotica*, were considered together in one account.

In addition to quantitative studies, non-quantitative studies are provided in each species account of this report, primarily to help with assessing sensitivity to disturbance where quantitative data were limited.

Assessing sensitivity to disturbance

The sensitivity of each species to human disturbance was in part assessed through the maximum AD/FID record held within the BDR database as follows:

Sensitivity category

- Maximum recorded AD/FID value > 500m = High sensitivity.
- Maximum recorded AD/FID value between 500 and 50m = Medium sensitivity.
- Maximum recorded AD/FID value <50m = Low sensitivity.

However, in addition to the maximum recorded AD/FID value, non-quantitative information on disturbance response was also used to assess likely sensitivity to disturbance. Non-quantitative information was especially used in the assessment of species where there was limited quantitative data evidence and low agreement between references. Using a combination of quantitative and non-quantitative information, the overall likely sensitivity of each species to human disturbance was evaluated. Species for which quantitative data were scarce tended to be species with low sensitivity to human disturbance, as published studies have tended to focus on the species of high sensitivity.

Assessing the quality of disturbance response distances

The quality of the quantitative AD/FID records held within the BDR database was assessed in terms of “level of evidence” and “degree of agreement” between references in order to determine the level of confidence that should be placed in the conclusions of these studies within a Scottish context (Mastrandrea *et al*., 2010). For each species, a chart (Figure 1) constructed by the Intergovernmental Panel on Climate Change (IPCC; Mastrandrea *et al*., 2010) was used to assess level of evidence and degree of agreement. The principle of the IPCC chart when applied to the current review is that the quality of the quantitative information is most robust when there are multiple, consistent independent lines of high-quality evidence.

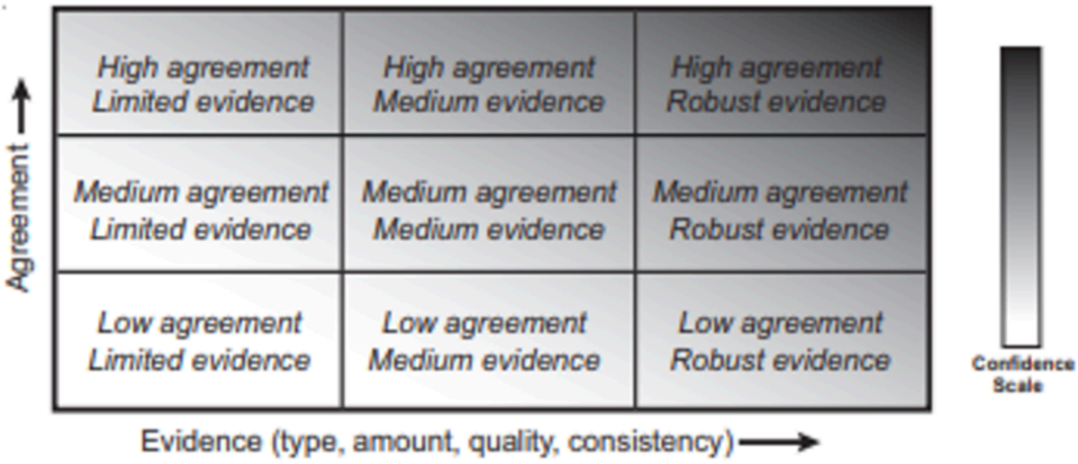

Figure 1. A depiction of evidence and agreement statements and their relationship to confidence that was created by the Intergovernmental Panel on Climate Change (IPCC; Mastrandrea et al., 2010).
The matrix has evidence (type, amount, quality and consistency) along the x axis and agreement along the y axis. Confidence increases towards the top-right corner as suggested by the increasing strength of shading where evidence is robust and agreement high. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality

The level of evidence was categorised in terms of “robust”, “medium” or “limited” and was evaluated by combining the total number of AD and FID records (one record = one AD/FID value for each source of disturbance in each reference) during the breeding and nonbreeding seasons, together with the number of named sources of human disturbance (e.g. pedestrian, motorised watercraft, aircraft etc.) as follows:

Level of evidence category

- ≥15 AD/FID records with ≥4 disturbance sources = Robust evidence.
- ≥15 AD/FID records with <4 disturbance sources = Medium evidence.
- 5 to 14 AD/FID records with ≥2 disturbance sources = Medium evidence.
- 5 to 14 AD/FID records with 1 disturbance source = Limited evidence.
- ≤4 AD/FID records with ≤4 disturbance source = Limited evidence.

The degree of agreement between AD/FID records for each species both within the same reference and also between different references was evaluated; the breeding season and nonbreeding seasons were assessed separately. The degree of agreement was categorised in terms of “high” (i.e. AD/FID values were very similar within/between references), “medium” (i.e. there was agreement between some references, other references were dissimilar) or “low” (i.e. little agreement in AD/FID values within/between references).

Assessing buffer zone ranges

The buffer zones suggested in this report to protect each presented bird species from human disturbance during the breeding and nonbreeding seasons are intended as a guide only.

For some species, published studies have previously recommended buffer zones; where these buffer zones are available, they have been incorporated into the suggested buffer range presented in this report. Buffer zones have also been estimated, where possible, from quantitative studies that have recorded AD/FID and MAD distances during the breeding and nonbreeding seasons. For species which lack quantitative data, buffers have been estimated from non-quantitative studies. For species which lack data for one season, or where buffers are considered to be similar between both seasons, a single buffer has been provided to include both breeding and nonbreeding seasons.

A precautionary approach has been used in the estimation of buffer zones in this report; the distance at which birds of the same species respond to disturbance often overlap between different disturbance sources, therefore general buffer zone ranges are presented for the breeding and nonbreeding seasons, rather than specific buffers for different sources of disturbance.

Species accounts – table content

For each species, a table summarising the AD/FID as well as MAD/buffer zones contained within the BDR database is presented. Each table summarises the sensitivity of the species in question to human disturbance, states the quality of quantitative AD/FID records held within the BDR database and provides a suggested buffer zone range to protect the species from human disturbance during the breeding and nonbreeding seasons. Each table contains the following headings and content:

Conservation status

- UK legislation under the Wildlife and Countryside Act 1981, listed in Schedule 1 for birds afforded special protection (Scottish Government, n.d.);
- UK conservation status under Birds of Conservation Concern 5 (BoCC5; Stanbury *et al.,* 2021);
- European legislation under the Birds Directive (European Commission Directive on the conservation of wild birds (2009/147) Article 4.1, listed in Annex 1 as being rare or vulnerable) (European Commission, 2010); and
- European conservation status under the International Union for the Conservation of Nature (IUCN) European Red List of Birds (BirdLife International, 2021a).

UK status

- UK Breeding/wintering/migration status in British Trust for Ornithology (BTO) BirdFacts (BTO, n.d.); and
- Scottish status was also added to this section if different from UK status (Forrester *et al*., 2012).

UK and Scottish population estimate

- Breeding and wintering numbers of birds in the UK (Woodward *et al*., 2020);
- Breeding and wintering numbers of birds in Scotland (Forrester *et al*., 2012); and
- Breeding population of raptors in Scotland/UK (Challis *et al.,* 2020).

UK long-term trend

- UK distribution and trends: BTO Bird Atlas 2007-11 (Balmer *et al*., 2013);
- Scottish distribution and trends: The digital birds of Scotland (Forrester *et al*., 2012); and
- Scottish white-tailed eagle population and future range modelling (Sansom *et al*., 2016).

AD/FID Quantitative disturbance distances

- The start of this section states if the species was included in Ruddock and Whitfield, (2007).
- Disturbance distance AD and FID values (presented in metres) contained in the BDR database are presented; references are provided in the current report and in the BDR database.
- Depending on the information available in the reference, measures of AD/FID may be presented as a single value, mean AD/FID, median AD/FID and/or range (minimum/maximum) of AD/FID values. One or several of these measures for each source of disturbance in each reference represents one record.
- Some references contain multiple AD/FID values for different sources of disturbance.

MAD and/or Buffer zone Quantitative distances

- MADs and buffer zones (presented in metres) contained in the BDR database are presented; references are provided in the current report and in the BDR database.

Ecology and non-quantitative information on disturbance responses

- A brief account of the ecology of each species is provided.
- Non-quantitative information on disturbance response was used to assess sensitivity to disturbance when quantitative data were lacking or assessed as being of poor quality. References are provided in the text and at the end of the report.

Likely sensitivity to disturbance, quality of quantitative information and buffer zone suggestion

- A summary of the sensitivity to human disturbance, the quality of quantitative data and a suggested buffer zone to protect from human disturbance during the breeding and nonbreeding seasons is provided.

Knowledge gaps

- Reference to what data are unavailable for each species.

Results – Species accounts

A summary of each bird species considered in this report is presented in Table 1, information includes: likely sensitivity to disturbance, quality of the quantitative information held within the BDR database and suggested buffer zones for the breeding (BR) and nonbreeding (NBR) seasons.

Buffer zones indicate the potential range of distances to protect the majority of birds from human disturbance; for more precise disturbance distances on a focal species, each assessment should be carried out on a site-specific basis.

Individual species accounts, summarising the data held for each species in the BDR database, are presented in Tables 2 to 66.

Table 1. Summary of likely sensitivity to disturbance, the quality of quantitative information in terms of Alert Distance (AD) and Flight Initiation Distance (FID) and suggested buffer zones during the breeding (BR) and nonbreeding (NBR) seasons considered for each bird species in this report.

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Whooper swan, *Cygnus cygnus*	Medium	Medium agreement Limited evidence	NBR = 200-600m
White-fronted goose, *Anser albifrons*	High	Medium agreement Limited evidence	NBR = 500-1000m
Bean goose, *Anser fabalis*	Medium	* Medium agreement Limited evidence	NBR = 200-600m
Pink-footed goose, *Anser brachyrhychus*	High	Low agreement Limited evidence	BR ≤1000m NBR = 500-1000m
Greylag goose, *Anser anser*	Medium	Medium agreement Limited evidence	BR and NBR = 200-600m
Barnacle goose, *Branta leucopsis*	Low/Medium	Medium agreement Medium evidence	BR and NBR = 50-200m
Common shelduck, *Tadorna tadorna*	High	Medium agreement Medium evidence	BR and NBR = 100-400m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Mallard, *Anas platyrhynchos*	Low/Medium	High agreement High evidence	BR = 50-100m NBR ≥ 100m
Gadwall, *Anas strepera*	Medium	Medium agreement Limited evidence	BR and NBR = 100-200m
Pintail, *Anas acuta*	Medium	Low agreement Limited evidence	BR and NBR = 100-200m
Shoveler, *Anas clypeata*	Medium	Medium agreement Limited evidence	BR and NBR = 100-200m
Eurasian wigeon, *Anas penelope*	High	Low agreement Medium evidence	BR = 100-200m NBR = 200-500m
Greater scaup, *Aythya marila*	High	Medium agreement Limited evidence	NBR = 150-450m
Common eider, *Somateria mollissima*	Medium/High	Medium agreement Medium evidence	BR = 100-200m NBR = 200-500m
Common scoter, *Melanitta nigra*	High	Medium agreement Limited evidence	BR = 300-500m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Common goldeneye, *Bucephala clangula*	High	Low agreement Medium evidence	BR = 100-150m NBR = 150-800m
Capercaillie, *Tetrao urogallus*	Medium/High	Medium agreement Medium evidence	BR (nesting females) and NBR = 100m BR (lekking males) = 500-1000m NBR = 100m
Black grouse, *Tetrao tetrix*	Medium	Medium agreement Medium evidence	BR (nesting females) and NBR = 100-150m BR (lekking males) = 500-750m NBR = 100m
Red-throated diver, *Gavia stellata*	High	Medium agreement Medium evidence	BR = 500-750m NBR = ≤1000m
Black-throated diver, *Gavia arctica*	High	Medium agreement Limited evidence	BR = 500-750m NBR = ≤1000m
Great northern diver, *Gavia immer*	Medium/High	Medium agreement Medium evidence	NBR = 100-350m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Slavonian grebe, *Podiceps auritus*	Medium	Low agreement Limited evidence	BR and NBR = 150-350m
White-tailed eagle, *Haliaeetus albicilla*	High	Low agreement Medium evidence	BR = 500-1000m NBR = 250-500m
Osprey, *Pandion haliaetus*	Medium/High	Low agreement Medium evidence	BR = 350-750m
Golden eagle, *Aquila chrysaetos*	High	Low agreement Medium evidence	BR = 750-1000m NBR = 250-500m
Red kite, *Milvus milvus*	Medium	Medium agreement Limited evidence	BR and NBR = 150-300m
Marsh harrier, *Circus aeruginosus*	Medium	Low agreement Limited evidence	BR and NBR = 300-500m
Hen harrier, *Circus cyaneus*	Medium	Medium agreement Limited evidence	BR and NBR = 300-750m
Common buzzard, *Buteo*	Low/Medium	Medium agreement Medium evidence	BR and NBR = 100-200m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Honey buzzard, *Pernis apivorus*	Medium	Medium agreement Limited evidence	BR = 100-200m
Northern goshawk, *Accipiter gentilis*	Medium	Medium agreement Limited evidence	BR = 300-500m
Kestrel, *Falco tinnunculus*	Low/Medium	Medium agreement Limited evidence	BR = 100-200m NBR = ≤50m
Eurasian hobby, *Falco subbuteo*	Medium	* Medium agreement Limited evidence	BR = 200-450m
Peregrine falcon, *Falco peregrinus*	Medium	Medium agreement Limited evidence	BR = 500-750m NBR = ≤200m
Merlin, *Falco columbarius*	Medium	Low agreement Limited evidence	BR = 300-500m NBR = ≤200m
Eurasian oystercatcher, *Haematopus ostralegus*	Medium	Medium agreement Robust evidence	BR = 50-100m NBR = 150-300m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Ringed plover, *Charadrius hiaticula*	High	Medium agreement Medium evidence	BR = 100-200m NBR = 100-300m
Grey plover, *Pluvialis squatarola*	Medium	Medium agreement Medium evidence	NBR = 150-300m
Golden plover, *Pluvialis apricaria*	Medium	Medium agreement Medium evidence	BR and NBR = 200-500m
Dunlin, *Calidris alpina*	Medium	Medium agreement Medium evidence	BR = 100-200m NBR = 150-300m
Red knot, *Calidris canutus*	Medium	Medium agreement Medium evidence	NBR = 100-300m
Purple sandpiper, *Calidris maritima*	Low/Medium	No quantitative evidence	BR and NBR <300m
Wood sandpiper, *Tringa glareola*	Medium	High agreement Limited evidence	BR = 150-300m
Common redshank, *Tringa totanus*	Medium	Medium agreement Robust evidence	BR = 100-200m NBR = 200-300m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Greenshank, *Tringa nebularia*	Medium/High	High agreement Robust evidence	BR and NBR = 300-500m
Black-tailed godwit, *Limosa limosa*	Medium	Medium agreement Medium evidence	BR and NBR = 100-200m
Bar-tailed godwit, *Limosa lapponica*	Medium	Medium agreement Medium evidence	NBR = 200-300m
Eurasian curlew, *Numenius arquata*	High	Medium agreement Robust evidence	BR = 200-300m NBR = 200-650m
Whimbrel, *Numenius phaeopus*	Medium	Medium agreement Limited evidence	BR and NBR = 100-300m
Red-necked phalarope, *Phalaropus lobatus*	Low	No quantitative evidence	BR <50m
Little tern, *Sternula albifrons*	Medium	Medium agreement Limited evidence	BR = 100-300m
Sandwich tern, *Thalasseus sandvicensis*	High	No quantitative evidence	BR ≥200m
Common tern, *Sterna hirundo*	Medium/High	Medium agreement Medium evidence	BR = 200-400m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
Arctic tern, *Sterna paradisaea*	Medium	Low agreement Limited evidence	BR ≥200m
Roseate tern, *Sterna dougallii*	High	Low agreement Limited evidence	BR ≥200m
Snowy owl, *Bubo scandiacus*	Medium	Low agreement Limited evidence	NBR = 150-500m
Long-eared owl, *Asio otus*	Medium	Low agreement Limited evidence	BR and NBR = 100-300m
Short-eared owl, *Asio flammeus*	Medium/High	Low agreement Limited evidence	BR and NBR = 300-500m
Tawny owl, *Strix aluco*	Low/Medium	* Medium agreement Limited evidence	BR = 50-200m NBR ≥50m
Barn owl, *Tyto alba*	Low	Medium agreement Limited evidence	BR = 50-100m NBR ≥50m
Corncrake, *Crex*	Medium	Low agreement Limited evidence	BR ≥100m

Species	Likely sensitivity to disturbance	Quality of quantitative information (AD/FID)	Buffer zone (m) suggestions during the breeding (BR) and nonbreeding (NBR) seasons
European nightjar, *Caprimulgus europaeus*	Medium/High	Medium agreement Limited evidence	BR = 150-500m
Kingfisher, *Alcedo atthis*	Low/Medium	High agreement Limited evidence	BR and NBR = 50-100m
Crested tit, *Lophophanes cristatus*	Low	High agreement Limited evidence	BR and NBR = 10-50m
Crossbill species, *Loxia spp*	Low	Medium agreement Medium evidence	BR and NBR = 50-200m

* One or zero AD/FID record is available; degree of agreement is based on MAD records and/or non-quantitative information.

Species: Swans and geese

Whooper swan, *Cygnus cygnus*

Conservation Status

UK: Amber List, Schedule 1 European: Least Concern, Annex 1

UK status

Scarce Breeder, Winter Migrant

UK and Scottish population estimate

UK population = 28 breeding pairs, 19,500 individuals in winter (Woodward *et al*., 2020); Scottish population = 3-7 breeding pairs, 4,142 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+488%) over 25 years.

Range increases of 35% and 16% of overwintering birds have been identified in Britain and Ireland respectively, consistent with an increase in the Icelandic breeding population (Balmer *et al*., 2013).

AD/FID Quantitative disturbance distances

Whooper swan was not included in Ruddock and Whitfield (2007).

Breeding season (Whooper swan):

Surveyor walking in a rural habitat in Denmark: FID = 155m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID = 21.7m (n = 10) (Jiang and Møller, 2017).

Breeding season (Tundra swan, *Cygnus columbianus*, stand in species for Whooper swan):

Surveyor walking in Europe: FID = 78m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season (Whooper swan):

Surveyor walking in Europe: FID = 155m (n = 1) (Møller, 2008a).

Nonbreeding season (Tundra swan, *Cygnus columbianus*, stand in species for Whooper swan):

Surveyor walking in Europe: FID = 200m (n = 1) (Møller, 2008a).

MAD and/or Buffer zone Quantitative distances

No MAD or buffer zones available for Whooper swan.

Ecology and non-quantitative information on disturbance responses

The Icelandic population of whooper swan overwinters exclusively in Britain and Ireland (Balmer *et al*., 2013). The highest densities are widespread in lowland areas of Scotland, northern and eastern England as well as Ireland; in Scotland and northern England the main notable absence is in highland areas (Balmer *et al*., 2013). Whooper swans overwinter in wetland areas including shallow, reed-fringed inland waterbodies in amongst grasslands and heaths or surrounded by forests or reedbeds, rivers, estuaries and shallow marine areas (Snow and Perrins, 1998). This species feeds almost entirely on aquatic vegetation in fresh and saline waters, but when this is not available, whooper swans will also forage in stubble fields and arable crops; increasingly, birds forage in flood lands and other wetlands in late winter and early spring (Snow and Perrins, 1998). Very few birds breed in the UK, some records stem from injured birds, although confirmed records in Shetland and the Outer Hebrides could reflect an expansion in breeding range (Balmer *et al*., 2013).

Whooper swans are known to be sensitive to human presence and “demands immunity from disturbance” (Snow and Perrins, 1998); several studies have shown that this species increases the time spent vigilant when disturbed (Rees *et al*., 2005; Black and Rees, 1984; Brazil, 1981). In China, several factors may have contributed to the decline in the number of whooper swans present during the breeding season; as well as factors to do with climate and habitat change, factors such as hunting, increased disturbance from tourists and an increase in human development projects (e.g. highways, mining, hydroelectric dam and oil field exploitation) have all contributed to the decline in the whooper swan population (Ma and Cai, 2002). In Scotland, the majority of deaths are from human-related causes, many due to collisions with overhead wires; this species is also susceptible to lead poisoning by ingesting spent gunshot (Forrester *et al*., 2012). Overwintering whooper swans in Scotland are known to adapt their activity patterns and foraging locations in response to disturbance, for example disturbance from farmers and dogs have led to abandonment of foraging areas and displacement between fields (Brazil, 1981).

However, whooper swans can habituate to some types of human activity, especially if the source of disturbance is predictable. In a study at Rongcheng Lake in China, an important wintering ground for migratory birds, Liu *et al.*, (2018) found that overwintering whooper swans became less sensitive to human visitors feeding the birds as the daily disturbance frequency became higher or as the natural food supply depleted. In a similar study at the Black Cart floodplain in Scotland, Rees *et al*. (2005) found that the distance at which >5% of a flock of whooper swans became alert because of human activity decreased with the number of previous disturbance incidents in the day, indicating that the swans became less sensitive to disturbance events if daily disturbance frequency was high, although there was no evidence that habituation to disturbance persisted over long periods. Rees *et al*. (2005) also found that the time taken for the birds to resume undisturbed behaviour varied with the duration of the disturbance event, which in turn depended on the type of disturbance involved, with pedestrians alerting the birds for longer periods than vehicles and aircraft. Small numbers of whooper swans winter at Hogganfield Loch, Glasgow, where they join mute swans, ducks and geese that feed on bread and grain from the hand. Although whooper swans at this site are slightly less ‘tame’ than mute swans, they will come to within 1 m of people providing food (Bernie Zonfrillo, pers. comm.).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Nonbreeding season buffer zone = 200-600m

Whooper swan is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for whooper swan, but the maximum FID value recorded for this species when approached by a pedestrian is 155m during both the breeding and nonbreeding seasons.

In the UK, whooper swan has the potential to be disturbed on roosting and foraging grounds during the nonbreeding season. Due to the scarcity of breeding whooper swans in the UK, this species is unlikely to be encountered on breeding grounds by humans. There are no published buffer zones for whooper swan, but from studies on geese, a minimum buffer zone of 200-600m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Lack of studies measuring AD/FID for a range of sources of disturbance, and clear evidence that habituation can occur but apparently to very different extents at different sites.

White-fronted goose, *Anser albifrons*

Conservation Status

UK: Red List

European: Least Concern, Annex 1

UK status

Winter Migrant

UK and Scottish population estimate

UK white-fronted goose population = 0-1 breeding pairs, 14,000 individuals in winter (Woodward *et al*., 2020). Scottish population has declined since Forrester *et al*. (2012) estimated a wintering population of c.16,000 individuals.

UK long-term trend

The European subspecies (*albifrons*) breeding population has increased but distribution has shifted eastwards; winter population declines have been recorded at most sites in Britain although the range expanded by 36% between 1981/84 – 2007/11 (Balmer *et al.*, 2013). The Greenland subspecies (*flavirostris*) continues to show a long-term decline in breeding numbers, winter numbers in Britain have declined since a peak in 1998/99 (Balmer *et al.*, 2013; Forrester *et al.*, 2012).

AD/FID Quantitative disturbance distances

Greenland white-fronted goose was not included in Ruddock and Whitfield (2007).

Nonbreeding season (Greenland white-fronted goose):

Hunting in Denmark: Min/Max FID = 200 to 500m (n = 400 to 600) (Fox and Madsen, 1997).

Nonbreeding season (tule greater white-fronted goose, *Anser albifrons elgasi*, stand in species for Greenland white-fronted goose):

Pedestrian (general) in the USA: Mean FID = 47m (n = 6); Min/Max FID = 25 to 100 (Ackerman *et al*., 2004).

MAD and/or Buffer zone Quantitative distances

No MAD or buffer zone available for white-fronted goose.

Ecology and non-quantitative information on disturbance responses

Two subspecies of arctic breeding white-fronted goose overwinter in the UK; the European (*albifrons*) subspecies which breeds in Russia winters mainly in southern England and the Greenland-breeding (*flavirostris*) subspecies winters mainly in Ireland and western and northern Scotland (Balmer *et al*., 2013; Wernham *et al*., 2002). In Britain, Islay and the Severn Estuary are two important overwintering sites (Balmer *et al*., 2013). In Scotland, numbers have declined in recent years due to chronic low productivity in the Greenland population; small foraging flocks on traditional peatland sites have been lost, coincident with a shift towards managed grasslands (Balmer *et al*., 2013). In the UK, white fronted geese forage in lowland areas including grasslands, arable fields and wetlands (Snow and Perrins, 1998)

This species is considered sensitive to human disturbance (Fox and Stroud, 2002; Forrester *et al*., 2012). Stroud *et al*. (2012) identified aircraft/helicopters, human disturbance of roost sites, and deliberate and accidental human disturbance from farmland feeding sites as likely to cause significant local, but not population-scale, impacts on Greenland white-fronted geese.

There is anecdotal evidence suggesting that this species avoids human activity more than other geese; for example, the flock that winters at southeast Loch Lomond is rarely seen from local roads because it tends to frequent fields that are not visible from roads (Fox *et al*., 2012). In contrast to that anecdotal observation, statistical analysis of detailed survey data on habitat use by Greenland white-fronted geese wintering in Islay found a tendency for goose numbers to be higher closer to roads (Griffin *et al*., 2020). However, that was thought likely to be due to counting bias (increased detection of goose flocks close to roads from vehicles used for these surveys). There was a very clear effect of shooting disturbance on the time-energy budgets of Greenland white-fronted geese on Islay (Griffin *et al*., 2020). Effects were proportional to the distance from the disturbance and became detectable where shooting occurred within ca. 800 m from Greenland white-fronted goose flocks. Greenland white-fronted goose flocks disturbed by shooting were prone to flushing, and when not flushed tended to reduce feeding time and increase vigilance for 3-5 minutes after the event (Griffin *et al*., 2020). The effect of shooting disturbance on Greenland white-fronted goose behaviour was much more acute than other causes of disturbance such as road or farm vehicles or birds of prey. Nevertheless, road vehicles were responsible for the largest numbers of flushes of Greenland white-fronted geese in Islay (Griffin *et al*., 2020). Marksmen vehicles caused particular disturbance, presumably because the geese learned to associate them with shooting (Griffin *et al*., 2020). Norriss and Wilson (1988) showed that disturbance has been an important factor affecting rates of population change in Ireland, with flocks with a restricted feeding range being more likely to suffer local population declines as a result of disturbance. Therefore, quantifying and reducing human disturbance of wintering Greenland white-fronted geese is recommended in the species action framework (Urquhart *et al*., 2015).

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Limited evidence

Nonbreeding season buffer zone = 500-1000m

Greenland white-fronted goose is assessed to have a high sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for white-fronted goose, the maximum FID value recorded for this species when disturbed by hunting activities during the nonbreeding season is 500m.

In the UK, white-fronted goose has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season. There are no published buffer zones for white-fronted goose, but from other studies on geese, a minimum buffer zone of 500-1000m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

There are very few published studies measuring AD/FID for white-fronted goose. Disturbance distance studies are required for a range of human activity for this species.

Bean goose, *Anser fabalis*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Escaped Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 230 (Taiga) individuals in winter (Woodward *et al*., 2020); Scottish population = c.250 individuals in winter, 10-100 during passage (Forrester *et al*., 2012).

UK long-term trend

Decreased considerably since early 20th century. Possibly increased slightly 1981-84 to 2007-11, but some local losses too (Balmer *et al*., 2013). Numbers in Scotland (mainly at Slamannan) increased between 1978 and 2004 (Forrester *et al*., 2012).

AD/FID Quantitative disturbance distances

Bean goose was not included in Ruddock and Whitfield (2007).

Nonbreeding season:

Hunting in Denmark: Min/Max FID = 200 to 500m (Fox and Madsen, 1997).

MAD and/or Buffer zone Quantitative distances

No MAD or buffer zone available for bean goose.

Ecology and non-quantitative disturbance responses

In Britain, bean geese (mainly the subspecies Taiga bean goose, *Anser fabalis fabalis*) overwinter in small numbers; the main concentrated wintering areas are on the Slamannan Plateau, Stirlingshire and in the Yare Valley, Norfork (Balmer *et al*., 2013) after migrating from breeding grounds across Western Siberia to Scandinavia (Wernham *et al*., 2002). Outside these main winter areas, the wintering range includes Orkney, Shetland, northeast Scotland, East Anglia, southeast and northwest England, although these areas may support few birds or birds for short periods only (Balmer *et al*., 2013). Bean geese forage on arable land, rough pasture and marshy areas (Snow and Perrins, 1998; Thom, 1986), mostly close to the coast, but also at some marshy inland sites (Balmer *et al*., 2013).

Bean geese were once a common winter visitor to Scotland, but numbers have fallen greatly since the early 20th century, in part due to changes in agriculture and climate changes (Thom, 1986), but increased human disturbance may play a role in the decline (BCM Environmental Services Limited, 2011).

Bean geese may be susceptible to hunting disturbance, although protected, in appearance they look similar to pink-footed geese (Thom, 1986). There are very few studies available investigating disturbance distances in this species, the upper disturbance for hunting activities has been reported to be 500m (Fox and Madsen 1997).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Nonbreeding season buffer zone = 200-600m

Bean goose is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for bean goose, the maximum FID value recorded for this species when disturbed by hunting activities during the nonbreeding season is 500m.

In the UK, bean goose has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season. A minimum buffer zone of 200-600m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

There are very few published studies measuring AD/FID for bean goose. Disturbance distance studies are required for a range of human activity for this species.

Pink-footed goose, *Anser brachyrhychus*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Winter Migrant

UK and Scottish population estimate

UK population = 510,000 individuals in winter (Woodward *et al*., 2020);

Scottish population = 200,000 individuals in October, 100,000-150,000 individuals in winter/spring (Forrester *et al*., 2012).

UK long-term trend

There has been a strong increase in the winter population (Balmer *et al*., 2013). Population increased from 90,000 in 1981/84 to 360,000 in 2007/11 (Balmer *et al*., 2013) and this increased to 510,000 in 2015/16 (Woodward *et al*., 2020). The British range doubled in size between 1981/84 – 2007/11 (Balmer *et al*., 2013).

AD/FID Quantitative disturbance distances

Pink-footed goose was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Mean FID = 61m (n = 4); Min/Max FID = 43 to 78m (Díaz *et al*., 2021).

Surveyor walking in tundra habitat in Svalbard: Range of mean FID = 41.7 to 175.0m (n = 24) (Madsen *et al*., 2009).

Migratory season:

Hunting in a farmland habitat in Denmark: Range of mean FID decreased from 500 to 350m following the closure of the hunting season (Madsen, 1985).

Nonbreeding season:

Hunting in a nearshore habitat in Denmark: Min/Max FID = 350 to 500m (n = 400 to 600) (Fox and Madsen, 1997).

MAD and/or Buffer zone Quantitative distances Breeding season:

Surveyor walking in tundra habitat in Svalbard: Buffer zone = 1000m (Madsen *et al*., 2009).

Ecology and non-quantitative disturbance responses

Pink-footed geese breeding in Iceland and eastern Greenland, migrate almost exclusively to Britain to overwinter (Balmer *et al*., 2013). Large concentrations of feeding and roosting flocks are recorded along the east coast and central-eastern lowlands of Scotland, Solway Firth as well as in a broad band across England from Lincolnshire to Norfolk with the highest densities close to the coast (Balmer *et al*., 2013). In the spring, this species migrates north back to breeding grounds, flocks stage in central and northern Scotland which accounts for large numbers of nonbreeding records recorded in April and early May (Balmer *et al*., 2013). Pink-footed geese generally avoid upland areas, this species favours foraging areas on flat intensively farmed lowland areas (e.g. improved or fertilised grasslands, stubble fields, pastures and newly sown cereal fields) but will also feed on extensive areas of saltmarsh in estuaries (Balmer *et al*., 2013; Snow and Perrins, 1998).

Pink-footed geese are sensitive to disturbance (JNCC, 2012) and there is potential for disturbance at roost sites in the winter which may shift locally in response to disturbance (Mitchell and Hearn, 2004). Overwintering roost sites in the UK include estuaries, large lakes and reservoirs, usually close to feeding grounds (Snow and Perrins, 1998). In Scotland, favoured winter daytime roosting sites include estuarine mudflats, lochs and reservoirs (Forrester *et al*., 2007). On foraging grounds on arable fields, pink-footed geese are highly responsive to disturbance from surrounding roads (Gill *et al*., 1996). A paper reviewed by Korschgen and Dahlgren, (1992) recorded that pink-footed geese were disturbed at a distance of 500m when more than 20 cars per day used a road during autumn; it was also noted that as few as 10 cars per day affected habitat use by geese and a buffer zone of 500m was suggested to render habitat acceptable to flocks of pink-footed geese.

Mitchell and Hearn (2004) have found that the main determinant of roost choice is lack of human disturbance, especially hunting disturbance; other factors such as exposure, shoreline vegetation, including trees, and availability of grazing appear to be unimportant. Hunting is known to alter the distribution of pink-footed geese; in the major staging areas in Denmark, disturbance from hunting can result in the emigration of almost the entire population to the Netherlands within one day (see Väänänen, 2001 for review).

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone ≤1000m

Nonbreeding season buffer zone = 500-1000m

Pink-footed goose is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for pink-footed goose is 500m when disturbed by hunting activities during the nonbreeding season. The maximum FID value recorded during the breeding season is a mean of 175m when approached by a pedestrian. A buffer zone of 1000m has been reported to protect pink-footed geese from pedestrian disturbance.

In the UK, pink-footed goose has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. A buffer zone up to 1000m is suggested to protect nesting birds and a buffer zone of 500-1000m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

There are few published studies measuring AD/FID for pink-footed goose. Disturbance distance studies are required for a range of human activity for this species.

Greylag goose, *Anser*

Conservation Status

UK: Amber List, Schedule 1 – Part II

European: Least Concern

UK status

Introduced/Resident Breeder, Winter Migrant

UK and Scottish population estimate

UK population = 47,000 breeding pairs, 230,000 individuals in winter (Woodward *et al*., 2020); Scottish population = at least 25,000 native/naturalised birds present all year round, with a further 85,000+ arriving from Iceland to winter in Scotland in the early 2000s (Forrester *et al*., 2012), although that number of migrants has decreased in recent years.

UK long-term trend

Population has increased considerably between 1981/84 – 2007-11, much of the increase has been of the resident population (Balmer *et al*., 2013).

AD/FID Quantitative disturbance distances

Greylag goose was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Mean FID = 180m (n = 4); Min/Max FID = 180 to 180m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Norway: Mean FID = 12.4 (n = 24); Min/Max FID = 6 to 20m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Poland: FID = 77 (n = 1) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Poland: Mean FID = 50.8 (n = 2); Min/Max FID = 49 to 52.4m (Díaz *et al*., 2021).

Nonbreeding season:

Surveyor walking in a wetland habitat in Denmark: Range of mean FID = 171 to 230m (n = 7 to 24) (Bregnballe *et al*., 2009).

MAD and/or Buffer zone Quantitative distances

No MAD or buffer zone available for greylag goose.

Ecology and non-quantitative disturbance responses

Greylag geese are widespread in the UK both during the breeding and nonbreeding seasons; three populations occur in the UK (native Scottish, reintroduced and Icelandic populations) but ranges now overlap to such an extent that it is impossible to separate them (Balmer *et al*., 2013). The resident British/Irish greylag goose population is now widespread throughout England (except the southwest and in north and southwest Wales) and Scotland (except the uplands and northeast); resident birds are sedentary, breeding and nonbreeding distributions are similar (Balmer *et al*., 2013). Resident birds breed near wetlands and occasionally on ledges of steep rocky slopes and tall heather, especially in Scotland (Snow and Perrins, 1998).

The Icelandic greylag goose population breeds in Iceland and winters in Britain (with smaller numbers wintering in Ireland, Norway and the Faeroe Islands); the majority of Icelandic birds winter in Scotland particularly in Orkney, Caithness and in east-central Scotland, with smaller numbers in southern Scotland, England and Wales (Balmer *et al*., 2013; Wernham *et al*., 2002). All greylag geese prefer foraging areas on low-lying agricultural land (Balmer *et al*., 2013), but this species will also forage on grasslands as well as fresh or saline shallow water areas (Snow and Perrins, 1998). Greylag geese show a strong preference for large, open fields that offer a clear view of potential predators (Newton and Campbell, 1973) although smaller fields may be used during the winter (see Hearn and Mitchell, 2004 for review).

Greylag geese generally show more tolerance towards human disturbance compared with other geese species present in the UK; birds on breeding grounds, roosting sites and in foraging areas may tolerate some degree of disturbance (Díaz *et al*., 2021; Hearn and Mitchell, 2004). However, this species will move away from areas that have high levels of human activity such as roads and human habitation. Keller (1991), found that overwintering greylag geese were heavily impacted by roads; in northeast Scotland, birds were not found within 100m of the nearest road and the median distance was 400m. In the Netherlands, Feige *et al*. (2008) found that this species will not breed or forage within a minimum distance of 100m of human buildings.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 200-600m

Nonbreeding season buffer zone = 200-600m

Greylag goose is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for greylag goose when approached by a pedestrian is a mean of 180m during the breeding season and a mean of 230m during the nonbreeding season.

In the UK, greylag goose has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. There are no published buffer zones for greylag goose, but from other studies on geese, a minimum buffer zone of 200-600m is suggested to protect breeding and nonbreeding birds from pedestrian disturbance.

Knowledge gaps

There are few published studies measuring AD/FID for greylag goose. Disturbance distance studies are required for a range of human activity for this species.

Barnacle goose, *Branta leucopsis*

Conservation Status

UK: Amber List

European: Least Concern, Annex 1

UK status

Escaped Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 1,550 breeding pairs, 105,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 70,000 in winter (Forrester *et al*., 2012).

UK long-term trend

Prolonged increase in wintering numbers over recent decades (Balmer *et al*., 2013). The breeding range of the resident population has increased by 88% between 1988/91 – 2007/11; the growth of the Greenland population has also increased the number of overwintering birds (Balmer *et al*., 2013).

AD/FID Quantitative disturbance distances

Barnacle goose was not included in Ruddock and Whitfield (2007).

Breeding season (barnacle goose):

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 5 to 20.1m (n = 4) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 12.6m (n = 4) (Jiang and Møller, 2017).

Surveyor walking in tundra habitat in Svalbard: Range of Mean FID = 7.5 to 27.0m (n = 162) (Madsen *et al*., 2009).

Breeding season (brent goose, *Branta bernicla*, stand in species for barnacle goose):

Surveyor walking in a rural habitat in Denmark: FID = 20m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 23.5m (n = 6) (Jiang and Møller, 2017).

Nonbreeding season (brent goose):

Pedestrian (general) in a shoreline habitat in England: Min/Max AD = 23 to 150m (n = 45); Median FID = 51.5m; Min/Max FID = 5 to 178m (n = 89) (Liley *et al*., 2010).

MAD and/or Buffer zone Quantitative distances

No MAD or buffer zone available for barnacle goose.

Ecology and non-quantitative disturbance responses

Although small numbers of barnacle geese are resident in England and Wales, the majority of this species migrates from breeding grounds in Svalbard and Greenland to overwinter in the UK (Balmer *et al*., 2013; Wernham *et al*., 2002). The wintering populations of barnacle geese are widely distributed around the coasts, estuaries and wetland areas of the UK; birds recorded along the coast and islands of northwestern Scotland are largely from the Greenland-breeding population, whilst birds on the Solway Firth and on the east coast of Britain are largely from the Svalbard population (Balmer *et al*., 2013). Breeding and nonbreeding resident birds are more widely distributed and may also occupy inland areas, particularly in England (Balmer *et al*., 2013). This species feeds on grasslands grazed by farm animals or on autumn stubbles (Snow and Perrins, 1998), the overwintering migratory populations may feed in inland areas, but these are often within a few kilometres of their coastal wintering locations (Balmer *et al*., 2013).

Barnacle geese are regarded as vulnerable to human disturbance on breeding grounds (Madsen *et al*., 2009) as well as over hunting grounds during migration (Madsen and Fox, 1995). However, numbers of barnacle geese overwintering in the UK has increased rapidly over the last 40 years and this has resulted in conflict in agricultural areas (see Percival *et al*., 1997 for review). On Islay in Scotland, where approximately two-thirds of the East-Greenland breeding population overwinter, Percival *et al*. (1997) found that tactics to scare birds (e.g. people walking towards birds until they took flight, the use of gas guns and plastic tape) from an agricultural area, resulted in some birds moving towards undisturbed sites, but many individuals persisted in using the heavily disturbed sites, suggesting that some individuals and family groups have a high tolerance of disturbance on nonbreeding grounds.

Barnacle goose have become resident in parts of Sweden, including urban Stockholm. In this city barnacle geese live in public parks and feed on roadside verges and grass-covered roundabouts (Bob Furness pers. obs.). They show very little response to the presence of people, and have clearly habituated to this urban environment, illustrating the wide range of behavioural responses that are context-dependent.

Likely sensitivity to disturbance = Low/Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 50-200m

Nonbreeding season buffer zone = 50-200m

Barnacle goose is assessed to have a low to medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are limited for barnacle goose. The maximum FID value recorded for barnacle goose when approached by a pedestrian is a mean of 27m during the breeding season; for brent goose, the maximum FID is 178m during the nonbreeding season.

In the UK, barnacle goose has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. There are no published buffer zones for barnacle goose, but from the range of published FID values, a buffer zone of 50-200m is suggested to protect breeding and nonbreeding birds from pedestrian disturbance.

Knowledge gaps

There are few published studies measuring AD/FID for barnacle goose specifically. Disturbance distance studies are required for a range of human activity for this species.

Species: Ducks

Common shelduck, *Tadorna tadorna*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Migrant/Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = at least 7,850 breeding pairs, 51,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 1,750 breeding pairs, 7,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

The UK breeding range increased by 17% between 1981/84 – 2007/11, but the population increased only by 2% between 1995 – 2010; range increases are associated with the continued colonisation of inland breeding sites (Balmer *et al*., 2013). Increased winter ranges are consistent with breeding ranges, however, despite this, winter population trends in the UK and Ireland show shallow, steady declines since the mid-1990s (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Common shelduck was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 35 to 52m (n = 18), Min/Max FID = 18 to 70m (Díaz *et al*., 2021).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 178.4m (n = 22) (Dwyer, 2010).

Surveyor walking in Europe: Mean FID = 36.30m (n = 10) (Møller and Erritzøe, 2010).

Surveyor walking in Europe: Mean FID = 48.6m (n = 7) (Møller, 2008a).

Surveyor walking over mudflats in Denmark: Mean FID = 225m (n = 102), Min/Max FID = 55 to 700m (Laursen *et al*., 2005).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median AD = 50 (n = 3), Min/Max AD = 50 to 70m; Range of median FID = 40 to 62.5m (n = >6), Min/Max FID = 25 to 100m (Liley *et al*., 2011).

Pedestrian (general) along the shoreline in England: Median FID = 77.5m (n= 8), Min/Max FID = 50 to 140m (Liley *et al*., 2010).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Range of mean FID = 148 to 250m; Min/Max FID = 99 to 300m (Smit and Visser, 1993).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 220m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 400m (Laursen *et al*., 2017).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Pedestrian walking/running along footpaths or the presence of railways close to intertidal areas in England: Buffer zone = 100m, although a buffer zone of 200m may be needed to protect a mix of intertidal species (Burton *et al*., 2002a)

Ecology and non-quantitative information on disturbance responses

In the UK, shelducks are found in most coastal regions where there is suitable lowland habitat (e.g. estuaries, muddy shores and coastal marshes) (Balmer *et al*., 2013); this species also increasingly breeds at inland sites (e.g. farmland, lakes, reservoirs and pig fields), particularly those in northern, central and southern England (Balmer *et al*., 2013). Shelducks feed mainly on salt-water molluscs when by the coast, but this species will also feed on aquatic invertebrates and plant material (Snow and Perrins, 1998). Breeding and nonbreeding distributions are similar; the highest concentrations of breeding shelduck are recorded along the East Anglian coastline, the Lancashire and Cumbrian marshes, the Uists and Orkney, as well as the area inland of the Wash extending into the Fens and Breckland (Balmer *et al*., 2013). Shelduck is generally a hole nesting species, nests are commonly located in tree hollows up to 8m above ground and mammal holes (e.g. rabbits) are also used; more rarely, this species may nest on the ground in the open or in dense vegetation up to 1km away from water (Snow and Perrins, 1998). Shelducks breeding in the UK do not migrate to an overwintering area, but the majority (≥90%) do have a well-defined moult migration to the Helgoland Bight of the Wadden Sea (Wernham *et al*., 2002). The moult migration starts as early as mid-June with birds gradually returning to the UK during mid-winter; a small number of birds remain in the UK to moult (Wernham *et al*., 2002).

Shelducks are potentially vulnerable to human disturbance, particularly during the moulting period when birds are completely flightless and are therefore more vulnerable to disturbance and predation (Salomonsen, 1968). Shelduck moulting areas are usually situated in places where there is relatively little disturbance, such as difficult to access mudflats (e.g. Meininger and Snoek, 1992; Bryant and Leng, 1975). Disturbance may also impact shelduck on their winter foraging grounds, Burton *et al*. (2002a) indicated that shelduck counts were significantly lower on English estuarine count sectors that were closer to footpaths, after curlew, shelduck was the second species most likely to take flight when disturbed by walkers. Burton *et al*. (2002a) also found that numbers of shelduck were reduced on count sections within 100m of railways, furthermore, Burton *et al*. (2002b) found that construction work around Cardiff Bay tended to reduce the densities of shelduck, although this tendency was not statistically significant in their study.

Although shelduck is not a quarry species, hunting is one of the principal causes of mortality in fledged shelducks in Scotland (Forrester *et al*., 2012). Forrester *et al*., 2012 identified a gap in current knowledge relating to human disturbance and shelduck and posed the question of whether the increase in breeding shelduck at inland sites is in response to human disturbance in coastal areas.

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-400m

Nonbreeding season buffer zone = 100-400m

Common shelduck is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for common shelduck when approached by a pedestrian is 70m during the breeding season and 700m during the nonbreeding season, although generally FID values recorded during the nonbreeding season are less than 500m. For non-motorised watercraft, mean FID values up to 400m have been recorded during the nonbreeding season

In the UK, shelduck has the potential to be disturbed on breeding grounds as well as on moulting, foraging and roosting grounds during the nonbreeding season; as a hole nesting species shelduck may be less likely to be disturbed when on the nest. A buffer zone of 100-400m is suggested to protect both breeding and nonbreeding shelduck from pedestrian and boating disturbance, although a buffer zone at the lower end of this range may be sufficient to protect nesting birds during the breeding season.

Knowledge gaps

Further studies are required to record AD/FID during the breeding season. Limited information on buffer zones.

Mallard, *Anas platyrhynchos*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Introduced/Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = at least 61,000-145,000 breeding pairs, 675,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 17,000-43,000 breeding pairs, 65,000-90,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

The UK breeding population increased by 20% between 1995-2010, range increased by 2% and 8% in Britain and Ireland respectively between 1988/91 - 2007/11 (Balmer *et al*., 2013). In contrast, although the range of wintering UK birds is similar to the breeding season, the wintering population has declined by 39% since around 1990 which is likely due to a reduction in overwintering European breeding migrants (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Mallard was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Scotland: Mean FID = 20m (n = 3), Min/Max FID = 4 to 28m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Spain: Range of mean FID = 10.8 to 20m (n = 19), Min/Max FID = 0.7 to 30.1m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Spain: Range of mean FID = 2.8 to 12m (n = 16), Min/Max FID = 1.4 to 12m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in France: Range of mean FID = 4.8 to 8m (n = 40), Min/Max FID = 3 to 15m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in France: Range of mean FID = 2 to 7.5m (n = 98), Min/Max FID = 0 to 13m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Hungary: Range of mean FID = 4.8 to 17.9m (n = 15), Min/Max FID = 2.4 to 28.6m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Hungary: Range of mean FID = 3.4 to 3.8m (n = 16), Min/Max FID = 0.6 to 8.3m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Czech Republic: Mean FID = 56.5m (n = 4), Min/Max FID = 38 to 68m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Czech Republic: Range of mean FID = 1 to 14m (n = 25), Min/Max FID = 0 to 15m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 12 to 57m (n = 70), Min/Max FID = 4 to 75m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Denmark: Range of mean FID = 5 to 11.1m (n = 29), Min/Max FID = 2 to 19m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Norway: Range of mean FID = 8.5 to 11.9m (n = 18), Min/Max FID = 4 to 18m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Norway: Range of mean FID = 4.5 to 6.1m (n = 38), Min/Max FID = 2 to 8m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: Mean FID = 30m (n = 2) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Finland: Range of mean FID = 6.5 to 7.9m (n = 9), Min/Max FID = 2 to 16m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Poland: Range of mean FID = 6 to 88m (n = 22), Min/Max FID = 0.7 to 98m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Poland: Range of mean FID = 3 to 73.9m (n = 30), Min/Max FID = 0.5 to 16.1m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Estonia: Range of mean FID = 19.1 to 38.3m (n = 4), Min/Max FID = 11.3 to 38.3m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Estonia: Range of mean FID = 4.1 to 6m (n = 10), Min/Max FID = 0.8 to 7.5m (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID = 9.9m (n = 339) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 162.52m (n = 7) (Dwyer, 2010).

Surveyor walking in Europe: Mean FID = 13.42m (n = 89) (Møller and Erritzøe, 2010).

Surveyor walking in Europe: Mean FID = 14.60m (n = 77) (Møller, 2008a).

Surveyor walking over mudflats in Denmark: Mean FID = 236m (n = 25), Min/Max FID = 60 to 400m (Laursen *et al*., 2005).

Surveyor walking in wetlands in Denmark: Range of mean FID = 108 to 195m (n = 5 to 188) (Bregnballe *et al*., 2009).

Surveyor walking in a range of habitats in Australia: Mean FID = 12.8m (n = 3) (Weston *et al*., 2012).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Range of median FID = 30 to 40m (n = 3), Min/Max FID = 30 to 50m (Liley *et al*., 2011).

Pedestrian (general) along the shoreline in England: AD = 50 (n = 1); Median FID = 25m (n= 5), Min/Max FID = 10 to 50m (Liley *et al*., 2010).

Motorised watercraft (motorboat) in nearshore waters off Denmark: Mean FID = 110m (Laursen *et al*., 2017).

Motorised watercraft (motorboat) on a lake in Japan: Mean FID = 99.30m (n = 28) (Mori *et al*., 2001).

Non-motorised watercraft (inflatable boat) in nearshore waters off Denmark: Mean FID = 100m (Laursen *et al*., 2017).

Non-motorised watercraft (rowing boat) in nearshore waters off Denmark: Mean FID = 85m; Min/Max FID = 80 to 90m (Laursen *et al*., 2017).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 50m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 280m (Laursen *et al*., 2017).

Non-motorised watercraft (kite surfer) in nearshore waters off Denmark: Mean FID = 40m (Laursen *et al*., 2017).

Non-motorised watercraft (Sailing dinghy) on Brent Reservoir, England: Mean FID = 100m (Batten, 1977).

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Mean FID = 18m (Borgmann, 2012).

Drone (operated by a surveyor) in a zoo in France: Min/Max AD = 4 to 8m (n = 9); Min/Max FID = 4 to 8m (n = 4) (Vas *et al.,* 2015).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 27m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season (Mallard):

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Buffer zone = 83m (Borgmann, 2012).

Nonbreeding season (Groups of dabbling ducks, *Anas* sp. including gadwall, mallard and pintail):

Pedestrian leisure boats in a range of habitats and locations: Buffer zone = 108m (Borgmann, 2012).

Ecology and non-quantitative information on disturbance responses

Mallard is a common, widespread and adaptable resident species in the UK; its absence is only notable in mountainous areas and non-aquatic habitats (Balmer *et al*., 2013). In the UK, this species is sedentary or dispersive over short distances, distribution is similar in both the breeding and nonbreeding seasons; the highest densities are found in lowland aquatic areas (Balmer *et al*. 2013; Wernham *et al*., 2002). Mallards inhabit a wide range of aquatic environments, large or small, including standing or flowing freshwater, ponds, canals, irrigation networks, sewage farms, brackish estuaries and shallow sheltered coastlines (Snow and Perrins, 1998). The breeding season can be greatly prolonged for this species, ground nests are usually concealed by vegetation, but birds will also nest under boulders, inside hollow trees and on man-made structures - nest boxes and baskets are readily used (Snow and Perrins, 1998).

In the winter, resident mallards are joined by European breeders which migrate south and west to overwinter in areas that include the UK (Wernham *et al*., 2002). Mallards are omnivorous and opportunistic with a wide diet consuming both plant and animal matter depending upon location and season; food can be obtained from water by pecking and sieving, dabbling and upending and also by grazing on land like geese or wigeon (Forrester *et al*., 2012; Snow and Perrins, 1998). This species will readily consume bread and other items offered by humans.

Mallards are known to be tolerant of humans and have adapted well to human environments; this species is a common occurrence on garden ponds, park lakes and sewage farms (see Woodward *et al*., 2015 for review). This species can habituate to human activity, especially if the source of disturbance is predictable, such as frequently used navigation routes used by boats or areas close to harbours (Platteeuw and Henkins, 1997). Mallards were considered to be one of the most tolerant species towards disturbance from water-based recreational activities on inland waterbodies in England and Wales (Tuite *et al*., 1984). Mallards have been noted to have shorter FIDs in response to an approaching human compared to other dabbling ducks, suggesting that they are more tolerant than the other members of the same family (Mori *et al*., 2001).

However, despite this species renowned tolerance of humans, habituation to human disturbance does vary between habitats; Díaz *et al*., 2021 showed that mallard FID values in urban habitats are generally lower than FID in rural habitats where human activity is likely to be much lower. During the breeding season, especially early on during incubation, mallards are known to be disturbed by humans. A literature review by Sinnott (2000) noted that in Montana, breeding mallards were more sensitive to disturbance from pedestrians and cyclists than from vehicles. In Iowa, disturbance from surveyors monitoring the use of artificial nests has been shown to cause a 10% nest abandonment rate (see Korschgen and Dahlgren, 1992 for review). A paper review by Korschgen and Dahlgren (1992) also noted that breeding mallards may be sensitive to disturbance from fishing activity; in Germany, the breeding stock of ducks (including mallard) at two small ponds declined by 85% due to disturbance from anglers and at the Seney National Wildlife Refuge in Michigan, mallards fail to nest in areas open to fishing.

The distribution of overwintering mallards in the UK is known to be strongly influenced by the presence of anglers (Cryer *et al*., 1987); as anglers and wintering ducks are attracted to the same limited areas, human presence can cause feeding or roosting birds to leave the area prematurely (Bell and Austin, 1985) which may have a detrimental effect on energy intake and expenditure (Knapton *et al*., 2000). Wildfowling disturbance on estuaries in the UK is also known to redistribute mallards (Madsen, 1994; Hirons and Thomas, 1993) and this species may congregate in refuge areas during the hunting season (see Sinnott, 2000 for review).

Likely sensitivity to disturbance = Low/Medium

Quantitative information = High agreement & High evidence

Breeding season buffer zone = 50-100m

Nonbreeding season buffer zone ≥ 100m

Mallard is assessed to have a low to medium sensitivity to human disturbance.

The maximum FID value recorded for mallard is 98m when approached by a pedestrian during the breeding season, although generally FID values recorded during the breeding season are less than 50m. The maximum FID value recorded during the nonbreeding season is 400m when approached by a pedestrian, although generally FID values are less than 200m; for motorised watercraft mean FID values of c.100m have been recorded and a range of mean FID values between 18-280m have been recorded for non-motorised watercraft.

In the UK, mallard has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. A buffer zone of 50-100m is suggested to protect nesting birds and a buffer zone ≥ 100m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian and boating disturbance.

Knowledge gaps

Mallard is relatively well studied, although the AD/FID values recorded during the breeding season is limited to one study.

Gadwall, *Anas strepera*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Migrant/Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = at least 1,250-3,200 breeding pairs, 31,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 100-150 breeding pairs, fewer than 150 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

The British breeding population increased by 83% between 1995 – 2010 corresponding with a large range expansion; in Ireland this is still a scarce breeding species (Balmer *et al*., 2013). UK wintering numbers also increased by 312% between 1983/84 – 2008/09 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Gadwall was not included in Ruddock and Whitfield (2007).

Breeding season (Gadwall):

Surveyor walking in Europe: FID = 55m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season (Gadwall):

Pedestrian (general) along the shoreline in England: Min/Max FID = 50 to 60m (n= 2) (Liley *et al*., 2010).

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Mean FID = 65m (Borgmann, 2012).

Motorised watercraft (motorboat) on a lake in Japan: Mean FID = 64.5m (n = 19) (Mori *et al*., 2001).

Nonbreeding season (Groups of dabbling ducks, *Anas* sp. including gadwall, mallard and pintail):

Pedestrian leisure (general) in a range of habitats and locations: Mean FID = 100m (Borgmann, 2012).

Unknown season (Gadwall):

Surveyor walking around a lake in Pakistan: Mean FID = 20m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season (Gadwall):

Commercial vehicle/machine (construction activity in England): Buffer zone = 200m (Wallis *et al*., 2019).

Nonbreeding season (Groups of dabbling ducks, *Anas* sp. including gadwall, mallard and pintail):

Pedestrian leisure boats in a range of habitats and locations: Buffer zone = 108m (Borgmann, 2012).

Ecology and non-quantitative information on disturbance responses

Gadwall is a resident species in the UK but is largely absent across much of Scotland, except in eastern Scotland, the Uists and Orkney (Balmer *et al*., 2013). Much of the current UK breeding population of gadwall is descended from an original breeding stock of wild caught birds at Dersingham Decoy, Norfolk around 1850, since this time the population has spread and now extends throughout much of the lowlands of central, eastern and northwest England (Balmer *et al*., 2013). The preferred habitat of gadwall is in lowland wetland areas that have fairly shallow, standing or slow-flowing open water with cover in the form of emergent vegetation, dry banks and islands; eggs are laid on the ground in a nest that is formed of a slight hollow lined with vegetation (Snow and Perrins, 1998). The increase in the number of reservoirs and particularly gravel pits has aided the spread of this species in Britain (Balmer *et al*., 2013; Briggs *et al*., 2012).

After the breeding season, resident gadwalls are joined by winter migrants from Iceland and the near Continent; the distribution of UK birds is slightly wider during the nonbreeding season compared to the breeding season due to dispersal from natal grounds, more inland sites are used by overwintering birds (Balmer *et al*., 2013) and some passage birds pass through the UK to overwinter in France, Spain and the Mediterranean (Wernham *et al*., 2002). Gadwall is a herbivorous species feeding on aquatic plants, but birds will also occasionally graze on land and eat cereal grains (Snow and Perrins, 1998).

Gadwalls are potentially sensitive to human disturbance, especially in areas where there are high levels of recreational disturbance. In the Netherlands, Platteeuw and Henkins (1997) report that overwintering gadwall and shovelers will often fly away from recreational disturbance (including water sports, anglers and swimmers) “at several hundreds of meters”. A study in a national park the south-eastern Virginia which has a high level of human recreational disturbance indicated that out of seven species of dabbling ducks, gadwall was one of the species most sensitive to disturbance (Pease *et al*., 2005). These sorts of disturbance events can impact activity budgets as gadwalls will spend more time displaying alert activity in areas of disturbance rather than feeding or resting (Paulus, 1984). A study by Briggs *et al*. (2012) found that gadwall can alter their habitat use in response to disturbance; birds have been shown to adjust their site preferences and patterns of site use in response to human disturbance in the southwest London area and consistently avoid areas where there is a high level of disturbance (e.g. water-skiing).

However, gadwall response to human disturbance varies. Mori *et al*. (2001) found that gadwall responded to pedestrian approach at relatively short distances in single-species flocks compared with some other wildfowl species. Conomy *et al*. (1998) found that gadwall were generally not disturbed by aircraft activity in North Carolina.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-200m

Gadwall is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for gadwall when approached by a pedestrian is a mean of 55m during the breeding season and 60m during the nonbreeding season; for motorised and non-motorised watercraft, mean FID values of c.65m have been recorded during the nonbreeding season.

In the UK, gadwall has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. A minimum buffer zone of 100-200m is suggested to protect both breeding and nonbreeding gadwall from pedestrian and boating disturbance.

Knowledge gaps

Further studies are required to record AD/FID during the breeding season. Limited information on buffer zones.

Pintail, *Anas acuta*

Conservation Status

UK: Amber List, Schedule 1

European: Vulnerable

UK status

Resident/Migrant Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 27 breeding pairs, 20,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 20-30 breeding pairs, fewer than 4,000-4,500 (occasionally up to 9,000) individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a weak decrease in breeding birds (-45%) over 25 years.

The small UK breeding population decreased in range by 32% between 1968/72 – 2007/11, the number of confirmed breeding records has also declined (Balmer *et al*., 2013). In contrast, the wintering ranged increased by 34% between 1981/84 – 2007/11, this corresponds with a long-term increase in numbers wintering in Britain since the early 1970s, although there has been a decline since the mid-2000s which may be due to a shift in the core wintering range (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Pintail was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: FID = 34.8m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season:

Pedestrian (general) along the shoreline in England: FID = 100m (n = 1) (Liley *et al*., 2010).

Surveyor walking in a range of habitats Sir Lanka: Mean FID = 49.7 (n = 17); Min/Max FID = 20 to 82m (Gnanapragasam *et al*., 2021).

Nonbreeding season (Groups of dabbling ducks, *Anas* sp. including gadwall, mallard and pintail):

Pedestrian leisure (general) in a range of habitats and locations: Mean FID = 100m (Borgmann, 2012).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 25m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season (Groups of dabbling ducks, *Anas* sp. including gadwall, mallard and pintail):

Pedestrian leisure boats in a range of habitats and locations: Buffer zone = 108m (Borgmann, 2012).

Ecology and non-quantitative information on disturbance responses

Pintail is a rare and localised breeder in the UK, main breeding clusters are located in Orkney, North Uist, Tiree, East Anglian coast and the Ouse Washes with a few isolated records elsewhere (Balmer *et al*., 2013). This species breeds on lowland wetlands which may be on coastlines; the nest (a slight hollow lined with vegetation) is on the ground in short vegetational cover (Snow and Perrins, 1998).

Overwintering pintail in the UK, or those that pass through on migration, come from widely dispersed breeding grounds that include Iceland, Fennoscandia and the Baltic States (Wernham *et al*., 2002). In the UK, wintering pintails aggregate in large numbers at relatively few sites; the Burry Inlet, South Wales and the Welsh Dee Estuary are key sites (Balmer *et al*., 2013). Pintail is an omnivorous species feeding on a wide variety of plant and animal materials (Snow and Perrins, 1998) birds show a preference for feeding in estuaries as well as marshes, floodplains, sheltered coastlands and agricultural areas (Balmer *et al*., 2013). Unlike most ducks, pintail have more nocturnal habits and tend to forage in the evenings or at night and they spend much of the day resting or roosting.

Pintail is potentially sensitive to disturbance. Due to the aggregated distribution of this species, it is vulnerable to localised, stochastic events; recreation/tourism disturbance of staging and wintering pintail is considered of significance in several countries (European Commission, 2007a). Pintails are sensitive to hunting pressures. In Greece, hunting activity can cause mass displacement of ducks from the most important feeding areas; pintails and shovelers may completely stop feeding on shooting days (summarised in Madsen and Fox, 1995). Management of hunting disturbance can influence local distribution and abundance; in Denmark, the establishment of refuge areas where hunting is banned has increased pintail numbers. Maximum counts increased from less than 100 to over 4,000 pintail at a single site (Ulvshale Nyord) (Madsen 1998b).

However, pintails are known to tolerate some human presence. For example, at a study site in Iberia, this species feeds in rice paddies at night and commutes to an adjacent reservoir to roost during the day (Parejo *et al*., 2019). In comparison to other species of dabbling duck, pintail in some situations may have a higher tolerance of human disturbance; a study in a national park in south-eastern Virginia, which has a high level of human recreational disturbance, indicated that out of seven species of dabbling ducks (American black duck, gadwall, mallard, American wigeon, shoveler and green-winged teal), pintail was the least sensitive to disturbance (Pease *et al*., 2005). In another study at a national wildlife refuge in New Mexico, which has high levels of ecotourism, Taylor *et al*. (2019) found that behavioural response to human disturbance depended on the energy reserves of pintail; during a cold winter pintail did not show a significant energetic response to disturbance, therefore the authors suggested that under cold conditions, energy was conserved for short-term survival rather than used to respond to disturbance.

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-200m

Pintail is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for pintail when approached by a pedestrian is a mean of 35m during the breeding season and 100m during the nonbreeding season.

In the UK, pintail has potential to be disturbed on breeding grounds and foraging areas, although human disturbance is more likely on roosting grounds during the nonbreeding season. A minimum buffer zone of 100-200m is suggested to protect both breeding and nonbreeding pintail from pedestrian disturbance.

Knowledge gaps

Further studies are required to record AD/FID during the breeding season. Limited information on buffer zones.

Shoveler, *Anas clypeata*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Migrant Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,100 breeding pairs, 19,500 individuals in winter (Woodward *et al*., 2020); Scottish population = 260-390 breeding pairs, 400-750 individuals in winter, 1,100-1,600 individuals during passage (Forrester *et al*., 2012).

UK long-term trend

The overall range size increased by 36% between 1981/84 – 2007/11, the majority of these gains have been in Britain, particularly in Orkney (Balmer *et al*., 2013). Breeding numbers remained relatively stable between 1968/72 – 2007/11, some fluctuation in distribution is associated with availability of suitable breeding wetlands. Wintering numbers increased by 70% between 1983/84 -2008/09 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Shoveler was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: FID = 28m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season:

Pedestrian (general) along the shoreline in England: Min/Max AD = 30 to 150m (n= 2), Min/Max FID = 15 to 100m (n = 3) (Liley *et al*., 2010).

Motorised watercraft (motorboat) on a lake in Japan: Mean FID = 114.2m (n = 12) (Mori *et al*., 2001).

Nonbreeding season (Australasian shoveler, *Anas rhynchotis*, stand in species for Northern shoveler):

Surveyor walking in a range of habitats in Australia: FID = 19.2m (n = 1) (Weston *et al*., 2012).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 22m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Commercial vehicle/machine (construction activity in England): Buffer zone = 200m (Wallis *et al*., 2019).

Ecology and non-quantitative information on disturbance responses

Shovelers are relatively scarce and local breeders in the UK. This species is largely absent across much of Scotland, except in the central lowlands and in the Uists and Orkney (Balmer *et al*., 2013). Shovelers have a dispersed distribution in southern and eastern England, their preferred habitat is in lowland areas including floodplains, reservoirs and gravel pits with associated wetland areas and some coastal estuaries (Balmer *et al*., 2013; Briggs *et al*., 2012); key breeding sites include the Lower Derwent, Yorkshire and Ouse and Nene Washes (Balmer *et al*., 2013). This species is a ground nesting bird, often on grass or rushes close to water (Snow and Perrins, 1998).

Wintering shoveler ranges are similar to their breeding areas (Balmer *et al*., 2013). Birds wintering in the UK are likely to be a mix of some resident birds and continental breeders, although some UK breeding birds will migrate to overwinter off northwestern Europe and North Africa (Wernham *et al*., 2002).

High overwintering concentrations are found along major waterways such as the Severn Trent, Thames and Great Ouse (Balmer *et al*., 2013). Shovelers are omnivorous and have a specialised bill for filtering water to feed on plankton, molluscs, insects and plant matter (Snow and Perrins, 1998).

Shovelers are potentially vulnerable to human disturbance in their wetland breeding and wintering areas; this species has been shown to alter its habitat use in response to disturbance (Briggs *et al*., 2012). In a study in the southwest London area, Briggs *et al*. (2012) found that wintering shovelers inhabiting inland waterbodies avoided disturbed areas (e.g. those used for recreational watersports) and used alternative sites in the event of isolated disturbance events; shovelers in this area showed a preference for reservoirs with other areas of water nearby which may serve act as alternative refuges in the event of disturbance. Tuite *et al*. (1984) listed wintering shoveler as one of the wildfowl species more susceptible to disturbance from water-based recreational activities on inland waterbodies in England and Wales; the greatest disturbance can be caused by power boating, with coarse fishing, sailing and rowing also important. In the Netherlands, Platteeuw and Henkins (1997) report that overwintering shovelers and gadwall will often fly away from a disturbance event “at several hundreds of meters”. However, other studies suggest that shovelers may be less sensitive to disturbance than other species of duck, especially gadwall, which share similar habitats. Pease *et al*. (2005) found that shovelers showed a strong flight response to human disturbance (e.g. people walking, biking and vehicles), although this was likely because shovelers were often closest to the source of disturbance compared with other species of dabbling duck. A paper review by Korschgen and Dahlgren (1992) noted that breeding shovelers may be sensitive to disturbance from fishing activity; in Germany, the breeding stock of ducks (including shovelers) at two small ponds declined by 85% due to disturbance from anglers.

Shovelers are sensitive to hunting pressures. In Greece, shovelers and pintails may completely stop feeding on shooting days (summarised in Madsen and Fox, 1995) and in Denmark, the establishment of refuge areas where hunting is banned has almost doubled the autumn and winter national totals of shoveler and wigeon (Madsen, 1998b). Shovelers in Denmark usually leave early before the hunting season starts, but the creation of refuges has encouraged some birds to stay in the country for longer (Väänänen, 2001).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-200m

Shoveler is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for shoveler when approached by a pedestrian is a mean of 28m during the breeding season and 100m (AD = 150m) during the nonbreeding season. A mean FID value of 114m has been recorded for shoveler when approached by watercraft during the nonbreeding season.

In the UK, shoveler has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. A minimum buffer zone of 100-200m is suggested to protect both breeding and nonbreeding shoveler from pedestrian and boating disturbance.

Knowledge gaps

Further studies are required to record AD/FID during the breeding season. Limited information on buffer zones.

Eurasian wigeon, *Anas penelope*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 200 breeding pairs, 450,000 individuals in winter (Woodward *et al*., 2020); Scottish winter population = 76,000-96,000 individuals (Forrester *et al*., 2012). Scottish breeding population may have declined since Forrester *et al*. (2012) estimated 240-400 breeding pairs.

UK long-term trend

Changes in breeding distribution suggest a decline in the Scottish uplands and gains in the islands, but there is some uncertainty over changes in breeding numbers (Balmer *et al*., 2013). Winter range expanded by 27% in Britain between 1981/84 – 2007/11, in Ireland there has been a 6% increase in range despite reported declines in numbers since the mid-1990s (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Wigeon was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: Mean FID 9.5m (n = 3) (Jiang and Møller, 2017).

Surveyor walking in an urban habitat in Finland: Range of mean FID = 4 to 4.4m (n = 18), Min/Max FID = 1 to 9m (Díaz *et al*., 2021).

Nonbreeding season:

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median FID = 60m (n = 6), Min/Max FID = 50 to 100m (Liley *et al*., 2011).

Pedestrian (general) along the shoreline in England: Min/Max AD = 30 to 125m (n = 8); Median FID = 75.5m; Min/Max FID = 20 to 100m (n = 22) (Liley *et al*., 2010).

Surveyor walking in Denmark: Mean FID = 269m (n = 42), Min/Max FID = 150 to 1000m (Laursen *et al*., 2005).

Surveyor walking over mudflats in Scotland: Mean FID = 151m (n = 7) (Dwyer, 2010).

Surveyor walking in wetland habitat in Denmark: Range of mean FID = 117 to 205m (n = 5 to 26) (Bregnballe *et al*., 2009).

Surveyor walking in Sir Lanka: Mean FID = 41.5 (n = 2); Min/Max FID = 27 to 56m (Gnanapragasam *et al*., 2021).

Surveyor on motorboat on a lake in Japan: Mean FID = 67.7m (n = 38) (Mori *et al*., 2001).

Non-motorised watercraft (hunting punt) in Denmark: Mean FID = 100m

Non-motorised watercraft (fishing boat) in Denmark: Mean FID = 200m

Non-motorised watercraft (wind surfer) in Denmark: Mean FID = 700m

(Fox and Madsen, 1997).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 230m (Laursen *et al*., 2017).

Non-motorised watercraft (motorboat) in nearshore waters off Denmark: Mean FID = 250m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 500m (Laursen *et al*., 2017).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 36m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Pedestrian walking/running around Strangford Lough in Ireland: Buffer zone = 250m (Mathers *et al*., 2000).

Commercial vehicle/machine (construction activity in England): Buffer zone = 200m (Wallis *et al*., 2019).

Ecology and non-quantitative disturbance responses

In the UK, Eurasian wigeon is an uncommon and localised breeder on lowland freshwater areas; the main breeding areas are in northern Scotland (Fife to the eastern Highlands north to Sutherland and Caithness, the Northern Isles and the Uists), as well as in the Pennines in England (Balmer *et al*., 2013). This species breeds under the cover of coniferous or deciduous wooded areas, close to or potentially fairly distant from water (Snow and Perrins, 1998).

During the nonbreeding season, wigeons are much more widespread around the UK; resident breeders are joined by overwintering birds from Iceland, Fennoscandia and Russia and have a preference for coastal areas (Balmer *et al*., 2013). The highest concentrations of wintering wigeon are recorded in the Northern Isles, inner Moray Firth, parts of central Scotland, large river valleys and estuaries in southern and eastern England as well as lakes in the west midlands of Ireland (Balmer *et al*., 2013). During the nonbreeding season, wigeons generally roost on the coast close to feeding grounds. Wigeon are vegetarian feeding on a diet of leaves, stems and roots (Snow and Perrins, 1998). This species can feed both during the day and night; where the feeding grounds are subject to daytime disturbance the birds may spend the day on the roost (Owen and Williams, 1976).

In a study at Strangford Loch, North Eastern Ireland, Mathers *et al*. (2000) record that overwintering wigeons are sensitive to human disturbance (particularly walking pedestrians) while foraging which is limited by tidal patterns; the study concluded that disturbance could have contributed to the decline of wigeon in Strangford Loch, although it is probably not the only factor involved. Wigeons are vulnerable to hunting disturbance, Madsen and Fox (1995) report that mobile shooting punts can cause greater disturbance than stationary ones; wigeons disturbed for a second time by a mobile punt took 168 minutes to resume feeding whereas fishing boats caused 20 minutes of disturbance. As wigeons can spend most of the daylight hours foraging during the autumn and winter, Madsen and Fox, (1995) note that birds can lose up 25% of foraging time on days with repeated disturbance. On the Exe Estuary, Fox *et al*. (1993) noted that just one disturbance incident at the wrong time can deter birds from feeding until the next tidal cycle.

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 200-500m

Eurasian wigeon is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for wigeon when approached by a pedestrian is a mean of 9.5m during the breeding season and a mean of 269m (max FID = 1000m) during the nonbreeding season, although generally, mean FID values recorded for pedestrian disturbance are less 200m. Mean FID values recorded for wigeon when approached by watercraft during the non-breeding season range from 100 to 700m.

In the UK, wigeon has the potential to be disturbed on breeding grounds, although human disturbance is more likely on roosting and foraging grounds at the coast during the nonbreeding season. A buffer zone of 100-200m is suggested to protect nesting wigeon and a buffer zone of 200-500m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian and boating disturbance.

Knowledge gaps

Few studies specify habituation to disturbance when recording AD/FID during the nonbreeding season.

Greater scaup, *Aythya marila*

Conservation Status

UK: Red List; Schedule 1

European: Least Concern

UK status

Scarce Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 0-1 breeding pairs, 6,400 individuals in winter (Woodward *et al*., 2020); Scottish population = 4,000-8,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Scaup population has weakly declined since a massive decline in Scottish wintering population in 1970s (Balmer *et al*., 2013; Forrester *et al*., 2012). The winter range did expand by 57% between 1981/84 – 2007/11, but numbers in Britain have generally declined since 1970, although numbers in Northern Ireland have shown a large increase (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Greater scaup was not included in Ruddock and Whitfield (2007).

No AD/FID distance available for scaup

Breeding season (pochard, *Aythya ferina*, stand in species for scaup):

Surveyor walking in a rural habitat in Denmark: FID = 10m (n = 1) (Díaz *et al*., 2021).

Breeding season (tufted duck, *Aythya fuligula*, stand in species for scaup):

Surveyor walking in a rural habitat in Denmark: FID = 10.7m (n = 34), Min/Max FID = 8 to 14 (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: FID = 28m (n = 2), Min/Max FID = 26 to 30 (Díaz *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season (Scaup):

Surveyor walking around inland waterbodies in the USA: Mean MAD = 146.4m (Trulio and White, 2017).

Watercraft (recreational boating) along the Mississippi river in the USA: Buffer zone = 450m (Havera *et al*., 1992).

Ecology and non-quantitative disturbance responses

In the UK, greater scaup is a very scarce breeder. This species mainly breeds on Arctic and sub-Arctic tundra; the breeding range in Europe stretches from western Siberia through European Russia to northern Fennoscandia and Iceland (Balmer *et al*., 2013; Wernham *et al*., 2002). In the past there have been several breeding records in Scotland particularly in base-rich or brackish waters in Orkney and the Outer Hebrides, but none since at least 1989 (Forrester *et al*., 2012; Snow and Perrins, 1998). The last confirmed breeding record was in Ireland (Co. Armagh) in 1999 (Balmer *et al*., 2013).

In the nonbreeding season, greater scaup winter on shallow coastal waters generally less than 10m deep (especially in the vicinity of sewage outlets), as well as sheltered bays, estuaries and brackish waters; it can also be found inland on large lakes and reservoirs (Snow and Perrins, 1998). The greatest numbers of wintering birds are found along the coast of northern and western Britain as well as northeastern and southwestern Ireland, wintering strongholds include the Dee, the Solway Firth, Loch Ryan, Ayrshire coast, Islay, the Firth of Forth and the Moray Firth and Lough Neagh (Balmer *et al*., 2013). Scaup are omnivorous feeding predominantly on molluscs (Snow and Perrins, 1998) mainly at night and they tend to flock together to roost on the sea during the day (Marchowski *et al*., 2015; Rare Breeding Birds Panel, 2020a).

The number of wintering scaup in the EU underwent a very large decline (> 50%) between 1990-2000, the reasons for this decline are largely unknown, but human disturbance is suspected to be important (European Commission, 2009). Increased disturbance from recreational activities from 1990 onwards may have reduced the amount of available wintering habitats, especially daytime roosts (European Commission, 2009). In the UK, human disturbance has been identified as one of the key threats to this species (Furness, 2016) and scaup at sea have been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013). Mendel *et al*. (2008) has also identified scaup as highly sensitive to human disturbance and boat activity in coastal areas. During migration to and from breeding grounds, Knapton *et al*. (2000) found that mixed species flocks of diving ducks, including greater scaup, feeding on staging grounds at Lake Erie in North America, are frequently disturbed by human activity. Havera *et al*. (1992) suggest that during spring and autumn migration, minimum buffer zones of 450m should be used to protect rafting diving ducks from boating activity.

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Limited evidence

Nonbreeding season buffer zone = 150-450m

Scaup is assessed to have a high sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for greater scaup. Studies measuring FID on other *Aythya* species (pochard and tufted duck) suggest that flushing distance is relatively low (<50m) during the breeding season and a buffer zone of 450m has been reported to protect migrating scaup from watercraft disturbance.

In the UK, scaup has the potential to be disturbed on roosting and foraging grounds at the coast during the nonbreeding season. Due to the scarcity of breeding scaup in the UK, this species is unlikely to be encountered on breeding grounds by humans. A buffer zone of 150-450m is suggested to protect roosting and foraging scaup during the nonbreeding season from pedestrian and boating disturbance.

Knowledge gaps

Lack of studies providing AD/FID for a range of disturbance types during the nonbreeding season.

Common eider, *Somateria mollissima*

Conservation Status

UK: Amber List

European: Endangered

UK status

Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 37,000 breeding pairs, 86,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 20,000 nesting females, 64,500 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

The distribution of breeding eiders has changed in the UK over the last 50 years. The breeding population increased in northwest Wales, Morecambe Bay and the Isle of Man between 1968/72 – 2007/11; in Northern Ireland, the population was ten times greater between 1977 – 2009 (Balmer *et al*., 2013). However, in western Scotland and Shetland, the population size and range has decreased (possibly as a result of predation, conflict with mussel farms and oil-pollution); declines in breeding numbers have also been noted elsewhere in Europe (Balmer *et al*., 2013). The overall winter range size has remained largely unchanged between 1981/84 – 2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Common eider was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: Mean FID = 51.3m (n = 4) (Jiang and Møller, 2017).

Surveyor walking towards nest site in the Canadian Arctic: Mean FID = 16m (n = 69), Max FID = 70m (Mallory, 2016).

Nonbreeding season:

Motorised watercraft (high speed ferry service route) in the southern Kattegat Sea, Denmark: Min/Max FID = 0 to 1000m (n = 969) (Larsen and Laubek, 2005).

Motorised watercraft (large commercial fishing ship) in the German North Sea: Median FID = 208m (n = 154), Maximum FID = 3200m (Schwemmer *et al*., 2011).

Motorised watercraft (surveyor approaching moulting eiders in a motorboat) in nearshore waters around Norway: Mean AD = 330m (n = 48), Min/Max AD = 150 to 600; Mean FID = 177m (n = 48), Min/Max FID = 30 to 400m (Dehnhard *et al*., 2020).

Aircraft (helicopter) flying over males and nonbreeding females close to a gravel runway in the Canadian Arctic: Mead FID = 500m (Mallory, 2016).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Motorised watercraft (motorboat) around small offshore islands in Sweden: Buffer zone = 200m (Gotmark *et al.,* 1989).

Ecology and non-quantitative information on disturbance responses

Eiders are seaducks associated with marine habitats during both the breeding and nonbreeding seasons; UK breeding birds are at the southernmost edge of the species' Arctic range (Wernham *et al*., 2002). In the UK, breeding eiders are mainly recorded around the coast in northern areas including: most of Scotland, northern England, Isle of Man, North Wales and Northern Ireland (Balmer *et al*., 2013). This ground nesting species favours shoreline habitats and islands, but some birds are known to nest up to 3km inland (Snow and Perrins, 1998). The nest is composed of a slight hollow lined with available material, and large quantities of small feathers and down, and is often under the shelter of a rock or vegetation (Snow and Perrins, 1998).

Eiders in the UK are generally sedentary or disperse only short distances between breeding and nonbreeding grounds. During the nonbreeding season, birds located in eastern coastal areas may be joined by some overwintering continental eiders (Wernham *et al*., 2002). In the winter, eiders may be found around much of the coastline of Britain with the exception of the Solway Firth, Cardigan Bay and the Bristol Channel; the highest concentrations are to be found in northern areas (Balmer *et al*., 2013). All year round, eiders feed very close to the coast in water up to 3m deep, primarily on molluscs and crustaceans (Snow and Perrins, 1998), although this species roosts in open water away from feeding areas in shallow water (Merkel and Mosbech, 2008) where they are less likely to be disturbed.

Common eiders are able to habituate to some types of human activity (e.g. pedestrians and aircraft) and this species can tolerate relatively high levels of human disturbance. During the breeding season, incubating female eiders can sit tightly on the nest, for example, on Craigleith Island in Scotland, some females will allow pedestrian approach to within 1-2m before flushing, although other individuals will flush at a greater distance (Goodship 2021, *pers. obs.*). On the Mingan archipelago in Canada, Bolduc and Guillemette (2003) found that eider nesting success was not impacted by the frequency of human visitors, but the timing of visits was important to avoid exposing eggs to predators. In Norway, Stein and Ims (2016) have shown that the absence of eiders from nests due to human disturbance can increase egg predation risk by a factor of 6.42 for an increase of one additional daily disturbance. Bolduc and Guillemette (2003) suggested that researchers and wildlife managers should visit eider colonies as late as possible and avoid visiting colonies associated with high densities of eider egg predators. On Nasaruvaalik Island in the Canadian High Arctic, Mallory (2016) found that female eiders breeding next to a gravel runway allowed the wings of an aircraft to pass over them while still remaining on the nest. Dierschke *et al*. (2016) have found that the presence of offshore wind farms does not affect eider distribution.

However, boating activity, particularly boats that are moving quickly through eider foraging, roosting and moulting areas, have been shown to cause disturbance. In a study on wintering eider in southwest Greenland, Merkel *et al*. (2009) found that disturbance from boats could reduce foraging activity by up to 60% on a daily basis; eiders attempted to compensate for lost feeding opportunities by feeding more often, moving to sub-optimal foraging locations and switching to night-time feeding. Responses to boats may be especially strong in Greenland because this species is hunted from boats there. Jarrett *et al*., 2018 found that eider flight activity increases in the presence of marine activity including slow vessels/craft (including motorised and non-motorised boats for pleasure and commercial activities) and fast powerboats. The same authors found that eiders have a very low response rate within the 200-300m distance band from a passing ferry (eiders favour swim responses over flight or dive responses) and that the likelihood of eider flying away from passing ferries increased strongly in rougher sea states (Jarrett *et al*., 2018). In Norway, Dehnhard *et al*. (2020) found that boats disturbed moulting eiders resulting in displacement up to 771m; although most flocks returned to pre-disturbance behaviour within 10 mins after the disturbance event, the authors suggested that disturbance from boats increased locomotion costs, displacement from accessible foraging habitat and/or time lost for foraging or resting.

Likely sensitivity to disturbance = Medium/High

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 200-500m

Common eider is assessed to have a medium to high sensitivity to human disturbance.

FID values for eider are wide ranging. The maximum FID value recorded for eider is 70m when approached by a pedestrian during the breeding season and 3.2km when approached by a large commercial fishing boat during the nonbreeding season. For motorised watercraft in nearshore waters, a maximum FID of 400m has been recorded during the nonbreeding season. A buffer zone of 200m has been reported to protect breeding eider from watercraft disturbance.

In the UK, eider has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. A buffer zone of 100-200m is suggested to protect nesting eider and a buffer zone of 200-500m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance as well as disturbance from watercraft in nearshore waters.

Knowledge gaps

More studies required to record AD/FID during the breeding season and for pedestrian activity on the beach during the nonbreeding season.

Common scoter, *Melanitta nigra*

Conservation Status

UK; Red List; Schedule 1

European: Least Concern

UK status

Resident/Migrant Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 52 breeding pairs in Scotland, 135,000 individuals in winter (Woodward *et al*., 2020); Scottish winter population = 25,000-30,000 individuals (Forrester *et al*., 2012). Scottish breeding population has declined since Forrester *et al*. (2012) estimated 95 breeding pairs.

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (-22%) over 25 years.

Breeding numbers have decreased in Scotland and Ireland since 1995/1999. The breeding population in Northern Ireland became extinct in 1993 (Balmer *et al*., 2013). The winter range expanded by 39% in Britain and Ireland between 1981/84 and 2007/11.

AD/FID

Quantitative disturbance distances

FID update (Schwemmer *et al*., 2011) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Scotland: Min/Max FID (incubating female) =c.2 to 20m (Dr L. Griffin, pers. obs.).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 40 to 310m (n = 2); Min/Max AD (80% opinion range) = <10 to 500m; Min/Max AD (90% opinion range) = 300 to 500m.

Range of median FID = 5 to 125m (n = 3); Min/Max FID (80% opinion range) = <10 to 300m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Motorised watercraft (large commercial ship) in the German North Sea: Median FID = 804m (n = 210), Maximum FID = 3200m (Schwemmer *et al*., 2011).

Motorised watercraft (high speed ferry service route) in the southern Kattegat Sea, Denmark: Min/Max FID = 0 to 1000m (Larsen and Laubek, 2005).

MAD and/or

Buffer zone

Quantitative distances

No buffer zone update published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 300 to 800m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative disturbance responses

The majority of common scoters breed in tundra habitats near freshwater bodies (Snow and Perrins, 1998). In the UK, this species only breeds in Scotland, where it is restricted to the Flow Country of Caithness and Sutherland, larger lochs in Inverness-shire and Perthshire, and to a few scattered loughs in western Ireland (Balmer *et al*., 2013). Most breeding sites are in remote moorlands where birds nest on the ground in long heather at least 10m from the water's edge, but at Loch Lomond and on Islay this species breeds on wooded islands (Snow and Perrins, 1998; Thom, 1986). The diet of common scoter is mainly molluscs which are obtained by diving, but in fresh water habitats this species will also feed on aquatic insects and fish eggs as well as occasionally small fish and seeds (Snow and Perrins, 1998).

Due to the low numbers of breeding common scoters in Scotland and the remote habitats in which they are found, the potential for disturbance from human recreational activities during the breeding season is limited, however, connectivity of breeding sites for human access (by tracks and roads) and forestry activity around breeding lochs will increase the potential disturbance risk for this species. Common scoters are known to be strongly site faithful and may continue to attempt breeding at historical sites despite an increased risk of human disturbance (Robson, 2017).

Common scoters are considered to be sensitive to human disturbance during the breeding season, but the level of sensitivity of individual birds likely depends on the stage of the breeding cycle as well as exposure to and ability to cope with human presence; birds nesting in more remote areas may be more sensitive to disturbance. In breeding lochs in Scotland (west Inverness-shire, Perthshire and Islay), it has been noted that incubating female common scoters will mostly sit tight when approached by a surveyor (moving slowly and quietly) to a distance of c.2-5m, although females incubating at nests on islands or mainland heaths are sometimes more "jumpy" and will leave the nest when approached to within c.10-20m (L. Griffin, pers. comm.). Some individuals appear to be highly tolerant of human disturbance; in Islay, a common scoter has been noted to remain at the nest within 20-40m of noisy fishing and pedestrian activity (e.g. talking loudly, getting in and out of boats and picnicking activity), the same bird even allowed a surveyor to fit a camera at the nest and instead of flushing, pecked the surveyor on the hand (L. Griffin, pers. comm.).

The distance at which female common scoter will return to a nest also varies between individual birds. Generally, females will not return until people are at least c.100-200m distant from a nest, but this distance is greater if the nest is in a remote location. In areas where birds may be habituated to people, female common scoter will return to nests at shorter distances; for example, on an island in Loch Garry that is near a regular fishing/camping location and a fish farm jetty, females have been noted to return to nests within 50-70m, although they often access the island on the side away from the sight of people (L. Griffin, pers. comm.). Human activity taking place between foraging areas and nest sites may prolong common scoter returning to their nests. At Loch Gorm on Islay, it has been noted that boats present on the loch or people fishing from the shore may delay foraging common scoter on the loch from returning to their nest on the heathland. Birds disturbed in this way have been observed to fly over their nests but not land, or they may carry on feeding for longer until the source of disturbance has gone. However, the severity of this kind of disturbance is difficult to judge, as common scoter may forage for between one and six hours, and birds may not resettle on their nests even when there is no apparent source of disturbance (L. Griffin, pers. comm.).

Foraging and resting common scoter present on freshwater lochs have been noted to be relatively tolerant of human presence and tend to flush only if a boat approaches rapidly and straight at the birds or makes a sudden appearance from behind an island etc. Common scoters have been observed to continue foraging within c.50-300m of boats and anglers on the bank, but this distance depends on how loud the agents of disturbance are and whether or not the disturbance is from one or multiple directions (L. Griffin, pers. comm.). Common scoter further away may be inquisitive and are known to approach slow moving boats, but if bird watchers with scopes for example approach to within <100m, common scoters tend to gently move a bit further away by "swim-feeding" (L. Griffin, pers. comm.).

Outside the breeding season, common scoter is rarely seen on land. Although this species may use freshwater lakes on migration, the majority of birds moult and overwinter at sea. They are present around much of the UK coastline, although patchily distributed in western Scotland and northwest Ireland (Balmer *et al*., 2013). The highest wintering concentrations are recorded in the Moray Firth, the coast from Angus south to County Durham, off Norfolk, Carmarthen Bay and the Irish Sea and off the South West coast of Ireland (Balmer *et al*., 2013). During the winter, common scoters roost communally at sea; they also periodically loaf on water during the day and, rarely, on islets or sandbanks (Cramp and Simmons, 1977).

Due to their distance from land during the nonbreeding season, the potential for human recreation disturbance is limited. However, common scoter is known to be particularly sensitive to human activities in marine areas including through the disturbance effects of ship and helicopter traffic (Garthe and Hüppop, 2004; Schwemmer *et al.*, 2011; Furness *et al*., 2013; Furness and Wade, 2012; Bradbury *et al.,* 2014; Kaiser *et al*., 2006). Common scoter may flush from boats that are over 3km away (Schwemmer *et al.*, 2011) and this species is likely to be at risk of disturbance or displaced from habitats as a result of offshore wind turbines (Furness *et al*., 2013). Dierschke *et al*. (2016) reviewed all available evidence from operational offshore wind farms on the extent of displacement or attraction of seabirds in relation to these structures; a weak avoidance of offshore wind farms was noted for common scoter and velvet scoter (*Melanitta fusca*).

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 300-500m

Common scoter is assessed to have a high sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for common scoter, but the maximum FID value recorded for this species is 3.2km when approached by commercial shipping during the nonbreeding season. Although there are no official AD/FID values recorded for breeding common scoter, Dr Larry Griffin has personally noted that incubating female common scoter will flush from a nest when approached by a surveyor at a maximum approximate distance of 20m and that foraging birds on freshwater lochs will keep a maximum distance of 300m away from quiet boats and pedestrians. Ruddock and Whitfield (2007) recommended that a buffer zone of 300 to 500m would be required to prevent flushing from the nest during the breeding season.

Buffer zone to protect common scoter from forestry operations in the UK range from 300 to 800m during the breeding season.

In the UK, common scoter has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-500m is suggested to protect nesting common scoter during the breeding season from pedestrian and boating (on breeding lochs) disturbance. For activities with a high potential for visual and audial disturbance (e.g. forestry operations), a buffer zone ≤800m may be necessary. In marine areas during the nonbreeding season, a large buffer zone between 1 to 4km may be necessary to protect foraging and roosting birds from shipping disturbance.

Knowledge gaps

Lack of studies recording AD/FID during the breeding season.

Common goldeneye, *Bucephala clangula*

Conservation Status

UK: Red List; Schedule 1–Part II

European: Least Concern

UK status

Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 200 breeding pairs, 21,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 150 breeding pairs, 10,000-12,000 in winter (Forrester *et al*., 2012).

UK long-term trend

UK breeding numbers increased from 13 to 38 between 1988/91 – 2007/11 and included colonisation of Perthshire and Aberdeenshire (Balmer *et al*., 2013). Wintering numbers have remained relatively stable between 1981/84–2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021; Laursen *et al*., 2017; Borgmann, 2012; Liley *et al*., 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Norway: FID = 18m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Norway: Mean FID = 10.4m (n = 5); Min/Max FID = 6 to 22m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: FID = 40m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Finland: FID = 4m (n = 1) (Díaz *et al*., 2021).

Surveyor walking up to a nest box in Canada: Min/Max FID = 0.1 to <16m (Mallory *et al*., 1998).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 5 to 125m (n = 4 to 5); Min/Max AD (80% opinion range) = <10 to 300m; Min/Max AD (90% opinion range) = 150 to 300m.

Range of median FID = 5 to 75m (n = 5 to 8); Min/Max FID (80% opinion range) = <10 to 150m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Pedestrian (general) along the shoreline in England: Min/Max AD = 75 to 100m (n = 3); Min/Max FID = 75 to 150m (n = 4) (Liley *et al*., 2010).

Pedestrian walking/running on Cannock Reservoir, England: Min/Max FID = 100 to 200m (Hume, 1976).

Non-motorised watercraft (sailing boat) on Cannock Reservoir, England: Min/Max FID = 350 to 400m (Hume, 1976).

Non-motorised watercraft (Sailing dinghy) on Brent Reservoir, England: Min/Max FID = 300 to 400m (Batten, 1977).

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Mean FID = 37m (Borgmann, 2012).

Non-motorised watercraft (sailing dinghy) in nearshore waters off Denmark: Min/Max FID = 300 to 400m

Non-motorised watercraft (rowing boat) in nearshore waters off Denmark: Mean FID = 360m

Non-motorised watercraft (sailing boat) in nearshore waters off Denmark: Mean FID = 360m

Non-motorised watercraft (kite surfer) in nearshore waters off Denmark: Mean FID = 740m

Motorised watercraft (motorboat) in nearshore waters off Denmark: Mean FID =640m

Motorised watercraft (jet-ski) in nearshore waters off Denmark: Mean FID = 765m, Min/Max FID = 700 to 830m

(Laursen *et al*., 2017).

Motorised watercraft (motorboat) on Cannock Reservoir, England: Min/Max FID = 550 to 700m (Hume, 1976).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Borgmann, 2012) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian (general): Buffer zone around active nests = 100-150m (Ruddock and Whitfield, 2007).

Forestry operations in the UK: Safe working distance = 150 to 300m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Nonbreeding:

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Buffer zone = 163m (Borgmann, 2012).

Ecology and non-quantitative disturbance responses

In Scotland, confirmed goldeneye breeding records are concentrated in Strathspey, Great Glen, River Dee and around Loch Tay; in England, confirmed breeding has been recorded in Northumberland and Avon (Balmer *et al*., 2013).

Goldeneye is a cavity nesting species with a preference for habitats around freshwater lakes, pools, rivers and deep marshes; this species will readily breed in nest boxes (Snow and Perrins, 1998; Dennis and Dow, 1984; Mallory and Weatherhead, 1993; Mallory *et al*., 1998). This species feeds during the daytime primarily on molluscs, crustaceans and insect larvae depending upon locality and season (Snow and Perrins, 1998). During the breeding season goldeneyes exhibit relatively low to moderate flushing distances in response to human disturbance, likely in part due to the lack of visual stimuli inside cavities (Ruddock and Whitfield, 2007; Mallory and Weatherhead, 1993; Mallory *et al*., 1998). In a study in Canada investigating female goldeneye nest defence, Mallory *et al*. (1998) found that 43% of female goldeneyes waited until the observer was on the tree before flushing and that this species flushed at closer distances as incubation proceeded. In Europe, Díaz *et al*. (2021) recorded low flushing distances (4 to 40m) in response to disturbance from a surveyor walking in the breeding season.

In the nonbreeding season, resident breeding goldeneye are joined by overwintering birds from Fennoscandia and Russian breeding grounds; they have a preference for coastal areas and a wide variety of freshwater habitats (Balmer *et al*., 2013). This species is widely distributed throughout Scotland and northern England with the exception of some upland areas; further south, winter distribution is patchy and focussed on suitable coastal areas, river valleys and wetland habitats (Balmer *et al*., 2013), they may also be found in the vicinity of sewage outfalls (Campbell and Milne, 1977). Goldeneye can be a gregarious flocking species, congregating at communal roost sites overnight (Snow and Perrins, 1998). Separate to their feeding grounds, goldeneyes roost on open water at the coast, on standing water or on rivers (Duncan and Marquiss, 1993). In some foraging and roosting areas goldeneye may be susceptible to human disturbance, especially from water-based leisure activities such as fishing and boating (e.g. Laursen *et al*., 2017; Tuite *et al*., 1984; Holloway, 1997; Hume, 1976; Campbell and Milne, 1977); disturbance from motorised watercraft can cause goldeneyes to flush over 800m away (Laursen *et al*., 2017). Goldeneye can also be sensitive to hunting pressures particularly during the winter when food may be scarce; in Ireland Evans and Day (2002) recorded that goldeneye moved away from the disturbed shorelines of Lough Neagh where hunting took place to central, relatively less disturbed areas of the Lough. In the Netherlands, Platteeuw and Henkins, 1997 considered goldeneye to be a particularly shy species, although goldeneye are generally not found in areas with high densities of recreation. However, not all wintering grounds are disturbed by human activity; in Orkney, goldeneye is largely present in very sheltered areas and inland lochs where marine activity is unlikely and therefore this species rarely comes into contact with marine activity in Orkney (Jarrett *et al*., 2018).

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Medium evidence

Breeding season buffer zone = 100-150m

Nonbreeding season buffer zone = 150-800m

Common goldeneye is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for goldeneye when approached by a pedestrian is 40m during the breeding season and 200m during the nonbreeding season. For non-motorised watercraft mean FID values ranging between 37 to 740m have been recorded and mean FID values between 640 to 765m (max FID = 830m) have been recorded for motorised watercraft.

There are few suggested buffer zones for goldeneye. Ruddock and Whitfield (2007) suggested that a buffer zone of 100 to 150m would be required to prevent flushing from the nest during the breeding season. In the nonbreeding season, Borgmann, (2012) suggested a buffer zone of 163m to protect birds from non-motorised watercraft disturbance, but a larger buffer zone may be required for noisy activities in heavily disturbed areas.

In the UK, goldeneye has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; as a hole nesting species, goldeneye may be less likely to be disturbed when on the nest. A buffer zone of 100-150m is suggested to protect nesting goldeneye and a buffer zone of 150-800m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian and boating disturbance.

Knowledge gaps

More studies required to record AD/FID during the breeding season and for pedestrian activity on the beach during the nonbreeding season.

Species: Grouse

Capercaillie, *Tetrao urogallus*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern, Annex 1

UK status

Re-introduced Breeder

UK and Scottish population estimate

Scottish population only = 1,100 individuals in winter (Woodward *et al*., 2020); Forrester *et al*. (2012) suggest 300 lekking males in early 2000s, and a winter population of 1,300 to 2,800 individuals.

UK long-term trend

Eaton *et al*. (2021) state a strong decrease in breeding birds (-49%) over 22 years.

There was a 55% decrease in the number of occupied 10 km squares between 1981-84 and 2008-11 (Balmer *et al*., 2013). The population declined from about 20,000 birds in the 1970s, but declines have been partially mitigated in some areas by predator control and removal of fences on which collisions were occurring (Forrester *et al*., 2012).

AD/FID

Quantitative disturbance distances

FID update (Jiang and Møller, 2017; Thiel *et al*., 2007; Catt *et al*., 1998) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: FID 77.5m (n = 1) (Jiang and Møller, 2017).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD for nesting females = 75m (n = 15); Min/Max AD (80% opinion range) = <10 to 150m; Min/Max AD (90% opinion range) = 100 to 150m.

Range of median FID for nesting females = 5 to 30m (n = 16); Min/Max FID (80% opinion range) = <10 to 100m.

Median AD for lekking males = 125m (n = 9); Min/Max AD (80% opinion range) = 100 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Median FID for lekking males = 75m (n = 7); Min/Max FID (80% opinion range) = 50 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Pedestrian (general) in a forest habitat in Europe: Mean FID = 27m (n = 752); Min/Max FID = 1 to 104m (Thiel *et al*., 2007).

Surveyor walking in a forest habitat in Scotland: Mean FID for males = 46m (n = 39)

Surveyor walking in a forest habitat in Scotland: Mean FID for females = 30m (n = 35)

(Catt *et al*., 1998).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Coppes *et al*., 2017; Thiel *et al*., 2007) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian leisure activity in forest land in Germany: Buffer zone = 800m (Coppes *et al*., 2017).

Forestry operations and recreational activities in Scotland:

Buffer zone for nests and broods = 100m

Forestry operations and recreational activities in Scotland:

Buffer zone for leks = 1000m

Buffer zone around leks for stalkers = 500 to 1000m (Kortland, 2006).

Forestry operations in the UK: Safe working distance = 200 to 800m (Currie and Elliot, 1997).

Forestry operations in Scotland: Safe working distance = 200 to 1000m (Forestry Commission Scotland, 2006).

Nonbreeding season:

Pedestrian (general) in a forest habitat in Europe: Buffer zone = 100m (Thiel *et al*., 2007).

Pedestrian leisure activity in forest land in Germany: Buffer zone = 800m (Coppes *et al*., 2017).

Ecology and non-quantitative disturbance responses

Capercaillie is a resident upland woodland species confined to pine forests in the north of Scotland (Balmer *et al*., 2013; Forrester *et al*., 2012). The main areas for this species include Easter Ross, Strathspey and Aberdeenshire, with only a few occupied sites outside of these areas; birds are largely sedentary, breeding and nonbreeding distribution ranges are similar (Balmer *et al*., 2013). Individual capercaillie normally use the same areas of summer and winter habitat in the same forest each year (Kortland, 2006). Mature conifer forests are typically used, especially Scots pine, open enough to support ground vegetation rich in dwarf shrubs (Forrester *et al*., 2012). Capercaillie is generally a ground nesting species, feeding on the ground in summer and mainly in the crowns of trees during winter (Snow and Perrins, 1998). Adults feed on plants including leaves, needles, stems, berries, mosses and rushes depending on the season; young chicks feed mostly on insects and spiders (Snow and Perrins, 1998). In winter, capercaillie live mostly in trees and eat conifer needles (Kortland, 2006).

Capercaillie populations in Scotland have declined significantly in the last 40 years. Reasons for the decline include loss of suitable habitat, unfavourable woodland management, climate change, predation, collisions with deer fences as well as disturbance (Kortland, 2006).

There is an increasing body of research that indicates that capercaillie stay away from areas where there is human activity. For example, in a study in the Spey valley in Scotland, Moss *et al*. (2014) investigated the impacts of human disturbance on capercaillie through the distribution of their droppings in relation to woodland tracks and entrances; droppings were found to be sparser within 300 to 800m of entrances and 70 to 235m of tracks, depending on track use and habitat. Moss *et al*. (2014) estimated that disturbance along the tracks deterred capercaillie from a belt of ground at least 140m wide and up to 470m long where people and dogs strayed off tracks. In another study by Summers *et al*. (2007) in the Cairngorms National Park, capercaillie avoided areas within 61 to 108m of public access tracks, the range being dependent on the level of pedestrian activity along the track. Capercaillie consistently disturbed away from foraging grounds may have fat reserves to survive only nine days (Hissa *et al*. (2003)). Kortland (2006) states that capercaillie can become habituated to predictable disturbance and will use habitat within 100m of tracks provided there is abundant screening and if walkers remain on the tracks; Kortland (2006) also states that if people or their dogs wander off tracks, capercaillie will stop using the areas where this happens.

The Capercaillie Biodiversity Action Plan Group (CBAPG) is responsible for implementing the Species Action Plan for Capercaillie on behalf of the UK Biodiversity Partnership. The current forest management for capercaillie builds on the Capercaillie Life project, which ran from 2002-2007 (Kortland, 2006). As recommended in Ruddock and Whitfield (2007), the guidance and management plans provided by the CBAPG should be followed in the UK. For survey work, NatureScot's guidance on capercaillie survey methods should be followed (NatureScot, 2013).

Likely sensitivity to disturbance = Medium/High

Quantitative information = Medium agreement & Medium evidence

Breeding season (Nesting females) buffer zone = 100m

Breeding season (Lekking males) buffer zone = 500-1000m

Nonbreeding season buffer zone = 100m

Capercaillie is assessed to have a medium to high sensitivity to human disturbance.

The maximum FID value recorded for capercaillie when approached by a pedestrian is a mean of 77.5m during the breeding season and a mean of 46m (max FID = 104m) during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for capercaillie during the breeding season is 100-150m for nesting females and 500-750m for lekking males. Buffer zones to protect capercaillie during the breeding season from pedestrian activity and forestry operations range from 800 to 1000m; during the nonbreeding season, buffer zones range from 100 to 800m.

The data presented in this report are broadly consistent with the buffer recommendations detailed in the forest management guide for capercaillie issued by the CBAPG. The CBAPG recommends that forestry operations and known recreational activities etc should be avoided within 1km of lek sites between 1 March and 15 May. Deer control work is acceptable within 1km of leks between 1 March and 15 May, however, stalkers must stay at least 500m from lek sites between 4am and 9am. An exclusion zone of 100m must be used to prevent disturbance to nests and broods. Pedestrian disturbance must be avoided within 100m from tracks when passing though capercaillie habitat.

In the UK, capercaillie has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season. The CBAPG recommends that a buffer zone of 500-1000m is used to protect leks and a buffer zone of 100m is used to protect nesting females to avoid pedestrian disturbance during the breeding season. Pedestrians should stick to paths when walking though capercaillie habitat at all times of the year and it is suggested that capercaillie habitat should not be disturbed within 100m.

Knowledge gaps

Lack of studies measuring AD/FID for pedestrian activity during the nonbreeding season.

Black grouse, *Tetrao tetrix*

Conservation Status

UK: Red List

European: Least Concern

UK status

Resident Breeder

UK and Scottish population estimate

UK population = 4,850 lekking males (Woodward *et al*., 2020); Scottish winter population = 7,500-19,000 individuals (Forrester *et al*., 2012). Forrester *et al*. (2012) estimated the Scottish population to be between 3,550-5,750 lekking males in the early 2000s, but population may have declined since that publication.

UK long-term trend

Declining in recent decades, especially latter part of 20th century, and range contracting; a 29% contraction in breeding range occurred between 1968/72 – 2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021; Jiang and Møller, 2017; Schranz, 2009) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in the Ukraine: Mean FID = 24.3m (n = 6);

Min/Max FID = 20 to 28m (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 24.3m (n = 6) (Jiang and Møller, 2017).

Surveyor walking over moorland in England: Range of mean FID = 74 to 86m (n = 44); Min/Max FID = 62 to 101m (Baines and Richardson, 2007).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD for nesting females = 5 to 75m (n = 8 to 11); Min/Max AD (80% opinion range) = <10 to 150m; Min/Max AD (90% opinion range) = 100 to 150m.

Range of median FID for nesting females = 5 to 30m (n = 8 to 11); Min/Max FID (80% opinion range) = <10 to 100m.

Median AD for lekking males = 225m (n = 17); Min/Max AD (80% opinion range) = 100 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Median FID for lekking males = 225m (n = 17); Min/Max FID (80% opinion range) = 50 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Surveyor walking over moorland in England: Range of mean FID = 17 to 88m (n = 107); Min/Max FID = 7 to 106m (Baines and Richardson, 2007).

Surveyor skiing in an alpine habitat in Switzerland:

Range of mean FID for males= 11.5 to 12m (n = 171); Min/Max FID = 1 to 80m

Range of mean FID for females= 8.1 to 11.3m (n = 77); Min/Max FID = 1 to 60m

(Schranz, 2009).

Pedestrian leisure activity (skiing and snow ploughs) in an alpine habitat in Bavaria:

Range of FID for black grouse under cover = <10 to 30m.

Range of FID for black grouse in the open = >30 to 100m.

(Zeitler, 2000)

MAD and/or

Buffer zone

Quantitative distances

Buffer zone updates (Arlettaz *et al*., 2013; Schranz, 2009) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 300 to 1000m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Nonbreeding season:

Pedestrian leisure (winter sports) in alpine habitats in Switzerland: Buffer zone = 120m (Arlettaz *et al*., 2013; Schranz, 2009).

Ecology and non-quantitative disturbance responses

Black grouse is a resident species in upland areas of Britain where it shows a preference for young plantations on moorlands, marginal farmland and woodland edges; as plantations mature, this habitat becomes less suitable and this may result in losses (Balmer *et al*., 2013). The highest abundance of this species has been recorded in upland areas of northern and central Scotland, the Southern Uplands, the Pennines and North Wales; birds are largely sedentary, and breeding and nonbreeding distribution ranges are similar (Balmer *et al*., 2013). Black grouse is generally a ground nesting species which feeds predominantly on plants; the main foods include buds, needles, pinecones, dwarf shrubs, grasses and berries, depending upon location and season (Snow and Perrins, 1998).

Disturbance caused by human recreational activities are considered to be a serious threat to grouse in central Europe (Storch, 2000). Disturbance in black grouse habitats can cause behavioural changes in the short-term and longer-term changes, in habitat use, spatial distribution and extinction of local populations (Storch, 2000; Zeitler 2000).

There is a growing body of evidence to show that recreational winter sports in the Alps causes disturbance to black grouse (Arlettaz *et al*., 2013; Schranz, 2009; Zeitler, 2000; Laiolo and Rolando, 2005; Baltic, 2005, Baltic *et al*., 2005). Zeitler found that black grouse kept distances of at least 150m away from new sources of disturbance such as newly operating snow generators and ski runs active outside the normal operational period. Under the cover of spruce or dwarf pines, Zeilter (2000) also found that this species can tolerate disturbances that occur within normal spatial and temporal patterns, but outside in the open, birds are more easily disturbed. Arlettaz *et al*. (2013) found that even moderate levels of disturbance, such as that caused by off-piste skiing activity, are enough to elicit a chronic stress response in black grouse. Compared with capercaillie, black grouse is a smaller species and may be more vulnerable to the risk of starvation if continually disturbed in foraging areas (Baltic *et al*., 2005; Hissa *et al*., 2003). Baines and Richardson (2007) highlight that access restrictions to wintering grounds where large numbers of birds regularly concentrate should be considered.

Flushing distance to disturbance varies depending on the time of year (Baines and Richardson, 2007). In the breeding season, lekking males are more vulnerable to disturbance compared with females on nests (Ruddock and Whitfield 2007; Storch, 2000). Because of the greater risk of disturbance at lek sites and the negative consequences for reproduction, ecotourism at grouse leks needs to be carefully managed (Storch, 2000). Baines and Richardson (2007) recommend that at black grouse breeding areas dogs should be kept on leads from April to August and viewing facilities should be provided for birdwatchers at leks.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season (Nesting females) buffer zone = 100-150m

Breeding season (Lekking males) buffer zone = 500-750m

Nonbreeding season buffer zone = 100-150m

Black grouse is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for black grouse when approached by a pedestrian is 101m during the breeding season and up to 100m during the nonbreeding season; FID values up to 100m have been recorded for disturbance from skiers and snow ploughs during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for black grouse during the breeding season is 100-150m for nesting females and 500-750m for lekking males.

Buffer zones to protect black grouse from forestry operations in the UK range from 300 to1000m during the breeding season. A buffer zone of 120m has been recommended to protect black grouse from pedestrian disturbance in Switzerland during the nonbreeding season.

In the UK, black grouse has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season.

Depending on the level of habituation to disturbance, buffer zones of 100-150m for nesting females and 500-750m for lekking males (considered to be the upper disturbance limits estimated by expert opinion (Ruddock and Whitfield, 2007)) are suggested to protect breeding birds from pedestrian disturbance. For forestry activities, buffer zones up to 1000m may be necessary during the breeding season. Buffer zones required to protect nonbreeding birds may be lower, a buffer zone of 100-150m is suggested to protect nonbreeding birds from pedestrian disturbance. For survey work, the monitoring methods presented in Gilbert *et al*. (1998) should be followed.

Knowledge gaps

Lack of studies measuring AD/FID for pedestrian leisure activity during the breeding season.

Species: Divers and grebes

Red-throated diver, *Gavia stellata*

Conservation Status

UK: Green List; Schedule 1

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,250 (1,000-1,550) breeding pairs, 21,500 individuals in winter (Woodward *et al*., 2020); Scottish population = 935-1,500 pairs, over 2,270 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a weak increase in breeding birds (+38%) over 12 years.

Winter range expanded by 32% between 1981/84 – 2007/11. Breeding numbers in Scotland increased by 38% between 1994 – 2006. Breeding range increased by 11% between 1968/72 – 2007/11, although a 9% range contraction was recorded between 1968/72 – 2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID updates (Díaz *et al*., 2021; Laursen *et al*., 2017; Jiang and Møller, 2017) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: FID = 110m (n = 3); Min/Max FID = 100 to 120m (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID = 110m (n = 3) (Jiang and Møller, 2017).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 225m (n = 12 to 13); Min/Max AD (80% opinion range) = 150 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Median FID = 125m (n = 14 to 15); Min/Max FID (80% opinion range) = 10 to 750m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Motorised watercraft (motorboat) in nearshore waters off Denmark: Mean FID = 1200m (Laursen *et al*., 2017).

Non-motorised watercraft (kite surfer) in nearshore waters off Denmark: Mean FID = 1400m (Laursen *et al*., 2017).

MAD and/or

Buffer zone

Quantitative distances

No buffer zone update published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 300 to 900m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative disturbance responses

In the UK, red-throated divers breed only in North and West Scotland and Co. Donegal in Ireland, on freshwater lochs or bog pools in open moorland, blanket bogs or open and wet peatland habitats (Balmer *et al*., 2013; Snow and Perrins, 1998). The highest breeding densities in Scotland are found in Shetland, parts of Orkney, Caithness, the western fringe of the Highlands and the Outer Hebrides (Balmer *et al*., 2013). Red-throated divers feed principally on fish; almost all birds at UK breeding sites commute from their freshwater nesting site to feed at sea in nearby shallow coastal areas, so this species is potentially vulnerable to human disturbance at sea as well as on breeding lochs. Human disturbance on and around waterbodies where red-throated divers breed can deteriorate the quality of diver breeding habitat and reduce their breeding success; the use of artificial nesting rafts has been shown to increase breeding success and help mitigate the effects of human disturbance (Nummi *et al*., 2013; Piper *et al*., 2002).

In the nonbreeding season, red-throated divers are usually to be found in inshore marine waters along sheltered coasts, only rarely occurring inland on freshwater bodies (Snow and Perrins, 1998). In the UK this species overwinters all around the coast of Britain and Ireland, the highest concentrations are found along the North Sea coasts, in South West Scotland and in South West Ireland (Balmer *et al*., 2013). This distribution partly agrees with diver distribution recorded during offshore aerial surveys which have revealed large congregations of wintering red-throated divers off South East England, especially in the Greater Thames (Balmer *et al*., 2013).

Red-throated diver has been assessed as having a very high sensitivity to boat disturbance (Furness *et al*., 2013); in marine areas this species has been identified as being particularly sensitive to human activities (Dierschke *et al.*, 2016), including through the disturbance effects of ship and helicopter traffic (Mendel *et al*. 2019; Garthe and Hüppop, 2004; Schwemmer *et al.,* 2011; Furness and Wade, 2012; Bradbury *et al.,* 2014; Dierschke *et al.,* 2016). Marine activity may also increase the number of red-throated diver flights; relative to the other two diver species, red-throated divers are much more likely to take flight in response to disturbance, but they have also been recorded flying more in the absence of disturbance than the other two diver species (Jarrett *et al*., 2018). Red-throated divers are very likely to take flight in the 200-300m distance band from a passing ferry (Jarrett *et al*., 2018) and other studies have suggested that this species will fly away from approaching vessels at a distance of at least 1km or more (Garthe and Hüppop, 2004; Schwemmer *et al.,* 2011; Topping and Petersen, 2011). In the German North Sea, Schwemmer *et al*. (2011) have shown that red-throated divers avoid active shipping lanes. Dierschke *et al*. (2016) reviewed all available evidence from operational offshore wind farms on the extent of displacement or attraction of seabirds in relation to these structures; a strong avoidance of offshore wind farms was noted for red-throated divers and black-throated divers.

However, as for other diver species, the response to human disturbance may vary between individuals. Within Irish coastal waters during the nonbreeding season, Gittings *et al*. (2015) found that two out of three red-throated divers flushed at distances of approximately 15m and 100m from a motorised boat, while a third was recorded at a distance of 400 to 500m from the boat, although, as noted by the author, the sample size in this study was very small; flushed birds flew a long way (at least 0.5km and over 1km) from the boat.

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 500-750m

Nonbreeding season buffer zone = ≤1000m

Red-throated diver is assessed to have a high sensitivity to human disturbance.

Divers have some of the highest AD/FID/MAD values recorded in the bird disturbance response database. Studies measuring AD/FID are limited for red-throated divers, but the maximum AD/FID value recorded for this species is 120m when approached by a pedestrian during the breeding season and 1400m when approached by non-motorised watercraft during the nonbreeding season. Ruddock and Whitfield (2007) suggested that the upper pedestrian disturbance limit for red-throated diver during the breeding season is 500-750m.

Buffer zones range from 300 to 900m for forestry operations during the breeding season.

In the UK, red-throated diver has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds (particularly by boat traffic) at the coast during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 500-750m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect breeding red-throated diver from pedestrian and boating (on breeding lochs) disturbance. For activities with a high potential for visual and audial disturbance (e.g. forestry operations), a buffer zone ≤900m may be necessary. In marine areas during the nonbreeding season, a large buffer zone ≤1km may be necessary to protect foraging and roosting birds from shipping disturbance.

Knowledge gaps

Lack of studies measuring AD/FID during the nonbreeding season. Current research on time budgets of red-throated divers in the nonbreeding season (using time-depth recorders deployed on leg rings on breeding birds) may indicate the extent to which they experience an energy bottleneck during winter and therefore may be vulnerable to impacts on body condition and overwinter survival.

Black-throated diver, *Gavia arctica*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 215 (190-250) breeding pairs, 560 individuals in winter (Woodward *et al*., 2020); Scottish population = c.200 breeding pairs, 700-800 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (+16%) over 12 years.

Believed to have declined during early 20th century due to persecution by anglers and collectors, but has increased since and recovered breeding range that had been lost (Forrester *et al*., 2012). A 10% breeding range was recorded between 1988/91 – 2007/11 this mirrors national survey results showing an increase from 187 territories in 1994 to 217 territories in 2006 Balmer *et al*. (2013). Winter range expanded by 51% between 1988/91 – 2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: FID = 125m (n = 1) (Díaz *et al*., 2021).

Motorised watercraft (pedestrian leisure) on a lake in Sweden: Range of mean FID = 189 to 278m (n = 6 to 12); range of median FID = 80 to 310m; Min/Max FID = 0 to 750m (Götmark *et al*., 1989).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 310 to 400m (n = 10); Min/Max AD (80% opinion range) = 100 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Median FID = 225m (n = 10 to 11); Min/Max FID (80% opinion range) = 50 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season:

Motorised watercraft (pedestrian leisure) on a lake in Sweden: Buffer zone = >100m around islands where divers are nesting, although an exact figure wasn't stated (Götmark *et al*., 1989).

Forestry operations in the UK: Safe working distance = 300 to 900m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in Massachusetts: Safe working distance = 152m, No-cut zone = 30m (Natural Heritage and Endangered Species Program, 2007).

Ecology and non-quantitative disturbance responses

Black-throated diver has a high sensitivity to human disturbance both during the breeding and nonbreeding seasons.

In the UK, black-throated divers breed mainly in the north and west of Scotland (Sutherland and Wester Ross) and the Outer Hebrides (Balmer *et al*., 2013) in large shallow freshwater lochs or extensive pools with islets and peninsulas (Snow and Perrins, 1998). Loch occupancy is associated with the abundance of small salmonids and complex shorelines (Balmer *et al*., 2013). In these locations, divers may be disturbed by a range of pedestrian leisure activities, especially activities involving boats. In a study investigating disturbance by fishing activities on black-throated divers, Bundy (1979) found that on larger waterbodies, fishing from the bank did not disturb divers and that adults with chicks kept 50m away from boats, however, on small waterbodies of less than 45ha, divers couldn't maintain a safe distance and were often absent. Götmark *et al*. (1989) found that black-throated divers will flush between 189 to 278m from motorised watercraft in areas where they breed. Mudge and Talbot (1993) found that black-throated divers had a high degree of chick mortality in some core areas of their Scottish breeding range between1983-87; almost 80% of nest failure was due to predation and water level changes, but 13% was due to human egg collectors and 5% to desertion following human disturbance. Artificial rafts are increasingly used by black-throated divers to nest upon (Balmer *et al*., 2013). The use of breeding rafts may moderate effects of fluctuating water levels and human disturbance and have been shown to increase productivity of the Scottish population by 44% (Hancock, 2000).

In the nonbreeding season, black-throated divers generally move to salt water locations around sheltered coasts. Concentrations occur in Cornwall and north west Scotland, and other wintering hotspots occur along the east coast of England and the north coast of Scotland (Balmer *et al*., 2013). This species can sometimes be seen at inland reservoirs during the nonbreeding season, occasionally frequenting large inland freshwater bodies (Snow and Perrins, 1998). Black-throated divers at sea have been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013) and will often swim or dive in the 200-300m distance band from a passing ferry (Jarrett *et al*., 2018). In the German North Sea, Schwemmer *et al*. (2011) have shown that black-throated divers avoid active shipping lanes. It seems likely that this species may avoid areas where marine activity takes place, making data gathering for this species difficult. Black-throated divers are less likely than the smaller red-throated diver to take flight in response to marine activity, instead this species favours a swim or dive response, similar to great northern diver (Jarrett *et al*., 2018).

Garthe and Hüppop (2004) ranked black-throated diver and red-throated diver as the most sensitive species to offshore wind farm disturbance/displacement impacts. Dierschke *et al*. (2016) have found that black-throated divers show a significant avoidance of offshore wind farms at more than 2km and that this species can completely disappear around offshore wind farms where formally there was a high density.

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 500-750m

Nonbreeding season buffer zone = ≤1000m

Black-throated diver is assessed to have a high sensitivity to human disturbance.

Divers have some of the highest AD/FID/MAD values recorded in the bird disturbance response database, although studies measuring AD/FID are limited for black-throated divers., The maximum FID when approached by watercraft during the breeding season is 750m, although the response varies and FID values recorded in other studies are considerably shorter. Ruddock and Whitfield (2007) suggested that the upper pedestrian disturbance limit for black-throated diver during the breeding season is 500-750m. A quantitative measure of FID during the nonbreeding season is not currently available.

Buffer zones of at least 100m have been recommended to protect breeding birds from watercraft disturbance, but out at sea during the nonbreeding season birds will flush from passing boats at a distance of 200-300m. Buffer zones range from 152 to 900m for forestry operations during the breeding season.

In the UK, black-throated diver has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds (particularly by boat traffic) on the coast during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 500-750m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007))is suggested to protect breeding black-throated diver from pedestrian and boating (on breeding lochs) disturbance, but a better understanding of the impact, if any, of disturbance on body condition and survival of black-throated divers would help to inform such decisions. For activities with a high potential for visual and audial disturbance (e.g. forestry operations), a buffer zone ≤900m may be necessary. In marine areas during the nonbreeding season, a large buffer zone ≤1km may be necessary to protect foraging and roosting birds from shipping disturbance.

Knowledge gaps

Lack of studies measuring AD/FID during the nonbreeding season.

Great northern diver, *Gavia immer*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern, Annex 1

UK status

Extremely Scarce Breeder, Winter Visitor

UK and Scottish population estimate

UK winter population = 4,400 individuals (Woodward *et al*., 2020);

Scottish population = 1 possible breeding record, 1,000-3,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Possibly increasing; distribution increased by 39% between 1981/84 – 2007/11, although apparent gains may be a consequence of improved coverage (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021; Jiang and Møller, 2017; Borgmann, 2012; Liley *et al*., 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: FID 76.8m (n = 1) (Jiang and Møller, 2017).

Motorised watercraft (pedestrian leisure) on an inland waterbody in Montana: Min/Max FID = 64 to 129m (Kelly, 1992).

Motorised watercraft (pedestrian leisure) on inland waterbodies: Range of mean FID = 10 to 200m (Ruddock and Whitfield, 2007).

Non-motorised watercraft (surveyor canoeing) on an inland waterbody in Wisconsin: Mean FID = 27.8m (n = 30), Min/Max FID = 3 to 90m (Titus and VanDruff, 1981).

Nonbreeding:

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Mean FID = 51m (Borgmann, 2012).

Pedestrian (general) along the shoreline in England: FID = 50m (n = 1) (Liley *et al*., 2010).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Borgmann, 2012) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian (Wisconsin Loon Project): MAD = 67m (Ruddock and Whitfield, 2007).

Pedestrian (Wyoming Bird Conservation Plan): Buffer zone = 165m (Ruddock and Whitfield, 2007).

Motorised watercraft (leisure boat) on an inland waterbody in Montana: MAD = 137m (Kelly, 1992).

Motorised watercraft on lakes in Wisconsin: Buffer zone from the shores of lakes or islands = 150m (Ruddock and Whitfield, 2007).

Human development (Damage Assessment, Remediation and Restoration Program in New England): Buffer zone = 165 to 330m (Ruddock and Whitfield, 2007).

Nonbreeding:

Non-motorised watercraft (pedestrian leisure) in a range of habitats and locations: Buffer zone = 218m (Borgmann, 2012).

Ecology and non-quantitative disturbance responses

Great northern divers are winter visitors to the UK; this species migrates south in winter from arctic breeding grounds. The coastal waters around the UK hold an internationally important wintering population of great northern divers and this species is also occasionally recorded on inland wetland areas and some larger reservoirs (Balmer *et al*., 2013; Wernham *et al*., 2002). The largest concentrations of wintering great northern divers are found in the Northern Isles, Outer Hebrides, North West Scotland south to Argyll as well as western and southern Ireland (Balmer *et al*., 2013). In England, this species is abundant off the Cornish coast (Balmer *et al*., 2013). Great northern divers feed primarily on fish up to 28cm, but the diet can also include crustaceans, molluscs, annelids, insects and amphibians, depending upon location and season (Snow and Perrins, 1998).

Great northern divers very rarely breed with black-throated divers. A single hybrid pair was recorded in Scotland for several consecutive seasons up to 2008 (Balmer *et al*., 2013). Birds recorded in the UK during spring are likely to be those migrating north, although small numbers do remain to summer in coastal waters in the north and west (Balmer *et al*., 2013).

During the breeding season in the high arctic, great northern divers can have a relatively high sensitivity to human disturbance, although the response can vary depending on habituation of individuals and the source of disturbance; disturbance limits of this species may be lower compared with those of red-throated or black-throated diver species (Ruddock and Whitfield, 2007). The majority of studies on breeding great northern divers suggest that they will flush when disturbed on their breeding grounds at a distance of 150 - 300m (Ruddock and Whitfield, 2007), which is generally lower than for black-throated and red-throated divers. Heimberger *et al*. (1983) found that great northern diver nesting success was greatest when sources of disturbance were beyond 600m. Breeding success has been shown to increase with the use of artificial breeding rafts (Piper *et al*., 2002).

During the nonbreeding season, great northern divers at sea have been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013, Jarrett *et al*., 2018); birds are quite likely to swim or dive in the 200-300m distance band from a passing ferry and may also swim (but very rarely fly) out of the path of ferries up to 4km away (Jarrett *et al*., 2018). In winter, great northern divers spend a high proportion of daylight hours foraging (David C. Jardine, unpublished data) and so it may be difficult to distinguish between behaviours of diving to avoid nearby boats and diving to hunt for food. However, if great northern divers are exposed to an energetic bottleneck in winter, any increase in energy costs caused by disturbance may influence body condition and therefore potentially influence overwinter survival.

FID values vary between individuals. Gittings *et al*. (2015) found that within Irish coastal waters, great northern divers tolerated a medium sized motorised boat travelling at slow to moderate speeds to within 10 to 20m during the nonbreeding season; great northern divers did not fly away from the boat at this distance, but some individuals did show a dive response at 10 to 20m. Great northern divers also respond to other marine activity, particularly slow vessels/craft (including motorised and non-motorised boats for pleasure and commercial activities) by swimming or diving; in Orkney, they are frequently found in areas where regular marine activity takes place, although rarely recorded close to shore (Jarrett *et al*., 2018).

In contrast to red-throated and black-throated divers, which tend to avoid areas of human activity such as piers, harbours and ferry terminals, great northern divers can often be watched foraging under piers or in harbours, close to human activity, which suggests that this species, or at least some individuals, are less sensitive to human disturbance than are the smaller diver species (David C. Jardine, pers. comm.).

Likely sensitivity to disturbance = Medium/High

Quantitative information = Medium agreement & Medium evidence

Nonbreeding season buffer zone = 100-350m

Great northern diver is assessed to have a medium to high sensitivity to human disturbance.

The maximum FID value recorded for great northern diver during the breeding season is a mean of 76.8m when approached by a pedestrian and 200m when approached by motorised watercraft. However, as this species does not breed in the UK, quantitative values recorded during the breeding season may not be relevant to disturbance in the UK. During the nonbreeding season, the maximum FID value recorded is 50m when approached by a pedestrian and a mean of 51m when approached by non-motorised watercraft.

A MAD value of 67m and 137m has been recorded for pedestrian and motorised watercraft disturbance respectively during the breeding season. Buffer zones from 150 to 165m have been reported to protect breeding great northern divers from watercraft and pedestrian disturbance, larger buffers up to 330 may be required for disturbance from human development. A buffer zone of 218m has been reported to protect nonbreeding birds from non-motorised watercraft disturbance.

In the UK, great northern diver has the potential to be disturbed (particularly by boat traffic) on foraging and roosting grounds at the coast during the nonbreeding season. A minimum buffer zone of 100-350m is suggested to protect nonbreeding great northern diver from pedestrian disturbance, but a better understanding of the impact, if any, of disturbance on body condition and survival of great northern divers would help to inform such decisions.

Knowledge gaps

Lack of studies measuring AD/FID for a range of disturbance activities, especially pedestrian activity on the beach during the nonbreeding season.

Slavonian grebe, *Podiceps auritus*

Conservation Status

UK: Red List; Schedule 1

European: Near Threatened, Annex 1

UK status

Resident Breeder, Winter Visitor

UK and Scottish population estimate

UK population = 28 breeding pairs, 995 individuals in winter (Woodward *et al*., 2020); Scottish winter population = 300-500 individuals (Forrester *et al*., 2012). Scottish breeding population has declined since Forrester *et al*. (2012) estimated 30 (30-80) breeding pairs.

UK long-term trend

Eaton *et al*. (2021) state a strong decrease in breeding birds (-61%) over 25 years.

Breeding numbers have decreased since 1993 (Balmer *et al*., 2013). Winter range expanded in Britain and Ireland between 1981/84 – 2007/11; part of this increase may stem from improved survey coverage, increases in Scotland may be in response to an increase in the Icelandic breeding population (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Liley *et al*., 2011) published since Ruddock and Whitfield (2007).

Breeding season (Slavonian grebe):

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 75 to 225 (n = 5); Min/Max AD (80% opinion range) = <10 to 300m; Min/Max AD (90% opinion range) = 150 to 300m.

Range of median FID = 30 to 125m (n = 5); Min/Max FID (80% opinion range) = <10 to 150m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Breeding season (great crested grebe, *Podiceps cristatus*, stand in species for Slavonian grebe):

Surveyor walking in an urban habitat in Finland: FID = 10m (n = 1) (Díaz *et al*., 2021).

Pedestrian walking/running around breeding lochs in Scotland: Min/Max FID = 8 to 30m (Summers *et al*., 1994, cited in Bright *et al*., 2006).

Pedestrian leisure (boats) on breeding lochs in Scotland: Mean FID = 6.4m (n = 7) (Summers *et al*., 1994, cited in Bright *et al*., 2006).

Non-motorised watercraft: Min/Max FID = 0 to 100m (Keller, 1989).

Nonbreeding season (Slavonian grebe):

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median AD = 50m (n = 2), FID = 30 (n = 1) (Liley *et al*., 2011).

Nonbreeding season (great crested grebe):

Non-motorised watercraft (sailing boat) in nearshore waters off Denmark: Mean FID = 90m

Non-motorised watercraft (kite surfer) in nearshore waters off Denmark: Mean FID = 340m (Laursen *et al*., 2017).

Vehicle (bus) near a treatment plant in Australia: FID = 70m (n = 1) (McLeod *et al*., 2013).

Pedestrian (general) along the shoreline in England: Median FID = 100m (n = 3); Min/Max FID = 20 to 100m (Liley *et al*., 2010).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season (Slavonian grebe):

Forestry operations in the UK: Safe working distance = 150 to 300m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative disturbance responses

In the UK, Slavonian grebes breed in Scotland where it is a rare breeding bird at the extreme southern end of the species' Arctic range; breeding is restricted to the eastern Highlands (Balmer *et al*., 2013). A female Slavonian grebe did attempt to breed with a great crested grebe in the East Midlands between 2006 and 2008 but breeding was not successful (Balmer *et al*., 2013). This species breeds on a wide variety of lochs including small, shallow fresh, brackish or slightly alkaline waters between 0.5 and 2m deep and between 1-20ha in area with rich floating, submerged and emergent vegetation (Snow and Perrins, 1998).

Breeding Slavonian grebes can be relatively tolerant of human presence and although they are threatened by predation at nests, by flooding and wave damage, human disturbance of nesting birds is not considered to be a threat (Forrester *et al*., 2007). However, lake selection may be influenced by human disturbance; in particular bank-anglers, whose presence may keep grebes off eggs for extended periods (Thom, 1986; Summers *et al*., 2011). Summers *et al*. (2011) note that Slavonian grebe breeding lochs tend to be located hundreds of metres from roads and houses which they suggest is an indication of human disturbance.

In the nonbreeding season, Slavonian grebes move to sheltered coastal inshore waters up to 10-20m in depth including sheltered bays, lagoons and estuaries, joining immigrants from other Arctic breeding areas (Wernham *et al*., 2002; Snow and Perrins, 1998). Wintering Slavonian grebes occur around most of the Scottish coast; the highest numbers are recorded in the Northern Isles, northwest Scotland, the Moray Firth, the Firth of Forth and Kintyre. In England, this species is also recorded along the coast of Northumberland and from East Anglia to Cornwall (Balmer *et al*., 2013). Nonbreeding Slavonian grebes on the sea do not normally come ashore. They forage in shallow marine habitats where they could potentially be disturbed by people on the shore, but, in areas where Slavonian grebes occur regularly, there can be considerable human activity. For example, in Argyll, Orkney and Shetland, Slavonian grebes overwinter in areas with frequent ferry and fishing vessel traffic, salmon and mussel farming activity (Argyll Bird Reports volumes 12 to 29, Upton *et al*., 2018; Jackson, 2018), and these populations appear to be tolerant of these practices.

However, flushing distances of individual birds depends on the extent of habituation and tolerance of disturbance in different areas (Ruddock and Whitfield, 2007). Slavonian grebe is known to have a very high sensitivity to boat disturbance; this species is very likely to respond to a passing ferry at a distance of 200-300m (the third highest response after black-throated and red-throated divers) by flying away (Jarrett *et al*., 2018). Slavonian grebes can be absent from areas where regular marine activity takes place; in response to marine activity, the evasive flights of Slavonian grebes are longer/further than for other species (Jarrett *et al*., 2018).

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 150-350m

Slavonian grebe is assessed to have a medium sensitivity to human disturbance.

Studies measuring AD/FID are limited for Slavonian grebe, but the maximum AD/FID values estimated by expert opinion are 300m for AD and 150m for FID when approached by a pedestrian during the breeding season. During the nonbreeding season, the maximum FID value recorded is a median value of 50m when approached by a pedestrian. A wider range of FID studies are available for great crested grebe; the maximum FID value recorded for great crested grebe when approached by non-motorised watercraft is 100m during the breeding season and a mean value of 340m during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance limit for Slavonian grebe during the breeding season is 150-300m. Buffer zones range from 150 to 300m for forestry operations during the breeding season.

In the UK, Slavonian grebe has the potential to be disturbed on its breeding grounds, although, due to the scarcity of breeding Slavonian grebes in the UK, human disturbance is more likely on roosting and foraging grounds at the coast during the nonbreeding season. A minimum buffer zone of 150-350m is suggested to protect both breeding and nonbreeding Slavonian grebe from pedestrian disturbance.

Knowledge gaps

Lack of AD/FID studies during the breeding season.

Species: Diurnal raptors

White-tailed eagle, *Haliaeetus albicilla*

Conservation Status

UK: Amber List; Schedule 1, 1A and A1

European: Least Concern, Birds Directive Annex 1

UK status

Re-introduced Resident Breeder, Accidental

UK and Scottish population estimate

Scottish population only = 122 breeding pairs (Woodward *et al*., 2020), in winter the number of adults is same as breeding population (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+1,216%) over 25 years.

White-tailed eagle was once widespread in the UK, but this species was driven to extinction by humans early in the 20th century (Balmer *et al*., 2013). In Scotland there has been a strong increase following re-introductions, starting slowly in the 1970s. There were 30 pairs in 2003 (Forrester *et al*., 2012). Population models suggest that the population will increase considerably in the coming years, as well as spread over much of Scotland; density-independent predictive models suggest that the white-tailed eagle population could continue to grow to over 200 pairs by 2025 (Sansom *et al.,* 2016). Re-introductions are now taking place in England, where numbers are also likely to increase.

AD/FID

Quantitative disturbance distances

No AD/FID updates published since Ruddock and Whitfield (2007).

Breeding season (white-tailed eagle):

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 510m (n = 8); Min/Max AD (80% opinion range) = 150 to 1000m; Min/Max AD (90% opinion range) = 500 to 750m.

Range of median FID = 125 to 225m (n = 10 to 11), Min/Max FID (80% opinion range) = 50 to 1000m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Breeding season (bald eagle, *Haliaeetus leucocephalus*, stand in species for white-tailed eagle):

Pedestrians walking/running and motorised vehicle (general) in the USA:

Mean FID = 200m, Min/Max FID = 50 to 990m

(Fraser *et al*., 1985)

Nonbreeding season (bald eagle):

Pedestrian walking/running in North America: Min/Max FID = 183 to 268m

Motorised watercraft in North America: Range of mean FID = 136 to 276m

Non-motorised watercraft in North America: Min/Max FID = 111 to 202m

Fishing boat in North America: Range of mean FID = 127 to 137m.

Bank angler in North America: Mean FID = 201 to 293m

(Stalmaster and Kaiser, 1997)

Aircraft disturbance in North America: Mean FID = 625 to 800m

(Grubb and King, 1991; Fleischner and Weisberg, 1986).

Unknown season (African fish eagle, *Haliaeetus vocifer*, stand in species for white-tailed eagle):

Surveyor walking in Africa: Mean FID = 68m (n = 2) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Update on buffer zones (SNH, 2015; Kortland *et al*., 2011; Horváth, 2009; Naylor, 2009) published since Ruddock and Whitfield (2007).

Breeding season (white-tailed eagle):

Forestry operations in Scotland: Buffer zone = 250 to 500m (Kortland *et al*., 2011).

Forestry operations in Scotland: Safe working distance = 500m (Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 900 to 1100m (Petty, 1998).

Forestry operations (tree felling) in Hungary: Buffer zone = 300 to 400m (Horváth, 2009).

Forestry operations in Finland: Buffer zone = 50 to 500m

Pedestrian walking/running in forest land in Finland: Buffer zone = 500m

Pedestrian camping in forest land in Finland = 1000m

Motorised vehicles (general) in forest land in Finland: Buffer zone = 1000m. (Koivusaari *et al*., 1988a,b).

Forestry operations in Sweden: Buffer zone = 500m

Industrial development in Sweden: Buffer zone = 2000m

Recommended general buffer zone in Sweden: Buffer zone = 500m

(Ruddock and Whitfield, 2007).

Public viewing platform on the island of Mull in Scotland: Buffer zone = 300m

Public parking area on an island in Scotland: Buffer zone = 600m

(MacLennan and Evans, 2003).

Aircraft disturbance in Scotland: Safe working distance = 500-750m (lateral), 1000m (altitudinal) (SNH, 2015).

Nonbreeding season (white-tailed eagle):

Forestry operations in Scotland: Buffer zone = 0 to 250m (Kortland *et al*., 2011).

Forestry operations (tree felling) in Hungary: Buffer zone = 100m (Horváth, 2009).

Ecology and non-quantitative disturbance responses

White-tailed eagles are resident breeders in the UK. Reintroduced white-tailed eagles now breed in four key breeding areas in the Western Highlands of Scotland: Outer Hebrides, Wester Ross, Skye and the Small Isles and North Argyll centred on Mull (Balmer *et al*., 2013). Further white-tailed eagles have been reintroduced to East and Central Scotland (Balmer *et al*., 2013) and most recently to the Isle of Wight where they are showing some signs of territorial behaviour (Pitches, 2021). These areas are all linked with sea coasts, lochs, rivers and wetlands where fish and other aquatic prey can be caught (Snow and Perrins, 1998). As a predator, scavenger and kleptoparasite, white-tailed eagles have a wide-ranging diet including fish, waterbirds, mammals and carrion (Snow and Perrins, 1998). This species prefers to nest in tall, mature trees, although nesting can take place on cliffs and crags and very occasionally on the ground (Snow and Perrins, 1998). The nest is a large structure, composed of big branches and twigs and often driftwood, juniper and seaweed, which is lined with vegetation; breeding birds are monogamous and often pair for life with pairs reusing the same nest (Snow and Perrins, 1998). Adults generally remain in their territories during the nonbreeding season, whereas immature birds can roam widely; some in Scotland travel inland following highland glens until they reach the east coast (Balmer *et al*., 2013). White-tailed eagles form communal roosts during the nonbreeding season, although territorial pairs may roost singly at or near nest sites (SNH, 2015).

White-tailed eagles are considered to be sensitive to human disturbance, but the level of sensitivity of individual pairs likely depends on the stage of the breeding cycle as well as exposure to and ability to cope with human presence; in remote areas this species may be scarce and unlikely to be encountered by people, which is likely to increase their sensitivity to disturbance. Some studies have shown that white-tailed eagles are much more approachable and more tolerant of human presence than golden eagles, which makes them particularly vulnerable to persecution (Forrester *et al*., 2012). Wallgren (2003) suggested that there has been a decreased fear of humans in Finnish white-tailed eagles although there was little evidence of habituation over three decades (1970s, 80s and 90s). During the nonbreeding season in Scotland, Kortland *et al*. (2011) suggest that forestry operations and activities up to and around white-tailed eagle nests may be carried out with little risk of disturbing white-tailed eagles (unless the eagles are actively nest-building which sometimes happens in December and January), although roost sites should be protected from repeated disturbance. To avoid this, forestry activities or recreational events within 250m of an active roost site should be avoided during the period from two hours before sunset until two hours after sunrise, at any time of year.

However, habituation to disturbance can vary widely across different habitats. In a survey recording white-tailed eagle nests in Croatia, Radović and Mikuska (2009) found that more than 95% of the white-tailed eagle population chose to nest more than 1000m away from the nearest human settlement, regardless of the availability of forests, and that nests were located up to 5,690m away from roads; the busier the road the more likely that some eagles chose to nest a long way from it, although illegal killing, nest robbery and hunting activities which still occur regularly in Croatia are likely to influence white-tailed eagle disturbance distances (Mikuska, 2009). At an onshore wind farm in Norway, Dahl *et al*. (2012) noted that post-construction, white-tailed eagles tended to vacate their territories within 500m from turbine locations and experienced significantly lower breeding success compared with the same territories before construction. Forrester *et al*. (2012) consider that human activities such as over-fishing inshore and clearance of woodland beside streams with the resultant loss of fish stocks from freshwater lochs may also impact white-tailed eagle populations. Ruddock and Whitfield (2007) noted that in Europe, forestry guidelines generally advise ‘no-cut’ zones around white-tailed eagle nests between 50 and 300m wide, whereas most North American no-cut zones around bald eagle nests are 400m, although these may be reduced in some situations.

In the UK, Hardey *et al*. (2013) state that white-tailed eagles should not be disturbed from eyries with eggs or small young unless a licenced surveyor has a specific need to record clutch or brood size; when chicks are eight weeks or more old, disturbance at the nest can cause premature fledging. To minimise the risk of disturbance Hardey *et al*. (2013) recommended that nesting areas are viewed from distances of 500 to 1000m away (Ruddock & Whitfield, 2007; Whitfield *et al*., 2008a). Adults may be secretive before laying, and, if disturbed during incubation, they will generally slip quietly off the nest and return once the disturbance is over, although it is recognised that different pairs or sites may have different sensitivities to disturbance.

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Medium evidence

Breeding season buffer zone = 500-1000m

Nonbreeding season buffer zone = 250-500m

White-tailed eagle is assessed to have a high sensitivity to human disturbance in remote areas, although it is important to note that different pairs or sites may have different sensitivities to disturbance; sensitivity may be lower in areas where eagles are habituated to human presence.

Quantitative studies measuring AD/FID are very limited for white-tailed eagle, but, from studies in the USA, the maximum FID value recorded for bald eagle when approached by a pedestrian is 990m during the breeding season and 268m during the nonbreeding season. The maximum FID value recorded for bald eagle during the nonbreeding season is a mean value of 293m when disturbed by fishing activity on the bank. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for white-tailed eagle during the breeding season is 500 to 1000m, although the authors also state that only one of eight respondents considered disturbance (AD) to occur between 750 to 1000m.

Recommended buffer zones for white-tailed eagle vary widely depending on the source of disturbance. Buffer zones to protect white-tailed eagles from forestry operations in Europe range from 50 to 1100m during the breeding season and 0-250m during the nonbreeding season; the majority of forestry buffer zone recommendations during the breeding season, including those for Scotland, range between 250 and 500m. Buffer zones to protect white-tailed eagles from pedestrian disturbance during the breeding season range from 300 to 1000m and a safe working distance for aircraft in Scotland is considered to be 500-700m (lateral) and 1000m (altitudinal).

In the UK, white-tailed eagle has the potential to be disturbed on breeding grounds as well as at communal roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed pre- and during egg laying early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 500-1000m is suggested to protect nesting white-tailed eagles and a buffer zone of 250-500m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance. Buffer zones at the lower end of these ranges may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

There are a range of studies providing buffer zones for white-tailed eagle, but studies recording AD/FID are required.

Osprey, *Pandion haliaetus*

Conservation Status

UK: Amber List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 240 breeding pairs (Woodward *et al*., 2020), almost all in Scotland, but reintroduction to Rutland in 1996 has been followed by increase in that area and a spread to Wales (Balmer *et al*., 2013). Scottish population = 230 breeding pairs in 2017 (Challis *et al*., 2020), an increase from 182-200 in 2004 estimated by Forrester *et al*. (2012).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+207%) over 25 years.

Ospreys became virtually extinct as a breeding species in Britain during the 1900s due to human persecution, but since natural recolonisation in the 1950s there has been a steady increase in range and abundance in Scotland and northern England (Balmer *et al*., 2013). A translocation programme at Rutland Water in 1996 is likely to continue to increase numbers (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

No AD/FID updates published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian (general) in the USA: Mean FID = 50m (Carrier and Melquist, 1976).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 225 (n = 12); Min/Max AD (80% opinion range) = 100 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Range of median FID = 175 to 225m (n = 12 to 14); Min/Max FID (80% opinion range) = 50 to 750m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Motorised watercraft (powerboat) in nearshore waters off Florida: Mean FID = 57.91m (n = 58); Min/Max FID = 30 to 140m (Rodgers and Schwikert, 2002).

Motorised watercraft (jet-ski) in nearshore waters off Florida: Mean FID = 49.53m (n = 71); Min/Max FID = 20 to 159m (Rodgers and Schwikert, 2002).

Motorised watercraft (airboat) on a lake in Florida: Mean FID = 103m (n = 18) (Rodgers and Schwikert, 2003).

MAD and/or

Buffer zone

Quantitative distances

Update on buffer zones (SNH, 2015; Naylor, 2009; Craig, 2002; Adams and Scott, 1979) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 350 to 1,000m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 500 to 800m (Petty, 1998).

Forestry operations in Ontario: Buffer zone = 200m (Naylor, 2009).

Forestry operations in Arizona: Buffer zone = 100m (Adams and Scott, 1979).

Forestry operations in Canada: Buffer zone = 100 to 800m

Forestry operations in Canada next to water edge: Buffer zone = 70 to 350m

(Ewins, 1997).

Pedestrian (general buffer zone) from Colorado Wildlife guidance: Buffer zone = c.402m (Craig, 2002).

Pedestrian (general buffer zone) in USA: Buffer zone = 400 to 1500m (Richardson and Miller, 1997).

Pedestrian (general): Buffer zone = 201m

Forestry operations in Washington State: No-cut zone = 40 to 61m

Forestry operations in Washington State: Restricted-cut zone = 201 to 335m

Motorised Vehicles in Washington State: Buffer zone = 201m

Campsites in Washington State: Buffer zone = 1000m

Hiking trails in Washington State: Buffer zone = 91m

(Rodrick and Milner, 1991).

Aircraft disturbance in Scotland: Safe working distance = 500-750m (lateral), 500m (altitudinal) (SNH, 2015).

Nonbreeding season:

Nearshore water habitat off Florida:

Motorised watercraft (powerboat): Buffer zone = 149m

Motorised watercraft (jet-ski): Buffer zone = 142m

Motorised and non-motorised watercraft: Buffer zone = 150m

(Rodgers and Schwikert, 2002).

Motorised watercraft (airboat) on a lake in Florida: Buffer zone = 250m (Rodgers and Schwikert, 2003).

Forestry operations in Canada: Buffer zone year-round restriction = 40 to 200m (Ewins, 1997).

Ecology and non-quantitative disturbance responses

Ospreys are summer visitors to the UK. Since breeding began at Loch Garten (Inverness-shire) in Scotland in the 1950s, the British osprey population has spread over much of north-east Scotland; the straths and lowlands of the eastern and central Highlands remain a stronghold, with a further significant population breeding in Tayside and central Scotland (Balmer *et al*., 2013). The species range expanded over the border into Cumbria and Northumberland between 2001-2010 and, due to a translocation programme, this species now breeds at Rutland Water and in Wales (Balmer *et al*., 2013). In the UK, ospreys are a tree-nesting species breeding near fresh water, often far inland on lochs, pools and rivers (Snow and Perrins, 1998). Ospreys predominately feed on a range of fish species, which are caught in the talons after a shallow dive of no more than 1m (Snow and Perrins, 1998). This species does not spend the winter in the UK, after the breeding season ospreys travel south to overwinter in sub-Saharan Africa (Snow and Perrins, 1998). Ospreys recorded in November and February are late passage birds or birds returning early respectively (Balmer *et al*., 2013).

Ospreys are considered to be sensitive to human disturbance, but the level of sensitivity of individual pairs likely depends on the stage of the breeding cycle as well as exposure to and ability to cope with human presence. Ospreys vary in their ability to habituate to human disturbance, the effect of disturbance on nesting ospreys is influenced by the timing of the disturbance event during the breeding season (Swenson, 1979; Levenson and Koplin, 1984). Swenson, 1979, suggested that if ospreys are habituated to human presence before nesting, their continued presence might not be detrimental to nesting success, whereas Levenson and Koplin (1984) found that forestry logging activity can have significant adverse effects on productivity. In Perthshire, Scotland, a pair of ospreys continued to breed normally in 2015 despite the occurrence of a music festival (T In The Park), which took place in the immediate surrounding area in the summer; mitigation measures put in place to protect the ospreys included: changes to the festival site layout, introduction of buffer zones around the nest (maximum buffer zone of 750m) and restrictions on activities including fireworks and lighting, all of which appeared to be successful in preventing disturbance to the birds (RSPB, 2015). A safe working distance for aircraft in Scotland is considered to be 500-750m (lateral) and 500m (altitudinal) (SNH, 2015), however, it has been noted by Network Rail that ospreys nesting alongside a powerline pylon in northern Scotland will behave normally when filmed from a helicopter at a distance of c.900m away; Network Rail now inform their pilots of this distance and use it to minimise disturbance risks (Andrew Stevenson, pers. Comm.).

Ospreys that are unaccustomed to human activities should be protected from disturbance. Rodrick and Milner (1991) recommend that roads are closed between April 1 and September 15 if they are located within 201m of a sensitive pair; the authors also suggest that in wild areas, people should not camp within 1km of occupied nests and hiking trails should not come within 91m of a nest tree. Rodrick and Milner (1991) have also presented a range of management recommendations for osprey that include forestry management around nest trees (see Ruddock and Whitfield, 2007 for review).

Ospreys have adapted well to nesting on a wide range of artificial platforms. In Canada, Ewins (1997) has reported that in some areas up to 70% of occupied osprey nests now occur on artificial support structures. In Alberta, Canada, it is common to see osprey nests on roadside telegraph poles adjacent to major highways, with the birds showing no reaction to high volumes of road traffic. In the UK, it has also been noted that ospreys will successfully breed on artificial platforms, some platforms are in public places (e.g. busy marinas) suggesting that osprey behaviour in the UK can be similar to that recorded in Canada (Andrew Stevenson, pers. Comm.).

In the UK, Hardey *et al*. (2013) state disturbance around osprey nests should be avoided while breeding birds are displaying, incubating or brooding small young. To minimise the risk of disturbance, Hardey *et al*. (2013) recommend that nests should be viewed from distances of 500–750 m (Ruddock and Whitfield, 2007; Whitfield *et al.*, 2008a).

Likely sensitivity to disturbance = Medium/High

Quantitative information = Low agreement & Medium evidence

Breeding season buffer zone = 350-750m

Osprey is assessed to have a medium to high sensitivity to human disturbance, although different pairs or sites may have a different sensitivity to disturbance; sensitivity may be lower in areas where ospreys are habituated to human presence.

Quantitative studies measuring AD/FID are very limited for osprey, but the highest FID value recorded for this species is a mean of 50m during the breeding season when approached by a pedestrian and a maximum of 159m during the nonbreeding season when approached by a jet-ski. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for osprey during the breeding season is 500 to 750m, although the authors also state that expert opinion of disturbance distances for this species varied widely.

Recommended buffer zones for osprey vary depending on the source of the disturbance. Buffer zones to protect ospreys from forestry operations in the UK range from 350 to 1000m during the breeding season. Buffer zones to protect ospreys from pedestrian disturbance during the breeding season range from 91 to 402m (although campsites may need a wider buffer zone of up to 1000m). A safe working distance for aircraft in Scotland is considered to be between 500 to 900m. In the nonbreeding season, buffer zones between 149 and 250m have been suggested to protect osprey from watercraft disturbance, but as this species does not overwinter in the UK, quantitative values recorded during the nonbreeding season may not be relevant to disturbance in the UK..

In the UK, osprey has the potential to be disturbed at nest sites, especially early on in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 350-750m is suggested to protect ospreys during the breeding season from pedestrian disturbance. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

A wide range of management recommendations exist in the literature suggesting buffer zones for osprey. Empirical studies measuring osprey AD/FID are limited. Further studies, particularly focussing on the AD/FID response to human leisure activities are required for this species.

Golden eagle, *Aquila chrysaetos*

Conservation Status

UK: Green List, Schedule 1, 1A and A1

European: Least Concern, Annex 1

UK status

Resident Breeder

UK and Scottish population estimate

Scottish population only = 510 breeding pairs (Woodward *et al*., 2020); c.1,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (+16%) over 33 years.

Due to human persecution, golden eagles became extinct in England, Wales and Ireland by the middle of the 19th century and the population became increasingly rare and fragmented in Scotland (Forrester *et al*., 2012). Respite from persecution during the two World Wars together with legal since 1954 allowed this species to survive in remoter Scottish hills and glens and eventually begin to recover (Forrester *et al*., 2012). In Scotland, Forrester *et al*. (2012) and Balmer *et al*. (2013) reported that there were 442 pairs in 2003, with numbers remaining stable from 1982 to 2003. However, (Woodward *et al*., 2020) found that the population had increased to 510 breeding pairs in Scotland in 2015.

AD/FID

Quantitative disturbance distances

FID updates (Spaul and Heath, 2017; Grubb *et al*., 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running in a shrub-steppe habitat in the USA: Mean FID = 779m (n = 11); Min/Max FID = 200 to 1300m (Spaul and Heath, 2017).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 400 to 625m (n = 15 to 14); Min/Max AD (80% opinion range) = 100 to 1500m; Min/Max AD (90% opinion range) = 750 to 1000m.

Range of median FID = 225 to 400m (n = 25 to 19); Min/Max FID (80% opinion range) = 10 to 1500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Off-road vehicle in a shrub-steppe habitat in the USA: Mean FID = 414m (n = 121); Min/Max FID = 90 to 1300m (Spaul and Heath, 2017).

Road vehicle in a shrub-steppe habitat in the USA: Mean FID = 553m (n = 107); Min/Max FID = 30 to 1100m (Spaul and Heath, 2017).

Aircraft (helicopter) disturbance across canyonlands in the USA: Mean AD = 400m (n = 8); Mean FID = 200m (n = 8) (Grubb *et al*., 2010).

Nonbreeding season:

Pedestrian walking/running in farmland habitat in Colorado:

Mean FID = 225m (n = 18); Min/Max FID = 105 to 390m (Holmes *et al*.,1993).

Motorised vehicle (general) in farmland habitat in Colorado:

Mean FID = 82m (n = 16); Min/Max = 14 to 190m (Holmes *et al*.,1993).

MAD and/or

Buffer zone

Quantitative distances

Update on buffer zones (SNH, 2015; D'Acunto *et al*., 2018; Grubb *et al*., 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Motorised vehicle and pedestrian walking/running (simulated results from a model) across shrub-steppe in the USA: Buffer zone = 600m (D'Acunto *et al*., 2018).

Pedestrian leisure activity (general) in the USA: Buffer zone = 800m (Ruddock and Whitfield, 2007).

Pedestrian (general) in North America: Buffer zone = 200 to 400m

Noise disturbance in North America: Buffer zone = 800m

Visual/audible disturbance in North America: Buffer zone = 200 to 1600m (Richardson and Miller, 1997).

Forestry operations in the UK: Safe working distance = 750 to 1500m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 900 to 1100m (Petty, 1998).

Forestry operations in Sweden: Buffer zone = 500m (McGrady *et al*., 2004).

Aircraft disturbance in Scotland: Safe working distance = 1000m (lateral), 500m (altitudinal) (SNH, 2015).

Aircraft (helicopter) disturbance across canyonlands in the USA: Buffer zone = 800m (Grubb *et al*., 2010).

Nonbreeding season:

Pedestrian walking/running or motorised vehicle across farmland in the USA: Buffer zone = 300m (Holmes *et al*., 1993).

Ecology and non-quantitative disturbance responses

Golden eagles are scarce resident breeders in the UK. This species is mainly confined to upland areas of the Scottish Highlands north and west of the Highland Boundary Fault and most Hebridean islands throughout the year (Balmer *et al*., 2013); the Uists, parts of Lewis, Harris and Mull support some of the highest densities in Europe (Forrester *et al*., 2012). Smaller numbers of golden eagles inhabit the hills and mountains of central and eastern Scotland as well as the Southern Uplands in the Scottish Borders and Dumfries & Galloway (South of Scotland Golden Eagle Project, 2021; Balmer *et al*., 2013). This species is absent from Orkney and Shetland (Balmer *et al*., 2013). One lone golden eagle was present in the Lake District for some years after its mate died and, in Ireland, a reintroduction project resulted in three breeding pairs in 2010 (Balmer *et al*., 2013). Adult golden eagles are highly sedentary and remain in their territories throughout the year, whereas immature birds roam widely within the uplands, although there is little difference in distribution between breeding and nonbreeding seasons (Balmer *et al*., 2013). Scottish golden eagles show a preference for nesting on cliffs, which may allow greater visibility of their surroundings compared to forest nesting birds in Europe, therefore buffer zones may need to be greater for Scottish breeding golden eagles compared with their European counterparts (McGrady *et al*., 2004; Ruddock and Whitfield, 2007). Territories may have 1–13 (normally 1–6) alternative nests (Hardey *et al*., 2013). Golden eagles feed mainly on mammals and birds, but reptiles, occasionally fish and insects, may also be eaten; taken alive or as carrion (Snow and Perrins, 1998). Golden eagles may roost singly or at the nest for territorial birds (SNH, 2015).

Golden eagle is a shy, scarce species which lives in remote areas of Scotland and is sensitive to human disturbance. However, the level of sensitivity of individual pairs likely depends on the stage of the breeding cycle as well as exposure to and ability to cope with human presence. Golden eagles now don’t appear to be affected by pesticides and other pollutants, although this species has probably been negatively affected by the long-term, extractive human use of moorlands by grazing, burning, hunting and forestry (RSPB, 2021a). Persecution still remains a significant problem in the central and eastern Highlands of Scotland where the land is managed for red grouse (Whitfield *et al*., 2003); in these locations, large areas of suitable golden eagle breeding habitat are unoccupied (Whitfield *et al*., 2007).

The distance at which golden eagles show no reaction to disturbance varies widely depending on the source of disturbance, individual birds, habitats and the time of the year. Caution should be exercised if applying buffer zones to the UK from studies carried out abroad; for example, many of the FID values and buffer zones listed for golden eagle in this report are from studies carried out in the USA where habituation to disturbance may be greater than it is for some golden eagle individuals present in remote locations in Scotland. Reaction to disturbance can be highly variable between individuals; Spaul and Heath (2017) report that during the breeding season in the USA, some golden eagles do not react to people on foot passing by the nest at 200m, whereas other individuals will react at 1300m. When approached by non-motorised vehicles, the lack of reaction between golden eagles has been found to vary between 400 and 1100m (Spaul and Heath, 2017). Grubb *et al*. (2010) found that an Apache helicopter in the USA could pass by a golden eagle on a nest at a distance of 400m, whereas other individuals will react to this disturbance at 3000m. Also in the USA, White and Sherrod (1973) found that golden eagles did not flush when a helicopter was 18m from the nest and Boeker (1970) report that golden eagles did not flush when a fixed-wing aircraft was within 60m of a nest site.

In the UK, Hardey *et al*. (2013) state that golden eagle nests should not be approached in March and early April as this species is particularly sensitive to human disturbance just before and during egg laying. Disturbance behaviour typically involves both adult birds circling together to a great height and often drifting away from the nest; if this behaviour is seen the observer should move away as quickly as possible (Hardey *et al*., 2013). Observer disturbance at nest sites should also be avoided on particularly wet, hot or cold days as the absence of the adults may result in the chilling or overheating of the eggs or young and disturbance may also cause premature fledging (Hardey *et al*., 2013).

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Medium evidence

Breeding season buffer zone = 750-1000m

Nonbreeding season buffer zone = 250-500m

Golden eagle is assessed to have a high sensitivity to human disturbance in remote areas, although this species is scarce and unlikely to be encountered in Scotland. Different pairs or sites may have a different sensitivity to disturbance; sensitivity may be lower in areas where golden eagles have some habituation of human presence.

Quantitative studies measuring AD/FID are very limited for golden eagle in the UK, but the maximum FID value recorded for this species in the USA when approached by a pedestrian is 1300m during the breeding season and 390m during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for golden eagle during the breeding season is 750 to 1000m, although the authors also state that the divergence of opinion on disturbance distance for this species during incubation was greater than that for any other species reviewed.

Recommended buffer zones for golden eagle vary widely depending on the source of disturbance. Buffer zones to protect golden eagles from forestry operations in Europe range from 500 to 1500m during the breeding season. Buffer zones to protect golden eagles from pedestrian disturbance during the breeding season range from 200 to 800m and a safe working distance for aircraft in Scotland is considered to be 1000m (lateral) and 500m (altitudinal).

In the UK, golden eagle has the potential to be disturbed on breeding grounds as well as on roosting and foraging grounds during the nonbreeding season; this species is most likely to be disturbed pre and during egg laying early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 750-1000m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect nesting golden eagles and a buffer zone of 250-500m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance. For activities with a high potential for visual and audial disturbance (e.g. forestry operations), a buffer zone ≥1500m may be necessary.

Knowledge gaps

There is a lack of disturbance distance studies in the UK.

Red kite, *Milvus milvus*

Conservation Status

UK: Green List, Schedule 1A

European: Least Concern, Annex 1

UK status

Resident/Introduced Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 4,400 breeding pairs (Woodward *et al*., 2020);

Scottish population = ≥ 273 breeding pairs in 2015 (Challis *et al*., 2020), 300-350 birds in winter (Forrester *et al*., 2012).

UK long-term trend

Red kites became extinct outside Wales in the late 19th century due to human persecution. Since the reintroduction of red kites outside of Wales in 1989, the range and abundance in England and Scotland has rapidly increased; the range increased sevenfold between 1988/91 and 2007/11 (Balmer *et al*., 2013). Reintroduction into Scotland started with the Black Isle in 1989, numbers in north and central Scotland have been doubling about every five years (Forrester *et al*., 2012).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 125m (n = 9 to 11); Min/Max AD (80% opinion range) = 10 to 300m; Min/Max AD (90% opinion range) = 150 to 300m.

Range of median FID = 30 to 75m (n = 11); Min/Max FID (80% opinion range) = 10 to 300m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Breeding season (Black kite, *Milvus migrans*, stand in species for red kite):

Surveyor walking in a rural habitat in Spain: Mean FID = 37.9m (n = 2); Min/Max FID = 35.5 to 40.3m (Díaz *et al*., 2021).

Unknown season (Black kite):

Surveyor walking in Africa: Mean FID = 26.7m (n = 8) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (SNH, 2015) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 300 to 600m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 400 to 600m (Petty, 1998).

Aircraft disturbance in Scotland: Safe working distance = 300m (lateral), 500m (altitudinal) (SNH, 2015).

Ecology and non-quantitative disturbance responses

Red kites are resident breeders in the UK. The first reintroduction programme in Scotland took place between 1989 and 1993 when 93 red kites of Swedish origin were reintroduced on the Black Isle. Following this, reintroduction programmes in Scotland have established populations in central Scotland (Stirling area) between 1996 to 2001, Dumfries and Galloway (Castle Douglas area) between 2001 to 2004 and in Aberdeenshire between 2007 to 2009 (Forrester *et al*., 2012; RSPB, 2018). In England, red kites were introduced into the Chilterns in 1989, by 2011 this population had increased to over 800 pairs and since this time the population has spread to colonise much of central southern England and satellite populations have spread to Wiltshire, Hampshire and Sussex (Balmer *et al*., 2013). The remnant native Welsh population has also expanded since the early 1990s and now covers most of Wales and parts of Shropshire and Herefordshire (Balmer *et al*., 2013).

Red kites prefer habitats containing open stands of woodland for nesting and communal roosting in winter (Forrester *et al*., 2012). This species builds a nest composed of dead twigs usually in trees (rarely on a cliff ledge or crag), and often old buzzard or raven nests will be reused (Snow and Perrins, 1998); in Scotland, most nests are in Scots pine or oak (Forrester *et al*., 2012). Red kites have a varied diet; they are mainly scavengers although they will also take live prey such as small mammals and birds (Snow and Perrins, 1998). In the UK, red kites are sedentary and do not migrate; in the winter this species may disperse short distances to supplementary feeding grounds, breeding and nonbreeding distributions are similar (Balmer *et al*., 2013).

Red kite is a species that associates closely with humans and in the past this species flourished in areas of human habitation. Red kite was once a common bird seen over London where they would feed in the city waste dumps, much like black kites do in some Indian cities today (N. Goodship pers. obs). In 1544, William Turner recorded red kites taking bread from the hands of children and fish from women; the Greek poet Homer called them ‘snatchers’ as they had a reputation for stealing hats off people’s heads (see Colwell, 2021 for review). There are also other historical records of red kites stealing herring and fish processing waste from workers on the shores of Loch Fyne (Baxter and Rintoul, 1953), and stealing food from the hands of children in the streets of other UK cities (Raye, 2021).

Today, red kites can be seen foraging over farmland, rough grasslands and heath (Snow and Perrins, 1998) where humans are present. In agricultural areas, this species may associate closely with tractors ploughing the ground in order to take earthworms, farmyards where they scavenge for waste, as well as roads where they scavenge for roadkill (Wildman *et al*., 1998). Red kites will come close to people when feeding opportunities are provided. For example, this species feeds on bird tables in hundreds of UK gardens where meat is put out for them (Orros and Fellowes, 2014), including in Scotland (Wildman *et al*., 1998). There are also a number of commercial feeding stations in the UK that encourage large flocks of red kites to come to bait in sites providing public viewing. Katzenberger (2021) concluded that, as the population increased between 1970 and 2020 as a consequence of reduced persecution, red kites in Germany moved closer to human settlements, which suggests a reduction in human avoidance by this species and most likely reflects the change from being persecuted to being protected.

However, despite their apparent tolerance of humans, red kites are still potentially sensitive to disturbance, especially early on during the breeding season when birds are laying and incubating as well as when present at communal roosts. In the UK, Hardey *et al*. (2013) recommend that searches for nests in woodland should not be carried out between mid-March and mid-April (once kites start to display) as disturbance at this stage of breeding may cause a pair to move several kilometres away; if disturbed whilst nest building (such as tree felling in the nesting wood), a breeding pair may stop nest building and start again with a new nest 500-1000m away. To minimise the risk of disturbance Hardey *et al*. (2013) recommended that nests are viewed from distances of 150–300m (Ruddock and Whitfield, 2007; Whitfield *et al.*, 2008a) and that no attempt should be made to locate the roosts of breeding red kites, as this causes excessive disturbance.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 150-300m

Nonbreeding season buffer zone = 150-300m

Red kite is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for red kite, but the maximum FID value recorded for black kite is 40.3m when approached by a pedestrian during the breeding season; there are no records of AD/FID values during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for red kite during the breeding season is 150-300m.

Buffer zones to protect red kites from forestry operations in the UK range from 300 to 600m during the breeding season. A safe working distance for aircraft in Scotland is considered to be 300m (lateral) and 500m (altitudinal).

In the UK, red kite is most likely to be disturbed at nest sites early on in the breeding season as well as at communal roosting areas during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 150 to 300m 500m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect both breeding and nonbreeding red kites from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. For activities with a high potential for visual and audial disturbance (e.g. forestry operations, aircraft), a buffer zone between 300-600m may be necessary. For activities with a high potential for disturbance (e.g onshore wind farms), a buffer zone up to 5km may be necessary.

Knowledge gaps

Lack of AD/FID studies during both the breeding and nonbreeding seasons.

Marsh harrier, *Circus aeruginosus*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern; Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 590-695 breeding pairs (Woodward *et al*., 2020); Scottish population <10 breeding pairs between 2003-2015 (Challis *et al*., 2020), 10-100 birds during spring passage and 10-40 birds during autumn passage (Forrester *et al*., 2012). There were 10-12 occupied home ranges in Scotland in 2019 which fledged 22 young (Marsh Harrier | Scottish Raptor Monitoring Scheme).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+389%) over 25 years.

Marsh harrier temporarily went extinct in the UK at the end of the 19th century, numbers then increased before a crash to just one pair in 1971 (Balmer *et al*., 2013). Since this time abundance and range have shown a large increase; breeding range doubled between 1988/91 and 2007/11 and the number of breeding females increased by 131% between 1995 and 2005 (Balmer *et al*., 2013). Woodward *et al*. (2020) recorded a further increase in UK breeding pairs in 2016.

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Poland: Min/Max FID = 54.6 to 130.1m (n = 2). (Díaz *et al*., 2021).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 215 to 225m (n = 4); Min/Max AD (80% opinion range) = 10 to 500m; Min/Max AD (90% opinion range) = 300 to 500m.

Range of median FID = 30 to 75m (n = 3), Min/Max FID (80% opinion range) = <10 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Unknown season (African marsh harrier, *Circus ranivorus*, stand in species for marsh harrier):

Surveyor walking in Africa: FID = 61m (n = 1) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Ecology and non-quantitative disturbance responses

As the name indicates, marsh harriers breed in wetland areas with shallow, standing, fresh or brackish waters surrounded by aquatic vegetation such as standing reeds and reedmace (Snow and Perrins, 1998), which are habitats often associated away from human habitation and disturbance. However, this species can also be found on irrigated fields, rush grassland, fens and peat bogs. Marsh harriers are mainly concentrated in south-eastern areas of England, although there has been some range expansion into northwest England, the Channel Islands, the Isles of Scilly and a few sites in eastern Scotland (Balmer *et al*., 2013). As a ground nesting species, marsh harriers build a nest in thick marshy vegetation and sometimes in plants growing in shallow water; the nest is composed of a large pile of grass, reeds and small sticks (Snow and Perrins, 1998). This species feeds on a variety of ground and marsh animals, depending on local conditions (Snow and Perrins, 1998).

Marsh harrier is a partial migrant, some British breeders overwinter in Britain while others migrate to southern Europe and northwest Africa or south of the Sahara (Wernham *et al*., 2002). During the winter in the UK, the highest number of marsh harriers is recorded in a broad coastal band along south-eastern England (Balmer *et al*., 2013), where they may forage on grassy plains or agricultural areas (Snow and Perrins, 1998), which can bring them into contact with sources of human disturbance, although this species seems able to tolerate and even benefit from humanised environments, such as rice fields (Alves *et al*., 2014). During the winter, marsh harriers may gather at communal roost sites; gatherings of more than 30 birds have been recorded in north Norfolk, over 20 in Lincolnshire and up to 15 on the Isle of Sheppey in Kent (see Bright *et al*., 2009 for review).

Marsh harrier is an adaptable and opportunistic species (Wernham *et al*., 2002); the response to human disturbance may vary between individuals depending on levels of habituation to disturbance. In a Spanish study investigating wetland occupation during the breeding season, García *et al*. (2015) found that variables affecting occupation included vegetation composition and characteristics, wetland dimensions and distance to other wetlands occupied by marsh harriers; human disturbance (i.e. distance to paths, roads and habitation) was not a factor affecting wetland occupation.

However, other studies have found that marsh harriers are potentially sensitive to human disturbance. Direct persecution, agro-pastoral activities and lead-poisoning may determine wetland occupation in many areas in Europe; human disturbance has been found to affect different aspects of marsh harrier breeding activity such as breeding effort, nest defence or provision of prey for offspring (Fernández and Azkona, 1993; Stanevicius, 2004). Fernández and Azkona (1993) found that a relatively low level of disturbance during the breeding season (such as a quiet pedestrian) can result in reduced parental care and reduced nutrition levels in the young. To minimise the risk of disturbance in the UK, Hardey *et al*. (2013) recommend that nesting areas are viewed from a distance of 300-500 m, although the reedbed nesting habitat may provide a degree of protection in terms of reducing the visible detection of disturbance by marsh harriers (Ruddock and Whitfield, 2007; Whitfield et al., 2008a). Hardey *et al*. (2013) discourage searches for roosting birds during the breeding season due to the disturbance that this can cause.

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 300-500m

Nonbreeding season buffer zone = 300-500m

Marsh harrier is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for marsh harrier, but the maximum FID value recorded for this species is 130m when approached by a pedestrian during the breeding season; there are no records of AD/FID values during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for marsh harrier during the breeding season is 300-500m, although the authors stated that this estimate was cautionary as survey samples for this species were low.

In the UK, marsh harrier is most likely to be disturbed at nest sites early on in the breeding season as well as at communal roosting areas and potentially foraging grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 300 to 500m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect both breeding and nonbreeding marsh harriers from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

Lack of AD/FID studies on marsh harrier, more empirical studies are required.

Hen harrier, *Circus cyaneus*

Conservation Status

UK: Red List, Schedule 1A

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 545 breeding pairs (Woodward *et al*., 2020);

Scottish population = 460 breeding pairs in 2016 (Challis *et al*., 2020), 350-450 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a weak decrease in breeding birds (-29%) over 12 years.

Hen harrier became virtually extinct in mainland Britain by the start of the 20th century, mainly due to persecution by gamekeepers; tiny populations remained on Orkney, the Outer Hebrides and possibly on Kintyre and on Arran (Forrester *et al*., 2012). Respite from persecution during the two World Wars together with legal protection allowed some recovery time for this species. In the UK plus the Isle of Man, numbers increased from 630 pairs in 1988-89 to 806 pairs in 2004; however, numbers fell again to 662 pairs in 2010 (Balmer *et al*., 2013). Woodward *et al*. (2020) reported a further decrease to 545 pairs in 2016. Steep population declines have been reported from Ireland (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Booms *et al*., 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Aircraft (helicopter) in Alaska: Mean FID = 70m (n = 6), Min/Max FID = 30 to 150m (Booms *et al*., 2010).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 225 to 310m (n = 23 to 24); Min/Max AD (80% opinion range) = <10 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Range of median FID = 30 to 225m (n = 27 to 29), Min/Max FID (80% opinion range) = <10 to 750m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (SNH, 2015) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 500 to 1000m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 500 to 600m (Petty, 1998).

Operational onshore wind farm in the UK: Distance to nearest nest = 200 to 300m (Madders and Whitfield, 2006).

Aircraft disturbance in Scotland: Safe working distance = 500-750m (lateral), 500m (altitudinal) (SNH, 2015).

Ecology and non-quantitative disturbance responses

Hen harriers are generally scarce resident breeders in the UK. This species usually breeds in heather moorland, farmland and newly afforested uplands throughout Scotland, Ireland and Wales. The highest concentrations of hen harrier are recorded in Orkney, Outer Hebrides (Uists) and Inner Hebrides, parts of the Highlands and locally in the Southern Uplands; smaller numbers are present in northern England, Wales and the Isle of Man (Balmer *et al*., 2013). Forestry is influencing population trends, but hen harriers usually only inhabit areas with young trees (<15 years); mature tree plantations are not used by this species (Balmer *et al*., 2013). In Scotland, hen harriers nest on the ground, and the nest, which is a low pile of available vegetation (heather, rushes, grass etc), is constructed in amongst thick marshy vegetation, rarely out in the open (Snow and Perrins, 1998). Male hen harriers may perform a 'sky-dance' over breeding territories early in the season (Forrester *et al*., 2012). Some female hen harriers, and occasionally males, can be aggressive towards people at the nest, even striking an intruder's head with feet and claws, Hardey *et al*. (2013) therefore recommend that head protection is used by surveyors approaching a nest site. This species feeds on small birds and rodents, typically by flying low over the ground and pouncing on prey; in the breeding season hen harriers will hunt along transects, following habitat edges (Snow and Perrins, 1998).

The hen harrier is a partial migrant, juveniles especially may disperse in the winter into southern England, Ireland and southwest Europe, but many adults remain in the UK throughout the year (Wernham *et al*., 2002). It is possible that in late autumn there is a small arrival and passage of wintering birds from Scandinavia, although there is no supporting ringing evidence for this (Forrester *et al*., 2012; Wernham *et al*., 2002). The overwintering population, which is probably largely composed of British and Irish breeders, is significantly different from the breeding distribution, with birds wintering in the lowlands, particularly around the coast all around the UK (Balmer *et al*., 2013). During the winter, hen harriers may gather at communal roost sites; exceptionally large roosts can hold up to 90 birds (in the Isle of Man), but more usually smaller numbers of 3-4 birds roost together, usually in wetlands, but sometimes also on heather moorland, lowland heath, conifer plantations and also in long grass (see Bright *et al*., 2009 for review).

Hen harriers are sensitive to human disturbance, and persecution in the form of nest destruction has been suggested to limit breeding attempts on grouse moors (Whitfield *et al*., 2008b). However, some individual hen harriers are able to habituate to human presence; this species can show a wide range of FID responses to different disturbance sources, some seemingly high disturbance activities such as a helicopter or operational wind turbines in the vicinity of nest sites can cause relatively little disturbance, whereas a pedestrian passing by can provoke a response at a relatively large distance (see Ruddock and Whitfield, 2007 for review; Booms *et al*., 2010; Madders and Whitfield, 2006).

Harriers prefer undisturbed grasslands for nesting (Urquhart, 2011). Tapia *et al*. (2004) found that hen harriers avoid areas with high levels of human activity such as roads and tracks. Another study found that northern harrier nests did not occur closer than 188m from the nearest building (see U.S. Fish and Wildlife Service, 1991 for review). Hiking trails have also been found to decrease the abundance of wintering harriers in riparian zones (Fletcher *et al*., 1999). Through habitat modelling, Tapia *et al*. (2004) suggest that the greatest threats to harrier populations are human infrastructure and human activities such as afforestation and wild-fires that change the habitat conditions.

Hen harriers are especially sensitive to disturbance early on during the breeding season when birds are laying as well as when they are present at roost sites. Hardey *et al*. (2013) state that if females are disturbed during the laying period, nests containing one or two eggs may be deserted. To minimise the risk of disturbance in the UK, Hardey *et al*. (2013) recommend that nesting areas are viewed from distances of 500-700m (Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a) and that care should be taken not to disturb nests in cold or wet weather around the time of hatching or when small young are present. Hardey *et al*. (2013) also discourage searches for roosting birds during the breeding season due to the disturbance that this can cause.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 300-750m

Nonbreeding season buffer zone = 300-750m

Hen harrier is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for hen harrier, but the maximum FID value recorded for this species is 150m when approached by a helicopter during the breeding season; there are no records of AD/FID values during the nonbreeding season. A non-quantitative study suggests that hen harrier will stay at least 188m away from human habitation. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for hen harrier during the breeding season is 500-750m. Hen harrier will nest at 200 to 300m from an operational wind turbine (Madders and Whitfield 2006) or closer (Ruddock and Whitfield, 2007).

In the UK, hen harrier is most likely to be disturbed at nest sites early on in the breeding season as well as at communal roosting areas and potentially foraging grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-750m is suggested to protect both breeding and nonbreeding hen harriers from pedestrian and aircraft disturbance, but habituation to disturbance influences the size of the buffer required and further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to disturbance. For activities with a high potential for visual and audial disturbance (e.g. forestry operations), a larger buffer zone between 500-1000m may be necessary during the breeding period.

Knowledge gaps

There are few studies have directly measured AD/FID for hen harriers, further empirical studies are required particularly focussing on sources of disturbance from human leisure activity.

Common buzzard, *Buteo buteo*

Conservation Status

UK: Green List

European: Least Concern

UK status

Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 63,000-87,500 breeding pairs (Woodward *et al*., 2020); Scottish population 15,000-20,000 breeding pairs, 40,000-60,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Reduced by persecution during late 19th and early 20th century, but this species has subsequently increased with legal protection. Increase has been especially strong in England where the species has spread its range dramatically since 1968-72 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Common buzzard was not included in Ruddock and Whitfield (2007).

Breeding season (common buzzard):

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 49.9 to 88.0m (n = 24); Min/Max FID = 15.3 to 100m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Denmark: FID = 55m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Spain: Range of mean FID = 41.5 to 191.50m (n = 7); Min/Max FID = 34 to 231.2m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Czech Republic: Mean FID = 55.3m (n = 3); Min/Max FID = 40.3 to 70.5m. (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in France: FID = 55m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in France: FID = 25m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Poland: Mean FID = 95.8m (n = 2); Min/Max FID = 30.5 to 161m. (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 60.3m (n = 26) (Jiang and Møller, 2017).

Surveyor walking over farmland in Denmark: Min/Max FID = 0 to 200m (n = 213) (Sunde *et al*., 2009).

Breeding season (rough-legged buzzard, *Buteo lagopus*, stand in species for common buzzard):

Surveyor walking in a rural habitat in Denmark: FID = 20.1m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: FID = 20.1m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season (common buzzard):

Surveyor walking in Europe: Mean FID = 54.06m (n = 9) (Møller, 2008a; Møller and Erritzøe, 2010).

Pedestrian (general activity) in Europe: Mean FID = 51.07m (n = 8) (Møller, 2008b).

Nonbreeding season (rough-legged buzzard):

Surveyor walking in Europe: FID = 20.1m (n = 1) (Møller, 2008a).

Pedestrian walking/running in farmland habitat in Colorado: Mean FID = 177m (n = 45); Min/Max FID = 55 to 900m (Holmes *et al*.,1993).

Motorised vehicle (general) in farmland habitat in Colorado: Mean FID = 71m (n = 62); Min/Max = 9 to 170m.

(Holmes *et al*.,1993).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Forestry operations in Scotland: Safe working distance = 200m

(Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 300 to 450m (Petty, 1998).

Ecology and non-quantitative disturbance responses

Although buzzards were persecuted in the 18th, 19th and early 20th centuries and were impacted by myxomatosis and organochlorine pesticides in the 1950s-60s, the population has rapidly increased; they are now widespread across the UK and are amongst the most abundant diurnal raptor species in Central Europe, (Balmer *et al*., 2013; Sunde *et al*., 2009; Thom, 1986). In the UK this species is most abundant in Wales, southwest and northern England, southern Scotland and the low ground of eastern Scotland, although this species has yet to colonise Shetland (Balmer *et al*., 2013). Buzzards forage over low vegetation, preferring unimproved pasture. They have a broad diet but rabbits are a key prey species (Balmer *et al*., 2013). Buzzards rest and nest on trees, rocky crags or cliffs, or rarely on steeply sloping ground. The nest is a substantial structure of branches, twigs, heather and other available material (Snow and Perrins, 1998). This species can occupy a wide variety of habitats that can be relatively undisturbed or densely populated by humans including: forests, woodland edges, agricultural land with isolated trees, hilly slopes, ridges or uplands with some degree of tree cover (Snow and Perrins, 1998; Thom, 1986). Buzzards are largely sedentary in the UK, and breeding and nonbreeding ranges are similar, although the range does expand slightly in the winter owing to the dispersal of immature birds (Balmer *et al*., 2013).

Due the potential of buzzards to live in close proximity with humans, it is not unexpected to find that this species may be disturbed at shorter distances compared with some other raptors. Studies measuring responses of buzzards to a walking pedestrian found that the FID response was generally lower than 100m with an upper limit of 200m (Díaz *et al*., 2021; Jiang and Møller, 2017; Sunde *et al*., 2009; Møller 2008a, b; Møller and Erritzøe, 2010). White and Sherrod (1973) found that rough-legged buzzards did not flush when a helicopter was 18m from the nest, although some caution should be exercised when comparing disturbance distances between common buzzards and rough-legged buzzards, as the latter species is a northerly breeding bird which may be less wary of humans than buzzards in the UK where some persecution still occurs.

Care must be taken to avoid excessive disturbance around buzzard nests during egg laying and early incubation as desertion can occur (Hardey *et al*., 2013). Santangeli *et al*. (2012) found that buffer zones greater than 100m around nests in intensively harvested areas in Finland resulted in higher occupancy than when harvesting occurred less than 100m from nests, suggesting that as wide a retention buffer zone as possible should be considered in each case (e.g., an increase in clear-cut distance from 0 to just 50 m more than doubled the occupancy).

Likely sensitivity to disturbance = Low/Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-200m

Common buzzard is assessed to have a low to medium sensitivity to human disturbance.

The maximum FID value recorded for buzzard when approached by a pedestrian is 231m during the breeding season and at least 54m (a mean value) during the nonbreeding season, however, the majority of recorded FID values are under 100m during the breeding season. MAD/buffer zones range from 200 to 450m to protect common buzzards from forestry operations during the breeding season in the UK.

In the UK, common buzzard has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed in breeding territories early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect both breeding and nonbreeding common buzzards from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a wider buffer zone up to 450m to avoid disturbance during the breeding period.

Knowledge gaps

A range of FID distances in response to a surveyor walking have been recorded across Europe, but studies investigating other types of human disturbance (e.g. agricultural activities and motorised vehicles) are lacking. Further studies to record AD/FID response to a range of human activities are required, especially during the nonbreeding season.

Honey buzzard, *Pernis apivorus*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern; Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = more than 100 territories and at least 60 confirmed breeding pairs in 2020 (Rare Breeding Birds Panel, 2020b);

Scottish population = 50 territories in Scotland in 2020 (Rare Breeding Birds Panel, 2020b). Challis *et al*. (2020) estimated <10 breeding pairs between 2003-2015. Forrester *et al*. (2012) estimated possibly up to 50 pairs in 2004 and 2-30 individuals during passage.

UK long-term trend

Eaton *et al*. (2021) state a weak increase in breeding birds (+57%) over 25 years.

Honey buzzards have spread into upland forests of northern and western Britain, but as this is a very cryptic species, population estimates shouldn't be too relied upon and there is some uncertainty about trends (Forrester *et al*., 2007; Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Honey buzzard was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Estonia: FID = 60m (n = 1) (Díaz *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Forestry operations in the UK: Safe working distance = 150 to 600m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 400 to 500m (Petty, 1998).

Ecology and non-quantitative disturbance responses

Honey buzzards are a summer visitor to the UK where they have a patchy distribution during the breeding season. The largest concentrations are along the south coast of England including Dorset through to Kent with other smaller breeding populations in Wales, Norfolk, North Yorkshire and Scotland (northeast, central and southern Scotland) (Balmer *et al*., 2013). Honey buzzards are superficially similar in appearance to common buzzards, but the former species is a more secretive woodland raptor specialising in mature woodlands with clearings to allow foraging (largely on insects, particularly bees and wasps), as well as mixed landscapes of detached woods, copses, meadows and small wetlands (Balmer *et al*., 2013; Snow and Perrins, 1998; Thom, 1986). This species breeds on branches or in forks of large trees, usually 10-20m above the ground in nests composed of twigs and green leaves; old carrion or common buzzard nests may be re-used (Snow and Perrins, 1998). Roosts generally occur near to the nest site during the breeding season (Hardey *et al*., 2013). In Scotland, nest woods can be either plantation forest or an older growth mix of deciduous and conifer trees and usually feature open glades, wooded rides and clear-felled areas (Forrester *et al*., 2012). Honey buzzards do not overwinter in the UK, after the breeding season birds migrate mainly to west and central regions of Equatorial Africa where they spend the winter in wooded areas (Snow and Perrins, 1998).

Honey buzzard is a cryptic species and their secretive habits sometimes allow them to inhabit woodland areas close to human habitation; this species has been considered to be vulnerable to persecution and/or interference with habitat, especially in the breeding season (Snow and Perrins, 1998). It may be difficult to determine how much honey buzzards are disturbed by human presence as, in contrast to other raptor species (sparrowhawks, goshawks and common buzzards), honey buzzards are usually silent when disturbed by humans at the nest site (Selås, 1997). For honey buzzard nests, Santangeli *et al*. (2012) reported that buffer zones greater than 100m around nests in intensively harvested areas in Finland resulted in higher occupancy than when harvesting occurred less than 100m from nests, suggesting that as wide a retention buffer zone as possible should be considered in each case (e.g., an increase in clear-cut distance from 0 to just 50 m more than doubled the occupancy).

However, habituation and tolerance of disturbance varies between individual honey buzzards. Some studies have found that this species is more tolerant of human activity than any other raptor species (see Roberts *et al*., 1999 for review). Roberts *et al*. (1999) did not find honey buzzards to be particularly sensitive in a study recording locations of nests in forests of central and lowland Britain. Roberts *et al*. (1999) found that of 48 honey buzzard nesting attempts, 24 (50%) were in trees adjacent to rides, paths or clearings, and a total of 37 (77%) were within 20m; the farthest nest tree was 150m from an access route and only one nest was believed to have failed as a direct result of human disturbance.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-200m

Honey buzzard is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for honey buzzard, but the maximum FID value recorded for this species is 60m when approached by a pedestrian during the breeding season. Buffer zone range from 150 to 600m to protect honey buzzards from forestry operations during the breeding season in the UK. In England, breeding honey buzzards are considered to have a high sensitivity to disturbance within 3km and medium sensitivity within an additional 2km around onshore wind farms.

In the UK, honey buzzard has the potential to be disturbed at nest sites early in the breeding season during egg laying and incubation. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect breeding honey buzzards from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a wider buffer zone up to 600m to avoid disturbance during the breeding period.

Knowledge gaps

A range of FID distances in response to a surveyor walking have been recorded across Europe, but studies investigating other types of human disturbance (e.g. agricultural activities, wind farms and motorised vehicles) are lacking. Further studies to record AD/FID response to a range of human activities are required, especially during the nonbreeding season.

Northern goshawk, *Accipiter gentilis*

Conservation Status

UK: Green List; Schedule 1

European: Least Concern

UK status

Re-introduced Resident Breeder

UK and Scottish population estimate

UK population = 620+ breeding pairs (Woodward *et al*., 2020);

Scottish population = 165 breeding pairs in 2017 (Challis *et al*., 2020), 350-450 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+206%) over 25 years.

Once widespread in Scotland, but was exterminated in the 1880s as a result of deforestation and persecution (Balmer *et al*., 2013). Since then, escaped falconry birds or deliberately released birds first bred in Scotland in 1972, and numbers have increased since then, though at highly variable rates in different parts of Scotland (Forrester *et al*., 2012). Similar increases after release have occurred in Wales and in England (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

AD/FID updates (Díaz *et al*., 2021; Grubb *et al*., 2013) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in an urban habitat in Poland: FID = 23.1m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Spain: FID = 140m (n = 1) (Díaz *et al*., 2021).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 125 to 175m (n = 10); Min/Max AD (80% opinion range) = 10 to 500m; Min/Max AD (90% opinion range) = 300 to 500m.

Range of median FID = 30 to 70m (n = 10), Min/Max FID (80% opinion range) = <10 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Forestry operations (logging truck noise) in North America:

Min/Max AD = 78 to 167m (Grubb *et al*., 2013).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Anonymous, 2012; Naylor, 2009) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations (blasting) in North America: Buffer zone = 1000m

Forestry operations (vehicle/machine) in North America: Buffer zone = 500m

Forestry operations (helicopter) in North America: Buffer zone = 1000m

(Anonymous, 2012).

Forestry operations in Ontario: Buffer zone = 200m (Naylor, 2009).

Forestry operations in the UK: Safe working distance = 250 to 450m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 375 to 425m (Petty, 1998).

Forestry operations in France/Italy at a disturbed site: 100m (Penteriani and Faivre, 2001).

Pedestrian (general buffer zone) from Colorado Wildlife guidance: Buffer zone = c.800m (Craig, 2002)

Ecology and non-quantitative disturbance responses

Goshawk is a relatively scarce resident species in the UK that is associated with state-owned forests. The highest numbers of breeding birds are present in the Scottish Borders, northeast Scotland and Wales, the latter is a major stronghold of this species, numbers are smaller elsewhere (Balmer *et al*., 2013). Goshawk breed on branches or in the forks of large trees, often conifers, usually 10-20m above the ground; the nest is composed of twigs and is freshly built each year, either as a completely new structure, or on top of an existing nest (Forrester *et al*., 2012; Snow and Perrins, 1998). The nests from different years are often clustered within the same tree (Hardey *et al*., 2013). This species may also occasionally breed in small broad-leaved trees, but they are then more susceptible to disturbance (Wernham *et al*., 2002). Goshawks are predators with a wide-ranging diet, prey items include birds as small as goldcrests and mammals as large as adult brown hares; pigeons, corvids and thrushes form the main part of the diet during the breeding season (Forrester *et al*., 2012; Snow and Perrins, 1998). Adults are sedentary and remain in their territories throughout the year, leading to similar patterns of distribution and abundance between seasons, whereas immature birds roam more widely outside key breeding areas (Balmer *et al*., 2013). Adults recorded outside known breeding areas in the winter may include the occasional continental migrant (Forrester *et al*., 2012).

Northern goshawk is a shy, scarce species and is sensitive to human presence, especially early in the breeding season; this species is considered to have low to moderate thresholds for new human disturbance (Anonymous, 2012). Hardey *et al*. (2013) advises that care must be taken to avoid excessive disturbance around goshawk nests during nest building and early incubation as some pairs are prone to desert at this time. Hardey *et al*. (2013) recommend that surveyors monitor nests from a distance of 300-500 m (Ruddock and Whitfield, 2007; Whitfield et al., 2008a) and the authors state that if disturbed early in the season, breeding goshawks may move up to 2.5 km to another nest site, with some pairs having up to four different nesting areas within their nesting range. In a study in Germany, Saga and Selås (2012) found that when goshawk pairs lost their nests during autumn, winter or early spring by natural causes or human disturbance, the birds often moved 500m or 1km away and constructed new nests elsewhere.

However, disturbance distance for individual goshawks depends on habituation to disturbance. Snow and Perrins (1998) state that this species requires freedom from disturbance but will live close to isolated dwellings or even fringes of towns.

At a disturbed forestry site in Arizona, Grubb *et al*. (2013) observed that goshawks present on the nest with 15-day old chicks did not appear to respond to logging trucks passing by the nest at 78m and they generally did not respond to passing aircraft, although in most cases aircraft were louder than the logging truck, indicating acclimatization to aircraft noise. Goshawks are generally considered to be much more tolerant to disturbance in urban environments compared with rural ones (Díaz *et al*., 2021; see Ruddock and Whitfield, 2007 for review).

The type of forest habitat influences goshawk disturbance; in Norway, Saga and Selås (2012) observed that logging did not reduce the proportion of nests used in the second or third breeding season after logging, but that nest reuse was greater in larger areas of mature forest as well as forests with a higher proportion of Norway spruce, which gives better cover than Scots pine and deciduous trees. Santangeli *et al*. (2012) found that buffer zones greater than 100m around nests in intensively harvested areas in Finland resulted in higher occupancy than when harvesting occurred less than 100m from nests, suggesting that as wide a retention buffer zone as possible should be considered in each case (e.g. an increase in clear-cut distance from 0 to just 50 m more than doubled the occupancy).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 300-500m

Northern goshawk is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are fairly limited for goshawk in the UK, but the maximum FID value recorded for this species is 140m when approached by a pedestrian and 167m when approached by a logging truck during the breeding season; there are no records of AD/FID values during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for goshawk during the breeding season is 300-500m; the authors noted that this range is generally in line with the published UK and international buffers.

Buffer zones range from 250 to 425m to protect goshawks from forestry operations during the breeding season in the UK; in America buffer zones for forestry operations can go up to 1km.

In the UK, goshawk has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed in breeding territories early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-500m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect both breeding and nonbreeding goshawks from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions, especially during the nonbreeding season. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a wider buffer zone up to 425m to avoid disturbance during the breeding period.

Knowledge gaps

There are a range of studies providing buffer zones for goshawks, but studies recording AD/FID are relatively few. FID empirical studies are required to record habituation levels of individual birds.

Kestrel, *Falco tinnunculus*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 31,000 breeding pairs (Woodward *et al*., 2020);

Scottish population = 2,750-5,500 breeding pairs in 2013 (Challis *et al*., 2020), 15,000-25,000 individuals in winter and 500-1,000 during passage (Forrester *et al*., 2012).

UK long-term trend

Breeding range in the UK declined by 6% between 1968/72 to 2007/11, UK population declined by 32% between 1995 to 2010, part of an overall decline of 44% since 1970 (Balmer *et al*., 2013). The decline in the kestrel population is thought to be stronger in Scotland than in England (Forrester *et al*., 2012), this species declined by 61% in Scotland between 1995-2018 (Harris *et al*., 2020). Losses have occurred in western Scotland, Wales and sparingly through the midlands and north of Ireland (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Kestrel was not included in Ruddock and Whitfield (2007).

Breeding season (kestrel):

Surveyor walking in a rural habitat in Spain: Range of mean FID = 2.8 to 12m (n = 16), Min/Max FID = 9.6 to 151.7m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Spain: Range of mean FID = 11.8 to 31.6m (n = 9), Min/Max FID = 10.9 to 31.6m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 18 to 48m (n = 6), Min/Max FID = 8.5 to 48m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Hungary: Range of mean FID = 25 to 41.5m (n = 5), Min/Max FID = 12.5 to 91.6m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Czech Republic: Range of mean FID = 31 to 61.3m (n = 6), Min/Max FID = 31 to 61.3m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Poland: Range of mean FID = 19.9 to 117.7m (n = 3), Min/Max FID = 19.9 to 120m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Poland: FID = 40.3m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID = 32.6m (n = 10) (Jiang and Møller, 2017).

Breeding season (lesser kestrel, *Falco naumanni*, stand in species for kestrel):

Surveyor walking in Europe: Mean FID = 44.3m (n = 5) (Jiang and Møller, 2017).

Nonbreeding season (kestrel):

Surveyor walking in Europe: Mean FID = 30.08m (n = 6) (Møller, 2008a).

Pedestrian (general activity) in Europe: Mean FID = 18.02m (n = 3) (Møller, 2008b).

Surveyor walking in Europe: Mean FID = 30.94m (n = 9) (Møller and Erritzøe, 2010).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Forestry operations in the UK: Disturbance free zone = 100 to 200m (Petty, 1998).

Ecology and non-quantitative information on disturbance responses

The kestrel is one of the most adaptable, widespread and abundant resident raptor species in the UK. Densities are highest in central and eastern England and southwest Ireland, but this species is scarcer in western Scotland, Wales and southwest England (Balmer *et al*., 2013). Breeding and nonbreeding ranges are very similar in the UK (Balmer *et al*., 2013). Kestrels inhabit a wide range of habitats, both in uplands and lowlands. Rural habitats include moorland, heathland, grassland, wetlands, woodlands and coastal areas; kestrels will also inhabit many areas close to human activity including: parklands, airfields, railways, motorways and other grass-verge highways, canal and river banks, as well as within human settlements including cities with open green spaces (Snow and Perrins, 1998). The nesting locations of this species are highly variable and include cavities or forks in trees and on cliffs, buildings, occasionally pylons, and they will readily take to nest boxes when available (Snow and Perrins, 1998). Kestrels will alarm call if disturbed or if responding to other raptors or corvids entering the nest area, they may also be seen displaying over the nesting territory (Hardey *et al*., 2013). This species is adaptable and opportunistic in its foraging behaviour; the diet is chiefly small mammals (especially voles), although birds, insects and lizards may also be taken depending upon location and season (Snow and Perrins, 1998).

The kestrel is considered a human-tolerant species, they occur in a variety of human-dominated environments including urban, suburban and agricultural habitats and are therefore able to habituate to at least some degree of human presence. However, although recorded FID values are generally lower for kestrel than for some other raptor species (e.g. Díaz *et al*., 2021), some studies have shown that kestrel breeding success can be impacted by human disturbance (Strasser, 2010). In a study on American kestrels, Strasser and Heath (2013) found that birds nesting in areas with higher levels of vehicle traffic were 9.9 times more likely to fail than birds nesting in lesser disturbed areas (the habitat and clutch initiation dates did not explain the reproductive outcome). In addition, proximity to large, busy roads and developed areas was found to negatively affect kestrel reproduction by causing increased stress hormones that promoted nest abandonment. The authors of the study suggested that their results demonstrated that the presence of kestrels in human-dominated areas does not necessarily indicate a tolerance for human presence and that disturbance may cause physiological stress responses that impact survival.

Negro and Hiraldo (1993) found that the breeding success of lesser kestrels in Spain was positively correlated with the height of their nests and it was suggested that birds selected the highest positions to avoid predation and disturbance (by carnivores or humans). However, response to human disturbance may differ between kestrels and lesser kestrels as the former is usually a solitary nesting species, whereas lesser kestrel is colonial breeder, sometimes breeding in colonies up to 500 pairs (Snow and Perrins, 1998).

Hardey *et al*. (2013) advises that care must be taken to avoid excessive disturbance around kestrel nests while pairs are displaying and laying as this may cause the birds to move location. Disturbance at kestrel nests should also be avoided when the chicks are three weeks old or more because they are prone to fledge prematurely from this age (Hardey *et al*., 2013).

The kestrel population is declining in the UK; this may be a consequence of the recovery of the buzzard population (through better protection) which competes with kestrels for small mammalian prey (Forrester *et al*., 2012). In addition, kestrels may be suffering from predation from the increasing UK population of goshawk and peregrine predators (Forrester *et al*., 2012). Concern has been raised by NatureScot over excessive kestrel disturbance at a site in northeast Scotland (NatureScot, 2019); the additional potential for stress caused by excessive human disturbance may increasingly have a detrimental impact upon this species.

Likely sensitivity to disturbance = Low/Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone ≤ 50m

Kestrel is assessed to have a low to medium sensitivity to human disturbance.

The maximum FID value recorded for kestrel when approached by a pedestrian is 152m during the breeding season and at least 31m (a mean value) during the nonbreeding season; the majority of recorded FID values are under 50m during the breeding season. Buffer zones range from 100 to 200m to protect kestrels from forestry operations during the breeding season in the UK.

In the UK, kestrel has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season; this species is most sensitive to disturbance early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect nesting kestrels and a buffer zone of ≤50m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

A range of FID distances in response to a surveyor walking have been recorded across Europe, but studies investigating other types of human disturbance (e.g. agricultural activities and motorised vehicles) are lacking. Further studies to record AD/FID response to a range of human activities are required, especially during the nonbreeding season.

Eurasian hobby, *Falco subbuteo*

Conservation Status

UK: Green List; Schedule 1

European: Least Concern

UK status

Migrant/Resident Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 2,050 breeding pairs (Woodward *et al*., 2020), Challis *et al*. (2020) estimated 632 breeding pairs in UK;

Scottish population is fewer than five breeding pairs, 10-30 individuals during passage (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a weak increase in breeding birds (+48%) over 25 years.

Hobby has undergone a large-scale expansion in range, consolidating their distribution in southern England and spreading north (Balmer *et al*., 2013). The UK population increased by 16% between 1995 and 2010; between 2008-11 this species was found to occupy four times as many 10 km squares as in 1968-72 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Hobby was not included in Ruddock and Whitfield (2007).

No AD/FID distances available for hobby.

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Forestry operations in the UK: Safe working distance = 180 to 450m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative disturbance responses

The hobby is a summer visitor to the UK. Hobbies are a fairly rare breeding species in Scotland, but south of a line from the Humber to the Mersey, this is a widespread breeding species (with the exception of west Wales and Cornwall where they remain scarce) (Balmer *et al*., 2013). Hobbies breed in lowland habitats with open expanses of low vegetation broken up by groups of tall trees or fringed by mature woodlands, warm enough to sustain an abundance of insect prey, principally dragonflies (Balmer *et al*., 2013; Snow and Perrins, 1998), however, as this species has spread north, lowland farmland areas have been increasingly used for breeding (Messenger and Roome. 2007; Sergio and Bogliani 1999). Hobbies nest on trees between 6 and 32m tall, usually in old carrion crow nests (Snow and Perrins, 1998). This species is relatively common in cultivated landscapes in Europe (Fuller *et al*., 1985; Bogliani *et al*., 1994) and they are able to adapt fairly well to intensively managed agroforestry systems (Sergio and Bogliani, 1999; 2000). Hobbies don’t overwinter in the UK, after the breeding season they migrate south to warmer latitudes and spend the winter mainly in southern Africa (Wernham *et al*., 2002).

Hobbies show some ability to habituate to human disturbance in farmland areas. Messenger and Roome (2007) observed that in a study of breeding hobbies on lowland farmland in Derbyshire, birds were generally unconcerned by the presence of humans inside vehicles near a nest site, but were usually alarmed by humans on foot close to nest sites; three cases of human related nest failures were thought to be due to unintentional disturbance by farmers or others working outside vehicles for extended periods in the immediate vicinity of the nest. Sergio and Bogliani (1999) documented similar tolerance to human disturbance, in Italy some hobby pairs appear to be extremely tolerant of humans inside tractors, some birds have also been observed to continue incubation whilst the ground just underneath the nest is ploughed. Sergio and Bogliani (1999) also reported that the local hobby population in their Italian study area appeared to have adapted fairly well to the intensively managed agroforestry system, with a recorded density and productivity in the range being similar to that reported for other European hobby populations in less intensively cultivated areas.

However, despite some tolerance shown towards human presence, hobbies are possibly still more likely to choose breeding habitats away from human disturbance if suitable habitat is available. In another study investigating hobby nest site selection in Italy, Sergio and Bogliani (2000) observed that hobbies select nesting areas with a higher extent of mature poplar plantations and further away from potential sources of human disturbance; mean distances of nest sites from roads ranged from 1,004 to 1,255m and mean distance to human habitation ranged from 1,024 to 1,546m. Hardey *et al*. (2013) advises that hobbies are particularly sensitive to disturbance during early incubation and that intensive nest searches are best carried out at a time when young are likely to have hatched.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 200-450m

Eurasian hobby is assessed to have a medium sensitivity to human disturbance, but this is a cautionary assessment due to the lack of available published studies reporting AD/FID values for this species.

Buffer zones range from 180 to 450m to protect hobbies from forestry operations during the breeding season in the UK.

In the UK, hobby has the potential to be disturbed at nest sites early in the breeding season during egg laying and incubation. Depending on the level of habituation to disturbance, a buffer zone of 200-450m is suggested to protect breeding hobbies from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

There is little published on the effects of human disturbance on hobbies. Studies are required to measure a range of human disturbance on the AD/FID for this species.

Peregrine falcon, *Falco peregrinus*

Conservation Status

UK: Green List, Schedule 1

European: Least Concern, Annex 1

UK status

Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,750 breeding pairs (Woodward *et al*., 2020);

Scottish population = 523 (479-592) breeding pairs in 2014 (Challis *et al*. 2020), 2,000-2,500 individuals during winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (+5%) over 22 years.

Although numbers decreased considerably due to organochlorine pesticides in the 1950s-60s, there has been a large increase in numbers after the pesticide ban; a 200% range expansion is reported between 1968-72 to 2008-11 (Balmer *et al*., 2013). However, population trends in different parts of the UK vary and populations in some upland areas have declined; in contrast with England, the population estimates for Scotland suggest an overall decline between 2002 to 2014 (Wilson *et al*.,2018),

AD/FID

Quantitative disturbance distances

No AD/FID updates published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 225 to 310 (n = 24 to 26); Min/Max AD (80% opinion range) = 10 to 750m; Min/Max AD (90% opinion range) = 500 to 750m.

Range of median FID = 125 to 225m (n = 30 to 31); Min/Max FID (80% opinion range) = 10 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season (Prairie falcon, *Falco mexicanus*, stand in species for peregrine falcon):

Pedestrian walking/running in farmland habitat in Colorado: Mean FID = 92m (n = 33); Min/Max FID = 24 to 185m (Holmes *et al*.,1993).

Motorised vehicle (general) in farmland habitat in Colorado: Mean FID = 85m (n = 27); Min/Max = 18 to 200m (Holmes *et al*.,1993).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Slankard *et al*., 2020; SNH, 2015) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian (general buffer zone) from Colorado Wildlife guidance: Buffer zone = c.802m (Craig, 2002).

Pedestrian leisure (climbing) in North America: Buffer zone = 800m

Pedestrian leisure (general) in North America: Buffer zone = 800 to 1500m

Noise disturbance in North America: Buffer zone = 800m

Pedestrian (general) in North America: Buffer zone = 200 to 1600m

(Richardson and Miller, 1997).

Pedestrian leisure (climbing) in the UK: Buffer zone = 200m (Brambilla *et al*., 2004).

Pedestrian leisure (climbing; walking/running) in North America: Buffer zone = 400 to 800m (Ellis, 1982).

Forestry operations in the UK: Safe working distance = 600 to 1000m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 400 to 600m (Petty, 1998).

Forestry operations in Poland: Strict buffer zone = 200m, Seasonal buffer zone = 500m (see Bright *et al*., 2006).

Aircraft disturbance in Scotland: Safe working distance = 500-750m (lateral), 500m (altitudinal) (SNH, 2015).

Aircraft n Europe: Buffer zone = 500m (Fyfe and Olendorff, 1976).

Construction activity at a bridge in the USA: Buffer zone = 46 to 91m (Slankard *et al*., 2020).

Quarrying activities: Buffer zone = 150 to 600m, depending on habituation and tolerance of the individual to human disturbance (British Columbia Ministry of Forests, Lands and Natural Resource Operations, 2013)

Nonbreeding season:

Pedestrian and vehicle disturbance in farmland habitat in Colorado: Buffer zone = 160m (Holmes *et al*.,1993).

Quarrying activities: Buffer zone = 50 to 500m, depending on habituation and tolerance of the individual to human disturbance (British Columbia Ministry of Forests, Lands and Natural Resource Operations, 2013)

Ecology and non-quantitative disturbance responses

The peregrine falcon is a resident species in the UK. Peregrine falcons are adaptable and highly mobile, they breed in a wide range of environments including uplands and coastal areas with suitable precipitous cliffs and crags as well as across much of the lowlands where they can breed in quarries or trees and man-made structures (Balmer *et al*., 2013; Snow and Perrins, 1998). Depending on the location of breeding, the nest can be formed of a slight scrape in earth or old nest debris of nest ledge or a depression on top of an old nest of another species (Snow and Perrins, 1998). Peregrines feed chiefly on birds taken on the wing, usually over open country, but if nesting by the coast, hunting may be carried out almost exclusively over the sea during the breeding season (Snow and Perrins, 1998). Prey recorded in Scotland ranges in size from goldcrest to geese with pigeons and red grouse often eaten (Forrester *et al*., 2012). In the UK, peregrines are non-migratory and breeding and nonbreeding ranges are similar (Balmer *et al*., 2013), though many individuals, especially immature birds may wonder extensively in autumn and winter (Snow and Perrins, 1998).

Peregrines vary in their tolerance to human disturbance. Generally, undisturbed habitats are preferred for breeding, but the use of man-made structures for nesting by some individuals can be very wide and varied including: tall buildings, bridges, electricity pylons, power stations, chimneys, gas towers, church towers, quarry machinery, ruins and windowsills in high-rise buildings (Balmer *et al*., 2013; Forrester *et al*., 2012; Ruddock and Whitfield, 2007 for review). The tolerance level of individual peregrines is likely to depend on the regularity and type of disturbance individuals are exposed to (Ruddock and Whitfield, 2007). Some individual falcons appear to be unaffected by loud disturbance events in close vicinity to the nest, for example, in Alaska, White and Sherrod (1973) found that peregrines did not flush when a helicopter was 18m from the nest and in Australia, Olsen and Olsen (1980) noted that water skiers can regularly pass within 50m of eyries without having any noticeable effect on behaviour. Hardey *et al*. (2013) consider that pairs in remote locations may be more sensitive to human activity whereas birds in urban areas, quarries or frequently visited sites may be more tolerant of disturbance. Hardey *et al*. (2013) also state that if licenced surveyors require to record clutch size, incubating peregrines can be flushed from the eyrie during good weather by loud noises (clapping, shouting), but despite such disturbance, some birds may not leave their eggs until the eyrie is reached. Breeding peregrines have been reported to tolerate large amounts of casual disturbance at high, inaccessible cliffs in the UK (see Bright *et al*., 2006 for review). Moore *et al*. (1997) state that in the absence of interference to eyries or their occupants, breeding peregrines will ignore most human disturbance. Olsen and Allen (1997) noted that peregrines can be very tolerant of quarrying activity in close proximity to nest sites; an incubating female on a nest located 15m high in a quarry in Australia was noted to return to her nest within ten minutes of blasting occurring within 100m of her nest, three young later successfully fledged from the nest.

However, despite the apparent tolerance of humans shown by some individuals, peregrines are still potentially sensitive to disturbance, especially early on during the breeding season when birds are laying and incubating; for some pairs human presence around the nest can prevent breeding (e.g. Olsen and Olsen, 1980). Ratcliffe (1984) suggested that peregrines don’t flush in the presence of humans “until at close range” but that disturbance may cause nest failure. In the UK, Hardey *et al*. (2013) recommend that nesting areas are viewed from distances of 500–750m (Ruddock & Whitfield 2007, Whitfield *et al.,* 2008a) to minimise the risk of disturbance and that visits made to the nest by licenced surveyors to measure and ring chicks should be made before the young are 25 days old because after this disturbance to a nest may cause premature fledging. Ruddock & Whitfield, (2007) state that activities above a nest are more likely to cause disturbance than those below.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 500-750m

Nonbreeding season buffer zone ≤ 200m

Peregrine is generally assessed to have a high sensitivity to human disturbance, although response distances by individual birds can vary widely.

Quantitative studies measuring AD/FID are very limited for peregrine, but the maximum FID value recorded for Prairie falcon in the USA is 185m when approached by a pedestrian and 200m when approached by a motorised vehicle during the nonbreeding season; there are no records of AD/FID values during the breeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for peregrine during the breeding season is 500 to 750m.

Buffer zones to protect peregrines from pedestrian disturbance during the breeding season in North America range from 200m to 1.6km, a 200m buffer zone has been suggested to protect breeding birds from climbing disturbance in the UK. Buffer zones to protect breeding peregrines from forestry operations in the UK range from 200 to 600m. A safe working distance for aircraft in Scotland is considered to be 500-750m (lateral) and 500m (altitudinal).

In the UK, peregrine has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed in breeding territories early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 500-750m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect nesting peregrines and a buffer zone ≤200m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions, especially during the nonbreeding season. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a wider buffer zone up to 600m to avoid disturbance during the breeding period.

Knowledge gaps

A range of buffer zones exist, but very few studies have measured peregrine AD/FID. Further studies, particularly focussing on the AD/FID response to human leisure activities and quarrying activities in the UK are required for this species.

Merlin, *Falco columbarius*

Conservation Status

UK: Red List, Schedule 1

European: Vulnerable, Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,150 breeding pairs (Woodward *et al*., 2020); Scottish population = 733 breeding pairs in 2008 (Challis *et al*. 2020), 3,000+ individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a weak increase in breeding birds (+94%) over 25 years.

Numbers were thought to be declining slightly up to 1950,and declining faster after 1950. During 1968-72 the population was estimated at 600-800 pairs (of which 280 pairs in Scotland), but surveys in 1983-84 and 1993-94 suggest an increasing population with about 1,100-1,500 pairs (of which 800 pairs in Scotland) (Forrester *et al*., 2012).

AD/FID

Quantitative disturbance distances

No AD/FID updates published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 225 to 400m (n = 19 to 22); Min/Max AD (80% opinion range) = <10 to 500m; Min/Max AD (90% opinion range) = 300 to 500m.

Range of median FID = 30 to 225m (n = 28 to 30); Min/Max FID (80% opinion range) = <10 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Pedestrian walking/running in farmland habitat in Colorado: Mean FID = 76 (n = 14); Min/Max FID = 17 to 180m (Holmes *et al*., 1993).

Motorised vehicle (cars) in farmland habitat in Colorado: Mean FID = 62 (n = 10); Min/Max FID = 44 to 85m (Holmes *et al*., 1993).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Naylor, 2009) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running or motorised vehicles in farmland habitat in Colorado: Buffer zone = 125m (Holmes *et al*., 1993).

Pedestrian activity (general) in North America: Buffer zone = 400m (Becker and Ball, 1983).

Forestry operations in the UK: Safe working distance = 200 to 400m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 200 to 300m (Petty, 1998).

Forestry operations in Ontario: Buffer zone = 200m (Naylor, 2009).

Nonbreeding season:

Pedestrian and vehicle disturbance in farmland habitat in Colorado: Buffer zone = 125m (Holmes *et al*.,1993).

Ecology and non-quantitative disturbance responses

Merlin is a resident breeder in the UK. This species preferentially breeds in upland moorland areas dominated with heather. Scotland holds more than half of the breeding population, the highest densities in the UK are located on Scottish islands, in the northern and eastern Scottish Highlands, the north Pennines and northwest Ireland (Balmer *et al*., 2013). Merlin chiefly feed on small birds caught in open country (Snow and Perrins, 1998). Like other falcons, merlin do not build their own nests but reuse those created by other species, usually corvids, or they lay their eggs in a scrape on the ground (Snow and Perrins, 1998). Tree-nesting merlin are likely to have a greater detection capability compared with birds nesting on the ground, although tree nesting merlin may respond to human disturbance at shorter distances (see Ruddock and Whitfield, 2007 for review). Breeding merlin roost on the ground in deep vegetation, in trees or on crags close to the nest site Hardey *et al*. (2013). In the nonbreeding season, wintering merlin are joined by immigrants from Iceland (Wernham *et al*., 2002). Merlins are much more widespread in the UK during the nonbreeding season, during the winter they tend to avoid uplands and inhabit lower-lying habitats (Balmer *et al*., 2013).

Merlin is a species known to tolerate some human disturbance and there are many individuals which nest in urban environments (Konrad, 2004; Haney and White, 1999) where reproductive output can be higher than in rural populations (see Ruddock and Whitfield, 2007 for review). Holmes *et al*., 1993 discussed that merlin may flush at shorter distances when disturbed on a paved road than when disturbed on gravel roads; the authors discussed that the reason for this may be that merlin perching along paved roads have habituated to the greater traffic volume associated with them, or that individuals with greater tolerance limits to disturbance may be using areas with greater disturbance levels.

However, tolerance of disturbance varies between individuals and merlin are potentially sensitive to disturbance, especially early on during the breeding season when birds are laying and incubating. Newton *et al*. (1981) suggested that increased human recreational disturbance in the Peak District may prevent this species from achieving former breeding numbers in this area. Holmes *et al*. (1993) showed that merlin were more likely to flush when approached by a human on foot than they were when approached by a vehicle. Besides pedestrians, other human activities may impact breeding merlin including camping and picnic areas, shooting and fishing activities (see Konrad, 2004 for review). Becker and Ball (1983) discussed that established breeding merlin populations may decline from increased stress and reduced productivity if human disturbance is persistent.

In the UK, Hardey *et al*. (2013) advise that care must be taken to avoid excessive disturbance around occupied merlin nesting ranges in late March and April, as this may cause the birds to move. To minimise the risk of disturbance Hardey *et al*. (2013) recommended that nesting areas are viewed from distances of 300–500m (Ruddock & Whitfield, 2007; Whitfield *et al.*, 2008a) and that no attempt should be made to locate the roosts of breeding merlin because of the potential for disturbance. Adult merlin flushed from nests may take a long time to return to a nest after disturbance, during which time the eggs are at risk of chilling; small young may also be dislodged (Hardey *et al*., 2013).

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 300-500m

Nonbreeding season buffer zone ≤ 200m

Merlin is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for merlin, but the maximum FID value recorded for this species in the USA is 180m when approached by a pedestrian and 85m when approached by a motorised vehicle during the nonbreeding season; there are no records of AD/FID values during the breeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for merlin during the breeding season is 300 to 500m.

Buffer zones to protect merlin from pedestrian disturbance during the breeding season in North America range from 125 to 400m. Buffer zones to protect breeding merlin from forestry operations in the UK range from 200 to 400m.

In the UK, merlin has the potential to be disturbed on breeding grounds as well as at roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed in breeding territories early in the breeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-500m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect nesting merlin and a buffer zone ≤200m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions, especially during the nonbreeding season. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

There are only a few published studies measuring merlin AD/FID. Further studies, particularly focussing on the AD/FID response to human leisure activities are required for this species.

Species: Waders

Eurasian oystercatcher, *Haematopus ostralegus*

Conservation Status

UK: Amber List

European: Vulnerable

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 95,500 breeding pairs, 305,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 84,500-116,500 breeding pairs, 80,000-120,000 in winter (Forrester *et al*., 2012).

UK long-term trend

Relatively stable, population declined by 29% in Scotland (causes are unclear) contrasting with a 48% increase in England, gains in Britain are almost exclusively at inland sites, though there are some gains along the south coast of England (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Oystercatcher was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Scotland: Mean FID = 20.2m (n = 9); Min/Max FID = 16 to 22m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Scotland: Mean FID = 24.5m (n = 2); Min/Max FID = 24 to 25m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 35 to 45.1m (n = 9); Min/Max FID = 18 to 40m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Denmark: FID = 28m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Norway: Range of mean FID = 18.6 to 24m (n = 14); Min/Max FID = 15 to 35m (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in Norway: Mean FID = 28m (n = 3); Min/Max FID = 28 to 28m (Díaz *et al*., 2021).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 43m (n = 62); Min/Max FID = 15 to 105m (Scarton, 2018a).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Mean FID = 58.1m (n = 63); Min/Max FID = 31 to 92m (Scarton, 2018a).

Nonbreeding season:

Surveyor walking along shoreline in Scotland: Mean FID of foraging birds = 43.81m (n = 165), Min/Max AD = 18 to 68m; FID was less in areas with more human activity (Azaki and Cresswell, 2021).

Surveyor walking over mudflats in Scotland: Mean FID = 137.61m (n = 22) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 97.3m (n = 147); Min/Max FID = 30 to 228m (Collop *et al*., 2016).

Surveyor walking in an estuary in England: Mean FID = 41m (n = 48) (Brett, 2012).

Surveyor walking along a shoreline in England: Mean FID = 39m (Carless, 2005).

Surveyor walking on mussel bed in England: Mean FID = 123 (n = 27); Min/Max FID = 90 to 140m (Stillman and Goss-Custard, 2002).

Surveyor walking on mussel bed in England: Range of mean FID = 26 to 48m (n = 83) (Urfi *et al*., 1996).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 76.7m (n = 17); Min/Max FID = 50 to 122m (Scarton, 2018b).

Surveyor walking in mudflats in Denmark: Mean FID = 119m (n = 172), Min/Max FID = 20 to 400m (Laursen *et al*., 2005).

Pedestrian walking/running along a shoreline in Northern Ireland: Mean FID = 29m (n = 53) (Fitzpatrick and Bouchez, 1998).

Pedestrian walking/running on grasslands in the Netherlands/Germany: Mean FID = 82m (Smit and Visser, 1993).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Range of mean FID = 85 to 136m; Min/Max FID = 25 to 300m (Smit and Visser, 1993).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median AD = 40m (n = 19), Min/Max AD = 20 to 80m; Range of median FID = 32.5 to 50m (n = 118); Min/Max FID = 0 to 200m (Liley *et al*., 2011).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 25 to 150m; Median FID = 46m (n = 129); Min/Max FID = 10 to 200m (Liley *et al*., 2010).

Pedestrian egg collector in the Netherlands /Germany: Mean FID = 46m (Smit and Visser, 1993).

Cattle disturbance in the Netherlands /Germany: Mean FID = 10m (Smit and Visser, 1993).

Agricultural activities in the Netherlands /Germany: Mean FID = 60m (Smit and Visser, 1993).

Aircraft (fixed-winged aeroplane) in the Netherlands /Germany: Mean FID = 500m (Smit and Visser, 1993).

Motorised vehicle (cars) in the Netherlands /Germany: Mean FID = 106m (Smit and Visser, 1993).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Mean FID = 74m (n = 10); Min/Max FID = 32 to 115m (Scarton, 2018b).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 60m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 160m (Laursen *et al*., 2017).

Non-motorised watercraft (kite surfer) in nearshore waters off Denmark: Mean FID = 130m (Laursen *et al*., 2017).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 82m. Conservative buffer zone of 100m is proposed (Scarton, 2018a).

Motorised watercraft in a coastal lagoon habitat in Italy: Buffer zone = 85m. Conservative buffer zone of 100m is proposed (Scarton, 2018a).

Nonbreeding season:

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 121m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Motorised watercraft in a coastal lagoon habitat in Italy: Buffer zone = 124m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Ecology and non-quantitative disturbance responses

Oystercatcher is a widespread species and breeds on almost all UK coasts (Balmer *et al*., 2013). High densities of breeding birds are associated with the upland margins in eastern Scotland and northern England, as well as with the Northern Isles (Balmer *et al*., 2013). This species breeds in a wide range of habitats where there may be contact with humans including coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water (Snow and Perrins, 1998), As this species share habitats that are often attractive to humans, oystercatchers are often exposed to human disturbance, including trampling on nests and pursuit of chicks and adults by dogs (Tratalos *et al*., 2021). Tolerance of human disturbance varies between individual oystercatchers Tjørve and Tjørve, 2010); there are a number of studies showing that human recreational disturbance reduces breeding success (e.g. Stillman and Goss-Custard 2002, Verhulst *et al*., 2001) and that population density is lower in areas where there are high numbers of people (Tratalos *et al*., 2021). Virzi (2010) found that human disturbance influenced territory choice in American oystercatchers *Haematopus palliates*. However, there are cases of oystercatchers nesting in suburban areas (Forrester *et al*., 2007), for example on flat roofs of buildings, in car parks, and on roundabouts. On the other hand, several studies suggest that oystercatcher is less sensitive to disturbance than other wader species, allowing a closer approach and showing habituation to recreational activity and construction work (see literature review in Woodward *et al*., 2015); Davidson and Rothwell (1993) consider oystercatcher to be less nervous than other wader species. Oystercatchers can show some behavioural plasticity in the choice of foraging areas (van Dijk, 2014; van de Pol *et al*., 2009; Safriel 1985) and nest site locations (Briggs, 1984; Heppleston 1972) which may allow some adaption to human presence.

In the nonbreeding season, oystercatcher is chiefly a coastal species, frequenting rocky and estuarine shores with the largest concentrations forming on the major estuaries (Balmer *et al*., 2013); the presence of humans along the shoreline may impact foraging success (Coleman *et al*., 2003) although Collop (2016) suggested that oystercatcher may be able to cope with a 10% reduction in time spent feeding caused by daily disturbance events on the Wash. Oystercatchers usually roost on the coast at high tide, although they can also roost communally inland (Goss-Custard, 1981). Disturbance from human activity may disrupt sleep patterns and ultimately have fitness implications for this species (McBlain *et al*., 2020), although for some roosting flocks, disturbance may only marginally affect daily energy expenditure (Linssen *et al*., 2019). However, the response of roosting birds to human disturbance is likely to depend on the source of disturbance. In a study in North Wales, McBlain *et al*. (2020) found that human disturbance (particularly pedestrians exercising dogs) at daytime roost sites led to increased vigilance and reduced sleeping time, while increased boat activity (leisure watercraft and commercial boats) resulted in a reduced duration of vigilance but increased “peek” (eye-blinking) frequency, possibly because boat locations were a more predictable source of disturbance than pedestrians. Burton *et al*. (1996) suggest that after redevelopment at Hartlepool West Harbour, Cleveland, the numbers of roosting oystercatcher declined, despite the creation of a new island roost, likely because of increased disturbance, particularly from people and boats due to the increased access to the marina.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Robust evidence

Breeding season buffer zone = 50-100m

Nonbreeding season buffer zone = 150-300m

Oystercatcher is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for oystercatcher when approached by a pedestrian is 105m during the breeding season and 400m during the nonbreeding season. For motorised watercraft, mean FID values of 58m and 74m have been recorded during the breeding and nonbreeding seasons respectively; during the nonbreeding season, a range of mean FID values between 60-160m have been recorded for non-motorised watercraft. The highest FID value of 500m was recorded for oystercatcher when approached by an aircraft in the nonbreeding season.

During the breeding season, buffer zones of 82m and 85m have been proposed to protect oystercatchers against pedestrian and motorised watercraft disturbance respectively; a conservative buffer zone of 100m has been suggested. During the nonbreeding season, buffer zones of 121m and 124m have proposed for pedestrian and motorised watercraft disturbance respectively, but for flocks of mixed waders containing more sensitive species (e.g. curlew), a buffer zone of 270m is suggested to protect winter roosts.

In the UK, oystercatcher has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower during the nonbreeding season. A buffer zone of 50-100m is suggested to protect nesting oystercatcher and a buffer zone of 150-300m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian and watercraft disturbance.

Knowledge gaps

More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft, especially during the breeding season.

Ringed plover, *Charadrius hiaticula*

Conservation Status

UK: Red List

European: Least Concern

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 5,450 (5,250-5,600) breeding pairs, 42,500 individuals in winter (Woodward *et al*., 2020); Scottish population = 4,900-6,700 breeding pairs, 23,000-25,000 in winter (Forrester *et al*., 2012).

UK long-term trend

There has been a 23% range contraction in Ireland and a 5% expansion in Britain since 1968-72; the British breeding population declined by c.37% between 1984-2007 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Ringed plover was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 9.0 to 28.5m (n = 38); Min/Max FID = 9 to 40m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: Mean FID = 20.4m (n = 5); Min/Max FID = 10 to 30m (Díaz *et al*., 2021).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max FID = 17 to c.100m (Liley and Sutherland 2007).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: FID = 31.91m (n = 1) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 41.1m (n = 30); Min/Max FID = 20 to 74m (Collop *et al*., 2016).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 47.7m (n = 18); Min/Max FID = 25 to 76m (Scarton, 2018b).

Surveyor walking in mudflats in Denmark: Mean FID = 42m (n = 59), Min/Max FID = 18 to 100m (Laursen *et al*., 2005).

Surveyor walking along a shoreline in Africa: Mean FID = 16.1m (n = 16.1), Min/Max FID = 10 to 29m (Mikula *et al*., 2018).

Surveyor walking in Europe: Mean FID = 22.50m (n = 10) (Møller, 2008a).

Surveyor walking along an inland waterbody in Africa: Range of mean FID = 15.7 to 30.5m (n = 63), Min/Max FID = 9 to 36m (Mikula *et al*., 2018).

Surveyor walking along a river delta in Africa: Mean FID = 24.0m (n = 6),

Min/Max FID = 13 to 40m (Mikula *et al*., 2018).

Surveyor walking in Africa: Mean FID = 7.8m (n = 12) (Weston *et al*., 2021).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Mean FID = 121m; Min/Max FID = 80 to 162m (Smit and Visser, 1993).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Min/Max FID = 30 to 100 (n = 3) (Liley *et al*., 2011).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 50 to 125m; Min/Max FID = 30 to 100m (Liley *et al*., 2010).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 77m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Ecology and non-quantitative disturbance responses

Ringed plover has a patchy but widespread and mainly coastal distribution in the UK; breeding birds are notably absent from coastal regions of southwest England, Yorkshire and southwest Wales (Balmer *et al*., 2013), which is due to the lack of suitable nesting beaches in these areas (Wernham *et al*., 2002). This species tends to be most numerous and concentrated on wide sandy or shingle tidal beaches, with access to suitable resting or nesting places above the highwater mark (Snow and Perrins, 1998). Inland breeding also occurs in some wetland habitats including along rivers, beside lochs and gravel pits, in the midlands of Ireland and in harvested peat bogs (Balmer *et al*., 2013). Ringed plover is a ground nesting species, usually in the open, but sometimes sheltered by vegetation, never far from water; the nest is a shallow scrape lined with pebbles and vegetation etc. (Snow and Perrins, 1998).

During the winter, ringed plovers are again mainly restricted to coastal areas around the UK where they inhabit muddy, sandy or pebbly coasts (Balmer *et al*., 2013). Resident breeders are joined by East Atlantic Flyway populations, some resident birds may remain on their breeding grounds during the winter while others move to new coastal areas; some southern and eastern England birds may also migrate to Ireland and Brittany (Wernham *et al*., 2002). Ringed plovers feed mainly on terrestrial and coastal invertebrates during the breeding season and principally on marine polychaete worms, crustaceans and molluscs during the nonbreeding season (Snow and Perrins, 1998). This species roosts communally, close to feeding sites along the shoreline, on sandbanks or bare arable fields, and in low vegetation (JNCC, 2012).

Ringed plovers are considered to be sensitive to disturbance particularly during the breeding season (see Conway *et al*., 2008 for review). As ringed plovers predominately breed on sand and shingle beaches which are also attractive to people, they are often exposed to human disturbance, including trampling on nests and pursuit of chicks and adults by dogs (Tratalos *et al*., 2021). Like other species of plover, if disturbed, ringed plovers will perform a distraction display to lure attention away from chicks or a nest site by running along the ground in a huddled “crouch-run” position, flicking wings, displaying one side of the body and giving an impression of an “exhausted bird” (Williamson, 1947). As this species will often creep along that ground from a disturbance source in this manner, rather than fly away, the estimation of FID for this species can be problematic.

Previous studies have shown that, particularly on the coast, recreational disturbance may affect the distribution, numbers and breeding success of this species (Tratalos *et al*., 2021, Liley and Sutherland 2007; Tratalos *et al*., 2005, Brown and Grice, 2005; Pienkowski, 1984). On the eastern shore of the Wash (Norfolk), Liley and Sutherland (2007) found that ringed plovers avoided areas of high disturbance caused by human recreational activity on the beach; a population model suggested that if nests were protected from humans (e.g. by fencing) the ringed plover size would increase by 8% and a complete absence of human disturbance would cause a population increase of 85%. Prater (1976) assessed that disturbance may have altered the habitat choice of ringed plovers in southeast England and on Lindisfarne, Pienkowski, (1984) found that ringed plovers abandoned territories without nesting by mid-May, which appeared to be associated with an increase in the use of the shore by humans at that time of year.

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-300m

Ringed plover is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for ringed plover when approached by a pedestrian is 100m during the breeding season and 162m during the nonbreeding season. However, as this species runs rather than flies away when disturbed, FID values are difficult to estimate. During the nonbreeding season, a buffer zone of 77m has been proposed to protect ringed plover against pedestrian disturbance, but for flocks of mixed waders containing more sensitive species (e.g. curlew), a buffer zone of 270m is suggested to protect winter roosts.

In the UK, ringed plover has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower during the nonbreeding season. A buffer zone of 100-200m is suggested to protect nesting ringed plover and a buffer zone of 100-300m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Lack of studies recording AD/FID during the breeding season. More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft, especially during the breeding season.

Grey plover, *Pluvialis squatarola*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Passage/Winter Visitor

UK and Scottish population estimate

UK winter population = 33,500 individuals (Woodward *et al*., 2020); Scottish population = 1,700-2,800 individuals in winter, 500-2,000 individuals in Spring passage, 5,000-10,000 individuals in Autumn passage (Forrester *et al*., 2012).

UK long-term trend

Wintering numbers have gradually declined since the mid-1990s, they were 15% lower in 2008-09 compared with 1988-89 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Grey plover was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Min/Max FID = 36 to 66m (n = 2) (Díaz *et al*., 2021).

Nonbreeding season:

Surveyor walking along a shoreline in England: Mean FID = 132.3m (n = 55); Min/Max FID = 35 to 251m (Collop *et al*., 2016).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 77.1m (n = 24); Min/Max FID = 43 to 205m (Scarton, 2018b).

Surveyor walking in a shorebird habitat in Australia: FID = 44m (n = 1) (Glover *et al*., 2011).

Surveyor walking along a shoreline in Africa: FID = 37m (n = 1) (Mikula *et al*., 2018).

Surveyor walking along a river delta in Africa: Mean FID = 41.1m (n = 8), Min/Max FID = 32 to 53m (Mikula *et al*., 2018).

Surveyor walking in Africa: Mean FID = 38.2m (n = 7) (Weston *et al*., 2021).

Surveyor walking in Sir Lanka: FID = 33 (n = 1) (Gnanapragasam *et al*., 2021).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 75 to 125m; Median FID = 75m (n = 10); Min/Max FID = 30 to 125m (Liley *et al*., 2010).

Surveyor walking in mudflats in Denmark: Mean FID = 132m (n = 80), Min/Max FID = 42 to 400m (Laursen *et al*., 2005).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Mean FID = 124m; Min/Max FID = 106 to 142m (Smit and Visser, 1993).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Mean FID = 75.8m (n = 16); Min/Max FID = 46 to 167m (Scarton, 2018b).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Surveyor walking along a shoreline in Africa: Mean MAD = 47m (n = 9) (Boer and Longamane, 1996).

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 148m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Buffer zone = 139m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Ecology and non-quantitative disturbance responses

Grey plovers are winter visitors and passage migrants to the UK; this species breeds in Russia and the Canadian high Arctic. Wintering and passage birds are restricted to coastal areas all around the around the UK coastline mostly on areas with intertidal mud and sandflats (Balmer *et al*., 2013). In Scotland, some of the largest numbers are to be found on the Eden Estuary, Firth of Forth, Solway, Orkney, Outer Hebrides, Tay and Tyninghame estuaries. During migration this species may also be found inland on lakes, pools or grasslands. Grey plover is usually a solitary species or occurs in small flocks while foraging; food is chiefly marine polychaete worms, molluscs and crustaceans during the nonbreeding season (Snow and Perrins, 1998) and like most plovers, grey plovers tend to run and then suddenly stop to feed. Grey plovers form large flocks at communal roosts, often with other waders in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments such as estuaries or lagoons (Snow and Perrins, 1998), therefore there is the potential to disturb this species on foraging and roosting grounds.

Grey plover was among the species noted to be most sensitive to disturbance by walkers and dogs on the Welsh Dee Estuary (see Woodward *et al*., 2015 for review). Kirby *et al*. (1993) noted that once grey plover had been disturbed (particularly by walkers and dogs), they were most likely to leave the estuary altogether. Similarly, Ross and Liley (2014) found that grey plovers in the Humber estuary were also among the wader species exhibiting the highest proportion of major flight responses to human recreational disturbance. However, Collop (2016) suggested that, along with curlew, oystercatcher and bar-tailed godwit, grey plover may be able to cope with a 10% reduction in time spent feeding caused by daily disturbance events on the Wash.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Nonbreeding season buffer zone = 150-300m

Grey plover is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for grey plover when approached by a pedestrian is 66m during the breeding season and 400m during the nonbreeding season. However, as some plovers tend to run rather than fly initially, FID values may be difficult to estimate. As grey plover does not breed in the UK, quantitative values recorded during the breeding season may not be relevant to disturbance in the UK. During the nonbreeding season, buffer zones of 148m and 139m have been proposed to protect grey plover against pedestrian and motorised watercraft disturbance respectively, but for flocks of mixed waders containing more sensitive species (e.g. curlew), a buffer zone of 270m is suggested to protect winter roosts.

In the UK, grey plover has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 150-300m is suggested to protect nonbreeding grey plover from pedestrian and watercraft disturbance.

Knowledge gaps

More studies to specify habituation to disturbance when recording AD/FID for pedestrian activity on the beach and in watercraft during the nonbreeding season.

Golden plover, *Pluvialis apricaria*

Conservation Status

UK: Green List

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 32,500-50,500 breeding pairs, 410,00 individuals in winter (Woodward *et al*., 2020); Scottish population = 15,000 breeding pairs, 10,000-30,000 individuals in spring passage, 20,000-60,000 in autumn passage, 25,000-35,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Decrease. Half of the Irish range and one fifth of the British range have been lost over the last 40 years, mirroring the 13% UK population decline (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Golden plover was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: FID = 47m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: Range of mean FID = 18.0 to 43.3m (n = 7); Min/Max FID = 18 to 48m (Díaz *et al*., 2021).

Surveyor walking in moorland habitat in England: Range of median FID = 191 to 227m (Finney *et al*., 2005).

Surveyor walking over moorland in Norway: Min/Max FID = 0 to >100m (n = 46) (Byrkjedal, 1987).

Pedestrian walking/running on moorland in England: Min/Max FID = 1 to 200m (n = 96) (Yalden and Yalden, 1990).

Pedestrian walking/running on moorland in England: Mean AD = 187m (n = 333); Min/Max AD = 38 to 491m (Yalden and Yalden, 1989).

Surveyor walking in Scotland: Min/Max AD = 100-300m; Min/Max FID = 50-150m (Andy Douse, pers. obs.).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 280.9m (n = 2) (Dwyer, 2010).

Surveyor walking in mudflats in Denmark: Mean FID = 143m (n = 38), Min/Max FID = 45 to 450m (Laursen *et al*., 2005).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Surveyor walking in moorland habitat in England: Mean MAD = 50 to 200m (Finney *et al*., 2005; Pearce-Higgins *et al*., 2007).

Pedestrian walking/running on moorland in England: MAD = 200m (Yalden and Yalden, 1990; Yalden and Yalden, 1989).

Ecology and non-quantitative disturbance responses

Golden plover breeds in highland areas and upland bogs, moors and swampy heaths with high abundances of Sphagnum moss and heather. In Scotland, the highest breeding densities occur on the Outer Hebrides, Shetland, the Flow Country of Caithness and Sutherland and in England. High breeding densities occur in the Pennines; breeding densities are low in Ireland and Wales (Balmer *et al*., 2013). During the breeding season golden plover is a strongly territorial species around the nest site and males perform display flights particularly during early pair formation (Snow and Perrins, 1998; Ratchliffe, 1976), but this behaviour declines during egg laying and individuals can be secretive during the early breeding phase and may not respond to human intrusion (Yalden and Yalden, 1989). Golden plover is a ground nesting species; the nest is a shallow scrape in amongst short vegetation or between stones and is lined with vegetation (Snow and Perrins, 1998).

During the nonbreeding season, golden plover has a widespread distribution around the UK's lowland fields (Balmer *et al*., 2013), often in the company of lapwings (Gillings and Fuller, 1999). Resident golden plover in the UK tend to move short distances to their wintering grounds, the majority remain in the UK and are joined by migrants mainly from Iceland (Wernham *et al*., 2002). Golden plovers are omnivorous, feeding mainly on terrestrial invertebrates (principally beetles and earthworms) but will also feed on some plant material including berries, seeds and grasses (Snow and Perrins, 1998). This species prefers to roost on ploughed arable land and damp grassland, but will use tidal flats, rocky shores and saltmarshes in intertidal areas (JNCC, 2012; Forrester *et al*., 2012).

Golden plovers are sensitive to human disturbance and numbers are known to be lower in areas of high disturbance (Finney *et al*., 2005; Pearce-Higgins *et al*., 2007; Yalden and Yalden, 1989). Some golden plovers will run from their eggs if disturbed, but flight is much more usual (Ratchliffe, 1976). During the breeding season, response to disturbance varies between individual golden plovers depending on a number of factors, including habituation to disturbance, alertness, the vulnerability of the chicks, how conspicuous the disturbance is (e.g. a walker appearing against a skyline may cause more disturbance than a walker hidden in a valley) and the predictability of the source of disturbance (Finney *et al*., 2005; Yalden and Yalden, 1989). As well as the nature of the breeding grounds, response to human disturbance also depends on whether nesting plovers tend to be "sitters" or "fliers" at the nest; the majority of individuals will fly direct from their nests as a human comes within sight, however, in certain areas or under certain conditions or at certain times, nearly all the birds sit close and flush only if the intruder chances to walk within about 3-10 m of the nest (Ratchliffe, 1976).

Yalden and Yalden (1989; 1990) found that breeding golden plovers are most likely to be disturbed by people walking across moorland if they are within 200m of a nest. Finney *et al*. (2005) also found that golden plovers avoided pedestrian disturbance across the Pennine Way, however, when this source of disturbance was made more predictable through the resurfacing of the public footpath, golden plovers reduced their avoidance distance of the footpath from 200 to 50m. Pearce-Higgins *et al*. (2007) discussed that high levels of disturbance can impact golden plover habitat usage, but only in limited circumstances where visitor pressure is very high (greater than at least 30 visitors per weekend day); with the provision of well-surfaced paths, the authors considered that access to large numbers of visitors can be permitted without reducing breeding success. Ratchliffe (1976) suggested that recreational pressures were unlikely to have much effect on breeding golden plover unless the source of disturbance was intense.

Pearce-Higgins *et al*. (2009) recorded a reduced occurrence of golden plovers within 200m of turbines across 12 upland wind farms. However, Fielding and Haworth (2010) and Douglas *et al*. (2011) suggest that under some circumstances, golden plovers may be more tolerant of wind farm infrastructure. At Farr wind farm, Fielding and Haworth (2010) showed that the median distance of 16 golden plover nests to the nearest turbine was 168.8m, with nine nests being less than 200m and three less than 100 m from the nearest turbine. At Beinn Tharsuinn wind farm, Douglas *et al*. (2011) found that the distribution of breeding golden plovers appeared to be unaffected by proximity to turbines or tracks, with no evidence for this lack of association changing through time.

Disturbance studies on golden plover are more limited during the nonbreeding season although flocks can be disturbed on foraging and roosting grounds; Ross and Liley (2014) reported high flush rates for golden plover around the Humber estuary during the winter. Furness (1973) noted that roosting golden plovers and bar-tailed godwits at Musselburgh lagoons were much more likely to be disturbed by people than were other waders.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 200-500m

Nonbreeding season buffer zone = 200-500m

Golden plover is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for golden plover when approached by a pedestrian is median of 227m (maximum AD is 491m) during the breeding season and a maximum of 450m during the nonbreeding season. MAD values up to 200m have been suggested to protect golden plover from pedestrian disturbance during the breeding season.

In the UK, golden plover has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; for some individuals, tolerance of human disturbance may be lower during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 200-500m is suggested to protect nesting golden plover as well as foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

AD/FID studies are required during the nonbreeding season.

Dunlin, *Calidris alpina*

Conservation Status

UK: Red List

European: Declining

UK status

Migrant Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 8,600-10,500 breeding pairs, 350,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 8,000-10,000 breeding pairs (*schinzii* subspecies), 37,000-58,000 individuals in winter (*alpina* subspecies) (Forrester *et al*., 2012).

UK long-term trend

Decline. Breeding population declined in the Outer Hebrides by 65% between 1983-2007, there were also losses in marginal upland areas, particularly in western Ireland, northern England and southern Scotland between 1968-72 to 2007-11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Dunlin was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking over moorland in Norway: Range of mean FID = 13.1 to 81.3m (n = 20) (Byrkjedal, 1987).

Pedestrian walking/running on moorland in England: Mean AD = 30m (n = 30); Min/Max AD = 8 to 83m (Yalden and Yalden, 1989).

Surveyor walking in Scotland: Min/Max FID = 50-100m (Andy Douse, pers. obs.).

Nonbreeding season:

Surveyor walking along a shoreline in England: Mean FID = 43.9m (n = 117); Min/Max FID = 9 to 194m (Collop *et al*., 2016).

Surveyor walking over mudflats in Scotland: Mean FID = 163.9m (n = 4) (Dwyer, 2010).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 39m (n = 40); Min/Max FID = 5 to 81m (Scarton, 2018b).

Surveyor walking along mudflats in Denmark: Mean FID = 70m (n = 317), Min/Max FID = 15 to 450m (Laursen *et al*., 2005).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median AD = 8m (n = 11); Range of median FID = 30 to 55m (n = 23); Min/Max FID = 8 to 100m (Liley *et al*., 2011).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 50 to 100m; Median FID = 75m (n = 19); Min/Max FID = 25 to 300m (Liley *et al*., 2010).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Range of mean FID = 71 to 163m; Min/Max FID = 57 to 300m (Smit and Visser, 1993).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Mean FID = 52.3m (n = 23); Min/Max FID = 9 to 175m (Scarton, 2018b).

MAD and/or

Buffer zone

Quantitative distances

Breeding:

Pedestrian walking/running in moorland habitat in England: Mean MAD = 50 to 200m (Pearce-Higgins *et al*., 2007).

Nonbreeding season:

Surveyor walking along a shoreline in North America: Buffer zone = 89m (Koch and Paton, 2014).

Pedestrian walking/running along footpaths or the presence of railways close to intertidal areas in England: Buffer zone = 25 to 75m, although a buffer zone of 200m may be needed to protect a mix of intertidal species (Burton *et al*., 2002a).

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 82m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Buffer zone = 124m, but this buffer zone would increase to 270m to protect mixed species winter roosts (Scarton, 2018b).

Ecology and non-quantitative disturbance responses

One of three subspecies of dunlin breeds in the UK (*schinzii* ssp.) in the upland areas of Scotland, Wales and northern England (Pennines) (Balmer *et al*., 2013). During the breeding season, *schinzii* ssp. are found on wet upland and montane heath, especially where pool systems occur, but also on the machairs of the Outer Hebrides and rarely on coastal saltmarsh (Snow and Perrins, 1998). In Scotland the highest breeding densities occur on the Northern Isles, Outer Hebrides and the Flow Country of Caithness and Sutherland; in England, high breeding densities occur in the Pennines (Balmer *et al*., 2013). Dunlins breed on the ground concealed in vegetation, the nest is a shallow scrape lined with grass and leaves (Snow and Perrins, 1998).

Wintering dunlins are widely distributed throughout the coastlines of Britain and Ireland, the largest concentrations are on estuaries (Balmer *et al*., 2013). The *alpina* ssp. which breeds in Fennoscandia and northwest Russia, winters in western Europe, including the UK; both *schinzii* and *arctica* subspecies winter mainly in northwest Africa (Wernham *et al*., 2002; Snow and Perrins, 1998). Dunlins mainly spend the winter on the coast, but they can also frequent a wide variety of coastal and inland waterbodies including lagoons, muddy freshwater shores, tidal rivers, flooded fields, sewage farms, saltworks, sandy coasts, lakes and dams (BirdLife International, 2021b). Dunlins feed mainly on invertebrates; insects may chiefly be eaten during the breeding season and marine invertebrates during the nonbreeding season (Snow and Perrins, 1998). Similar to other waders, dunlins roost during high tides and at night, but this species prefers large fields of naturally fertilised short pasture or soil-based crops with few vertical structures that could be used by predators (Shepherd and Lank, 2004).

Dunlins are potentially sensitive to human disturbance during the breeding season. As a ground nesting species, dunlin is vulnerable to predator disturbance; Jackson (2001) showed that hatching success can be increased by excluding ground predators with fences around nesting areas. This species can be disturbed by human recreational activity taking place over their breeding grounds, although in the Peak District, Pearce-Higgins *et al*. (2007) found that, like golden plover, the provision of well-surfaced paths in breeding areas that receive at least 30 visitors a day can reduce the impact of human disturbance on the breeding success of this species. Yalden and Yalden (1989) suggest that dunlins are less sensitive to human intruders on their territories compared with golden plovers. Dunlins are relatively small birds and, like many other wader species, have cryptic plumage colour (Ferns, 2003) that can make them difficult to see on the ground, especially in amongst vegetation. For this reason, dunlins are more often detected in flight or when calling and estimating AD for this species is difficult.

During the nonbreeding season, reports of disturbance on dunlins are mixed. Kirby *et al*. (1993) found dunlin to be one of the more commonly disturbed species at roost sites on the Welsh Dee Estuary and tended to leave it altogether when disturbed by dogs and walkers. Davidson and Rothwell (1993) did not include it among the more nervous species (compared with redshank, bar-tailed godwit and curlew), and Burton *et al*. (2002a) recorded that it was the last species to fly when disturbed by walkers, although counts were still significantly lower at sites close to footpaths (see literature review in Woodward et al., 2015). Burton *et al.* (2002b) also noted that dunlin is threatened by disturbance on intertidal mudflats from construction work in the UK. Furness (1973) noted that roosting dunlins at Musselburgh lagoons were much less likely to be disturbed by people or aircraft than were bar-tailed godwits or golden plovers.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 150-300m

Dunlin is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for dunlin when approached by a pedestrian is 100m (maximum AD is 83m) during the breeding season and 450m during the nonbreeding season. For motorised watercraft, a range of mean FID values between 9-175m have been recorded during the nonbreeding season.

MAD values up to 200m have been suggested to protect dunlin from pedestrian disturbance during the breeding season. During the non-breeding season, buffer zones ranging between 25 to 89m have been proposed to protect dunlin against pedestrian disturbance, but for mixed winter flocks, it has been suggested that buffer zones should be larger between 200 to 270m. To protect against motorised watercraft disturbance, a 124m buffer has been proposed to protect dunlin during the nonbreeding season, but for flocks of mixed waders containing more sensitive species (e.g. curlew), a buffer zone of 270m is suggested to protect winter roosts.

In the UK, dunlin has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect nesting dunlin and a buffer zone of 150-450m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.

Red knot, *Calidris canutus*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Passage/Winter Visitor

UK and Scottish population estimate

UK winter population = 265,000 individuals (Woodward *et al*., 2020); Scottish winter population = 20,400-25,800 individuals (Forrester *et al*., 2012).

UK long-term trend

Slight increase. Wintering range increased by 27% in Britain and 58% in Ireland between 1981/84 to 2007/11, the population has increased by 15% between 1983/84 and 2008/09 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Red knot was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: FID = 26m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: FID 26m (n = 1) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: FID = 60.01m (n = 1) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 71.8m (n = 78); Min/Max FID = 20 to 240m (Collop *et al*., 2016).

Surveyor walking in a range of habitats in Australia: Mean FID = 21.3m (n = 8) (Weston *et al*., 2012).

Pedestrian (general) along a shoreline in Australia: Mean FID = 74.4m (Lilleyman *et al*., 2016).

Pedestrian leisure (unspecified) along the shoreline in England: FID = 51m (n = 1) (Liley *et al*., 2010).

Non-motorised watercraft (rowing boat) in nearshore waters off Denmark: Mean FID = 260m (Laursen *et al*., 2017).

Motorised watercraft (motorboat) in nearshore waters off Denmark: Mean FID = 200m (Laursen *et al*., 2017).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Pedestrian (general) along a shoreline in Australia: Buffer zone = 100m (Lilleyman *et al*., 2016).

Pedestrian walking/running along footpaths close to intertidal areas in England: Buffer zone = 150m, although a buffer zone of 200m may be needed to protect a mix of intertidal species (Burton *et al*., 2002a).

Ecology and non-quantitative disturbance responses

Red knot are winter visitors and passage migrants to the UK; this species breeds in the high Arctic in Greenland and Canada (Balmer *et al*., 2013). During the nonbreeding season, birds migrate to northwest Europe; over 65% of the population overwinters in the UK where it is strictly a coastal species (Balmer *et al*., 2013). The distribution of knot is widespread around most of the UK, the highest concentrations are found on muddy and sandy shores, especially in estuaries (the Wash is an internationally important site), but this species is generally absent from northern and western Scotland (Balmer *et al*., 2013). In Scotland birds can be found throughout the year due to birds on passage and failed breeders returning to wintering grounds early (Snow and Perrins, 1998). Outside the breeding season, red knot feed mainly on intertidal invertebrates, chiefly molluscs (Snow and Perrins, 1998).

Among shore birds, red knot has long been known to be highly vulnerable to human disturbance, particularly at their roost sites (Woodward *et al*., 2015; Furness, 1973; Mitchell *et al*., 1988). Like other members of the Scolopacidae family, knot roost together at high tide on undisturbed rocks, sandy spits or offshore islets (Snow and Perrins, 1998). Furness (1973) found that red knot on the Forth Estuary will fly to another roost approximately 10 miles away if disturbance is high enough. Mitchell *et al*., (1988) showed that numbers of knot fell by 79% at roosts on the Welsh Dee Estuary between 1979/80 to 1985/86 and that birds moved to disturbance-free sites on the Alt Estuary; for some knots disturbance (particularly from dogs, horse-riders and walkers) at their roost could result in an extra round trip of approximately 25 miles which may account for 14% of their daily energy expenditure. Kirby *et al*. (1993) also note that knot tended to leave the Dee Estuary altogether when disturbed by dogs and walkers. Burton *et al*. (1996) suggested that after redevelopment at Hartlepool West Harbour, Cleveland, the numbers of wintering knot declined despite the creation of a new island roost, likely because of increased disturbance, particularly from people and boats due to the increased access to the marina. Pfister *et al*. (1992) suggested that the severity of the impact of human disturbance on knot at Plymouth Beach is probably most evident in their long-term decline in abundance at that site.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Nonbreeding season buffer zone = 100-300m

Red knot is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for knot is 240m when approached by a pedestrian and a mean of 260m when approached by a non-motorised watercraft during the nonbreeding season; the majority of mean FID values are under 100m when approached by a pedestrian. The maximum FID value recorded for knot when approached by a pedestrian during the breeding season is 26m, but as this species does not breed in the UK, quantitative values recorded during the breeding season may not be relevant to disturbance in the UK. A buffer zone up to 150m has been suggested to protect knot from pedestrian disturbance during the nonbreeding season, but in flocks of mixed waders during the nonbreeding season containing more sensitive species, a larger buffer zone up to at least 200m may be required to protect against disturbance.

In the UK, red knot has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower at roost sites. A buffer zone of 100-300m is suggested to protect nonbreeding knot from pedestrian disturbance.

Knowledge gaps

Lack of studies specifying AD/FID at roost sites during the nonbreeding season.

Purple sandpiper, *Calidris maritima*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern

UK status

Scarce Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1 breeding pair in Scotland, 9,900 individuals in winter (Woodward *et al*., 2020); Scottish winter population = 16,000 individuals (Forrester *et al*., 2012). Scottish breeding population may have decreased since Forrester *et al*. (2012) estimated 1-5 pairs.

UK long-term trend

Eaton *et al*. (2021) state a strong decrease in breeding birds (-67%) over 25 years.

Determining trends for this species is difficult due to difficulties with data comparison (Balmer *et al*., 2013). However, the UK wintering population recorded at the open-coast decreased by 27% between 1984/85 - 2006/07; Irish population declined by 33% between 1987/88 - 1997/98 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Purple sandpiper was not included in Ruddock and Whitfield (2007).

No AD/FID distances available for purple sandpiper.

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for purple sandpiper.

Ecology and non-quantitative information on disturbance responses

Purple sandpiper is a very rare breeding species in the UK, confined to two breeding sites in the Cairngorms National Park, Scotland, where it breeds at the southernmost edge of the species' Arctic range (Balmer *et al*., 2013; Forrester *et al*., 2012). In these locations, very small numbers of purple sandpiper breed on mountains above 1,000m; adults and young occupy habitat beside the wet margins of streams, flushes and pools (Forrester *et al*., 2012). Like many other waders, purple sandpiper is an open ground nesting species, the nest is a small cup part filled with leaves (Snow and Perrins, 1998).

Purple sandpiper is primarily a winter visitor to the UK, it is found on all coasts where there is suitable habitat, but it prefers exposed, shallow rocky coastlines (Balmer *et al*., 2013; Wernham *et al*., 2002). In the UK, this species is the most northerly of wintering waders, density is highest along the coasts of the northern North Sea, Northern Isles and Outer Hebrides as well as exposed headlands in Ireland; southern England and Wales hold small populations and relatively few birds use estuaries (Balmer *et al*., 2013). Three separate breeding populations winter around the coasts of the UK, the majority of the northern and western birds breed in Canada whilst those wintering in eastern Britain originate from breeding populations in Scandinavia and Svalbard (Balmer *et al*., 2013). Purple sandpipers feed both during the day and at night in the littoral zone, the winter diet of this species is largely composed of small winkles and blue mussels, kelp flies are also hunted for amongst seaweed (Forrester *et al.*, 2012).

Dierschke (1994) found that purple sandpipers spend only about half as long foraging during winter as do other wader species, it has been noted that this species will not forage during rising tides, also high tides during daylight hours restricts the foraging period (Simon Cohen, pers. comm.). Burton and Evans (1997) concluded that the predictable food supply on rocky shores allows purple sandpipers to achieve higher survival rates than estuarine waders. These features suggest that purple sandpipers are likely to be much less vulnerable to adverse effects from human disturbance. In addition, purple sandpipers are less prone to being disturbed by human presence than are most wader species, possibly because of their crypsis and the greater opportunity to remain undetected in rocky shore habitat compared with waders that frequent open mud or sand. Indeed, purple sandpipers tend to crouch on the rocks as a pedestrian approaches, only flying off if the person comes very close (perhaps within about 5 to 8 m). Cramp and Simmons (1982) describe purple sandpiper as "noted for tameness throughout the year". Baxter and Rintoul (1953) state "the purple sandpiper is one of the tamest of the waders, it will sit drowsily by the side of the sea until one is within a few feet of it".

Although this review has been unable to find FID data for purple sandpiper, the literature indicates that this will be smaller than for most estuarine waders.

Likely sensitivity to disturbance = Low/Medium

Quantitative information = No evidence

Breeding season buffer zone <300m

Nonbreeding season buffer zone <300m

Purple sandpiper is assessed to have a low to medium sensitivity to human disturbance.

There are a lack of disturbance studies and recommended buffer zones for purple sandpiper. Due to the scarcity and remote locations of breeding purple sandpipers in the UK, this species is unlikely to be encountered on breeding grounds by humans. Non-quantitative studies suggest that buffer zones required to protect purple sandpiper during the nonbreeding season may be lower than those for estuarine waders.

In the UK, purple sandpiper mainly has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season. From studies on other wader species, a buffer zone <300m is suggested to protect breeding and nonbreeding purple sandpiper from pedestrian disturbance.

Knowledge gaps

Lack of studies providing AD/FID values during the nonbreeding season.

Wood sandpiper, *Tringa glareola*

Conservation Status

UK: Amber List, Schedule 1

European: Least Concern, Annex 1

UK status

Scarce Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 30 breeding pairs in Scotland (Woodward *et al*., 2020); Scottish passage population = 10-50 individuals during spring and 20-50 individuals during autumn (Forrester *et al*., 2012). Scottish population estimate has increased since Forrester *et al*. (2012) estimated a breeding population of 18-21 pairs.

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+528%) over 25 years.

The small breeding population in northern Scotland has increased in range and size since 1988/91 when the population was six pairs (Balmer *et al*., 2013). A total of 27 breeding pairs were recorded in 2010 (Balmer *et al*., 2013), this has increased to 30 pairs in 2013-17 (Woodward *et al*., 2020).

AD/FID

Quantitative disturbance distances

FID updates (Díaz *et al*., 2021; Gnanapragasam *et al*., 2021; Mosvi *et al*., 2019; Jiang and Møller, 2017; Whitfield and Rae, 2014) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Mean FID = 20.3m (n = 3), Min/Max FID = 16 to 23m (Díaz *et al*., 2021).

Surveyor walking in Europe: FID = 20.3m (n = 3) (Jiang and Møller, 2017).

Surveyor walking in Norway:

Mean FID of "guard" parents = 59m (n = 27), Min/Max FID = 15 to 100m;

Mean FID of "non-guard" parents = 38m (n = 14), Min/Max FID = 21 to 60m

(Whitfield and Rae, 2014)

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 225m (n = 5); Min/Max AD (80% opinion range) = <10 to 300m; Min/Max AD (90% opinion range) = 150 to 300m.

Range of median FID = 5 to 125m (n = 8); Min/Max FID (80% opinion range) = <10 to 300m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season:

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 33m (n = 15); Min/Max FID = 10 to 57m (Gnanapragasam *et al*., 2021).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 33m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Whitfield and Rae, 2014) published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 200 to 600m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Pedestrian (general activity) in Norway: Buffer zone = 160m (Whitfield and Rae, 2014).

Ecology and non-quantitative information on disturbance responses

In the UK, wood sandpiper is a rare breeding species confined to boggy habitats in Scotland; highest densities are recorded in Sutherland and Caithness, but other breeding sites have been recorded in Inverness-shire, Wester Ross and the Outer Hebrides (Balmer *et al*., 2013). Wood sandpipers breed mainly in marshes and swamps, usually close to lochs (Forrester *et al*., 2012). This species nests on the ground in amongst dense vegetation or in old tree nests of other birds (Svensson *et al*., 2009; Snow and Perrins, 1998). Both male and female wood sandpiper parents typically care for young chicks with a division in roles between a "guard" bird which maintains an alert posture at a "look-out" location with a clear view of the surrounding area, and a "non-guard" bird which broods and stays close to chicks (Whitfield and Rae, 2014). The diet of wood sandpiper is most likely composed of terrestrial and freshwater insects, although little is known about the diet of this species in Scotland (Forrester *et al*., 2012).

Wood sandpipers do not generally overwinter in the UK, after the breeding season this species migrates south to winter in Africa (Wernham *et al*., 2002). Wood sandpipers are recorded in Britain during passage (Balmer *et al*., 2013), many migrants are likely to be from the Scandinavian breeding population (Wernham *et al*., 2002). In Scotland, wood sandpipers recorded outside the breeding season are mostly located at inland sites beside freshwater burns and lochs; more rarely they may be recorded along the coast (Forrester *et al*., 2012).

Wood sandpipers are potentially susceptible to human disturbance (Kalejta-Summers and Chisholm, 2009) and this species has been described as a "wary and nervous bird" (e.g. Oiseaux-Birds, 2021; Australian Government, 2021) particularly in flocks, although solitary birds will sometimes tolerate close approach (Australian Government, 2021). Beaman and Madge, (1998) state that wood sandpipers are considered to flush easily. During the breeding season the distance at which parents with young chicks react to an approaching pedestrian depends on whether or not the birds are on guard duty. In a study in Norway, Whitfield and Rae (2014) observed that birds on guard duty reacted sooner to a surveyor approaching the nest (alarm called at a mean distance of 72m, Mean FID = 59m) than a parent not on guard duty on the nest (alarm called at a mean distance of 44m, Mean FID = 38m). Whitfield and Rae (2014) also noted that the wood sandpipers in their study area (which was not subject to any human disturbance, other than research activities) did not react to human presence between 150–200m.

Likely sensitivity to disturbance = Medium

Quantitative information = High agreement & Limited evidence

Breeding season buffer zone = 150-300m

Wood sandpiper is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for wood sandpiper is 100m when approached by a pedestrian during the breeding season. Ruddock and Whitfield (2007) suggested that the upper pedestrian disturbance limit for wood sandpiper during the breeding season is 150 to 300m. Buffer zones for wood sandpipers range from 200 to 600m for forestry operations and 160m for pedestrian disturbance during the breeding season. The maximum FID value recorded for wood sandpiper when approached by a pedestrian during the nonbreeding season is 57m, but as this species does not generally overwinter in the UK, quantitative values recorded during the nonbreeding season may not be relevant to disturbance in the UK.

In the UK, wood sandpiper has the potential to be disturbed on breeding grounds.

A precautionary buffer zone of 150-300m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect nesting wood sandpiper from pedestrian disturbance.

Knowledge gaps

Further AD/FID studies required during the breeding season investigating a range of disturbance sources.

Common redshank, *Tringa totanus*

Conservation Status

UK: Amber List

European: Declining

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 22,000 breeding pairs, 100,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 11,700-17,500 breeding pairs, 4,000-25,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Strong Decline. There has been a 44% contraction of breeding range across the UK between 1968-72 to 2007-11, losses in range and abundance reflect a 39% population decline in the UK between 1995-2010 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Redshank was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Scotland: FID = 21 (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 19 to 41.3m (n = 16); Min/Max FID = 12 to 57m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Spain: FID = 18m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 39m (n = 20); Min/Max FID = 21 to 55m (Scarton, 2018a).

Surveyor walking in Europe: Mean FID 27.8m (n = 19) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 149.9m (n = 43) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 79.8m (n = 53); Min/Max FID = 28 to 187m (Collop *et al*., 2016).

Surveyor walking along mudflats in Denmark: Mean FID = 137m (n = 73), Min/Max FID = 40 to 450m (Laursen *et al*., 2005).

Surveyor walking around inland waterbodies in Africa: Range of mean FID = 24 to 38.7m (n = 5), Min/Max FID = 22 to 41m (Mikula *et al*., 2018).

Surveyor walking in Europe: Mean FID = 4.74m (n = 2) (Møller and Erritzøe, 2010).

Surveyor walking in Europe: Mean FID = 29.71m (n = 7) (Møller, 2008a).

Pedestrian leisure (bait digging) along tidal flats in England: FID = 22m (n = 1) (Fearnley *et al*., 2013).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Median AD = 60m (n = 15); Range of median FID = 30 to 70m (n = 51); Min/Max FID = 10 to 130m (Liley *et al*., 2011).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 20 to 125m; Median FID = 44.5m (n = 78); Min/Max FID = 10 to 150m (Liley *et al*., 2010).

Pedestrian walking/running along a shoreline in Ireland: Mean FID = 37m (n = 29) (Fitzpatrick and Bouchez, 1998).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 33 (n = 26); Min/Max FID = 15 to 55m (Gnanapragasam *et al*., 2021).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 175m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 260m (Laursen *et al*., 2017).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 37m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 55m. Conservative buffer zone of 100m is proposed (Scarton, 2018a).

Pedestrian walking/running along footpaths close to intertidal areas in England: Buffer zone = 50m, although a buffer zone of 200m may be needed to protect a mix of intertidal species (Burton *et al*., 2002a).

Ecology and non-quantitative disturbance responses

Redshank has a patchy breeding distribution in Scotland, England and Northern Ireland. The species breeds in a variety of damp habitats including coastal marshes, lowland wet grasslands and rough pasture on moorland fringes (Balmer *et al*., 2013). In Scotland the highest breeding densities occur on the Northern Isles, Outer Hebrides and in Caithness; in England, high breeding densities occur in the Pennines, Lancashire and on the coastal marshes of southeast England (Balmer *et al*., 2013). Redshank is a ground nesting species, the nest is a shallow scrape in amongst short vegetation and/or tussocks and is lined with vegetation (Snow and Perrins, 1998).

Wintering redshanks are widely distributed throughout the coastlines of Britain and Ireland, the largest concentrations are on estuaries and the Northern Isles (Balmer *et al*., 2013). Redshanks can feed on a wide range of prey species, but the majority of the diet is made up of crustaceans, molluscs and polychaete worms on estuaries and earthworms and cranefly larvae inland (Snow and Perrins, 1998).

In common with other waders, redshank may be frequently disturbed by human activities on more urbanised wintering sites. The flight distance when disturbed by humans may be lower for redshank compared with some other wader species, especially if redshank are habituated to activities that might cause disturbance (Fitzpatrick and Bouchez, 1998). However, redshanks are considered to be susceptible to disturbance from construction and other activities and this species often feeds closer to shore than other waders (see literature review in Woodward *et al*., 2015). Disturbance from construction work around Cardiff Bay was found to significantly reduce the densities and feeding activity of redshank on adjacent intertidal mudflats (Burton *et al*., 2002b). Work by West *et al*. (2002) and Goss-Custard *et al*. (2006) has aimed to quantify the impacts of disturbance on the wader mortality rates. In the UK, populations of redshank breeding on saltmarshes declined by >50% between 1985 and 2011 which has been linked to nest trampling disturbance by grazing cattle (Sharps *et al*., 2017).

Redshanks, as with all waders, usually roost on the coast at high tide (BirdLife International, 2021b), but this species is also known to roost communally at inland sites including disturbed sites at a sport centre and an oil terminal complex (CAWOS, 2019). Response to disturbance at roost sites varies between individuals, Davidson and Rothwell (1993) report that redshanks roosting in narrow tidal creeks with frequent passers-by on the shore may tolerate people within 20m, yet this species on some large estuaries will take flight when a person is still over 100m away (Smit and Visser, 1993). Davidson and Rothwell (1993) considered that redshanks are one of the more nervous species of wader (in addition to bar-tailed godwit and curlew), compared with oystercatcher, turnstone and dunlin.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Robust evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 200-300m

Common redshank is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for redshank when approached by a pedestrian is 57m during the breeding season and 450m during the nonbreeding season. When approached by non-motorised watercraft during the nonbreeding season, the maximum FID recorded for redshank is a mean of 260m. In the UK, a buffer zone of 50m has been proposed to protect redshank against pedestrian disturbance during the nonbreeding season, but this buffer zone may need to be increased to 200m to protect a mix of intertidal species. A buffer zone of 100m has been suggested to protect redshank from pedestrian disturbance during the breeding season in Italy.

In the UK, redshank has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower at roost sites. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect nesting redshank and a buffer zone of 200-300m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Further studies recording AD/FID from a range of disturbance sources during the breeding season are required.

Greenshank, *Tringa nebularia*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,100 breeding pairs in Scotland, 920 individuals in winter (Woodward *et al*., 2020); Scottish winter population = 50-90 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Increasing. According to Balmer *et al*. (2013), greenshank breeding range has expanded by 2% since 1968-72 and 2007-11; the range of nonbreeding birds has expanded by 48% in Britain and 13% in Ireland since 1981-84 and 2007-11. Gains are most evident in Scotland and eastern England and related to increased abundance, probably as a result of milder climatic conditions (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Greenshank was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 30 to 45.5m (n = 4); Min/Max FID = 20 to 53m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Norway: FID = 30m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: FID = 84m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 36.2m (n = 5) (Jiang and Møller, 2017).

Surveyor walking in Scotland: Min/Max AD = 200-500m; Min/Max FID = 100-300m (Andy Douse, pers. obs.).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: FID = 494.17m (n = 1) (Dwyer, 2010).

Surveyor walking in Europe: Mean FID = 30m (n = 2) (Møller and Erritzøe, 2010).

Surveyor walking along mudflats in Denmark: Mean FID = 94m (n = 35), Min/Max FID = 38 to 250m (Laursen *et al*., 2005).

Surveyor walking in a wetland habitat in Denmark: Mean FID = 78m (n = 32) (Bregnballe *et al*., 2009).

Surveyor walking in Africa: Mean FID = 51.3m (n = 27) (Weston *et al*., 2021).

Surveyor walking in a shorebird habitat in Australia: Mean FID = 55.41m (n = 17); Min/Max FID = 25 to 145m (Glover *et al*., 2011).

Surveyor walking in a range of habitats in Australia: Mean FID = 47.60m (n = 7) (Weston *et al*., 2012).

Surveyor walking in a variety of habitats: Mean AD = 55.1m (n = 7) (Blumstein *et al*., 2004).

Surveyor walking in a variety of habitats in Australia: Mean FID = 70.0m (n = 3) (Paton *et al*., 2000).

Pedestrian walking/running near inland waterbodies in Australia: Mean AD = 95m; Mean FIS = 75m (Taylor, 2006).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 29.4 (n = 8); Min/Max FID = 21 to 36m (Gnanapragasam *et al*., 2021).

Pedestrian leisure (unspecified) along the shoreline in England: FID = 40m (n = 2) (Liley *et al*., 2010).

Animal (dogs) disturbance in Australia: Mean FID = 80.3m (n = 2) (Paton *et al*., 2000).

Watercraft (surveyor in an unspecified boat) in Australia: Mean FID = 60.7m (n = 3) (Paton *et al*., 2000).

Non-motorised watercraft (surveyor canoeing) in Australia: Mean FID = 51.5m (n = 2) (Paton *et al*., 2000).

Drone (surveyor operating a drone) in France: Min/Max AD = 4 to 10m (n = 5); Min/Max FID = 4 to 10m (n = 2) (Vas *et al.,* 2015).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 35m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Surveyor walking along a shoreline in Africa: Mean MAD = 40m (n = 7) (Boer and Longamane, 1996).

Pedestrian walking/running near inland waterbodies in Australia: MAD = 75 to 95m (Taylor, 2006).

Ecology and non-quantitative disturbance responses

Common greenshank is an uncommon breeding species in Scotland which is on the western edge of the world breeding range of this species (Balmer *et al*., 2013; Wernham *et al*., 2002). In Scotland, greenshanks are largely restricted to the bogs and moors of the northwest Highlands and Hebridean islands; the highest densities are in Sutherland, Wester Ross, Lewis, Harris and North Uist (Balmer *et al*., 2013). Greenshank is a ground nesting species; the nest is a shallow scrape made between rocks/tussocks/dead tree stumps and is located in the open, within and on the edge of native and non-native coniferous forests (Forrester *et al*., 2012; Snow and Perrins, 1998). Breeding greenshanks are highly site-faithful and may even use the same nest scrape in consecutive years (Wernham *et al*., 2002). Males are highly territorial and perform song flights high into the sky over the breeding site (Forrester *et al*., 2012).

Common greenshank is a migratory species; birds breeding in Palaearctic regions migrate south during the nonbreeding season (Wernham *et al*., 2002).

Although the movements of nonbreeding Scottish birds are not well understood (Wernham *et al*., 2002), most greenshanks move to coastal areas near breeding regions during the nonbreeding season (Forrester *et al*., 2012). Passage birds are more widespread in the UK, found in all coastal regions as well as inland, but wintering birds are more concentrated to the south and west (Balmer *et al*. 2013; Forrester *et al*., 2012). The highest concentrations of wintering greenshank are found on key estuaries throughout the UK especially in Ireland and parts of western Scotland, where birds are more widely distributed; recent gains have been recorded in eastern England and Ireland (Balmer *et al*., 2013). Nonbreeding greenshanks feed mainly on invertebrates and small fish (Snow and Perrins, 1998).

Greenshanks are regarded as potentially vulnerable to human disturbance, particularly when disturbance coincides with areas of habitat change. This species has probably been negatively affected by the long-term, extractive human use of moorlands by grazing, burning, hunting and forestry (RSPB, 2021a). Mason *et al*. (2021) suggest that moorland species in Britain such as common greenshank have probably been negatively affected by the long-term, extractive human use of moorlands by grazing, burning, hunting and forestry. Reduction of suitable moorland breeding habitat has occurred in the Flow County of Caithness and Sutherland through commercial afforestation (Forrester *et al*., 2012). Greenshank is threatened by the degradation and loss of wetland habitats through environmental pollution, reduced river flows and human disturbance in the Yellow Sea; in Europe greenshank may be affected by habitat degradation caused by off-road vehicles or dry conditions (BirdLife International, 2021b).

Breeding greenshanks are considered to be shy and to have highly cryptic behaviour, presumably in response to predation risk (Nethersole-Thompson 1951). Similar to golden plover, the distance at which greenshank are likely to fly away from human disturbance may depend on how conspicuous the disturbance is (e.g. a walker appearing against a skyline may cause more disturbance than a walker hidden in a valley) and the predictability of the source of disturbance. Gilbert *et al*. (1998) recommended to keep disturbance to a minimum for survey work and suggest that there is no need to search for nests or to get close to adults; adults with young chicks are likely to be disturbed when pool systems and lochs are checked in June.

Likely sensitivity to disturbance = Medium/High

Quantitative information = High agreement & Robust evidence

Breeding season buffer zone = 300-500m

Nonbreeding season buffer zone = 300-500m

Greenshank is assessed to have a medium to high sensitivity to human disturbance.

AD and FID values recorded for greenshank are wide ranging. The maximum AD value when approached by a pedestrian is 500m during the breeding season. The maximum FID value when approached by a pedestrian is 300m during the breeding season and 494m during the nonbreeding season. The majority of recorded FID values are lower than these maximum values which likely relate to differences in habitat. During the nonbreeding season, mean FID values between 51.5 to 60.7m have been recorded for watercraft disturbance and a maximum FID of 10m has been recorded for a drone.

MAD between 40 (mean value) and 95m (maximum value) have been suggested in Africa and Australia respectively for greenshank during the nonbreeding season, although no studies have yet recommended buffer zones for this species in the UK.

In the UK, greenshank has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-500m is suggested to protect nesting greenshanks as well as foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

More AD/FID studies are required during the breeding season. Future studies should specify habituation to disturbance when recording AD/FID

Black-tailed godwit, *Limosa limosa*

Conservation Status

UK: Red List, Schedule 1

European: Near Threatened

UK status

Migrant Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 53 breeding pairs (mainly *limosa* subspecies), 41,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 5-11 breeding pairs (*islandica* subspecies), 300-600 individuals in winter, 1,000+ individuals during spring and autumn passage (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (+9%) over 25 years.

Winter range of the *islandica* subspecies has expanded by 177% and 55% in Britain and Ireland respectively between 1981/84 - 2007/11, this is linked to a sustained breeding population increase in Iceland; expansion may be linked to climatic and habitat changes on breeding and wintering grounds (Balmer *et al*., 2013). In contrast, the subspecies *limosa* which breeds in England has decreased and fluctuated since the 1970s (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Black-tailed godwit was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: FID = 46.5m (n = 1) (Jiang and Møller, 2017).

Surveyor walking around a lagoon in Denmark: Mean FID = 72 to 95m (n = 203) (Holm and Laursen, 2009).

Nonbreeding season:

Surveyor walking in a range of habitats in Australia: Mean FID = 21m (n = 6) (Weston *et al*., 2012).

Surveyor walking in a shorebird habitat in Australia: Mean FID = 31.25m (n = 4); Min/Max FID = 27 to 35m (Glover *et al*., 2011).

Pedestrian (general) along the shoreline in England: AD = 125 (n = 1); Min/Max FID = 30 to 150m (n = 3) (Liley *et al*., 2010).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 36.9 (n = 7); Min/Max FID = 18 to 46m (Gnanapragasam *et al*., 2021).

Unknown season:

Surveyor walking around a lake in Pakistan: Mean FID = 36m (Mosvi *et al*., 2019).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Pedestrian walking/running along footpaths or the presence of railways close to intertidal areas in England: Buffer zone = 50 to 75m, although a buffer zone of 200m may be needed to protect a mix of intertidal species (Burton *et al*., 2002a)

Ecology and non-quantitative information on disturbance responses

Small numbers of black-tailed godwit breed in the UK. In England, the nominate subspecies *limosa* is associated with increasingly modified agricultural areas, breeding in lowland wet grasslands and flood meadows (Forrester *et al*., 2012); the main breeding areas are located in East Anglia, but confirmed breeding records of this subspecies have also been recorded in Lancashire, Yorkshire and Kent (Balmer *et al*., 2013). Very small numbers of the *islandica* subspecies mainly breed in Orkney and Shetland on moorland with a preference for wet marshland and mesic grasslands (Balmer *et al*., 2013; Forrester *et al*., 2012). Black-tailed godwit is a ground nesting species, nests are a shallow scrape lined with stems and leaves located in short vegetation (Snow and Perrins, 1998).

In the nonbreeding season, resident black-tailed godwits are joined by large numbers of the Iceland breeding *islandica* subspecies (Balmer *et al*., 2013). Overwintering birds are scattered around the UK, the highest densities are found in coastal areas around East Anglia, the Thames Basin, North Wales, northwest England, the east and south Irish coasts and the Shannon Estuary; this species is generally absent on the west coast of mainland Scotland (Balmer *et al*., 2013). Most of the overwintering population is composed of the *islandica* subspecies which has a preference for coastal estuaries (although they may also inhabit inland sites); the resident *limosa* subspecies prefers to winter at inland freshwater sites (Balmer *et al*., 2013; Forrester *et al*., 2012). Black-tailed godwits feed chiefly on invertebrates during the winter and migration periods, plant material may also be consumed (Snow and Perrins, 1998).

Black-tailed godwits appear to be able to habituate to some types of human presence and may have a relatively high level of tolerance towards human disturbance, particularly during the nonbreeding season. Burton *et al*. (2002a) considered overwintering black-tailed godwit to be one of the most tolerant species to walkers along footpaths in estuaries in England at low tide, although numbers were still significantly lower at sites close to a footpath. In a similar study on English east coast estuary sites, Gill *et al*. (2001) found no evidence that human presence reduced the number of black-tailed godwits; the authors also found that the presence of marinas or footpaths did not impact the number of godwits supported on the adjacent mudflats. A study investigating human disturbance on black-tailed godwit, curlew and teal in Co. Cork, Ireland, found that out of the three species, black-tailed godwits were the least affected by disturbance events and were likely to move <50m from their original position when a disturbance event occurred (Sexton, 2017). Birds at high tide roosts are considered to be susceptible to disturbance (Davidson and Rothwell 1993), but Percival (2011) found that roosting black-tailed godwits in the Humber appear to be tolerant of a relatively high disturbance environment. Percival (2011) found that black-tailed godwits roost at high tide on the North Killingholme Haven Pits which are located in an area adjacent to the Humber Sea Terminal and to car import compounds; there was no evidence found in this study that industrialisation had reduced the ability of the pits to support the godwit population.

However, black-tailed godwit may be sensitive to disturbance during the breeding season (e.g. Frikke, 1991). In a study in the Netherlands, Reijnen *et al*. (1996) found that >10% of the breeding black-tailed population was lost beyond 100m of a road with 5000 cars per day. In another study in Denmark on breeding black-tailed godwits, Holm and Laursen (2009) found that one person walking the same route seven times per day in March–June reduced black-tailed godwit territory density within 300–500 m. In a management plan for black-tailed godwit (2007-2009), the European Commission suggested that this species is especially sensitive to disturbance in breeding areas, and there is a need to assess the effects of increasing disturbance on breeding success in agricultural environments (European Commission 2007b).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 100-200m

Nonbreeding season buffer zone = 100-200m

Black-tailed godwit is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for black-tailed godwit when approached by a pedestrian is a mean of 95m during the breeding season and 150m during the nonbreeding season. A buffer zone from 50 to 75m has been suggested to protect black-tailed godwit from pedestrian disturbance during the nonbreeding season, although in flocks of mixed waders during the nonbreeding season containing more sensitive species, a 200m buffer zone may be required to protect against disturbance.

In the UK, black-tailed godwit has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 100-200m is suggested to protect both breeding and nonbreeding black-tailed godwit from pedestrian disturbance.

Knowledge gaps

More AD/FID studies are required during the breeding season and wider range of studies are required for different disturbance sources.

Bar-tailed godwit, *Limosa lapponica*

Conservation Status

UK: Amber List

European: Secure, Annex 1

UK status

Passage/Winter Visitor

UK and Scottish population estimate

UK winter population = 53,500 individuals (Woodward *et al*., 2020); Scottish winter population = 10,000-14,000 individuals (Forrester *et al*., 2012).

UK long-term trend

Stable. The UK wintering population has remained largely stable between 1981-84 to 2007-11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Bar-tailed godwit was not included in Ruddock and Whitfield (2007).

Breeding:

Surveyor walking in Europe: Mean FID 33.3m (n = 5) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 96.91m (n = 3) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 84.4m (n = 92); Min/Max FID = 32 to 225m (Collop *et al*., 2016).

Surveyor walking in an estuary in England: Mean FID = 39m (n = 23) (Brett, 2012).

Surveyor walking along mudflats in Denmark: Mean FID = 156m (n = 120), Min/Max FID = 40 to 450m (Laursen *et al*., 2005).

Surveyor walking in a variety of habitats in Australia: Mean FID = 22.1m (n = 196) (Blumstein, 2003).

Surveyor walking in a variety of habitats in Australia: Mean FID = 22.1m (n = 177); Min/Max FID = 2.1 to 102.2m (Blumstein *et al*., 2003).

Surveyor walking in a variety of habitats in Australia: Mean FID = 48.6m (n = 2) (Paton *et al*., 2000).

Surveyor walking in a shorebird habitat in Australia: Mean FID = 59.50m (n = 4); Min/Max FID = 45 to 69m (Glover *et al*., 2011).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 34 (n = 2); Min/Max FID = 18 to 50m (Gnanapragasam *et al*., 2021).

Pedestrian leisure (walking and watercraft) along the shoreline in England: AD = 30m (n = 1); FID = 25m (n = 1) (Liley *et al*., 2011).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Range of mean FID = 107 to 219m; Min/Max FID = 88 to 225m (Smit and Visser, 1993).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 200m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 230m (Laursen *et al*., 2017).

Watercraft (surveyor in an unspecified boat) in Australia: Mean FID = 53.5m (n = 2) (Paton *et al*., 2000).

Non-motorised watercraft (surveyor canoeing) in Australia: Mean FID = 41.9m (n = 2) (Paton *et al*., 2000).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for bar-tailed godwit.

Ecology and non-quantitative disturbance responses

The European bar-tailed godwit population (*Limosa lapponica lapponica*) breeds in the Arctic in Northern Scandinavia and around the White Sea (Balmer *et al*., 2013; Engelmoer, 2008). This species does not breed in the UK, although in Scotland, small numbers of immature birds remain on the coastline throughout the summer. The European population winters in Western Europe, mainly in the UK and the Western part of the Wadden Sea (Versluijs, 2011). During the nonbreeding season, bar-tailed godwit is chiefly a coastal species around the UK on low-lying shores, the largest numbers occur on major estuaries (Balmer *et al*., 2013). This species is largely absent from much of northern and western Scotland and elsewhere where there are sections of steep cliff coastline (Balmer *et al*., 2013). Bar-tailed godwits feed chiefly on invertebrates, especially on insects, molluscs, crustaceans and annelid worms (Snow and Perrins, 1998).

Bar-tailed Godwits join mixed wader roosts at high tide where they can be disturbed by human activity. This species has been described as relatively sensitive to disturbance compared to other wader species (see literature review in Woodward *et al*., 2015). On a high tide roost in a cultivated grassland area near the Dutch Wadden Sea, Smit and Visser (1993) showed that bar-tailed godwits were disturbed 64% of the time by human activity whereas 18% had a natural cause. Davidson and Rothwell (1993) considered that in addition to curlew and redshank, bar-tailed godwits are a more nervous wader species compared with oystercatcher, turnstone and dunlin. Kirby *et al*. (1993) found that like other sensitive wader species including grey plover, knot and dunlin, bar-tailed godwit tended to leave the Welsh Dee Estuary when disturbed by dogs and walkers. Collop (2016) showed that in comparison to other wader species present at Poole Harbour, bar-tailed godwit had the greatest vulnerability to the impacts of disturbance, although it was also stated that over-winter survival for this species at this site was predicted to be below 100% and the same author suggested that bar-tailed godwits on the Wash may be able to cope with a 10% reduction in time spent feeding caused by daily disturbance events. Furness (1973) noted that roosting bar-tailed godwits at Musselburgh lagoons were much more likely to be disturbed by people and aircraft than were other waders.

However, in a study on inland coastal meadows around the Dutch Wadden Sea, Versluijs (2011) suggested that wintering bar-tailed godwits may tolerate some human activity. The authors of the study found that human activity caused 29% of total disturbance whereas birds flew up earlier more often (37%) to natural causes (e.g. predators). Of the birds that reacted to human disturbance, most of the flocks were present near roads and bicycle paths; often when a tractor or truck passed by the birds they flew up and they were also regularly disturbed by stopping cars and cyclists (Versluijs, 2011).

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Medium evidence

Nonbreeding season buffer zone = 200-300m

Bar-tailed godwit is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for bar-tailed godwit is 450m when approached by a pedestrian; the majority of FID values are less than a mean of 200m when approached by a pedestrian. For non-motorised watercraft, a range of mean FID values between 42 to 230m have been recorded during the nonbreeding season. The maximum FID value recorded for bar-tailed godwit when approached by a pedestrian during the breeding season is a mean of 33.3m, but as this species does not breed in the UK, quantitative values recorded during the breeding season may not be relevant to disturbance in the UK.

In the UK, bar-tailed godwit has the potential to be disturbed on foraging and roosting grounds during the nonbreeding season. There are no published buffer zones for bar-tailed godwit, but from studies on other waders, a minimum buffer zone of 200-300m is suggested to protect foraging and roosting bar-tailed godwit during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Current studies provide a good range of FID values. Future studies should specify habituation to disturbance when recording AD/FID.

Eurasian curlew, *Numenius arquata*

Conservation Status

UK: Red List

European: Vulnerable

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 58,500 breeding pairs, 125,000 individuals in winter (Woodward *et al*., 2020); Scottish population = 58,800 breeding pairs, 85,700 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Strong Decline. Breeding range contracted by 78% in Ireland and 17% in Britain over the last 40 years, there has been a 44% population decline in the UK between 1995 – 2010 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Curlew was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 40 to 65m (n = 12) (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Finland: Range of mean FID = 34.5 to 44.6m (n = 16) (Díaz *et al*., 2021).

Surveyor walking in Europe: Mean FID 57.6m (n = 10) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking over mudflats in Scotland: Mean FID = 235.16m (n = 36) (Dwyer, 2010).

Surveyor walking along a shoreline in England: Mean FID = 340.3m (n = 39); Min/Max FID = 88 to 570m (Collop *et al*., 2016).

Surveyor walking in an estuary in England: Mean FID = 88m (n = 24) (Brett, 2012).

Surveyor walking in a coastal lagoon habitat in Italy: Mean FID = 140.5m (n = 11); Min/Max FID = 59 to 305m (Scarton, 2018b).

Surveyor walking along mudflats in Denmark: Mean FID = 298m (n = 110), Min/Max FID = 58 to 650m (Laursen *et al*., 2005).

Surveyor walking around inland waterbodies in Africa: Range of mean FID = 50m (n = 2), Min/Max FID = 46 to 54m (Mikula *et al*., 2018).

Surveyor walking in Europe: Mean FID = 62.75m (n = 4) (Møller and Erritzøe, 2010).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 44.3 (n = 8); Min/Max FID = 21 to 113m (Gnanapragasam *et al*., 2021).

Pedestrian leisure (bait digging) along tidal flats in England: AD = 45m (n = 1) (Fearnley *et al*., 2013).

Pedestrian leisure (walking and watercraft) along the shoreline in England: Range of median FID = 22.5 to 50m (n = 22); Min/Max FID = 15 to 100m (Liley *et al*., 2011).

Pedestrian leisure (unspecified) along the shoreline in England: Min/Max AD = 25 to 200m; Median FID = 75m (n = 37); Min/Max FID = 30 to 150m (Liley *et al*., 2010).

Pedestrian walking/running along a shoreline in Ireland: Mean FID = 38m (n = 41) (Fitzpatrick and Bouchez, 1998).

Pedestrian walking/running on grasslands in the Netherlands/Germany: Mean FID = 213 (Smit and Visser, 1993).

Pedestrian walking/running on tidal flats in the Netherlands /Germany: Range of mean FID = 211 to 339m; Min/Max FID = 124 to 550m (Smit and Visser, 1993).

Pedestrian egg collector in the Netherlands/Germany: Mean FID = 140m (Smit and Visser, 1993).

Agricultural activities in the Netherlands/Germany: Mean FID = 129m (Smit and Visser, 1993).

Aircraft (helicopter) in the Netherlands/Germany: Mean FID = 200m (Smit and Visser, 1993).

Animals (dogs) in the Netherlands/Germany: Mean FID = 90m (Smit and Visser, 1993).

Motorised vehicle (cars) in the Netherlands/Germany: Mean FID = 188m (Smit and Visser, 1993).

Non-motorised watercraft (kayak) in nearshore waters off Denmark: Mean FID = 220m (Laursen *et al*., 2017).

Non-motorised watercraft (wind surfer) in nearshore waters off Denmark: Mean FID = 400m (Laursen *et al*., 2017).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Mean FID = 140.3m (n = 19); Min/Max FID = 70 to 205m (Scarton, 2018b).

MAD and/or

Buffer zone

Quantitative distances

Nonbreeding season:

Surveyor walking in a coastal lagoon habitat in Italy: Buffer zone = 267m, buffer zone of 270m is recommended to protect mixed species winter roosts (Scarton, 2018b).

Pedestrian walking/running along footpaths close to intertidal areas in England: Buffer zone = 200m (Burton *et al*., 2002a).

Motorised watercraft (motorboat) in a coastal lagoon habitat in Italy: Buffer zone = 219m, buffer zone of 270m is recommended to protect mixed species winter roosts (Scarton, 2018b).

Pedestrian walking/running on grasslands in the Netherlands/Germany: Mean MAD = 100m (Smit and Visser, 1993).

Pedestrian walking/running on salt marsh in the Netherlands/Germany: Mean MAD = 200m (Smit and Visser, 1993).

Ecology and non-quantitative disturbance responses

With the recent loss of breeding curlews from most of Ireland and parts of western Britain over the past 40 years, the distribution of breeding curlews has become patchy with losses in western Scotland, Wales and southwest England and some gains in eastern and southeast England (Balmer *et al*., 2013). This species breeds in upland areas, the highest concentrations are now in northern England, especially the Pennines, eastern Scotland and the Northern Isles (Balmer *et al*., 2013). Curlew is a ground nesting species; the nest is a large depression lined with dried grass and feathers on tussocks or low hummocks (Snow and Perrins, 1998). Curlews are site faithful and will return to the same breeding grounds each year (Wernham *et al*., 2002).

Curlews are present around the UK coastline throughout the year, but coastal distribution is much more widespread outside the breeding season. During the winter, resident curlews leave their upland breeding areas and most spend the winter on or near the coast as well as adjacent farmland, the highest densities are on the major estuaries (e.g. the Wash, Morecambe Bay and the Solway), in the Northern Isles and in western Ireland (Balmer *et al*., 2013). Curlews are also site faithful in the winter and birds seldom move between estuaries (Wernham *et al*., 2002). Resident birds are joined by migrant birds from continental Europe during the nonbreeding season (Wernham *et al*., 2002). Curlews are omnivorous, intertidal invertebrates form the main part of the diet during the nonbreeding season (Snow and Perrins, 1998).

Changes in land-use, agricultural practices and drainage of wetland areas are considered to be the causes responsible for the decline in curlew numbers in the UK (Balmer *et al*., 2013). Human disturbance on breeding and wintering areas (including shooting that takes place in France) is believed to be of secondary importance (European Commission, 2007c). However, studies have shown that curlews are threatened by disturbance on intertidal mudflats (BirdLife International, 2021b), walkers (Burton *et al*., 2002a) and the flooding of mudflats and saltmarshes for tidal barrage construction (Burton, 2006), probably through indirect mechanisms associated to reductions of food resources or access/ displacement from wintering grounds (see literature review in Woodward *et al*., 2015). Curlew may also be at risk from improvements to water quality which has been found to cause reductions in benthic invertebrate densities at sites close to sewage outfalls (Burton *et al*., 2002b).

Curlews often roost on the coast at high tide with other waders (BirdLife International, 2021b), although large numbers of curlew will also roost on fields and marshland. A study by Scarton (2018b), identified Eurasian curlew to be the most sensitive species to human approach compared with other species of roosting waders. Davidson and Rothwell (1993) considered that curlew is one of the more nervous species of wader (in addition to bar-tailed godwit and redshank), compared with oystercatcher, turnstone and dunlin; although Collop (2016) suggested that large waders such as curlew may be able to cope with a 10% reduction in time spent feeding caused by daily disturbance events on the Wash. Furness (1973) noted that roosting curlews and bar-tailed godwits at Musselburgh lagoons were much more likely to be disturbed by aircraft than were other waders. A study investigating human disturbance on curlew, black-tailed godwit and teal in Co. Cork, Ireland, found that out of the three species, curlews were more susceptible to being greatly disturbed by human presence and activity; curlews predominantly left the study area when disturbed by anthropogenic causes (Sexton, 2017).

Likely sensitivity to disturbance = High

Quantitative information = Medium agreement & Robust evidence

Breeding season buffer zone = 200-300m

Nonbreeding season buffer zone = 200-650m

Curlew is assessed to have a high sensitivity to human disturbance.

The maximum FID value recorded for curlew when approached by a pedestrian is a mean of 65m during the breeding season and a mean of 340m (maximum FID of 650m) during the nonbreeding season. Also during the nonbreeding season, mean FID values have been recorded for curlew disturbed by aircraft (200m), motorised vehicles (188m), motorised watercraft (205m) and non-motorised watercraft (220 to 400m).

During the nonbreeding season, mean MAD values between 100 to 200m have been suggested to protect curlew from pedestrian disturbance. Buffer zones of 200 and 267 have been proposed for pedestrian disturbance and a buffer zone of 219m has been proposed for motorised watercraft disturbance; a buffer zone of 270m is suggested to protect winter roosts.

In the UK, curlew has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; tolerance of human disturbance may be lower at roost sites during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 200-300m is suggested to protect nesting curlew and a buffer zone of 200-650m is suggested to protect foraging and roosting birds during the nonbreeding season from pedestrian disturbance.

Knowledge gaps

Current studies provide a good range of FID values during the nonbreeding season, additional studies required for the breeding season.

Whimbrel, *Numenius phaeopus*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 310 breeding pairs in Scotland only (Woodward *et al*., 2020). Scottish population estimate has decreased since Forrester *et al*. (2012) who estimated a population of 400-500 breeding pairs.

UK long-term trend

Overall breeding range contracted by 29% between 1968/72 - 2007/11, although there was a mixture of gains and losses in northern Scotland; the breeding population fell from 410-470 pairs in the 1980s to c.290 pairs in 2009 (Balmer *et al*., 2013). However, winter migrant records increased by 212% between 1981/84 to 2007/11, probably as a result of milder winters (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Whimbrel was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Finland: Mean FID = 56.7m (n = 3), Min/Max FID = 25 to 90m (Díaz *et al*., 2021).

Surveyor walking in Europe: FID = 37.7m (n = 2) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking in a range of habitats: Mean FID = 37.7m (n = 28) (Blumstein, 2006).

Surveyor walking in a shorebird habitat in Australia: FID = 90m (n = 1) (Glover *et al*., 2011).

Surveyor walking in Africa: Mean FID = 57.2m (n = 21) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for whimbrel.

Ecology and non-quantitative information on disturbance responses

In the UK, whimbrel breed in Scotland and most of the confirmed records are in Shetland which covers 76% of the range; breeding has also been confirmed in Orkney and probable breeding was recorded in the Outer Hebrides and Caithness between 2007 and 11 (Balmer *et al*., 2013). In Scotland, this species breeds on heathlands, blanket bog and grazed acid grassland with little heather (Forrester *et al*., 2012). Whimbrel is a ground nesting species, the nest is a shallow depression lined with vegetation which may be on bare ground or in short vegetation (Snow and Perrins, 1998). This species forages on invertebrates and plant material, the proportion of each depends upon location and season (Forrester *et al*., 2012; Snow and Perrins, 1998).

Whimbrels do not overwinter in the UK, after the breeding season, this species migrates south to winter mainly along the western and southern coasts of Africa and on the islands and coasts of the western Indian Ocean (Wernham *et al*., 2002). Migrating whimbrels are regularly recorded around the coast of the UK (although there is a notable absence of passage birds in northeast Scotland), passing to and from breeding grounds in Greenland, Iceland, Fennoscandia and Russia to nonbreeding grounds; migrant birds are recorded in coastal areas as well as at inland sites (the latter particularly in England) (Balmer *et al*., 2013).

Whimbrels are regarded as potentially vulnerable to human disturbance, although it is possibly a minor factor compared to other threats faced by this species (BirdLife International, 2021b; Forrester *et al*., 2012; Wilke and Johnston-González, 2010). The main threats to whimbrel in Scotland are habitat degradation and climate change (Forrester *et al*., 2012). However, during shorebird migration and on the wintering grounds, excessive disturbance can reduce foraging and resting time, increase energy expenditure, decrease the level of use of available habitat and perhaps indirectly increase mortality (Watts *et al*., 2021; Wilke and Johnston-González, 2010). In a study on migrating shorebirds in America, Forgues (2010) found that off-road vehicles driving along beaches caused a significant decline in whimbrel numbers in the study area; birds maintained a distance of at least 75m from approaching vehicles. Peters and Otis (2007) found that nonbreeding whimbrel selecting a roost site in South Carolina showed a general trend towards avoidance of boat activity within 1000m.

In a study in Columbia, Johnston-Gonzalez and Abril (2019) suggested that whimbrel roost site selection was best explained by a combination of access to feeding territories and isolation from potential sources of mainland predators, but not by avoidance of human disturbance. Watts *et al*. (2021) did not find that human disturbance was a widespread threat to whimbrel night roosts in north America. In an anecdotal observation in Mozambique, Allport (2016) observed that a feeding flock of 40 whimbrel responded rapidly to a drone at c.20m above the ground; the authors noted that this response was consistent with the reaction of whimbrels to threats by predators rather than normal human disturbances, which generally did not cause a significant reaction in the study area.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-300m

Nonbreeding season buffer zone = 100-300m

Whimbrel is assessed to have a medium sensitivity to human disturbance.

The maximum FID value recorded for whimbrel when approached by a pedestrian is 90m during both the breeding and nonbreeding seasons, although quantitative studies are limited for this species.

In the UK, whimbrel has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during migration. There are no published buffer zones for whimbrel, but from studies on other waders, a minimum buffer zone of 100-300m is suggested to protect both breeding and nonbreeding whimbrel from pedestrian disturbance.

Knowledge gaps

More AD/FID studies are required during the breeding season and wider range of studies are required for different disturbance sources.

Red-necked phalarope, *Phalaropus lobatus*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 64 territorial breeding males (Woodward *et al*., 2020); Scottish population = 13-48 breeding pairs, 0-15 individuals during passage (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+267%) over 25 years.

The population of breeding red-necked phalarope in the UK seriously declined in the 19th century, this was followed by a temporary recovery in the early 20th century followed by a further decline since the 1930s (Forrester *et al*., 2012). The current relic breeding population has fluctuated considerably in range and size; the current range is larger compared with 1988/91, but smaller than in 1968/72 (Balmer *et al*., 2013). The number of breeding males ranged from 15-30 between 1978 to 2005 and 19-27 in 2010 (Balmer *et al*., 2013). Woodward *et al*. (2020) records the UK population at 64 breeding males in 2013-17. Breeding records in Ireland were not confirmed between 2007-11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Red-necked phalarope was not included in Ruddock and Whitfield (2007).

No AD/FID distances available for red-necked phalarope.

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for red-necked phalarope.

Ecology and non-quantitative information on disturbance responses

In the UK, red-necked phalarope breeds only in Scotland where it is a rare breeding bird at the southernmost edge of the species' circumpolar range (Balmer *et al*., 2013; Wernham *et al*., 2002). The main breeding areas are located in Shetland with other breeding sites in the Outer and Inner Hebrides and one in northeast Scotland (Balmer *et al*., 2013). This species breeds in areas of open water surrounded by vegetation, in Scotland they favour pools with rich nutrient content and low acidity (Forrester *et al*., 2012). Red-necked phalarope is a ground nesting species, the nest is a cup-shaped depression lined with leaves and stems (Snow and Perrins, 1998). This species forages whilst swimming, wading and walking, chiefly feeding on invertebrates (Snow and Perrins, 1998).

Red-necked phalarope do not overwinter in the UK, after the breeding season this species winters pelagically, favouring upwelling areas with abundant planktonic food (Wernham *et al*., 2002). A small number of migrant birds are recorded each spring, mostly in central and eastern England, whilst on their way to breeding grounds in the north (Balmer *et al.*, 2013).

The red-necked phalarope is well known to be one of the most tolerant of wild birds to human presence. Adults have been recorded brooding chicks in a human's hand, and during migration phalaropes allow close approach by people without disturbance (Cramp and Simmons 1982). Hildén and Vuolanto (1972) state: "Observation of phalaropes is very easy due to their tameness. A stationary observer can watch birds without disturbing them at a distance of only a few meters; egg laying, for instance, has been observed at close range without the use of a hide." According to Congreve and Freme (1930) "The remarkable tameness of this species when breeding is well known; however, one male phalarope that F met with was so ridiculously tame that it actually fed its captured youngsters as he held them in his hand". Michael (1938) described how red-necked phalaropes on migration would feed within 1 to 2 m of people at the edge of a lake.

Jørgensen *et al.* (2007) showed that red-necked phalaropes that nest in association with Arctic terns *Sterna paradisaea* often, but not always, respond to tern 'dreads' caused by predators or human disturbance long before the predator or human disturbance is close enough to cause the phalaropes to flee. They considered this to indicate the important role that colonies of terns can play in providing warning and defence for breeding phalaropes against threats from predators. In most cases, the behavioural response of phalaropes to tern dreads was simply to look up to identify the cause of the tern activity.

Everett (1971) suggested that the main threats to the very small breeding population of red-necked phalaropes in Scotland were drainage of pools, flooding of nest sites, damage to pool edges by cattle, and disturbance to nesting phalaropes by birdwatchers and photographers. The rarity of the red-necked phalarope, combined with its exceptional tolerance of humans, can result in breeding birds being seriously disturbed by people who spend too long too close to birds on breeding sites. Forrester *et al*., (2012) update that assessment to point out that conservation management can improve pools for phalaropes, but that egg collecting and deliberate human disturbance can still be significant factors. The impact of human disturbance is, paradoxically, because these birds are both rare and exceptionally tame, and a few irresponsible birdwatchers or photographers may deliberately disturb these rare birds on nesting sites.

Likely sensitivity to disturbance = Low

Quantitative information = No evidence

Breeding season buffer zone <50m

Red-necked phalarope is assessed to have a low sensitivity to human disturbance.

There are a lack of disturbance studies recording AD/FID values for red-necked phalarope. However, non-quantitative studies suggest that buffer zones required to protect red-necked phalarope during the breeding season may be much lower than those required for other waders.

In the UK, red-necked phalarope has limited potential to be disturbed on breeding grounds. From non-quantitative studies, a buffer zone <50m is suggested to protect breeding red-necked phalarope from pedestrian disturbance.

Knowledge gaps

Lack of studies providing AD/FID values during the breeding season.

Species: Terns

Little tern, *Sternula albifrons*

Conservation Status

UK: Amber List; Schedule 1

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 1,450 breeding pairs (Woodward *et al*., 2020); Scottish population = 331 Apparently Occupied Nests (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (-14%) over 15 years.

Range loss perhaps indicates there has been a shift into fewer, larger colonies (Balmer *et al*., 2013). Approximately stable in Scotland, though apparently declined by about 25% in England, Wales and Ireland (Forrester *et al*., 2012).

AD/FID

Quantitative disturbance distances

Little tern was not included in Ruddock and Whitfield (2007).

Nonbreeding season (little tern):

Surveyor walking: Mean FID = 21.5m (n = 18) (Blumstein, 2006).

Breeding season (least tern, *Sterna antillarum*, stand in species for little tern):

Surveyor walking towards nesting site along a shoreline in Florida: Mean FID = 59m (n = 17) (Rodgers and Smith,1995).

Surveyor walking towards nesting site in the USA: FID = 64m (n = 1) (Erwin, 1989).

MAD and/or

Buffer zone

Quantitative distances

Breeding season (least tern, *Sterna antillarum*, stand in species for little tern):

Surveyor walking towards nesting site along a shoreline in Florida: Buffer zone = 154 to 180m (Rodgers and Smith,1995)

Surveyor walking towards nesting site in the USA: Buffer zone = 100 to 200m. A buffer zone of 200 to 300m may be required to protect colony sites early in the season before birds are established (Erwin, 1989).

Ecology and non-quantitative disturbance responses

Little tern is a summer visitor to the UK. The majority of little terns (c.75%) breed on beaches in England, the majority are located on three sections of the coast: the Humber/Lincolnshire, East Anglia and the Solent (Balmer *et al*., 2013). Other colonies exist in North Wales, the Isle of Man, Orkney, the southern Outer Hebrides and the Inner Hebrides (Balmer *et al*., 2013). This species makes a shallow scrape on the ground for a nest and forages by plunge diving for small fish and invertebrates (Snow and Perrins, 1998). After the breeding season, little terns migrate south to overwinter off the coasts of Africa and the Arabian Peninsula (Wernham *et al*., 2002).

Human disturbance is one of the main factors affecting breeding success and distribution of little tern colonies in England; birds avoid sites with regular human disturbance (Balmer *et al*., 2013; Mitchell and Hearn, 2004; Brown and Grice, 2005). Colonies subject to frequent human disturbance have often been abandoned by little terns in favour of areas away from human activity.

On the other hand, there have been examples of little terns taking to nest on flat gravel-covered roofs (where of course they avoid human disturbance despite people being active on the ground below and adjacent to the buildings). Foraging little terns often patrol along the shore a few metres from land, and in such situations can fly close to people without showing any strong response, so human disturbance of foraging little terns is less likely to be a problem than disturbance of birds at nests (Bob Furness, pers. obs.). Little terns do not attack people and nest in small numbers in scattered colonies; the apparent relatively low sensitivity of individuals to disturbance compared to high impact of human disturbance at colonies probably arises because people are often unaware that they are walking into a little tern colony; nests tend to be both cryptic and scattered, and adult behaviour tends to be cryptic when people are close to nests.

Likely sensitivity to disturbance = Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 100-300m

Little tern is assessed to have a medium sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low.

There are no AD/FID records available for little tern during the breeding season, but the maximum FID value recorded for least tern when approached by a pedestrian during the breeding season is 64m. Buffer zones between 100 and 200m have been proposed to protect least terns from pedestrian disturbance during the breeding season, a larger buffer between 200 to 300m is suggested to protect colony sites early in the season before birds are established .

In the UK, little tern has the potential to be disturbed at breeding colonies. A minimum buffer zone of 100m is suggested to protect little tern colonies from pedestrian disturbance, but this may need to be increased to 300m to avoid disturbance early in the breeding season (i.e. during egg laying).

Knowledge gaps

Lack of studies on little tern providing AD/FID values during the breeding season.

Sandwich tern, *Thalasseus sandvicensis*

Conservation Status

UK: Amber List

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 14,000 (13,000-15,000) breeding pairs, 65 individuals in winter (Woodward *et al*., 2020); Scottish population = 1,100 Apparently Occupied Nests, 500 to 5,000 individuals during passage periods (Forrester *et al*., 2012).

UK long-term trend

Wide annual fluctuation in colony size due to variation in the proportion of adults breeding, but overall, there has been a 23% contraction in range since 1968-72 (Balmer *et al*., 2013). Colonies have been lost, particularly in eastern Scotland,

with increasing proportions of the breeding population at just one site (Sands of Forvie NNR) (Forrester *et al*., 2012).

AD/FID

Quantitative disturbance distances

Sandwich tern was not included in Ruddock and Whitfield (2007).

No AD/FID records for sandwich tern.

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone records for sandwich tern.

Ecology and non-quantitative disturbance responses

Sandwich tern is a summer visitor to the UK. This species breeds in a small number of large colonies patchily distributed around the coasts of Britain and Ireland; some of the highest densities are recorded in northeast Scotland, Northumberland and Norfolk (Balmer *et al*., 2013). Colonies are largely absent along the coast of northwest Scotland, central and southern Wales and southwest England (Balmer *et al*., 2013). Sandwich terns nest on exposed open ground at the coast and on inshore islands, they generally select areas that are distant from human activity. This species makes a nest of a shallow scrape on the ground and forages by plunge diving for fish (Snow and Perrins, 1998). After the breeding season, Sandwich terns migrate south to overwinter in West Africa (Wernham *et al*., 2002).

Sandwich tern colonies are considered to be highly vulnerable to human disturbance, and colonies may be deserted as a result (Gregersen, 2006; Forrester *et al*., 2007; Garthe and Flore, 2007; Herrmann *et al*., 2008; Spaans *et al*., 2018). However, the response of breeding Sandwich terns to human activity seems to vary considerably among colonies. At the Farne Islands, Sandwich terns have habituated to presence of people on limited footpaths around the perimeter of their colony and continue to incubate when people are no more than 20m away. At many other Sandwich tern colonies where people are not normally present, Sandwich terns will leave their nests and chicks when people approach at much greater distances. Recognising that monitoring numbers and breeding success of Sandwich terns by visiting colonies tends to cause excessive disturbance, Spaans *et al*. (2018) tested the use of a drone, flown 15-20 m above nesting Sandwich terns at appropriate dates through the breeding season at colonies in The Netherlands, to count breeding numbers and breeding success from photographs. They found that the drone caused “hardly any visible disturbance to the birds” but gave highly accurate data on breeding numbers and breeding success, so was considered much better than using human observations at Sandwich tern colonies. The same conclusion was reached by Valle and Scarton (2021) in Italy.

Away from their colonies, Sandwich terns seem to be at relatively low risk of human disturbance when at sea. Perrow *et al*. (2011) followed breeding adult Sandwich terns foraging at sea from colonies in north Norfolk over distances of up to 72 km, keeping the boat about 20 to 100m from the bird. They note that “birds generally seemed to ignore the boat”. On the rare occasions (<1% of tracked birds) where birds seemed to respond to the boat, they increased their distance from the bird, and considered that foraging tracks and behaviours were broadly unaffected by their boat following the selected individuals. Sandwich terns will rest on shore at quiet coastal sites, especially during late summer after breeding is completed. This study has been unable to find data on flight initiation distances at such sites, but the locations used by Sandwich terns for post-breeding roosting seem to indicate that they select open areas with low risk of human disturbance (Tierney *et al*., 2016).

Likely sensitivity to disturbance = High

Quantitative information = No evidence

Breeding season buffer zone ≥ 200m

Sandwich tern is assessed to have a high sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low.

There are a lack of disturbance studies recording AD/FID values for Sandwich tern. However, non-quantitative studies suggest that buffer zones required to protect Sandwich terns during the breeding season may be similar to those required for other tern species.

In the UK, Sandwich tern has the potential to be disturbed at breeding colonies. From studies on other tern species, it is suggested that buffer zones around breeding colonies should not be less than 200m to protect from pedestrian disturbance.

Knowledge gaps

Lack of studies providing AD/FID values during the breeding season.

Common tern, *Sterna hirundo*

Conservation Status

UK: Amber List

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 11,000 (8,900-13,500) breeding pairs (Woodward *et al*., 2020); Scottish population = 4,800 Apparently Occupied Nests, 2,000-20,000 individuals during passage periods (Forrester *et al*., 2012).

UK long-term trend

Declining breeding distribution in Scotland and Ireland contrasting with gains in eastern and central England; the breeding range has virtually halved in Ireland since 1968-72, whilst in Britain a 13% expansion is apparent (Balmer *et al*., 2013). Gains in inland England are likely to have resulted from the creation of man-made waterbodies, losses in Scotland and Ireland have been attributed to increases in predation (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Common tern was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in tern colony in North America: Mean FID = 10m (Nisbet, 2000).

Surveyor walking in tern colony in the USA: Range of mean FID = 7.3 to 8.1m (Burger and Gochfeld, 1988).

Surveyor walking towards nesting site in the USA: Mean FID = 142m (n = 18); Min/Max FID = 48 to 400m (Erwin, 1989).

Drone in North America: Min/Max FID = 91 to 122m (n = 502) (Chabot *et al*., 2015).

Nonbreeding season:

Surveyor walking in a range of habitats in Australia: Mean FID = 20.5m (n = 8) (Weston *et al*., 2012).

Surveyor walking in Sir Lanka: FID = 66 (n = 1) (Gnanapragasam *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Pedestrian walking/running near a tern colony in a range of locations: Buffer zone = 100 to 400m (Carney and Sydeman, 1999).

Surveyor walking towards nesting site in the USA: Buffer zone = 200m. A buffer zone of 300m may be required to protect colony sites early in the season before birds are established (Erwin, 1989).

Motorised watercraft near a tern colony in a range of locations: Buffer zone = 100m (Carney and Sydeman, 1999).

Motorised watercraft (Jet-ski) in the USA: Buffer zone = 100m (Burger, 1998).

Ecology and non-quantitative disturbance responses

Common tern is a summer visitor to the UK. In Scotland, common tern is primarily a coastal breeding species, the main concentrations are on lochs and islands of the west coast, Outer Hebrides, Northern Isles and the Inner Moray Firth (Balmer *et al*., 2013). In central and eastern England, breeding common terns are more often located at inland colonies (although there are some coastal colonies such as those in Northumberland) and, in Ireland, colonies are clustered by the coast as well as inland (Balmer *et al*., 2013). This species breeds on the ground in the open, usually on bare substrate, and makes a shallow scrape on the ground for a nest (Snow and Perrins, 1998). Like other tern species, common terns chiefly feed on marine fish by plunge diving (Snow and Perrins, 1998). After the breeding season, British breeding common terns migrate south to overwinter off the west coast of Africa, principally along the Gulf of Guinea coast between Sierra Leone and Ghana (Wernham *et al*., 2002).

Common terns may tolerate some forms of human disturbance and are able to habituate to human presence within colonies. Research studies within common tern colonies have shown that even with repeated disturbance, handling and trapping of chicks and adults, breeding success is not significantly reduced (Nisbet, 2000; Galbraith *et al*., 1999; Morris and Burness, 1992; Burger and Gochfeld, 1991), although removing the first egg may cause some pairs to move to another nest site within the colony (Arnold *et al*., 1998). Morris and Burness (1992) found that attaching radio transmitters to common terns did not affect nest attendance or chick feeding rates. Nisbet (2000) found that after 30 years of visiting breeding tern colonies, common terns allow approach to within 10m. Chabot *et al*. (2015) have found that common terns quickly become habituated to the presence of a drone.

However, ecotourists visiting tern colonies that are not habituated to regular human presence may be a cause of disturbance. Erwin (1980) found that common terns were disturbed from preferred nesting sites on barrier beaches in New Jersey by human activity. Common terns nesting in colonies with more exposure to human leisure activity return faster to the colony after banding than terns nesting in more remote colonies (Burger and Gochfeld, 1991; Nisbet, 1981). Erwin (1998) regards a 200m buffer zone (300m early in the season before birds are established) is required to protect common tern colonies from disturbance (people on foot) at colonies in Virginia and New Carolina, although Nisbet (2000), recommends that waterbird colonies should be managed to promote habituation with the presence of wardens or monitors to disturb the colony '*frequently, regularly and predictably*'.

Likely sensitivity to disturbance = Medium/High

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 200-400m

Common tern is assessed to have a medium to high sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is likely to be low.

The maximum FID value recorded for common tern is 400m when approached by a pedestrian during the breeding season, although the majority of recorded FID values are under 200m. When approached by a drone during the breeding season, the maximum FID value recorded is 122m. During the breeding season, buffer zones ranging between 100 and 400m have been proposed to protect common terns from pedestrian disturbance and a buffer zone of 100m has been proposed for motorised watercraft disturbance.

In the UK, common tern has the potential to be disturbed at breeding colonies. A buffer zone between 200-400m is suggested to protect common tern colonies from pedestrian disturbance, although a larger buffer zone may be required if terns are not habituated to disturbance or if disturbance occurs early in the breeding season (i.e. during egg laying).

Knowledge gaps

Current studies provide a moderate range of FID values during the breeding season. Future studies should specify habituation to disturbance when recording AD/FID.

Arctic tern, *Sterna paradisaea*

Conservation Status

UK: Amber List

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 53,500 breeding pairs (Woodward *et al*., 2020); Scottish population = 47,300 Apparently Occupied Nests, 10,000-200,000 individuals during passage periods (Forrester *et al*., 2012).

UK long-term trend

UK breeding range shows an overall range contraction of 31% since 1968-72, losses are greatest in western Scotland (especially Northern Isles) which have been attributed to predation (particularly American mink) and food shortages (Balmer *et al*., 2013). Annual colony sizes fluctuate, a 29% decline in numbers was recorded for Britain and Ireland between 1985/88 – 1998/2002 and a 15% decline during 2000-11, poor productivity and poor recruitment are noted as reasons for the decline (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Arctic tern was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking towards nesting site in Canada: Range of mean FID = 37 to 92m (n = 143); Max FID = 160 (Mallory, 2016).

Aircraft (helicopter) flying over a tern colony in Canada: Mean FID = 1000m (Mallory, 2016).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Surveyor walking towards nesting site in Canada: Buffer zone = 100 to 200m (Mallory, 2016).

Aircraft (helicopter) flying over a tern colony in Canada: Buffer zone = 2000m (Mallory, 2016).

Ecology and non-quantitative disturbance responses

Arctic tern is a summer visitor to the UK where it is a breeding bird at the southern end of the species' Arctic range. Arctic terns breed predominantly in coastal areas of Scotland and Ireland; in Scotland the highest abundance is recorded in the Northern Isles, Outer Hebrides and northern Scotland (Balmer *et al*., 2013). There are relatively few colonies in England, some colonies are present along the Northumberland coast, north-east Anglia, Merseyside and one on the Isle of Man, in Wales colonies are restricted to Anglesey and its offshore islands (Balmer *et al*., 2013). As with other tern species, Arctic terns breed on open bare ground by making a shallow scrape for a nest; they forage on marine fish by plunge diving (Snow and Perrins, 1998). Arctic terns undertake some of the most extensive migration journeys undertaken by any bird; after the breeding season, Arctic terns migrate to Antarctic waters where they spread along food rich areas at the edge of the ice pack (Wernham *et al*., 2002).

During the UK breeding season, Arctic terns tend to nest in larger colonies than common terns, and also tend to be much more aggressive towards humans that approach their nests, swooping and pecking people on the head. Human disturbance of nesting Arctic terns is therefore less likely to cause problems than human disturbance of common terns, as people tend to be deterred from Arctic tern nesting areas by the birds' aggression (Bob Furness, pers. obs.). However, there is some evidence to suggest that in a highly disturbed environment, human disturbance can have an effect on Arctic terns. It has been demonstrated on the Isle of May that for Arctic terns, the presence of visitors substantially decreases chick provisioning rates compared to when visitors are not present on the island. The highest level of disturbance was found during the afternoon and evening, when peak chick provisioning occurred (Bogdanova *et al*., 2014).

Foraging Arctic terns show very little or no behavioural response to the presence of people on the shoreline, so disturbance of foraging or commuting Arctic terns is unlikely. Arctic terns will roost on beaches when not breeding, mostly after the breeding season, and at that time may be displaced from a resting area by human disturbance. However, they are more likely to simply move to a nearby undisturbed area (Bob Furness, pers. obs.).

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone ≥ 200m

Arctic tern is assessed to have a medium sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low.

The maximum FID value recorded for Arctic tern during the breeding season is 160m when approached by a pedestrian and 1km when approached by a helicopter, although quantitative studies are limited for this species. Buffer zones between 100 and 200m and up to 2km have been suggested to protect Arctic terns from pedestrian disturbance and helicopter disturbance respectively during the breeding season.

In the UK, Arctic tern has the potential to be disturbed at breeding colonies. A minimum buffer zone of 200m is suggested to protect Arctic tern colonies from pedestrian disturbance, although a larger buffer zone may be required if terns are not habituated to disturbance or if there is likely to be aerial disturbance above the colony.

Knowledge gaps

Few studies producing AD/FID values during the breeding season.

Roseate tern, *Sterna dougallii*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 100 breeding pairs (Woodward *et al*., 2020); Scottish population = 4 breeding pairs, 5-20 during spring and autumn passage (Forrester *et al*., 2012).

UK long-term trend

Eaton *et al*. (2021) state a stable number of breeding birds (+26%) over 25 years.

Numbers of roseate terns at the UK’s most important roseate tern colony on Coquet Island have continued to grow; the number of breeding adults that were hatched on the island itself has risen steadily from 20% in 2006 to nearly 60% in 2019 (Eaton *et al*., 2021).

AD/FID

Quantitative disturbance distances

Roseate tern was not included in Ruddock and Whitfield (2007).

Breeding season:

Pedestrian leisure (unspecified) along the shoreline of Cape Cod Peninsula: Mean FID = 115.3m (n = 356), Max FID = 200m (Althouse *et al*., 2019).

Surveyor walking in tern colony in America: Range of mean FID = 6 to 6.5m (Burger and Gochfeld, 1988).

Nonbreeding season:

Surveyor walking in Africa: FID = 44.0m (n = 1) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Pedestrian leisure (unspecified) along the shoreline of Cape Cod Peninsula: Minimum buffer zone = 100m (Althouse *et al*., 2019).

Pedestrian activity around a tern colony: Buffer zone = 100 to 180m (Carney and Sydeman, 1999).

Ecology and non-quantitative information on disturbance responses

Roseate tern is a summer visitor to the UK where it is a very rare and localised breeder at the coast; inland records are extremely rare for this species (Wernham *et al*., 2002). The majority (97%) of the UK and Ireland breeding population is located at three colonies including: Coquet Island (northeast England) and Rockabill and Lady's Island Lake in the east of Ireland; numbers occurring at other colonies are very small, this species occasionally attempts to breed with common terns (Balmer *et al*., 2013). Roseate terns prefer breeding sites close to clear, shallow sandy fishing grounds; they generally nest under some cover from vegetation or rocks but will also nest on open sand, and will use tern nest boxes which can give added protection from predators, weather and disturbance; birds forage by plunge diving for marine fish (Snow and Perrins, 1998). Roseate terns do not overwinter around the UK, after the breeding season, British birds migrate south to overwinter in coastal Ghana (Wernham *et al*., 2002; Forrester *et al*., 2012).

Roseate tern is considered to be a particularly sensitive species to human disturbance. As this species is confined to so few breeding colonies, there is potential for significant disturbance during the breeding season as colonies are vulnerable to localised, stochastic events (OSPAR Commission, 2009). Uncontrolled disturbance to nesting terns (by humans or predators) can lead to abandonment and long-term disuse of sites (Monteiro *et al*., 1996). In the Azores archipelago, disturbance to wildlife has increased through human recreational activities (fishing, boating, scuba-diving, crab and limpet collecting, picnicking). The largest Azorean colony of roseate terns (200 clutches) was completely abandoned in 1992 after disturbance from picnickers, and in 1990, about 40 eggs were broken by fishermen; in each case, roseate terns did not return to the colony the following year indicating that disturbance may play an important role in colony shifting from year to year (Monteiro *et al*., 1996). At a stopover site in Cape Cod, Althouse *et al*. (2019), found that pedestrian activity (particularly activity involving rapid movement such as jogging) caused terns to flush at greater distances compared with shorebirds and gulls, even though gulls are kleptoparasites of terns (although common terns are more commonly targeted in a mixed tern colony). Althouse *et al*. (2019) suggested that a minimum buffer zone of 100m should be used by managers to protect staging roseate terns, although larger buffer zones may be necessary in areas that are frequented by smaller tern flocks because terns in small flocks may be more sensitive to disturbance than when in larger flocks. Carney and Sydeman (1999) suggested that tern colonies should not be entered within 100 to 180m.

In overwintering grounds in coastal Ghana, roseate terns are vulnerable to trapping by humans for food, sport and sale, the majority of trappings involve first-year birds which affects recruitment into the breeding population (Forrester *et al*., 2012).

Likely sensitivity to disturbance = High

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone ≥ 200m

Roseate tern is assessed to have a high sensitivity to human disturbance at breeding colonies, particularly because this species is confined to so few breeding colonies.

Quantitative studies are limited for roseate tern, but the maximum FID value recorded for this species when approached by a pedestrian is 200m during the breeding season and 44m during the nonbreeding season. Buffer zones between 100 and 180m have been suggested to protect roseate terns from pedestrian disturbance during the breeding season.

In the UK, roseate tern has the potential to be disturbed at breeding colonies. A minimum buffer zone of 200m is suggested to protect roseate tern colonies from pedestrian disturbance.

Knowledge gaps

Lack of studies providing AD/FID values during the breeding season.

Species tables: Owls

Snowy owl, *Bubo scandiacus*

Conservation Status

UK: Former breeder, Schedule 1

European: Least Concern

UK status

Accidental, Former Breeder

UK and Scottish population estimate

Scottish population = 1 breeding pair annually 1967-75 (Forrester *et al*., 2012). No known breeding attempts since 2001 in Ireland (Balmer *et al*., 2013).

UK long-term trend

Small but fluctuating numbers occur. Five different individuals were on St Kilda in May-August 2007 (Miles and Money, 2008). Two nonbreeding mobile birds were recorded during the summer (one in the Outer Hebrides, the other in the Channel Islands) between 2008 and 11; six or seven mobile birds were present during the winters between 2007 and 11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Snowy owl was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor approaching a nest site on Baffin Island, Canada: Min/Max FID (of brooding female) = 274.3 to 548.6m. (Watson, 1957).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for snowy owl.

Ecology and non-quantitative information on disturbance responses

Snowy owl is a rare winter migrant to Scotland. This species has a circumpolar breeding distribution on the high-arctic tundra, migrants in Scotland may originate from the European Arctic (Balmer *et al*., 2013). One pair bred in Fetlar in Shetland between 1967-75, but successful breeding attempts ceased when the breeding male died during the winter of 1975/76 (Balmer *et al*., 2013). Snowy owl is a ground nesting species, the nest is usually a shallow scrape on a raised bit of ground above the snow (Snow and Perrins, 1998). In a study in Norway, Solheim *et al*. (2021) suggested that male snowy owls selected elevated mounds, rocks or heights around the nest site in order to have the best view of the territory and keep a look out for prey and potential threats. A wide distribution of a small number of overwintering birds (6-7 individuals) was recorded in the UK between 2007 and 11, mainly in the Outer Hebrides, Orkney, Scottish Highlands, Channel Islands and Western Ireland (Balmer *et al*., 2013). Snowy owls feed on small mammals and medium sized birds (lemmings or voles on tundra), foraging may take place during the day although most hunting is carried out in the twilight of morning or evening (Snow and Perrins, 1998). Nonbreeding birds at St Kilda in summer 2007 fed on mice, adult puffins and skua chicks (Miles and Money, 2008). Outside the breeding season, snowy owls are solitary birds, in over wintering areas they are often seen resting on the ground or on mounds, rocks and fences.

Due to their remote breeding grounds, breeding snowy owls are largely free from direct human disturbance. However, snowy owls that are disturbed by pedestrians and predators on breeding grounds will strongly defend their nest sites and this species is known to attack people as well as Arctic foxes and dogs that come too close (Wiklund and Stigh, 1983; Watson, 1957; Sutton and Parmelee 1956). On Baffin Island in Canada, Watson (1957) noted that surveyors could not approach a nest without being seen by the male snowy owl and he described the attack as “silent and unexpected”; the owls would sometimes beat their wings on the surveyor’s head and give a painful blow with the back of their feet, sometimes with claws extended. Sutton and Parmelee (1956) also report being struck by the talons of snowy owls on Baffin Island, but also note that some warning of an attack is given; owls would hoot from a distant hilltop or while flying from one lookout post to another. Wiklund and Stigh, (1983) noted that as soon as an intruder faced an approaching snowy owl, the owl generally interrupted the attack even when only 5-10m from the intruder. Sutton and Parmelee (1956) found that snowy owls would not attack until the surveyors were within 100 yards (ca 91.5m) of a nest or young. Watson (1957) recorded at one location on Baffin Island that brooding female snowy owls flew away from surveyors at 300 yards (ca 274.3m), alighting 500 yards (ca 457m) beyond, and the male came no nearer than 50 yards (ca 46m), although when the surveyor moved 300 yards away from the nest the female returned at once, while the male watched from a perch. At another location, Watson (1957) noted that the owls were a bit shyer and brooding females would fly when the surveyor was 600 yards (ca 548.6m) away and the males would not come closer than 200 yards (ca 183m), though the nests contained young.

In Norway, studies on snowy owls have suggested that this species is potentially sensitive to a wide range of human disturbance, sources of pedestrian disturbance may include: tourism, recreation, reindeer husbandry, motorised traffic, dogs, photographers, ornithologists and scientists (Heggøy and Øien, 2014). Other human related disturbance including: egg collection, illegal hunting (still legal hunting in Alaska), environmental contaminants (PCBs, POPs) and collisions (cars, aeroplanes and power lines) are also considered potential threats (Heggøy and Øien, 2014).

On the Outer Hebrides, flushing distances to human disturbance have been found to be quite variable as snowy owls often sit in open machair grassland areas where people can be visible at long distances, however, birds can often be approached quite closely (c. 10m) without flushing if the approach is done slowly and sensitively, although birds will flush if birdwatchers/tourists approach too closely or surround an individual (Andrew Stevenson, pers. comm.) Snowy owls can be flushed by crofting/farming activities as well, although these sorts of regular activities are often ignored by individual birds, especially if the activity is at a distance (Andrew Stevenson, pers. comm.) On St Kilda, the current resident snowy owl has habituated to some degree to human presence, although this bird will avoid the village on the island where human activity is highest (Andrew Stevenson, pers. comm.). In New Hampshire, pedestrians wishing to approach migrant snowy owls during the nonbreeding season are advised to keep at least 100 feet (ca 30.5m) away from birds on the ground, as at this distance snowy owls may stare at a human present and any closer may cause birds to flush (New Hampshire Audubon, 2021). New Hampshire guidelines state that "*flushed birds have collided with stationary objects and once airborne they attract the attention of crows, gulls and hawks, which will pursue and harass them, reducing opportunities to hunt*" (New Hampshire Audubon, 2021)

In a study in Norway, Solheim, (2021) found that nonbreeding male snowy owls would approach and attack a vole lure on a line that was pulled by a surveyor who was sitting on the ground or in a car ca 100-500m away, the two female owls included in the study did not show any detectable reaction to the lures. The authors also noted that snowy owls perched 100m or closer to the road; surveyors usually watched the owls from a car to prevent disturbing the birds (Solheim, 2021).

Hardey *et al*. (2013) recommend that snowy owls should not be disturbed during laying or incubation, the authors also recommend that due to the rarity of this species within Britain and Ireland, all observations on the breeding snowy owl should be made from a distance, unless licenced surveyors have a specific need to collect information on clutch or brood size.

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Nonbreeding season buffer zone = 150-500m

Snowy owl is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for snowy owl; the maximum FID value recorded for this species is 548.6m when approached by a pedestrian in Canada during the breeding season, but as this species does not breed in the UK, quantitative values recorded during the breeding season may not be relevant to disturbance in the UK. There are no records of AD/FID values for pedestrian disturbance during the nonbreeding seasons, but Solheim, (2021) indicates that snowy owls may approach people within 100-500m.

In the UK, snowy owl is most likely to be disturbed on foraging and roosting grounds during the nonbreeding season. There are no published protection buffer zones for snowy owls, but from non-quantitative studies as well as studies on other owl species, a minimum buffer zone of 150-500m is suggested to protect foraging and roosting snowy owls during the nonbreeding season from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions.

Knowledge gaps

Lack of British studies measuring AD/FID for a range of pedestrian disturbance activities.

Long-eared owl, *Asio otus*

Conservation Status

UK: Green List

European: Least Concern

UK status

Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 1,800-6,000 breeding pairs (Woodward *et al*., 2020); Scottish population = 600-2,200 breeding pairs, 2,000-12,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Census methods do not provide accurate population estimates for this elusive and cryptic species (Forrester *et al*., 2012; Balmer *et al*., 2013), so trends in numbers are uncertain. However, while numbers may have declined in Scotland and England, they seem to have increased in Ireland between 1968 and 72 and 2007-11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Spain: FID = 12m (n = 1) (Díaz *et al*., 2021).

Surveyor approaching a nest in Italy: Min/Max FID = 3 to 42.5m (Galeotti *et al*., 2000).

Surveyor walking in a forest habitat in the USA: Min/Max FID = c.3 to 8m (Wilson, 1938).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 30m (n = 5 to 6); Min/Max AD (80% opinion range) = <10 to 300m; Min/Max AD (90% opinion range) = 150 to 300m.

Range of median FID = 5 to 30m (n = 5 to 7); Min/Max FID (80% opinion range) = <10 to 300m

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Disturbance free zone = 75 to 125m (Petty, 1998).

Construction work in California: Exclusion zone = 150m (Ruddock and Whitfield, 2007).

Ecology and non-quantitative information on disturbance responses

Long-eared owl is a solitary and territorial resident breeder in the UK with a habitat preference for open spaces with coniferous and scrub habitats containing abundant prey; this species will also breed in deciduous woodland (Balmer *et al*., 2013; Snow and Perrins, 1998). Breeding locations are widespread and scattered across Britain and Ireland, although long-eared owls are relatively uncommon in Scotland and England (Balmer *et al*., 2013). In Ireland it is the most abundant owl species and probably benefits from the absence of competing dominant tawny owls; in England, numbers are highest in northern areas with declines in the southeast and Wales (Balmer *et al*., 2013). In Scotland, long-eared owls are predominantly present in the south, east and north-east (except for the Black Isle where numbers are declining) and are absent from the north-west and the Northern Isles, except for a few pairs on the Inner and Outer Hebrides (Balmer *et al*., 2013; Forrester *et al*., 2012). Long-eared owls generally nest in trees; this species doesn't build its own nest but reuses old nests of other species, principally crows, sparrowhawks and magpies; nest boxes will also be used (Forrester *et al*., 2012; Snow and Perrins, 1998). Some long-eared owls may not lay eggs after establishing a nesting territory and separating early breeding failure from genuine non-breeding is particularly difficult for this species (Hardey *et al*., 2013). The diet of long-eared owl is mainly small rodents, especially voles, but other prey items may also include some birds, larger mammals and shrews; the diet is often more diverse in summer (Snow and Perrins, 1998).

During the nonbreeding season, resident breeding long-eared owls are joined by migrants from Fennoscandia, Russia and elsewhere in eastern Europe; there are fewer movements between eastern Britain and the Low Countries (Wernham *et al*., 2002). British breeders are fairly sedentary, although male birds may remain further north than females in some parts of the range (Wernham *et al*., 2002), but generally distributions between breeding and nonbreeding seasons are fairly similar (Balmer *et al*., 2013). In winter, communal roosts form, often in scrub near water and always in proximity to open habitat suitable for hunting (Wernham *et al*., 2002).

Long-eared owls are highly cryptic in woodland, very secretive and difficult to find which makes this a problematic species to survey and may provide some protection against some sources of human disturbance. Nesting birds vary in their behaviour towards intruding people. At the approach of a human, most remain tight on the nest to within a few metres (Galeotti *et al*., 2000), a few fly to deeper cover, and a few will swoop at people or perform a distraction display a few metres away (Cramp, 1985). In a study in Italy, Galeotti *et al*. (2000) found that nest defence increased significantly throughout the breeding season because older chicks were defended more strongly than younger chicks and eggs; median flushing distances of females occurred in the range of 3-42.5m from the start of incubation to early fledging. In a study in the USA on breeding owls, Wilson (1938) recorded that once disturbed by a surveyor, long-eared owls would flush at distances of c.3-8m and land again c.22-90m away.

Whilst long-eared owls are mostly found in woodland in the UK, in eastern Europe this species often occurs in urban habitats, both for breeding and for communal roosting. In urban habitats, long-eared owls may apparently be highly tolerant of human activity and they are thought to benefit from milder microclimates in urban roosts as well as reduced predation risk and availability of urban bird prey (Makarova and Sharikov, 2015; Mérö and Žuljević, 2020; Mak *et al*., 2021). Pirovano *et al*. (2000) found that long-eared owls adapt well to urban environments in the winter, in a study in Italy the authors observed urban roosts of up to 75 birds in public parks and private gardens.

However, long-eared owls can be sensitive to disturbance, particularly early in the nesting cycle and at communal roosts (Hardey *et al*., 2013). Hardey *et al*. (2013) recommend that any disturbance of potential roost sites by surveyors should be carried out as close to dusk as possible so that birds are not forced to leave roosts for long periods during daylight.

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 100-300m

Nonbreeding season buffer zone = 100-300m

Long-eared owl is assessed to have a medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for long-eared owl, but the maximum FID value recorded for this species is 42.5m when approached by a pedestrian during the breeding season; there are no records of AD/FID values during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for long-eared owl during the breeding season is 150 to 300m.

Buffer zones range from 75 to 125m to protect long-eared owls from forestry operations during the breeding season in the UK. An exclusion zone of 150m around nest sites has been recommended for construction activity in the USA.

In the UK, long-eared owl is most likely to be disturbed at nest sites early on in the breeding season as well as at communal roosting areas during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 100-300m is suggested to protect both breeding and nonbreeding long-eared owl from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions, especially during the nonbreeding season. A buffer zone at the lower end of this range, or even lower may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

Lack of British studies measuring AD/FID for a range of pedestrian disturbance activities.

Short-eared owl, *Asio flammeus*

Conservation Status

UK: Amber List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder, Passage/Winter Visitor

UK and Scottish population estimate

UK population = 620-2,200 breeding pairs (Woodward *et al*., 2020); Scottish population = 125-1,250 breeding pairs, 300-3,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Balmer *et al*. (2013) note widespread declines in numbers in Britain and Ireland, as also found in continental Europe. Declines have occurred in Scotland (Forrester *et al*., 2012) which most likely relate to maturing of plantation forestry so loss of nesting habitat in young plantations.

AD/FID

Quantitative disturbance distances

FID update (Booms *et al*., 2010) published since Ruddock and Whitfield 2007.

Breeding season:

Aircraft (helicopter) in Alaska: Mean FID = 55m, Min/Max FID = 50 to 60m.

(Booms *et al*., 2010).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 75 to 125m (n = 13 to 12); Min/Max AD (80% opinion range) = <10 to 500m; Min/Max AD (90% opinion range) = 300 to 500m.

Range of median FID = 5 to 75 m (n = 14); Min/Max FID (80% opinion range) = <10 to 500m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 300 to 600m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 275 to 325m (Petty, 1998).

Ecology and non-quantitative information on disturbance responses

Short-eared owl is a resident breeder and migrant species in the UK where it mainly inhabits areas of open country in Scotland and northern England (Balmer *et al*., 2013). Numbers are highest on Orkney, Outer Hebrides (Uists) and in the Pennines, elsewhere numbers of breeding birds are widely scattered and involve a small number of pairs in lowland coastal marshes and extensive grassland (Balmer *et al*., 2013). Short-eared owls have a habitat preference for upland heather grass-heather moorland, rough grassland, bogs and young forestry plantations populated with small mammal prey, particularly field voles (Balmer *et al*., 2013; Forrester *et al*., 2012). Arable areas are little used for breeding as are re-stocked conifer forests (Forrester *et al*., 2012). This species nests and often roosts on the ground; the nest is a shallow scrape roughly lined with pieces of vegetation in amongst the thick cover of grass, reeds and heather etc (Snow and Perrins, 1998).

In the nonbreeding season, some British breeding short-eared owls migrate to southern Europe while others remain in the UK but move from uplands to coastal marshes, dunes and farmland; birds remaining in the UK are joined by Fennoscandian breeders (Balmer *et al*., 2013;. Wernham *et al*., 2002). Overwintering birds can be found along the British east coast from Fife to Kent as well as around large river valleys and lowlands of England; birds breeding in Orkney, the Uists and the Pennines overwinter close to their breeding grounds (Balmer *et al*., 2013). In winter, short-eared owls generally roost communally, regularly on the ground at favoured locations in amongst vegetation (Wernham *et al*., 2002). Roosts can hold a dozen owls or more, but due to the mobility of the population in winter, there can be a high turn-over of numbers at roost sites (Wernham *et al*., 2002).

Fernandez-Bellon *et al*. (2021) reviewed the threats to short-eared owls and identified ecological factors (particularly prey availability, but also predation and extreme weather), changes in land use (habitat loss and agricultural intensification), persecution (shooting), and accidental nest destruction resulting from agricultural practices, as significant threats. They did not identify human disturbance as a threat. Forrester *et al*. (2007) identify habitat loss and illegal persecution as threats in Scotland, but did not indicate human disturbance to be a factor, although they note that short-eared owl roosts tend to be in remote locations away from human activity.

Van Gompel (1979) identified human disturbance as a major cause of displacement and abandonment of roost sites of short-eared owls wintering on the Belgian coast, though part of that related to illegal hunting of the species in Belgium. Cramp (1985) notes that short-eared owls are “wary”, but “not markedly shy”. However, Cramp (1985) states that birds in winter roosts tend to fly when a person approaches within ca.50m of a roost site, although such birds “rarely fly far before alighting”. Human disturbance near the nest normally results in the female sitting tight, often only flushing off the nest when almost stepped on (Cramp, 1985). Adults, mostly males, will sometimes attack people that approach the nest, sometimes use a distraction display, and sometimes alternate between these behaviours (Cramp, 1985). Reaction distance of males to humans increases when there are chicks in the nest, but typically the male may attack a person when they approach within 200m of the nest, barking in agitation and swooping towards the person, not normally making contact, but in some cases hitting and even drawing blood (Cramp, 1985).

Hardey *et al*. (2013) suggest that short-eared owls are potentially sensitive to disturbance during the breeding season, the authors recommend that the nests of this species should not be visited in cold, wet weather. Hardey *et al*. (2013) also recommend that vantage points for viewing short-eared owls are situated at least 500m away from areas of activity / nests to minimise the risk of disturbance and that searches for roost sites should be avoided due to the disturbance that this causes.

Likely sensitivity to disturbance = Medium/High

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone = 300-500m

Nonbreeding season buffer zone = 300-500m

Short-eared owl is assessed to have a medium to high sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for short-eared owl; the maximum FID value recorded for this species is 60m when approached by a helicopter in Alaska during the breeding season. There are no records of AD/FID values for pedestrian disturbance during either the breeding or nonbreeding seasons, but Cramp (1985) indicates that pedestrian disturbance may have an FID value within c.50m. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for short-eared owl during the breeding season is 300 to 500m.

Buffer zones range from 275 to 600m to protect short-eared owls from forestry operations during the breeding season in the UK.

In the UK, short-eared owl is most likely to be disturbed at nest sites in the breeding season as well as at communal roosting areas during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 300-500m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect both breeding and nonbreeding short-eared owls from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a larger buffer zone up to 600m to avoid disturbance during the breeding period.

Knowledge gaps

Lack of studies measuring AD/FID for a range of pedestrian disturbance activities.

Tawny owl, *Strix aluco*

Conservation Status

UK: Amber List

European: Least Concern

UK status

Resident Breeder

UK and Scottish population estimate

UK population = 50,000 breeding pairs (Woodward *et al*., 2020); Scottish population = 6,000 breeding pairs, 12,000 individuals plus ‘floaters’ in winter (Forrester *et al*., 2012).

UK long-term trend

Atlas survey methods are not very good for tawny owl, and trends in numbers are uncertain. Balmer *et al*. (2013) suggest increases in north and west Scotland between 1968-72 and 2008-11. Forrester *et al*. (2012) predict an increase in tawny owl numbers in Scotland as new native woodlands develop and increasing areas of plantation conifer forests reach maturity.

AD/FID

Quantitative disturbance distances

Tawny owl was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat: FID = 26.1m (n = 1) (Díaz *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Forestry operations in the UK: Disturbance free zone = 75 to 125m (Petty, 1998).

Breeding season (Barred owl, *Strix variata,* stand in species for tawny owl):

Forestry operations in Ontario: Buffer zone = 200m (Naylor, 2009).

Ecology and non-quantitative information on disturbance responses

Tawny owl is a widespread, common resident breeding species in deciduous and mixed woodlands throughout Britain (Balmer *et al*., 2013). Tawny owls will also inhabit tree-dotted farmland, urban parks and orchards, and even large gardens (Snow and Perrins, 1998). This species is absent from treeless areas including the Northern Isles, Outer Hebrides, some Inner Hebridean islands, Isles of Scilly and open areas of northern Scotland, it is also absent in the Channel Islands and Ireland (Balmer *et al*., 2013). Tawny owl is generally a hole nesting species, selecting holes usually up to 12m above ground (although they can be up to 25m above ground), they will readily take to using nest boxes; this species will also nest on cliffs or buildings often in old magpie nests or occasionally squirrel dreys (Snow and Perrins, 1998). Compared with other owls, tawny owls have a fairly wide diet depending on location. In woodland the diet is mainly rodents (but also birds, amphibians, shrews, earthworms and beetles), in towns, mainly birds are eaten, although also small rodents and other prey as available (Snow and Perrins, 1998). Tawny owls are highly sedentary and show a high degree of site fidelity, birds rarely move more than a few kilometres from their natal sites throughout their lives (Wernham *et al*., 2002); breeding and nonbreeding distributions are very similar (Balmer *et al*., 2013). Tawny owl is a solitary species and individuals remain alone or in their pairs throughout the year.

Forrester *et al*. (2007) did not suggest that human disturbance represented a significant threat to tawny owls in Scotland, their range of habitats brings them into close contact with people, especially in urban environments. While they appear to be tolerant of human activity, van der Horst *et al*. (2019) attributed lower densities of tawny owl territories close to main roads due to a combination of collision mortality and disturbance of owls by vehicle traffic. When disturbed at the nest, tawny owls vary considerably in terms of behaviour. Females guard the nest, and most go silently into cover if disturbed by a human at the nest, but a few individuals will attack, especially birds in urban habitats where they experience more human disturbance (Cramp, 1985). The most aggressive individuals may attack a person when they come within 50m of a nest containing young, usually swooping from behind and in extreme cases making physical contact and drawing blood (Cramp, 1985). Sacchi *et al*. (2004) found that tawny owls in urban parkland preferred nest boxes that were more than 6m above the ground, and suggest that this is part of a protection strategy against human disturbance. Frohlich and Ciach (2018) found that urban areas with high levels of human noise at night held lower densities of tawny owls. They suggest that tawny owl hunting efficiency may be reduced in noisy environments, indicating that human noise may be a stronger influence on tawny owls than visual disturbance.

Likely sensitivity to disturbance = Low/Medium

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 50-200m

Nonbreeding season buffer zone ≥50m

Tawny owl is assessed to have low to medium sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for tawny owl; the maximum FID value recorded for this species is 26m when approached by a pedestrian during the breeding season; there are no records of AD/FID values for pedestrian disturbance during the nonbreeding season. Cramp (1985) indicate that pedestrians shouldn't approach nests any closer than c.50m. Buffer zones range from 75 to 125m to protect tawny owls from forestry operations during the breeding season in the UK.

In the UK, tawny owl is most likely to be disturbed at nest sites in the breeding season, but there is also potential for disturbance at roosting and foraging areas during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 50-200m is suggested to protect nesting tawny owls and a buffer zone of ≥50m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence.

Knowledge gaps

Lack of studies measuring AD/FID for a range of pedestrian disturbance activities. Lack of MAD/buffer zones for tawny owl.

Barn owl, *Tyto alba*

Conservation Status

UK: Green List, Schedule 1

European: Least Concern

UK status

Resident Breeder

UK and Scottish population estimate

UK population = 4,000-14,000 breeding pairs (Woodward *et al*., 2020);

Scottish population = 500-1,000 breeding pairs (Challis *et al.,* 2020; Forrester *et al*., 2012), 1,000-2,000 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

According to Balmer *et al*. (2013), barn owls declined from the mid-19th century to the present, owing to changes in agriculture, loss of nest sites, and road traffic collision mortality. However, milder winters, nest box provision and agri-environment schemes may have mitigated that decline in recent years. Atlas maps show a large increase in barn owl distribution in Britain and Ireland between 1968-72 and 2007-11. Forrester *et al*. (2012) note that the Scottish population has been steadily growing since the 1980s.

AD/FID

Quantitative disturbance distances

No AD/FID updates published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a forest habitat in the USA: Min/Max FID = c.1.5 to 30m (Wilson, 1938).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 5m (n = 10 to 11); Min/Max AD (80% opinion range) = <10 to 100m; Min/Max AD (90% opinion range) = 50 to 100m.

Median FID = 5m (n = 11); Min/Max FID (80% opinion range) = <10 to 100m

(Ruddock and Whitfield 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Shawyer, 2011) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian walking/running in the UK: Buffer zone = 10 to 20m

Artificial lighting in the UK: Buffer zone = 20 to 30m

Motorised vehicle (general) in the UK: Buffer zone = 30 to 40m

Light commercial vehicle/machine (construction activity) in the UK: Buffer zone = 40 to 60m

Heavy commercial vehicle/machine (construction activity) in the UK: Buffer zone = 150 to 175m (Shawyer, 2011).

Forestry operations in the UK: Safe working distance = 100 to 250m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Forestry operations in the UK: Disturbance free zone = 75 to 125m (Petty, 1998).

Ecology and non-quantitative information on disturbance responses

Barn owl is a resident breeding species in the UK. This species is widespread across Britain, but these owls avoid high-altitude and urban areas and are absent from remote islands including the Outer Hebrides and Northern Isles; distribution is patchy in Ireland (Balmer *et al*., 2013). Barn owls can exploit a wide range of habitats, but they prefer lowlands with trees, especially farmlands with a combination of trees, hedges and aquatic areas with some rough grasslands where mice and other prey can be hunted in low flight (Snow and Perrins, 1998). Barn owl is a cavity nesting species using holes in trees, buildings, cliffs, quarries or rocky outcrops; nests are reused for successive broods and in successive years (Snow and Perrins, 1998). The diet is made up of small mammals, mostly mice and voles, some shrews and also some small birds and amphibians are eaten (Snow and Perrins, 1998). Adult barn owls are sedentary, but juveniles will disperse a median distance of 12km away from their natal sites in the first few weeks after fledging (Wernham *et al*., 2002); breeding and nonbreeding distributions are very similar (Balmer *et al*., 2013). Barn owl is a solitary species and individuals remain alone or in their pairs throughout the year.

As the name indicates, barn owls frequently nest in farm buildings, but will also use nest boxes or natural holes in trees. When nesting, barn owls tend to sit tight when a person approaches the nest, even when they come very close (Cramp, 1985). Although eggs may be deserted due to disturbance, barn owl chicks and adults can be ringed at the nest with almost no risk of adults deserting the nest due to the disturbance (Arthur French, pers. Comm.). Barn owls that are hunting show very little avoidance of people or of vehicles. Collision with road traffic is a major cause of mortality in barn owls (Forrester *et al*., 2007; de Jong *et al*., 2018).

Barn owls can be sensitive to disturbance at the nest site, particularly early in the nesting cycle. Hardey *et al*. (2013) recommend that licenced surveyors should take special care to avoid disturbance during pre-laying through to hatching, although the authors also state that nest inspections should not have a detrimental effect if carried out carefully. Hardey *et al*. (2013) also recommend that barn owls should not be flushed from nests or roosts in daylight because they may be mobbed by other birds and will be reluctant to return, which may affect their survival, particularly in the winter months. In a study in the USA on breeding owls, Wilson, (1938) recorded that once disturbed by a surveyor, barn owls would flush at distances of c.1.5-30m and land again c.90-150m away.

Likely sensitivity to disturbance = Low

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 50-100m

Nonbreeding season buffer zone ≥50m

Barn owl is assessed to have a relatively low sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for barn owl; the maximum FID value recorded for this species is 30m when approached by a pedestrian during the breeding season; there are no records of AD/FID values for pedestrian disturbance during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for barn owl during the breeding season is 50 to 100m, although the authors state that, as barn owl frequently nest in nest boxes '*overly prescriptive 'exclusion zones' based on the upper limits of apparent signs of disturbance in some pairs or situations may not be an appropriate management option in several situations'.*

Buffer zones range from 75 to 250m to protect barn owls from forestry operations during the breeding season in the UK. The Wildlife Conservation Partnership guidance recommends buffer zones of 10-20m to protect barn owl from pedestrian disturbance and buffer zones from 20-175m to protect against a range of other disturbances.

In the UK, barn owl is most likely to be disturbed at nest sites in the breeding season, but there is also potential for disturbance at roosting and foraging areas during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 50-100m (considered to be the upper disturbance limit estimated by expert opinion (Ruddock and Whitfield, 2007)) is suggested to protect nesting barn owls and a buffer zone of ≥50m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions. A buffer zone at the lower end of this range may be sufficient to protect individuals that have some habituation to human presence. Forestry operations may require a wider buffer zone up to 250m to avoid disturbance during the breeding period.

Knowledge gaps

Lack of studies measuring AD/FID for a range of human disturbance activities.

Species: Other species

Corncrake, *Crex crex*

Conservation Status

UK: Red List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 1,000 territorial breeding males mostly in Scotland (Woodward *et al*., 2020). Scottish population estimate has increased since Forrester *et al*. (2012) estimated a population of 1,060 breeding pairs in 2004, 0-10 birds in passage.

UK long-term trend

Eaton *et al*. (2021) state a strong increase in breeding birds (+108%) over 25 years.

Once an abundant and widespread breeding bird in the UK, there has been a long-term population decline since 1968/72 (Balmer *et al*. 2013). However, the British range increased by 14% between 1988/91 and 2008/11 and the population increased by 141% between 1993 and 2009, although there have been continued losses in Ireland (Balmer *et al*. 2013). Gains are largely a result of conservation measures, agri-environmental schemes and a reintroduction programme in eastern England (Balmer *et al*. 2013).

AD/FID

Quantitative disturbance distances

Corncrake was not included in Ruddock and Whitfield (2007).

Nonbreeding season:

Pedestrian walking/running at a stopover site in Egypt: Mean FID = 2.8m (Eason et al., 2010).

MAD and/or

Buffer zone

Quantitative distances

Breeding season:

Pedestrian (bird monitoring methods in the UK): MAD = 100m (not necessary to approach closer than 100m to pinpoint singing male) (Gilbert *et al*.,1998).

Ecology and non-quantitative information on disturbance responses

Corncrakes are summer visitors to the UK. The breeding population of corncrake is now mainly confined to a small number of coastal and island strongholds in Scotland and Ireland; the main breeding concentrations are in the Outer and Inner Hebrides with smaller numbers in Orkney, Shetland and coastal areas of Co. Donegal and West Connaught (Balmer *et al*., 2013). A growing breeding population is also present in the Nene Washes in eastern England where this species was introduced in 2002; a small number of passage birds moving to breeding grounds are also regularly recorded in eastern areas of Scotland and England (Balmer *et al*., 2013). Corncrakes prefer habitats that are composed of cool, moist stands of grass or herbage (including machair and fields of clover and cereals) that are tall enough to provide concealment; a nest is formed out of dead leaves on the ground concealed by vegetation (Snow and Perrins, 1998). Corncrakes are omnivorous feeding mainly on invertebrates, but small amounts of plant material, especially seeds, are also eaten (Snow and Perrins, 1998). Although there are historical records of corncrakes wintering in the UK, this species is largely migratory; after the breeding season, corncrakes migrate south through France crossing into Africa via Morocco to overwinter in trans-Saharan Africa (Wernham *et al*., 2002).

Isolated corncrake populations may be vulnerable to disturbance from birdwatchers, but in general this species is not thought to be very sensitive to human disturbance (RSPB, 1996). The decline in corncrake numbers was first noticed in the middle of the 19th century (Balmer *et al*. 2013; Cocker and Mabey, 2005), but even up to the late 1960s this species was an abundant and widespread breeding bird in the UK. Corncrakes were unable to adapt to changes in land management practices that followed agricultural intensification, particularly the changes that led to the motorisation and early mowing of grass crops for silage which kill their young (Balmer *et al*. 2013). Conservation measures brought about by the RSPB and adopted into agri-environmental schemes to delay mowing until August and to mow fields from the centre outwards to allow chicks to escape (these methods are referred to as Corncrake Friendly Mowing, CFM) have resulted in recent gains in corncrake numbers (RSPB, 2021b; Balmer et al., 2013; O'Brien *et al*., 2006).

Despite being a rather timid and highly cryptic species, more often heard than seen, corncrakes are able to tolerate human presence; this species inhabits agricultural areas and will live in close proximity to human activity. For example, in the UK, corncrakes have been reported to call within close proximity to human habitation (e.g. Norris, 1945; Cocker and Mabey, 2005) and the number of corncrakes recorded in a Moscow city park reportedly remained stable between 1928 and 1994 despite heavy recreational pressure (summarised in RSPB, 1996). Some corncrakes are able to habituate to human presence to such an extent that they will visit human dwellings to be fed (Cocker and Mabey, 2005).

However, the small, isolated populations that are now present in the UK are more likely to be impacted by disturbance than a widespread species (RSPB, 1996). In 2014, a male corncrake was heard calling for the first time in 15 years on Rathlin Island in Northern Ireland, but it is thought that this bird left the island due to disturbance caused by a helicopter landing briefly in an uncropped hayfield where the corncrake had been calling (RSPB, 2014).

Likely sensitivity to disturbance = Medium

Quantitative information = Low agreement & Limited evidence

Breeding season buffer zone ≥100m

Corncrake is assessed to have a medium sensitivity to human disturbance; the sensitivity of this species has increased as breeding populations have become more isolated.

Quantitative studies measuring AD/FID are very limited for corncrake; the maximum FID value recorded for this species when approached by a pedestrian is 2.8m during the nonbreeding season. A MAD of 100m has been recommended to protect corncrakes from pedestrian disturbance during the breeding season.

In the UK, corncrake has the potential to be disturbed on breeding grounds. Depending on the level of habituation to disturbance, a buffer zone of at least 100m is suggested to protect breeding corncrake from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions.

Knowledge gaps

Lak of any AD/FID studies during the breeding season.

European nightjar, *Caprimulgus europaeus*

Conservation Status

UK: Amber List

European: Least Concern, Annex 1

UK status

Migrant Breeder, Passage Visitor

UK and Scottish population estimate

UK population = 4,600 (3,700-5,500) territorial breeding males (Woodward *et al*., 2020); Scottish population = 27 territorial males, 1 record in winter, 0-4 during spring and autumn passage (Forrester *et al*., 2012).

UK long-term trend

Historically a widespread breeding species in the UK, the range contracted by 51% and 88% in Britain and Ireland respectively between 1968/72 and 1988/91 (Balmer *et al*., 2013). However, since this time the British breeding population doubled from 2,100 territorial males in 1981 to 4,600 in 2004, the breeding range also expanded by 18% between 1988/91 and 2008/11 (Balmer *et al*., 2013; Woodward *et al*., 2020).

AD/FID

Quantitative disturbance distances

FID update (Dolman, 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a forest habitat in England: Mean FID = 10m (n = 22) (Dolman, 2010).

Pedestrian walking/running, disturbance estimated by expert opinion:

Range of median AD = 5 to 18m (n = 12); Min/Max AD (80% opinion range) = <10 to 150m; Min/Max AD (90% opinion range) = 100 to 150m.

Median FID = 5m (n = 14); Min/Max FID (80% opinion range) = <10 to100m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

MAD and/or

Buffer zone

Quantitative distances

Buffer zone update (Langston *et al*., 2007) published since Ruddock and Whitfield (2007).

Breeding season:

Pedestrian leisure activity (general) on a heathland habitat in England: Buffer zone = 150m (Langston *et al*., 2007)

Pedestrian leisure activity (general) on a heathland habitat in England: Buffer zone = 500m (Murison, 2002).

Forestry operations in the UK: Safe working distance = 50 to 200m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative information on disturbance responses

Nightjars are summer visitors to the UK. Only a small proportion of the European population breeds in the UK, the majority of birds breed in Spain (Wernham *et al*., 2002). Nightjars in Britain are widely distributed across England and Wales, the highest concentrations are in East Anglia and southern England (Balmer *et al*., 2013). Although historically nightjar was once widespread in Scotland (as they were throughout the UK), this is now a very scarce breeding species mostly confined to the south-western area of Dumfries and Galloway (Balmer *et al*., 2013) in clearings within conifer plantations (Forrester *et al*., 2012). This is a nocturnal species which feeds on flying insects, mostly moths and beetles (Snow and Perrins, 1998). The preferred habitat of nightjars in the UK includes lowland heathland and felled or recently planted conifer plantations, though coastal moorland (Cornwall), sweet chestnut coppice (Kent) and sand dunes (Suffolk) may also be occupied (Balmer *et al*., 2013). Nightjars make a shallow scrape on the ground for a nest which may be located in the open, in woodland clearings or in amongst scrub and tall vegetation (Snow and Perrins, 1998). . Some suitable habitat is available in Scotland in the form of young conifer plantations, but the lowland dry heaths generally associated with this species in England are rare in Scotland (Forrester *et al*., 2012). Nightjars do not overwinter in the UK, after the breeding season, this species migrates south to overwinter in eastern and southern Africa (Wernham *et al*., 2002).

Nightjars are highly cryptic in woodland, secretive and difficult to find. Their camouflage may provide protection against some sources of human disturbance (e.g. some pedestrians and predators) and birds will often sit unseen on the ground at their roost or nest site until approached within a few metres (Wernham *et al*., 2002). Ruddock and Whitfield (2007) discuss that nightjars avoid movement because they may in part rely on their cryptic plumage to avoid detection, therefore, records of AD may be unreliable for this species as passive disturbance is very hard to detect.

In a study investigating nightjar predation within forest habitats in England, Dolman (2010) recorded no evidence to show that recreational disturbance caused birds to flush close to paths or that nightjar breeding success was impacted by disturbance; the authors found that nightjar nests were only predated by mammalian predators (primarily fox and badger), with no predation by crow or any other diurnal avian predator and no instances of flushing by dogs were observed.

However, conversely, other studies have shown that nightjars are impacted by disturbance and breeding success is known to be lower in areas where there are high levels of human recreation. In a study investigating the effects of recreational disturbance on breeding nightjars on heathland sites in England, Langston *et al*. (2007) found that failed nests were significantly closer to paths than successful nests (median distance from nearest path = 45m for unsuccessful nests (n = 26) versus 150m for successful nests). Langston *et al*. (2007) also found that nightjar nests surrounded by a greater total path length were associated with higher losses (mainly due to predation by corvids); the authors suggested that paths should be buffered by 150m to protect breeding nightjars from dogs and pedestrians. In a similar study involving the same habitat in England, Murison (2002) also showed that sites with no public access had significantly higher breeding success than sites with open access; nightjar density was lower within 500m of heavily traversed pathways and nest failures were found up to 225m from paths. Along routes with known territories and nest sites adjacent to paths, Murison (2002) suggested that dogs should be kept on leads or excluded from key sites between May and August to protect breeding nightjars. In another study on English heathland habitat, Liley and Clarke (2003) found that nightjar density was lower within 500m of urban development, although this may have been at least partly due to a lack of woodland near urban developments which is one of the preferred foraging habitats of nightjars.

In a long-term study (10 years) at Sherwood Pines Forest Park in Nottinghamshire, Lowe and Durrant (2014) found that breeding nightjar density significantly decreased in areas that were heavily disturbed by recreational activities; the authors suggested that human recreational disturbance may drastically alter settlement patterns and the nest site selection of arriving females and that buffer zones around territories should be based on the response to disturbance of females rather than males.

Likely sensitivity to disturbance = Medium/High

Quantitative information = Medium agreement & Limited evidence

Breeding season buffer zone = 150-500m

Nightjar is assessed to have a medium to high sensitivity to human disturbance.

Quantitative studies measuring AD/FID are very limited for nightjar; a mean FID value recorded for nightjar is 10m when approached by a pedestrian during the breeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for nightjar during the breeding season is 150 to 300m although they noted that '*estimates of static disturbance distances should be viewed with some scepticism because avoiding any movement is probably part of the suite of behaviours nightjars use to escape detection. This trait is also likely to lead to low active disturbance distances, with birds only flushing from the nest when an approaching potential predator is close*'. Buffer zones for nightjar range from 150 to 500m for pedestrian disturbance and 50 to 200m for forestry operations.

In the UK, nightjar has the potential to be disturbed on breeding grounds. A buffer zone of 150-500m is suggested to protect breeding nightjar from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions.

Knowledge gaps

Further AD/FID studies required during the breeding season investigating a range of disturbance sources.

Kingfisher, *Alcedo atthis*

Conservation Status

UK: Green List, Schedule 1

European: Least Concern, Annex 1

UK status

Migrant/Resident Breeder

UK and Scottish population estimate

UK population = 3,850-6,400 breeding pairs (Woodward *et al*., 2020); Scottish population = 330-450 breeding pairs, 1,200-1,800 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Breeding range has fluctuated over the last 40 years, losses have generally outweighed gains although there have been gains in eastern areas of England and Scotland (Balmer *et al*., 2013). Breeding numbers increased between the mid-1980s and 2005, but since this time numbers have fallen (Balmer *et al*., 2013). Wintering distribution increased between 1981/84 and 2007/11, possibly linked to milder winters (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

Kingfisher was not included in Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in a rural habitat in Spain: FID = 24m (n = 1) (Díaz *et al*., 2021).

Surveyor walking in an urban habitat in France: Mean FID = 9.5m (n = 2), Min/Max FID = 5 to 14m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Poland: FID = 24.6m (n = 1) (Díaz *et al*., 2021).

Nonbreeding season:

Surveyor walking in Europe: FID = 24m (n = 1) (Møller and Erritzøe, 2010).

Surveyor walking in Europe: Mean FID = 16.27m (n = 2) (Møller, 2008a).

Surveyor walking in a range of habitats in Sir Lanka: Mean FID = 14.8 (n = 8); Min/Max FID = 3 to 26m (Gnanapragasam *et al*., 2021).

Nonbreeding season (Azure kingfisher, *Ceyx azureus*, stand in species for European kingfisher):

Surveyor walking in a range of habitats in Australia: Mean FID = 11.7m (n = 10) (Weston *et al*., 2012).

Unknown season (Malachite kingfisher, *Alcedo cristata*, stand in species for European kingfisher):

Surveyor walking in Africa: Mean FID = 10.3m (n = 4) (Weston *et al*., 2021).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone available for kingfisher.

Ecology and non-quantitative information on disturbance responses

Common kingfishers are resident birds in the UK which inhabit lowland river areas. This species is one of the most northerly members of a mainly tropical family, the *ispida* race is present in the UK and much of Europe, but is replaced in the Mediterranean Basin by the nominate *atthis* which also breeds in central Asia (Wernham *et al*., 2002). Kingfisher is absent from the Scottish Highlands and islands, but in lowland areas of England and Wales it is widespread; only a small population is present in Scotland which is concentrated on the mainland mainly in the southern and eastern lowlands (Balmer *et al*., 2013), but smaller numbers are also found north to the Moray Firth (Forrester *et al*., 2012). Preferred habitats of this species are still or gently flowing freshwater streams, small rivers, canals, drains and ditches where birds can plunge dive from a perch to catch small fish and aquatic insects, although occasionally insects may be caught in the air (Snow and Perrins, 1998). Kingfishers breed in tunnels that are excavated into steep or vertical banks, usually (but not always) over water (Snow and Perrins, 1998). In the UK, this species is mainly sedentary, although juveniles disperse away from breeding territories; some kingfishers move to coastal habitats in winter, although generally distribution is similar in both the breeding and nonbreeding seasons (Balmer *et al*., 2013). Migration is rare in the UK, although some individuals may cross the English Channel or the North Sea (Wernham *et al*., 2002).

Kingfishers are shy, reclusive birds and are potentially sensitive to human disturbance, particularly during the breeding season. If the presence of humans prevents kingfishers from entering their nests for extended periods of time, chicks may weaken from cold or hunger and reduce their begging calls, which in turn may stimulate the parents to provide less food (RSPB, 2021c). Kingfishers may not nest in areas if there is ongoing disturbance nearby; a study on watercourses in Ireland indicated that kingfisher numbers were lowest in areas that had the highest percentage of paths and tracks, roads and human trampling, which may suggest that such disturbances could be having a negative effect on the kingfisher population, although low fish densities also likely impacted kingfisher density in the Irish study (BirdWatch Ireland, 2010). A study in Spain indicated that the highest densities of kingfishers are located along rivers with the lowest human population density as well as minor agricultural use, indicating that this species prefers more pristine watercourses (Peris and Rodriguez, 1997). However, kingfishers can breed successfully on rivers within urban areas such as the River Kelvin in Glasgow and the Rivers Black Cart and White Cart in Paisley, and appear to be unaffected by people walking along the riverbank paths, possibly because the rivers are wide enough to mitigate disturbance.

A number of studies in Asia have investigated the impact of human disturbance on common kingfishers. In a study in Dhaka, Bangladesh, investigating daily activity patterns of common kingfishers, Sultana and Sarker, (2016) found that kingfishers were more active in the morning compared with the afternoon, which the authors suggested was due to increased human presence and high traffic noise along waterbodies during the afternoon. Biswas and Rahman (2012) estimated that approximately 15% of the major threats for kingfishers at Chittagong University in Bangladesh were due to human disturbance around nesting, feeding and roosting areas, as well as some public superstition and dislike towards kingfishers. Noor *et al*. (2014) found that kingfisher density was low in areas with high levels of vehicular traffic and human habitation along the bank of the Dal Lake in Jammu and Kashmir, India.

Likely sensitivity to disturbance = Low/Medium

Quantitative information = High agreement & Limited evidence

Breeding season buffer zone = 50-100m

Nonbreeding season buffer zone = 50-100m

Kingfisher is assessed to have a low to medium sensitivity to human disturbance.

The maximum FID value recorded for kingfisher when approached by a pedestrian is 25m during the breeding season and 26m during the nonbreeding season. There are no published buffer zones for kingfisher.

In the UK, kingfisher has the potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season; as a hole nesting species kingfisher may be less likely to be disturbed when on the nest. Depending on the level of habituation to disturbance, a minimum buffer zone of 50-100m is suggested to protect breeding kingfisher from pedestrian disturbance, but further studies on the impacts of human disturbance are required to help inform such decisions.

Knowledge gaps

Further AD/FID studies required during the breeding and nonbreeding seasons to investigate a range of disturbance sources.

Crested tit, *Lophophanes cristatus*

Conservation Status

UK: Green List, Schedule 1

European: Least Concern

UK status

Resident Breeder

UK and Scottish population estimate

UK population = 1,000-2,000 breeding pairs in Scotland (Woodward *et al*., 2020; Forrester *et al*., 2012); Scottish winter population = 5,600-7,900 individuals in winter (Forrester *et al*., 2012).

UK long-term trend

Crested tit was probably widespread in Scotland when ancient native pinewood covered much of the highlands, but this species declined and fragmented as the forest was cut down (Forrester *et al*., 2012). However, new pine plantations planted in the 20th century have allowed the range to extend again and it is likely that the population has also increased (Forrester *et al*., 2012). The Scottish breeding range increased by 28% between 1968/72 and 2007/11 and the wintering range expanded by 50% between 1981/84 and 2007/11 (Balmer *et al*., 2013).

AD/FID

Quantitative disturbance distances

FID updates (Jiang and Møller, 2017; Møller, 2008a; Dolman, 2010) published since Ruddock and Whitfield (2007).

Breeding season:

Surveyor walking in Europe: Mean FID = 6.2m (n = 34) (Jiang and Møller, 2017).

Pedestrian leisure (unspecified) in Denmark: Mean FID = 6.08m (n = 7) (Møller *et al*., 2007).

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 75m (n = 9); Min/Max AD (80% opinion range) = <10 to 100m; Min/Max AD (90% opinion range) = 50 to 100m.

Range of Median FID = 5 to 30m (n = 10); Min/Max FID (80% opinion range) = <10 to100m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Breeding season (Willow tit, *Parus montanus*, stand in species for crested tit):

Surveyor walking in Europe: Mean FID = 5.6m (n = 7) (Jiang and Møller, 2017).

Breeding season (Marsh tit, *Parus palustris*, stand in species for crested tit):

Surveyor walking in Europe: Mean FID = 6.3m (n = 40) (Jiang and Møller, 2017).

Breeding season (Blue tit, *Parus caeruleus*, stand in species for crested tit):

Surveyor walking in Europe: Mean FID = 5.4m (n = 262) (Jiang and Møller, 2017).

Breeding season (Coal tit, *Periparus ater*, stand in species for crested tit):

Surveyor walking in Europe: Mean FID = 5.8m (n = 13) (Jiang and Møller, 2017).

Breeding season (Great tit, *Parus major*, stand in species for crested tit):

Surveyor walking in Europe: Mean FID = 5.9m (n = 450) (Jiang and Møller, 2017).

Nonbreeding season:

Surveyor walking in Europe: Mean FID = 6.32m (n = 18) (Møller and Erritzøe, 2010).

Surveyor walking in Europe: Mean FID = 6.08m (n = 7) (Møller, 2008a).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season:

Forestry operations in the UK: Safe working distance = 50 to 200m (Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Ecology and non-quantitative information on disturbance responses

In the UK, crested tit is a resident species confined to pinewoods of northern Scotland; the core range covers the Caledonian pinewoods of upper Strathspey and pinewoods of lower Strathspey; the *scoticus* race occurs almost exclusively in native pinewoods and Scots pine plantations in the coastal plains of Moray and Nairn (Balmer *et al*., 2013; Wernham *et al*., 2002). Smaller numbers of crested tits are also recorded in pine plantations in Easter Ross and east Inverness-shire, as well as remnant pine forests of the glens from Strathbran and Strathfarrar south to Glen Garry (Balmer *et al*., 2013). The density of wintering crested tits has been found to be ten times higher in ancient native pinewoods compared with planted pinewoods (Summers e*t al*., 1999). Crested tit is a hole nesting species, generally in rotten tree stumps, and nest boxes are regularly used (Thom, 1986). Food is mainly insects and spiders, although plant material (mainly conifer seeds) may be eaten outside of the breeding season (Snow and Perrins, 1998), this species often forages on the ground or in low branches (Svensson *et al*., 2009). Adult crested tits are sedentary and although juveniles disperse over short distances post-breeding, breeding and nonbreeding distributions are similar (Balmer *et al*., 2013).

Crested tits can be tolerant of human presence; there are a number of records of birds visiting garden bird tables and feeders on Skye and in Gairloch, (Balmer et al., 2013) the RSPB Loch Garten Nature Centre in Speyside and in Moray (Forrester et al., 2012), particularly during the winter (Highland Nature, 2014) although Svensson *et al*. (2009) mentions that this behaviour is relatively rare. Like other species of the tit family, crested tits can be very inquisitive and at times may approach humans making a noise, but this behaviour depends on the stage of nesting; in the spring this species can be very elusive and difficult to find (Highland Nature, 2014). Svensson *et al*. (2009) note that crested tits are usually difficult to approach, although this species is not known to be particularly shy.

In studies using distance sampling analysis to estimate the density of crested tits in Scotland, the distance at which a pedestrian walking a transect line could detect a crested tit ranged between 39.3 to 62.5m; tits recorded along transects are usually detected by a contact or scolding call and therefore FID values are likely to be lower than detection distances (see summary in Ruddock and Whitfield, 2007; Calladine 2006; Summers *et al*., 1999).

Likely sensitivity to disturbance = Low

Quantitative information = High agreement & Limited evidence

Breeding season buffer zone = 10-50m

Nonbreeding season buffer zone = 10-50m

Crested tit is assessed to have a relatively low sensitivity to human disturbance.

Quantitative studies measuring AD/FID are limited for crested tit; the maximum mean FID value recorded for this species when approached by a pedestrian is 6.2m during the breeding season and 6.3m during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for crested tit during the breeding season is 50-100m. Buffer zones for crested tit range from 50 to 200m for forestry operations.

In the UK, crested tit may have some potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 10-50m is suggested to protect breeding and nonbreeding crested tits from pedestrian disturbance.

Knowledge gaps

Further AD/FID studies required during the breeding and nonbreeding seasons to investigate a range of disturbance sources.

Crossbill species, *Loxia spp.*

Conservation Status

Common crossbill (*Loxia curvirostra*):

UK: Green List, Schedule 1

European: Least Concern

Scottish crossbill (*Loxia scotica*):

UK: Amber List, Schedule 1

European: Least Concern, Annex 1

Parrot crossbill (*Loxia pytyopsittacus*):

UK: Amber List

European: Least Concern

UK status

Common crossbill:

Migrant/Resident Breeder, Passage/Winter Visitor

Scottish crossbill:

Endemic (Scotland) breeder

Parrot crossbill: Scarce Visitor, Occasional Breeder (Scotland)

UK and Scottish population estimate

Common crossbill:

Breeding: UK = 26000 pairs; Scotland = 5,000 to 50,000 pairs depending on cone crops elsewhere in Europe and in UK (Forrester *et al*., 2007).

Scottish crossbill:

Breeding Scotland only = 300 to 1,300 pairs (Forrester *et al*., 2007).

Parrot crossbill:

Breeding: Scotland only = ca. 100 pairs

UK long-term trend

Huge fluctuations, but also a long-term (20th and 21st century) increase in common crossbill numbers and range relating to increase in amount of mature plantation forestry (Balmer *et al*., 2013; Forrester *et al*., 2007).

AD/FID

Quantitative disturbance distances

FID update (Díaz *et al*., 2021; Møller and Erritzøe, 2010; Møller, 2008b; Møller *et al*., 2007) published since Ruddock and Whitfield (2007).

Breeding season (common crossbill, *Loxia curvirostra*):

Surveyor walking in a rural habitat in Denmark: Range of mean FID = 4.7 to 5.5m (n = 7); Min/Max FID = 4.1 to 8.2m (Díaz *et al*., 2021).

Surveyor walking in a rural habitat in Spain: Mean FID = 9.2 to 16.4 (n = 4); Min/Max FID = 6.4 to 16.4m (Díaz *et al*., 2021).

Pedestrian (general) in Denmark: Mean FID = 4.6m (n = 12) (Møller *et al*., 2007).

Breeding season (parrot crossbill, *Loxia pytyopsittacus*):

Surveyor walking in a rural habitat in Denmark: Mean FID = 4.2m (n = 2); Min/Max FID = 2.8 to 5.72m (Díaz *et al*., 2021).

Breeding season (crossbill spp, *Loxia spp*):

Pedestrian walking/running, disturbance estimated by expert opinion:

Median AD = 5m (n = 16); Min/Max AD (80% opinion range) = <10 to 150m; Min/Max AD (90% opinion range) = 100 to 150m.

Median FID = 5m (n = 17); Min/Max FID (80% opinion range) = <10 to 150m.

(Ruddock and Whitfield, 2007; Whitfield *et al*., 2008a).

Nonbreeding season (common crossbill, *Loxia curvirostra*):

Pedestrian (general) in Europe: Mean FID = 4.74m (n = 2) (Møller and Erritzøe, 2010).

Pedestrian (general activity) in Europe: Mean FID = 4.73m (n = 2) (Møller, 2008b).

MAD and/or

Buffer zone

Quantitative distances

No MAD or buffer zone updates published since Ruddock and Whitfield (2007).

Breeding season (common crossbill, *Loxia curvirostra*):

Forestry operations in Canada: Buffer zone = 70m (Waterhouse and Harestead, 1999).

Forestry operations in the UK: Safe working distance = 50 to 150m

(Currie and Elliot, 1997; Forestry Commission Scotland, 2006).

Breeding season (Scottish crossbill, *Loxia scotica*):

Forestry operations in the UK: Safe working distance = 150 to 300m

(Currie and Elliot, 1997).

Forestry operations in Scotland: Safe working distance = 50 to 150m

(Forestry Commission Scotland, 2006).

Breeding season (parrot crossbill, *Loxia pytyopsittacus*):

Forestry operations in Scotland: Safe working distance = 50 to 150m

(Forestry Commission Scotland, 2006).

Ecology and non-quantitative disturbance responses

Where ranges overlap, common and Scottish crossbills cannot reliably be told apart using visual identification, however, Scottish crossbills are limited in range to northeast Scotland and the eastern Highlands, so outside of this range, records refer solely to common crossbills (Balmer *et al*., 2013). Crossbills are associated with conifer plantations and are widely distributed throughout most of Scotland and Wales, exceptions are treeless areas of northwest Scotland, Northern Isles and some Hebridean islands (Balmer *et al*., 2013). Distribution in England is patchy, some of the higher densities are in conifer plantations in Norfolk, Hampshire and Dorset (Balmer *et al*., 2013). Crossbills forage by extracting seeds from conifers, this species may start breeding as early as midwinter, depending on availability of conifer seeds and consequently, breeding and nonbreeding distributions in the UK are fairly similar (Balmer *et al*., 2013; Snow and Perrins, 1998). Within northern Europe, this species feeds mainly on the seeds of Norway spruce, whereas the larger-billed parrot crossbill and Scottish crossbill are able to extract seeds from the tougher cones of Scots pine (Summers, 2018). Crossbills build nests high in conifer trees (Snow and Perrins, 1998).

Common crossbills can be found in deep dense forest, woodland edges or detached stands, they appear to tolerate human disturbance as they can be found in mature conifers in small towns and they will occasionally use overhead cables for perching or drinking from roof-top water tanks (Snow and Perrins, 1998). Crossbills are rarely found on the ground and disturbance studies on crossbill spp. indicate that human disturbance distances are relatively low (Díaz *et al*., 2021; Møller and Erritzøe 2010; Møller, 2008b; Møller *et al*., 2007), likely because their foraging and breeding habitat high up in trees keeps crossbills at a distance from human disturbance.

Likely sensitivity to disturbance = Low

Quantitative information = Medium agreement & Medium evidence

Breeding season buffer zone = 50-200m

Nonbreeding season buffer zone = 50-200m

Crossbill species are assessed to have a relatively low sensitivity to human disturbance.

The maximum FID value recorded for crossbill species when approached by a pedestrian is a maxmum of 16.4m during the breeding season and a mean of 4.7m during the nonbreeding season. Ruddock and Whitfield (2007) considered from expert opinion that the upper pedestrian disturbance distance limit for crossbill species during the breeding season is 100 to 150m, which is consistent with safe working distances used by Forestry Commission Scotland. Currie and Elliot (1997) suggest that safe working distances should be larger for Scottish crossbill (up to 300m), likely due to species differences in conservation status (Ruddock and Whitfield, 2007).

In the UK, crossbill species may have some potential to be disturbed on breeding grounds as well as on foraging and roosting grounds during the nonbreeding season. Depending on the level of habituation to disturbance, a buffer zone of 50-200m is suggested to protect breeding and nonbreeding crossbills from pedestrian disturbance.

Knowledge gaps

Lack of studies measuring AD/FID for Scottish crossbills during the breeding season.

Recommendations for further research

It has been acknowledged that all bird species assessed in this review are likely to vary their response to human disturbance in different areas due to differing levels of habituation between individuals as well as a wide range of other factors that can influence behavioural responses to disturbance (see '**Habituation and other factors influencing disturbance distance**' section). Furthermore, this review has identified that there are a number of bird species where quantitative data on disturbance distances in relation to human activities are lacking (see '**Data gaps**' section). Therefore, due to these variable factors and data gaps, the range of disturbance distances presented in this review are intended as a guide only. For studies that require to understand more precisely the distance a focal species will respond to a given source of disturbance under a given set of environmental conditions, specific bird disturbance distance studies need to be carried out on a site-specific basis.

Future disturbance distance studies investigating the impacts of human activity on bird disturbance should aim to record quantitative records of disturbance distances in terms of AD and FID. These measures of disturbance distances can be recorded by measuring the distance between a source of disturbance and the position of a focal bird when 1) the focal bird is first alerted to the source of disturbance (AD) and 2) when the focal bird first responds to the source of disturbance by moving away (FID). FID should still be recorded even if it is not possible to record AD; AD is usually more difficult to determine than FID, as alert behaviour is often cryptic compared with the FID response of physically moving away from the source of disturbance.

Standardised data should be collected in order to efficiently compare data recorded in different disturbance distance studies. Any study aiming to deliberately disturb birds in Scotland should also discuss the plan with NatureScot in advance in order to ensure that the work is compliant with legislation and with conservation objectives and welfare considerations. The following list provides a guide to basic information that should be recorded at the time of a disturbance distance study:

- Focal bird species, and age/sex of bird where that can be determined from plumage;
- Study location;
- Date;
- Weather conditions;
- Details of the source of disturbance (e.g. person walking, dog running, rock climber, motorboat, canoe, drone etc. moving towards focal bird);
- Whether the source of disturbance is visual or acoustic or both;
- AD distance (if it is possible to identify);
- FID distance; and
- Whether the study location is likely to be disturbed or undisturbed; if it is disturbed then what the likely source of disturbance is (e.g. is the study location frequented by people/boats/aircraft etc., or is it a remote and relatively undisturbed site).

Secondary factors that would be useful to record at the time of a disturbance distance study include the following:

- The initial distance between the source of disturbance and the focal bird (i.e. the study starting distance before the point of AD or FID has been reached);
- A record of whether the focal bird is likely to be breeding or nonbreeding;
- Specific habitat of the study location (e.g. sandy beach, cliffs, estuary mudflats etc.);
- Time of day;
- Tidal state (where coastal);
- Type of behaviour focal bird is displaying before the disturbance event (e.g. foraging/roosting/nesting/loafing);
- Type of AD behaviour (e.g. head-up, alarm calling, aggressive display, unknown);
- Type of FID behaviour (e.g. walk/run away, fly away 50m, swim/dive away from source of disturbance);
- Whether the focal bird is alone or with other birds (if it is the latter, then record the identity of other bird species and the flock size); and
- Length of time spent flying away from the source of disturbance.

Outside the field of applied impact assessments and academic research, there is also a need to record disturbance distances for bird species in a range of study locations under a variety of environmental conditions (including different seasons and weather conditions) in order to better understand the realistic range of natural disturbance distances. Disturbance distance studies do not necessarily involve sophisticated equipment or a particular knowledge of disturbance-based research. Disturbance distance studies can be carried out by anybody who can use a measuring device (e.g. a measuring tape or a range finder) and who has a good knowledge of bird species identification. Disturbance distance studies would, therefore, be highly appropriate as a Citizen Science project to build up a more detailed picture of sensitivity of birds to human disturbance. Alternatively, studies of disturbance responses would make excellent undergraduate or Masters research projects. Collating disturbance responses into one database will help to build a clearer picture of the potential impacts of disturbance on birds caused by human activities.

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APPENDIX 3: PLATE 9B-9: SALINITY DATA AND TEES BAY

Plate 9B-9: Salinity Data and Tees Bay