



Humber Low Carbon Pipelines

Preliminary Environmental Information Report
Volume II Chapter 12 Noise and Vibration
October 2022

nationalgrid

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12. Noise and Vibration

12.1 Introduction

- 12.1.1 This Chapter reports the results of the preliminary assessment of the potential impacts and effects of the Project in terms of noise and vibration and describes:
- Relevant legislation, policy and guidance;
 - Engagement undertaken to date;
 - The proposed assessment methodology and associated significance criteria;
 - Preliminary baseline conditions;
 - Potential impacts of construction, operation, and decommissioning;
 - Potential design, mitigation, and enhancement measures;
 - Summary of the preliminary assessment of potential significant effects; and
 - Next steps.
- 12.1.2 This assessment considers the simultaneous construction of a dual pipeline system (one for carbon dioxide and one for hydrogen), as well as the associated Above Ground Installations (AGIs). The majority of the carbon dioxide pipeline would be up to 600 mm (24") nominal diameter and the hydrogen pipeline would be up to 900 mm (36") nominal diameter. This is referred to as the Base Case in this Preliminary Environmental Information Report (PEIR). Also under consideration is the possibility of deploying a larger carbon dioxide pipeline, with a diameter up to 750 mm (30") (with the hydrogen pipeline remaining the same diameter as within the Base Case). This is referred to in this PEIR as Sensitivity 1. Further details regarding the Base Case and Sensitivity 1, as well as the diameter and capacity of the pipelines are provided in Sections 2.3 and 2.4 of Chapter 2: Project Description (Volume II). This chapter assesses the impacts and effects associated with the Base Case. It is anticipated that the types of potential impacts for the Base Case and Sensitivity 1 will be the same, although the magnitude of impacts may differ. A full assessment of Sensitivity 1 will be undertaken and recorded within the Environmental Statement (ES) if the larger carbon dioxide pipeline diameter is taken forward into the Development Consent Order (DCO) application.
- 12.1.3 This Chapter (and its associated figures and appendices) is intended to be read as part of the wider PEIR.

12.2 Legislation, policy and guidance

- 12.2.1 A summary of the international and national legislation, planning policy and guidance relevant to the noise and vibration assessment for the Project is set out below.

Legislation

The Control of Pollution Act 1974 (Ref 12.1)

- 12.2.2 Sections 60 and 61 of the Control of Pollution Act 1974 (Ref 12.1) give the local authority powers to control noise arising from construction and demolition works, regardless of whether a statutory nuisance has been caused or is likely to be caused. These powers may be exercised either before works start or after they have commenced.
- 12.2.3 Best practicable means (BPM) is also defined within the Control of Pollution Act.

The Environmental Pollution Act 1990 (Ref 12.2)

- 12.2.4 The Environmental Protection Act 1990 (Ref 12.2) provides a local authority with powers to serve a noise Abatement Notice in the event that they believe that unnecessary and objectionable noise is being created. The Abatement Notice may require that the noise be stopped altogether or limited to certain times and level to avoid causing a nuisance in the future.

Policy

Overarching National Policy Statement for Energy, 2011 (EN-1) (Ref 12.3)

- 12.2.5 EN-1 (Ref 12.3) sets out national policy for energy infrastructure. Section 5.11 of the document provides generic impacts relating to noise and vibration. It also defines the elements that should be included in the applicant's noise and vibration assessment where impacts are likely to arise, as defined below:
- A description of the noise generating aspects of the development;
 - Identification of noise sensitive receptors and noise sensitive areas that may be affected;
 - The characteristics of the existing noise environment;
 - A prediction of how the noise environment will change with the proposed development;
 - An assessment of the effect of predicted changes in the noise environment on any noise-sensitive receptors;
 - If likely to cause disturbance, an assessment of the effect of underwater or subterranean noise; and
 - Measures to be employed in mitigating the effects of noise.
- 12.2.6 EN-1 (Ref 12.3) stipulates the requirements for a project to demonstrate good acoustic design. It also provides guidance on the Infrastructure Planning Commission (IPC) decision making process.

Draft Overarching National Policy Statement for Energy, 2021 (Draft EN-1) (Ref 12.4)

- 12.2.7 The Draft EN-1 (Ref 12.4) sets out national policy for energy infrastructure. Section 5.12 of the document provides generic impacts relating to noise and vibration. It also defines the elements that should be included in the applicant's noise and vibration assessment

where impacts are likely to arise, which are consistent with those listed above for EN-1 (Ref 12.3).

- 12.2.8 The Draft EN-1 (Ref 12.4) stipulates the requirements for a project to demonstrate good acoustic design. It also provides guidance on the Secretary of State's decision making process.

National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines, 2011 (EN-4) (Ref 12.5)

- 12.2.9 EN-4 (Ref 12.5) provides the primary basis for decisions by the IPC on applications it receives for gas supply infrastructure and gas and oil pipelines. The document provides a high level overview of key acoustic considerations and what needs to form part of an applicant's noise and vibration assessment for proposed schemes, which is split out for different components, including gas reception facilities and gas/oil pipelines.
- 12.2.10 EN-4 (Ref 12.5) references the guidance provided in Section 5.11 of EN-1 (Ref 12.3) in terms of generic noise and vibration considerations, the items to be included within the applicant's assessment, and the IPC decision making process.

Draft National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines, 2021 (Draft EN-4) (Ref 12.6)

- 12.2.11 The Draft EN-4 (Ref 12.6) provides the primary basis for decisions by the Secretary of State on applications it receives for gas supply infrastructure and gas and oil pipelines. The document provides a high level overview of key considerations and what needs to form part of an applicant's noise and vibration assessment for proposed schemes, which is split out for different components, including gas reception facilities and gas/oil pipelines.
- 12.2.12 The Draft EN-4 (Ref 12.6) references the guidance provided in Section 5.12 of the Draft EN-1 (Ref 12.4) in terms of generic noise and vibration considerations, the items to be included within the applicant's assessment, and the Secretary of State's decision making process.

National Planning Policy Framework (July 2021) (Ref 12.7)

- 12.2.13 The National Planning Policy Framework (NPPF) (Ref 12.7) was introduced by the Department of Communities and Local Government (DCLG) in March 2012 and subsequently updated in July 2018, February 2019 and July 2021. The document sets out the Government's planning policies for England and how these are expected to be applied. The NPPF includes statements relating to noise and the requirement to take it into account during the planning process.

Noise Policy Statement for England (DEFRA, 2010) (Ref 12.8)

- 12.2.14 The Noise Policy Statement for England (NPSE) (Ref 12.8) sets out the long-term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

Planning Practice Guidance – Noise (2019) (Ref 12.9)

- 12.2.15 The Department for Communities and Local Government 'Planning Practice Guidance' (PPG) (Ref 12.9) was published on 6 March 2014 and updated in July 2019.

- 12.2.16 The PPG on Noise expands upon the NPPF and NPSE and sets out more detailed guidance on noise assessment. Like the NPPF and NPSE, the guidance does not include any specific noise levels but sets out further principles that should underpin an assessment.

Guidance

World Health Organisation (WHO), Guidelines for Community Noise (Ref 12.10)

- 12.2.17 The WHO Guidelines for Community Noise (Ref 12.10) provide general guidance and guidelines which have been set for different health effects, using the lowest noise level that produces an adverse health effect in specific human environments.

WHO, Night Noise Guidelines for Europe (Ref 12.11)

- 12.2.18 The WHO Night Noise Guidelines (Ref 12.11) was published in 2009 and presents the conclusions of the WHO working group responsible for preparing guidelines for exposure to noise during sleep to protect the public from adverse health effects.

British Standards (BS) 4142:2014+A1:2019 - Methods for Rating and Assessing Industrial and Commercial Sound (Ref 12.12)

- 12.2.19 BS 4142 (Ref 12.12) provides a method for rating industrial and commercial sound and a method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing processes and other associated operational activities.
- 12.2.20 The rating method takes into account specific source characteristics, such as tonality, impulsivity and intermittency which are more likely to give rise to disturbance. The impact assessment procedure described in BS 4142 (Ref 12.12) is based on the comparison of the rating sound level with the background sound level prevailing at the assessment locations.

BS 5228-1:2009+A1:2014 - Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise (Ref 12.13)

- 12.2.21 BS 5228-1 (Ref 12.13) gives recommendations for basic methods of noise control relating to construction work. It also provides guidance concerning methods of predicting and measuring noise and assessing its impact on those exposed to it. The prediction method considers the noise emission level of the plant, the separation distance between the source and the receiver and the effect of the intervening topography and structures.

BS 5228-2:2009+A1:2014 - Code of Practice for Noise and Vibration Control on Construction and Open Sites – Vibration (Ref 12.14)

- 12.2.22 BS 5228-2 (Ref 12.14) provides guidance on vibration levels that can be used to assess the likely impacts of construction activities. The standard gives guidance on the significance of vibration effects in terms of human response to vibration and the structural response from affected buildings.

BS 7445-1:2003 - Guide to Quantities and Procedures (Ref 12.15)

- 12.2.23 BS 7445 (Ref 12.15) defines the basic quantities to be used for the description of noise in community environments and describes basic procedures for the determination of these quantities.

BS EN 60942:2018 - Electroacoustics – Sound Calibrators (Ref 12.16)

- 12.2.24 BS EN 60942 (Ref 12.16) specifies the acoustic performance requirements for sound calibrators deployed during noise surveys.

BS EN 61672-1:2013 - Electroacoustics – Sound Level Meters (Ref 12.17)

- 12.2.25 BS EN 61672 (Ref 12.17) specifies the electroacoustical performance specifications for sound measuring instruments deployed during noise surveys.

Calculation of Road Traffic Noise Memorandum (Ref 12.18)

- 12.2.26 Calculation of Road Traffic Noise (CRTN) (Ref 12.18) sets out standard procedures for calculating noise levels from road traffic. The calculation method uses a number of input parameters, including traffic flow volume, average vehicle speed and percentage of heavy duty vehicles, to predict the LA10,18hour or LA10,1hour noise level.

Canal & River Trust, Code of Practice for Works Affecting the Canal & River Trust (2022) (Ref 12.19)

- 12.2.27 The two-part 'Code of Practice for Works Affecting the Canal & River Trust' (Ref 12.19) gives guidance and details procedures where work may affect the property of the Canal & River Trust.
- 12.2.28 Part 1 of the Code provides the noise and vibration requirements for construction works, including the adoption of BPM, whereas Part 2 of the Code provides the requirements for service crossings of waterways, specifically the use of trenchless techniques.

Design Manual for Roads and Bridges, LA 111 Noise and Vibration (2019) (Ref 12.20)

- 12.2.29 The Design Manual for Roads and Bridges (DMRB) document Ref. LA 111 'Noise and Vibration' (Ref 12.20) provides guidance on the assessment of noise and vibration impacts due to road traffic. LA 111 includes an impact magnitude criteria for changes in road traffic noise occurring during construction and operational phases, which is applicable across a range of projects.

Institute of Environmental Management & Assessment (IEMA), Guidelines for Environmental Impact Assessment (Ref 12.21)

- 12.2.30 The IEMA Guidelines for Environmental Impact Assessment (Ref 12.21) address the key principles of noise impact assessment and are applicable to all development proposals where noise effects are likely to occur. The guidelines provide specific support on how noise impact assessment fits within the Environmental Impact Assessment (EIA) process.

IGEM/TD/1 Edition 6 - Steel Pipelines for High Pressure Gas Transmission (2021) (Ref 12.22)

- 12.2.31 IGEN/TD/1 (Ref 12.22) contains information on the construction, operation and maintenance of onshore steel pipelines and associated installations. The standard sets out key considerations in terms of the control of noise and defines high-level guidance in terms of noise abatement measures during the construction, operation and maintenance phases.

ISO 9613-2:1996 - Acoustics. Attenuation of Sound During Propagation Outdoors. Part 2: General Method of Calculation (Ref 12.23)

- 12.2.32 ISO 9613-2 (Ref 12.23) specifies an engineering method for calculating the attenuation of sound during outdoor propagation conditions. The methodology accounts for a number of physical effects including geometrical divergence, atmospheric absorption, ground effects, reflections from surfaces and screening by obstacles.

PD 8010-1:2015+A1:2016 Pipeline Systems – Part 1: Steel Pipelines on Land – Code of Practice (Ref 12.24)

- 12.2.33 PD 8010 (Ref 12.24) gives recommendations for and guidance on the design, selection, specification and use of materials, routeing, land acquisition, construction, installation, testing, operation, maintenance and abandonment of land pipeline systems constructed from steel.
- 12.2.34 The document stipulates that an assessment of noise levels should be made for a proposed station or terminal and account taken of predicted noise levels compared with existing background noise levels in the intended sites.
- 12.2.35 Where there is a possibility of pipeline construction and permanent facilities giving rise to noise complaints, the document notes that an environmental noise survey should be carried out by suitably qualified persons before the pipeline route is established, so that prior noise assessment can be made and the route or the construction method changed if necessary to minimise disruption.

12.3 Consultation and engagement

- 12.3.1 A summary of the EIA Scoping Opinion from the Planning Inspectorate (PINS) and subsequent responses to this EIA Scoping Opinion are outlined below. Furthermore, all engagement undertaken to date is outlined in this Section.

Response to the EIA Scoping Opinion

- 12.3.2 An EIA Scoping Opinion (Appendix 1.2: EIA Scoping Opinion, (Volume III)) was received by the Applicant from PINS on 20 May 2022. Table 12.1 lists the comments that PINS and consultation bodies made in relation to Noise and Vibration and shows how the Applicant is responding to these

Table 12.1: Summary of EIA Scoping Opinion in relation to noise and vibration

Section reference	Applicant's proposed matter	Stakeholder/statutory consultee comments	Response
2.2.10	Directional drilling	<i>The Applicant is advised to consult with the Canal and River Trust regarding directional drilling proposals for the Ouse, Aire and Calder Navigation and Stainforth and Keadby Canal, to minimise the risk of interference with deep structural sheet piling that may be present in certain locations. The Applicant's attention is drawn to the consultation response from the Canal and River Trust in this regard (see Appendix 2 of this Opinion).</i>	Canal & River Trust assets will be considered as part of the ES.
3.8.1	Traffic flows (human receptors) - operational phase	<p><i>The Applicant wishes to scope out this matter from further assessment on the basis that AGIs will not be manned and therefore operational phase traffic flows will not give rise to significant adverse noise effects on nearby human receptors.</i></p> <p><i>The Inspectorate agrees that, subject to confirmation of the number and type of vehicle operational vehicle movements in the ES description of development, operational traffic flows are not likely to result in significant effects and that an assessment of this matter can be scoped out of the ES.</i></p>	Agreement noted. This matter is not assessed further within the PEIR and will not form part of the ES, provided that appropriate justification is contained in the Project Description that accompanies the ES.

Section reference	Applicant's proposed matter	Stakeholder/statutory consultee comments	Response
3.8.2	Noise from operation of the pipelines (human receptors)	<p><i>The Applicant wishes to scope out this matter from further assessment on the basis that buried pipelines will not generate significant noise levels.</i></p> <p><i>The Inspectorate considers that significant noise effects from buried pipelines are unlikely and is content this matter can be scoped out of further assessment.</i></p>	Agreement noted. This matter is not assessed further within the PEIR or ES.
3.8.3	Noise from operation of the PIG traps and block valves (human receptors)	<p><i>The Applicant wishes to scope out this matter from further assessment on the basis that PIG trap and block valve AGIs are not expected to generate significant levels of noise during normal operation.</i></p> <p><i>The Inspectorate agrees that this matter can be scoped out of further assessment. The ES should include relevant engineering specifications to demonstrate that there are no sources of noise producing equipment and should demonstrate that consultation has been undertaken with relevant Environmental Health Officers on any necessary control measures.</i></p>	Agreement noted. This matter is not assessed further within the PEIR or ES.

Section reference	Applicant's proposed matter	Stakeholder/statutory consultee comments	Response
3.8.4	Vibration (human receptors) - operational phase	<p><i>The Applicant wishes to scope out this matter from further assessment on the basis that significant ground borne vibration resulting from the AGIs is not anticipated, due to low levels of vibration from equipment installations or through inclusion of appropriate vibration isolation.</i></p> <p><i>The Inspectorate agrees that this matter can be scoped out of further assessment. The ES should include relevant engineering specifications to demonstrate that there are no sources of vibration producing equipment and/ or that that consultation has been undertaken with relevant Environmental Health Officers on any necessary control measures.</i></p>	Agreement noted. This matter is not assessed further within the PEIR or ES.
3.8.5	Mitigation measures	<i>The ES should include an assessment of any environmental effects generated by the presence of any mitigation measures (e.g. landscape and visual effects of noise screening), where significant effects are likely to occur.</i>	To be included in the relevant chapter(s) of the ES, once the requirement for operational phase mitigation measures is determined.
3.8.6	Methodology	<i>The ES should explain how vibration criteria used to determine impact significance will inform the mitigation and monitoring requirements in the CEMP/ DEMP.</i>	<p>Vibration criteria to be adopted for the assessment is defined in the Significance Criteria section of the PEIR and ES.</p> <p>Construction phase monitoring requirements will form part of the Register of Commitments to be included in the ES.</p>

Section reference	Applicant's proposed matter	Stakeholder/statutory consultee comments	Response
Appendix 2	Construction traffic with Hull City Council's administrative area	<i>Whilst the development is proposed to be undertaken outside of Hull City Council's administrative area, construction traffic could be routed along the Strategic Road Network and local highway network within the City. In such circumstances, assessment of potential noise and vibration impact on sensitive receptors and identification of appropriate mitigation measures should be undertaken. Hull City Council would wish to be consulted on such matters</i>	To be included as part of the ES if the construction traffic flows are considered to have the potential to give rise to significant impacts.

Engagement undertaken to date

12.3.3 Table 12.2 provides a summary of the engagement undertaken to inform the assessment to date.

Table 12.2: Summary of engagement undertaken

Consultee	Date and method of engagement	Summary of issues raised	Response
East Riding of Yorkshire Council (ERYC) - Public Protection Team	04 February 2022, 07 March 2022 Email	<i>Document sent by Project team to ERYC which outlined the potential noise and vibration impacts associated with the Project and the proposed assessment methodology to be followed for the ES. ERYC agreed with the proposed assessment methodology.</i>	PEIR and ES to follow the agreed assessment methodology.
	04 April 2022, 14 April 2022 Email	<i>Project team provided method statement for proposed baseline noise survey to be undertaken at sensitive receptors in the vicinity of the Pump Facility at Easington. ERYC advised that they were happy with proposed noise survey strategy.</i>	Baseline noise survey undertaken in accordance with the proposed method statement.
	27 July 2022 Email	<i>Project team provided baseline noise survey report for information following completion of the survey at sensitive receptors in the vicinity of the Pump Facility. No queries or comments on the resultant dataset raised at this stage.</i>	Baseline survey data to be used to inform operational phase assessment for the Pump Facility.
Lincolnshire County Council (LCC) – Environmental Protection Team	30 November 2021, 03 December 2021 Email	<i>Document sent by Project team to LCC which outlined the potential noise and vibration impacts associated with the Project and the proposed assessment methodology to be followed for the ES. LCC agreed with the proposed assessment methodology, however, it was noted that this is more likely to fall within the remit of West Lindsey District Council.</i>	PEIR and ES to follow the agreed assessment methodology.

Consultee	Date and method of engagement	Summary of issues raised	Response
Selby District Council (SDC) - Environmental Protection Team	30 November 2021, 03 December 2021 Email	<p>Document sent by Project team to SDC which outlined the potential noise and vibration impacts associated with the Project and the proposed assessment methodology to be followed for the ES. SDC agreed in principle with the proposed assessment methodology, but provided the following supplementary comments:</p> <ul style="list-style-type: none"> Justification would be required if siting construction compounds near sensitive receptors and recommendation for use of acoustic screening if that occurs. Details of proactive compliance monitoring is to be well defined for construction works. Assessment to adopt shorter $L_{Aeq,T}$ averaging periods when assessing construction works that are of an impulsive nature, e.g. percussive piling. Cumulative impacts with the Connected Project, Drax's Bioenergy with Carbon Capture and Storage (BECCS) project, should be considered. For operational noise, SDC require BS 4142 (Ref 12.12) rating noise levels to be below measured background levels. 	PEIR and ES to follow the agreed assessment methodology, accounting for the additional items raised by SDC, where appropriate.
North Lincolnshire Council (NLC) - Environmental Protection Team	30 November 2021, 04 February 2022 Email	<p>Document sent by Project team to NLC which outlined the potential noise and vibration impacts associated with the Project and the proposed assessment methodology to be followed for the ES. NLC agreed in principle with the proposed assessment methodology, but sought clarification on the following items:</p>	<p>In response to NLC queries, the Project team noted that the requirement for monitoring during the various phases of the Project would be dependent on the outcome of the impact assessment.</p> <p>It was also noted that a low frequency assessment would be undertaken if the spectral noise data for the plant/equipment</p>

Consultee	Date and method of engagement	Summary of issues raised	Response
		<ul style="list-style-type: none"> Query raised by NLC regarding monitoring carried out to verify noise levels during the construction, commissioning, or operational phases. Query raised by NLC regarding an assessment of low frequency noise effects, particularly during the operational stage. 	incorporated on the AGIs contain significant levels of low frequency noise.
West Lindsey District Council (WLDC) – Environmental Protection Team	30 November 2021, 17 February 2022 Email	Document sent by Project team to WLDC which outlined the potential noise and vibration impacts associated with the Project and the proposed assessment methodology to be followed for the ES. WLDC agreed with the proposed assessment methodology.	PEIR and ES to follow the agreed assessment methodology.
Canal & River Trust	13 July 2022 Email	<p>Canal & River Trust provided their ‘Code of Practice for Works Affecting the Canal and River Trust’ to the Project team via email.</p> <p>Canal & River Trust advised that all works that impact on the canal and river infrastructure are to fulfil the requirements of the Code of Practice.</p>	Canal & River Trust assets will be considered as part of the ES.

12.4 Assessment methodology and significance criteria

Study Area

- 12.4.1 The Study Area for the construction and decommissioning phase assessments will consider noise and vibration sensitive receptors that are located within 300 m of the Proposed Order Limits, as indicated in Figure 12.1 (Volume IV). This has been determined based on the guidance set out in BS 5228-1 (Ref 12.13), BS 5228-2 (Ref 12.14) and other related guidance documents, including DMRB document ref. 'LA 111 - Noise and Vibration' (Ref 12.20).
- 12.4.2 For certain construction activities such as trenchless crossings, there is a potential requirement for works to be undertaken on a 24-hour basis. To account for the more stringent threshold criteria during the night as derived from BS 5228-1 (Ref 12.13), the Study Area for the night-time construction phase assessment has been extended to consider sensitive receptors that are located within 600 m of the trenchless crossings. At distances in excess of 600 m, the construction noise levels would typically be below the lowest threshold levels for the night-time period as derived from BS 5228-1 (Ref 12.13).
- 12.4.3 For the assessment of operational phase noise levels, the Study Area will extend out to the nearest or most exposed noise sensitive receptors surrounding the Pump Facility at Easington.

Baseline data collection

Desk study

- 12.4.4 With the exception of the Pump Facility, the baseline conditions of the Project were established via a desk study using the following sources:
- Aerial photography and mapping; and
 - Department for Environment, Food and Rural Affairs (DEFRA) Round 3 road and rail strategic noise maps and noise action plans (Ref 12.26 & 12.27).

Site visits and surveys

- 12.4.5 A baseline noise survey has been undertaken to establish the prevailing acoustic environment at noise sensitive receptors situated in the vicinity of the Pump Facility. At this stage, there are currently two Pump Facility site options under consideration, with Option A located to the north of Warmer Lane and Option B to the south. The results of the noise survey have been used to inform the operational phase assessment for the Pump Facility, accounting for both site options.
- 12.4.6 The baseline noise survey was limited to receptors surrounding the Pump Facility at Easington; this is on the basis that the Pump Facility is the only AGI that would generate operational phase noise emissions under normal conditions.
- 12.4.7 The baseline noise survey comprised unattended noise monitoring at five locations as defined in Table 12.3, which accounted for the surrounding noise sensitive receptors in the vicinity of the Pump Facility site. The noise survey was undertaken between 9 June 2022 and 17 June 2022.

Table 12.3: Baseline measurement locations

Reference	NGR Location	Description
P1	538124E, 421490N	Spring Farm Bungalow to the north-west of the Pump Facility locations, situated ~0.72 km from Site Option A and ~1.0 km from Site Option B.
P2	537970E, 420970N	Southfield Farm to the west of the Pump Facility locations, situated ~0.74 km from Site Option A and ~0.67 km from Site Option B.
P3	538277E, 419448N	Sunnybank to the south of the Pump Facility locations, situated ~1.26 km from Site Option A and ~0.69 km from Site Option B.
P4	539311E, 419479N	Two Hoots to the south of the Pump Facility locations, situated ~1.17 km from Site Option A and ~0.48 km from Site Option B.
P5	539598E, 420901N	Coastal path to the east of the Pump Facility locations, situated ~0.23 km from Site Option A and ~0.48 km from Site Option B.

- 12.4.8 Further information regarding the baseline survey methodology is provided in Appendix 12.1 (Volume III).
- 12.4.9 The noise surveys were carried out using Class 1 sound level meters and calibrator conforming to the requirements of BS EN 61672 (Ref 12.17) and BS EN 60942 (Ref 12.16) respectively. The meters had been calibrated to traceable standards within the preceding two years and the calibrator within the previous 12 months. The sound level meters were field calibrated once set up in the measurement positions and on completion of the survey. No significant calibration drift was observed, i.e., within a +/- 0.5 dB tolerance.
- 12.4.10 The noise monitoring equipment at all positions was located at least 3.5 m from any significant reflective surfaces, other than the ground. All measurements were taken with the microphone situated approximately 1.5 m above the local ground level.
- 12.4.11 Baseline noise surveys have not been undertaken as part of the construction phase assessment. This is on the basis that the pre-development noise levels at the majority of receptors within the Study Area are expected to be below the lower bound daytime cut-off value set out in Annex E of BS 5228-1 (Ref 12.13), owing to the rural setting.

Impact assessment methodology

Construction phase and decommissioning phase – noise

- 12.4.12 Construction activities would involve the use of a variety of working methods, for which an estimate of the expected noise levels over a representative period has been prepared, in accordance with industry best practice.

- 12.4.13 Noise levels from the construction works experienced by a receptor would vary over time as the distances to noise producing plant and the type of construction activity change. This reflects the transient nature of the construction works for the pipelines.
- 12.4.14 Noise predictions have been undertaken based on the methodology contained within BS 5228-1 (Ref 12.13). The noise predictions have been used to determine whether the construction phase and decommissioning phase activities have the potential to result in significant adverse effects at the surrounding noise sensitive receptors. The prediction method considers the noise emission level of the proposed plant items, the separation distance between the source and the receptor, and the intervening ground conditions.
- 12.4.15 To inform the noise prediction calculations, the separation distances between the proposed construction working width and the surrounding sensitive receptors have been derived using AddressBase mapping data.
- 12.4.16 Due to the nature of the land within the defined Study Area, soft ground attenuation has been adopted for the construction phase noise predictions. No allowance has been made for acoustic screening provided by intervening landforms or structures.
- 12.4.17 Standard construction working hours would be Monday-Saturday 07:00 to 19:00 hrs. However, 24-hour working would be required to align with critical work activities. At this stage, it has been assumed that all trenchless crossings would require 24-hour working. Where 24-hour working will be required, it has been assumed that only essential items of plant/equipment would be utilised during the evening and night-time periods to minimise potential impacts. This is reflected in the different plant lists for the day and night-time periods that have been used to inform the assessment.
- 12.4.18 The significance criteria given in Annex E.2 of BS 5228-1 (Ref 12.13) have been used to assess the noise effects during the construction and decommissioning phases. The methodology within Annex E.2 adopts the use of fixed threshold levels at noise sensitive receptors in the vicinity of the proposed construction works. Refer to Appendix 12.2 (Volume III) for further information on the BS 5228-1 (Ref 12.13) criteria.
- 12.4.19 Unless ambient noise levels within the defined Study Area are sufficiently high to provide masking of construction noise, the lower bound daytime cut-off value of 65 dB $L_{Aeq,T}$ applies. For evening (plus non-core weekend daytime) and night-time periods, this reduces to 55 dB $L_{Aeq,T}$ and 45 dB $L_{Aeq,T}$ respectively. As a result of these lower bound threshold levels, baseline measurement data does not need to be collected along the length of the Proposed Order Limits to derive the acoustic criteria.
- 12.4.20 To predict the likely noise levels associated with the Project, the construction works have been divided into the phases/activities set out in Table 12.4. Detailed plant lists for each activity are provided in Appendix 12.3 (Volume III). At this stage, the construction methodology associated with the Humber tunnelling works are still to be determined and therefore this does not form part of the PEIR. This will form part of the ES, with construction phase noise and vibration assessments undertaken in accordance with BS 5228-1 (Ref 12.13) and BS 5228-2 (Ref 12.14) respectively.

Table 12.4: Construction phase activities

Work phase	Construction activity
Pipelines	Setting out and erection of temporary fencing
	Haul Road Construction
	Topsoil strip and site preparation

Work phase	Construction activity
	Open trench excavations
	Trenchless pipe installations – Horizontal Directional Drilling (HDD) (day/night split)
	Trenchless pipe installations – micro tunnelling/auger boring (day/night split)
	Pipeline fabrication
	Pipeline installation
	Backfilling/Reinstatement
	Hydrotesting and pipeline cleaning
AGIs	Setting out and erection of temporary fencing
	Site preparation and earthworks
	Building and equipment substructure works
	Erection of buildings/structures
	Equipment installation works
	Hardstanding and access roads
Compounds	Use of temporary construction compounds

- 12.4.21 For the purposes of assessing construction impacts, it is assumed that each phase of the works would be programmed so it is not affected by preceding or subsequent work phases, as these will be separated by either time or distance, i.e., cumulative noise levels from the various work teams will not be significant.
- 12.4.22 During the decommissioning phase of the Project, the resultant noise levels are expected to be broadly similar to those generated during the construction phase, albeit localised to the AGIs based on the assumption that the buried pipelines would remain in situ.

Construction phase and decommissioning phase – vibration

- 12.4.23 Certain construction works can produce ground-borne vibration, which has the potential to give rise to impacts at sensitive receptors including buildings, transport infrastructure and watercourses.
- 12.4.24 Construction induced vibration levels have been predicted using the empirical formula contained in Annex E of BS 5228-2 (Ref 12.14). The vibration levels have been assessed against the relevant Peak Particle Velocity (PPV) threshold levels within the standard.
- 12.4.25 The significance criteria for the construction and decommissioning phase vibration levels have been derived from Annex B of BS 5228-2 (Ref 12.14). Refer to Appendix 12.2 (Volume III) for further information on the BS 5228-2 (Ref 12.14) vibration criteria.
- 12.4.26 For human receptors, a PPV vibration level of 1.0 mm/s has been adopted as the threshold for potentially significant vibration impacts. Beyond this level, it is likely that vibration in residential environments would cause complaint but can be tolerated if prior warning and explanation has been given to residents.

- 12.4.27 The main source of vibration associated with the Project is expected to be attributable to vibratory compaction, vibratory piling activities associated with the trenchless crossings, and tunnelling. These sources have therefore been considered as part of a quantitative assessment.

Operational phase – Pump Facility

- 12.4.28 At this stage, the location and configuration of the Pump Facility have not been defined. The details of noise emitting plant/equipment associated with the Pump Facility is therefore not currently available to inform operational phase noise predictions.
- 12.4.29 In the absence of design information, BS 4142 (Ref 12.12) rating noise limits have been provided for the impact magnitude categories set out in Table 12.6; the criteria are set relative to the baseline noise levels measured at receptors surrounding the Pump Facility.

Significance criteria

Receptor sensitivity

- 12.4.30 Receptor sensitivity has been categorised for a range of receptor types, which has been informed from guidance contained in the following documents:
- DMRB document Ref. LA 111 'Noise and Vibration' (Ref 12.20);
 - IEMA document 'Guidelines for Environmental Noise Impact Assessment' (Ref 12.21); and
 - Scottish Government Technical Advice Note: 'Assessment of Noise' (Ref 12.25). Although the Project is not located in Scotland, the Technical Advice Note provides useful guidance on the categorisation of sensitive receptors, which reduces reliance on professional judgement.

Table 12.5: Receptor sensitivity

Receptor Sensitivity	Type of Receptor
High	Residential properties, educational establishments, hospitals, places of worship, hotels, children's nurseries, nursing homes.
Medium	Commercial premises including offices, halls, public municipal areas, bars and restaurants.
Low	Industrial premises.
Negligible	All other areas such as those used primarily for agricultural purposes.

Magnitude of impact

- 12.4.31 The magnitude of the impact within this assessment has been described using the following scale:
- High;

- Medium;
- Low; and
- Negligible.

12.4.32 Although the lowest measure of magnitude of effect is defined as 'Negligible', it should be noted that noise and vibration levels may still be audible/perceptible during the construction and operational phases.

12.4.33 The criteria in Table 12.6 have been adopted for the assessment of magnitude of impact.

Table 12.6: Magnitude of impact criteria

Impact	Magnitude Criteria			
	Negligible	Low	Medium	High
Construction & decommissioning phases – daytime noise	Less than 55 dB LAeq,T	Between 55 & 65 dB LAeq,T	Between 65 & 75 dB LAeq,T	Greater than 75 dB LAeq,T
Construction & decommissioning phases – night-time noise	Less than 40 dB LAeq,T	Between 40 & 45 dB LAeq,T	Between 45 & 55 dB LAeq,T	Greater than 55 dB LAeq,T
Construction phase – road traffic noise	Less than 1 dB increase in road traffic noise	1.0 to 2.9 dB increase in road traffic noise	3.0 to 4.9 dB increase in road traffic noise	Greater than or equal to 5 dB increase
Construction & decommissioning phases – vibration	Less than 0.3 mm/s PPV	0.3 to less than 1.0 mm/s PPV	1.0 to 9.9 mm/s PPV	Greater than or equal to 10 mm/s PPV
Operational phase – noise	In excess of 5 dB(A) below background sound level	In the range of 5 dB(A) below and 5 dB(A) above background sound level	Between 5 and 10 dB(A) above background sound level	In excess of 10 dB(A) above background sound level

Notes:

1. Daytime construction phase noise levels are based on a time period 'T' which equates to the duration of a working day on site.
2. The construction noise impact criteria will apply if the works occur for a duration exceeding 10 or more days or nights in any 15 consecutive days or nights; or a total number of days exceeding 40 in any 6 consecutive months.
3. Operational phase noise criteria is based on rated noise levels as defined in BS 4142 (Ref 12.12).

Significance of effects

- 12.4.34 The overall significance of an effect is determined by combining the sensitivity of the receptor and magnitude (as presented in Table 12.7). The assessment of significance relies on best practice and the relevant published standards and guidance documents as defined in Section 12.2.
- 12.4.35 The significance of an effect is reported as either 'significant' or 'not significant' under the terms of the EIA Regulations. Where impact significance is assessed as 'Negligible' or 'Minor', the overall effect is not significant. Where the impact significance is assessed as 'Moderate' or 'Major', the overall effect is significant.

Table 12.7: Determining significance of effects

Magnitude	Sensitivity of receptor/receiving environment to change			
	High	Medium	Low	Negligible
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Assumptions and limitations

- 12.4.36 To ensure transparency within the EIA process, the following limitations and assumptions have been identified:
- The construction and decommissioning assessments have assumed the use of standard construction techniques commensurate for the type of works being undertaken. The final techniques, plant selection and programme are expected to be determined by the Main Works Contractor, in consultation with relevant authorities prior to commencement of construction. The assessment will be refined during the preparation of the ES, as further information becomes available;
 - The selection of trenchless crossing techniques that have been used to inform the PEIR construction phase assessment has been based on preliminary design information. The number of trenchless crossing and techniques to be used may be subject to change at ES stage as the design progresses. This will be informed by the statutory consultation;
 - Standard construction working hours would be Monday-Saturday 07:00 to 19:00 hrs. However, 24-hour working would be required to align with critical work activities. Where 24-hour working would be required, it has been assumed that only essential items of plant/equipment would be utilised during the evening and night-time periods to minimise potential impacts;
 - For the purposes of assessing construction impacts, it has been assumed that each primary phase of the works would be programmed so it is not affected by preceding or subsequent work phases, as these would be separated by either time or distance, i.e., cumulative noise levels from the various work teams would not be significant;

- During the decommissioning phase of the Project, it is assumed that the resultant noise levels would be broadly similar to the construction phase, albeit localised to the AGIs on the basis that the buried pipelines would remain in situ;
- The details of noise emitting plant/equipment associated with the Pump Facility have not been defined at this stage. In light of this, rating noise limits have been provided on the basis that these would not exceed the representative background sounds levels at the surrounding receptors; and
- The assessment does not currently account for cumulative effects as a result of the Project in combination with other committed developments. The scope of projects to be considered in the cumulative assessment will be agreed at the ES stage with the relevant local authorities.

12.5 Baseline conditions

Existing baseline

Desk study

- 12.5.1 The majority of the Proposed Order Limits is located within a rural setting, typically comprising agricultural land use. The acoustic environment varies significantly along the Proposed Order Limits depending on proximity to prominent noise sources; these sources include agricultural activities, road and rail infrastructure, industrial facilities, commercial premises/activities, wind turbines, an airport and the North Sea.
- 12.5.2 Due to the nature of the Project, the Proposed Order Limits flank substantial industrial facilities in several areas. In these areas, low-level noise emissions from the facilities are likely to characterise the acoustic environment at the nearest surrounding receptors.
- 12.5.3 Included within the Proposed Order Limits are several major transport infrastructure routes including the M180 and M62 motorways and the South Humberside Main Line. At locations where the route crosses or is in close proximity to motorways, trunk roads, rail lines and runways, noise from road, rail and air traffic will dominate the acoustic environment throughout the day and night.
- 12.5.4 A number of Site of Special Scientific Interest (SSSI) are located within or close to the Proposed Order Limits. These include:
- Messingham Sand Quarry SSSI (~280 m west of Proposed Order Limits);
 - Manton Stone Quarry SSSI (~100 m south of Proposed Order Limits);
 - North Killingholme Haven (~350 m east of Proposed Order Limits);
 - Humber Estuary SSSI, Ramsar site, Special Protection Area (SPA) and Special Area of Conservation (SAC) (within Proposed Order Limits); and
 - Dimlington Cliff SSSI (within Proposed Order Limits).

Site Survey

- 12.5.5 Table 12.8 presents the results of the baseline noise survey undertaken at sensitive receptors situated in the vicinity of the Pump Facility at Easington. The table also provides the representative background sound level for the daytime and night-time

periods following a statistical analysis undertaken in accordance with BS 4142 (Ref 12.12).

Table 12.8: Measured noise levels

Ref.	Time period	Measured noise levels		Representative background sound level
		L _{Aeq,T}	L _{A90,T}	
P1	Daytime	46 – 60 dB L _{Aeq,16hr}	34 – 42 dB L _{A90,16hr}	35 dB L _{A90,60min}
	Night-time	40 – 42 dB L _{Aeq,8hr}	31 – 38 dB L _{A90,8hr}	33 dB L _{A90,15min}
P2	Daytime	45 – 60 dB L _{Aeq,16hr}	36 – 43 dB L _{A90,16hr}	37 dB L _{A90,60min}
	Night-time	42 – 45 dB L _{Aeq,8hr}	34 – 39 dB L _{A90,8hr}	34 dB L _{A90,15min}
P3	Daytime	46 – 57 dB L _{Aeq,16hr}	32 – 40 dB L _{A90,16hr}	31 dB L _{A90,60min}
	Night-time	49 – 50 dB L _{Aeq,8hr}	28 – 36 dB L _{A90,8hr}	29 dB L _{A90,15min}
P4	Daytime	46 – 60 dB L _{Aeq,16hr}	37 – 43 dB L _{A90,16hr}	37 dB L _{A90,60min}
	Night-time	38 – 40 dB L _{Aeq,8hr}	32 – 40 dB L _{A90,8hr}	33 dB L _{A90,15min}
P5	Daytime	50 – 57 dB L _{Aeq,16hr}	47 – 52 dB L _{A90,16hr}	48 dB L _{A90,60min}
	Night-time	50 – 55 dB L _{Aeq,8hr}	48 – 51 dB L _{A90,8hr}	48 dB L _{A90,15min}

12.5.6 Further information regarding the survey results is provided in Appendix 12.1 (Volume III).

Future baseline

12.5.7 On the basis that the majority of the Proposed Order Limits is located within a rural setting, typically comprising agricultural land use, there is generally not expected to be significant changes to the baseline conditions in the future.

12.5.8 In instances where the Proposed Order Limits are located close to transport infrastructure, such as roads and rail lines, there is potential for growth in the traffic flows in the future baseline scenario. In the absence of significant alterations to the wider road or rail network, the variation in traffic flows would be expected to be incremental and therefore unlikely to give rise to perceptible changes in the acoustic environment.

12.5.9 Where the Proposed Order Limits are located close to prominent industrial facilities including the Connected Projects, there is potential that the noise levels generated by these facilities may change as a result of any new development. These changes are not expected to alter the acoustic environment significantly for the surrounding sensitive receptors, as this would be controlled via the planning/permitting processes, as applicable.

12.6 Design development, impact avoidance and embedded mitigation

- 12.6.1 BPM as defined by the Control of Pollution Act 1974 (Ref 12.1) would be implemented which would serve to minimise the noise and vibration impacts at receptors in the vicinity of the construction and decommissioning phase works. The BPM measures that would typically be implemented are listed below which would be briefed to all relevant parties via site inductions, toolbox talks and at start of shift briefings:
- Where practicable, temporary enclosures should be used to screen all static or semi-static plant from noise sensitive receptor locations;
 - Drop heights of materials should be minimised, i.e., lorry with lifting boom or dumper carefully depositing materials;
 - Operators of moving plant to be briefed on a regular basis with an emphasis on the importance of noise mitigation, and avoiding movements over irregular surfaces (which tends to create more noise/vibration emissions);
 - At all times, workers' shouting or raised voices to be kept to a minimum;
 - All plant and equipment should comply with the noise limit and noise marking requirements;
 - All plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise and vibration emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective would not be operated until repaired;
 - All plant and equipment should be maintained so they are kept in good running order which ensures optimum performance;
 - Machines in intermittent use should be shut down or throttled down to a minimum during periods between works;
 - As far as is reasonably practicable, the location and orientation of semi-static equipment should be chosen to minimise the noise impact on sensitive receptors;
 - All personnel on site should undergo site specific inductions and briefings. Where relevant, specific noise and vibration control measures should be incorporated into the contractor's method statements; and
 - Where safe to do so, noise from reversing alarms would be controlled and limited as far as possible through the use of a banksman or other means.

12.7 Preliminary assessment of potential impacts

- 12.7.1 This Section details the preliminary assessment of impacts for the Project during construction, operation and decommissioning phases.

Construction

Construction Noise

12.7.2 Table 12.9 presents the predicted construction phase noise levels associated with the primary construction activities, at a reference distance of 10 m.

Table 12.9: Predicted construction noise levels at 10 m (free-field)

Work phase	Construction activity	Activity noise level at 10 m (dB L _{Aeq,T})
Pipelines	Setting out and erection of temporary fencing	80
	Haul Road Construction	87
	Topsoil strip and site preparation	83
	Open trench excavations	86
	HDD – Day	85
	HDD – Night	84
	Micro tunnelling/auger boring – Day	87
	Micro tunnelling/auger boring – Night	77
	Pipeline fabrication	86
	Pipeline installation	85
	Backfilling/Reinstatement	87
	Hydrotesting and pipeline cleaning	86
AGIs	Setting out and erection of temporary fencing	80
	Site preparation and earthworks	87
	Building and equipment substructure works	83
	Erection of buildings/structures	84
	Equipment installation works	83
	Hardstanding and access roads	88
Compounds	Use of temporary construction compounds	80

12.7.3 Table 12.10 presents the noise levels at various distances from the activities, by estimating the noise reduction with distance from the source. A +3 dB building façade correction factor has been applied in accordance with BS 5228-1 (Ref 12.13).

Table 12.10: Construction phase noise levels at various setback distances

Work phase	Construction activity	Noise level at range of setback distances, dB L _{Aeq,T}				
		10 m	50 m	100 m	200 m	300 m
Pipelines	Setting out and temporary fencing	83	68	60	52	48
	Haul Road Construction	90	75	67	59	55
	Topsoil strip and site preparation	86	71	63	55	51
	Open trench excavations	89	74	66	58	54
	HDD – Daytime	88	73	65	57	53
	HDD – Night-time	87	72	64	56	52
	Micro tunnelling/auger boring – Day	90	75	67	59	55
	Micro tunnelling/auger boring – Night	80	65	57	49	45
	Pipeline fabrication	89	74	66	58	54
	Pipeline installation	88	73	65	57	53
	Backfilling/Reinstatement	90	75	67	59	55
	Hydrotesting and pipeline cleaning	89	74	66	58	54
AGIs	Setting out and temporary fencing	83	68	60	52	48
	Site preparation and earthworks	90	75	67	59	55
	Building & equipment substructure	86	71	63	55	51
	Erection of buildings/structures	87	72	64	56	52
	Equipment installation works	86	71	63	55	51
	Hardstanding and access roads	91	76	68	60	56
Compounds	Use of construction compounds	83	68	60	52	48

12.7.4 Table 12.11 identifies the number of receptors that are predicted to experience daytime noise levels in excess of 65 dB L_{Aeq,T} as a result of the construction works. The list of affected receptors is provided in Appendix 12.4 (Volume III).

Table 12.11: Number of properties exceeding threshold criteria - daytime work

Work phase	Construction activity	65 dB L _{Aeq,T} threshold setback distance (m)	Number of receptors exceeding daytime criteria	
			High sensitivity receptor	Medium sensitivity receptor
Pipelines	Setting out and temporary fencing	65	9	3
	Haul Road Construction	120	27	8
	Topsoil strip and site preparation	85	13	4
	Open trench excavations	110	24	8
	HDD	100	0	0
	Micro tunnelling/auger boring	120	4	2
	Pipeline fabrication	110	24	8
	Pipeline installation	100	19	6
	Backfilling/Reinstatement	120	27	8
	Hydrotesting and pipeline cleaning	110	24	8
AGIs	Setting out and temporary fencing	65	1	0
	Site preparation and earthworks	120	2	0
	Building & equipment substructure	85	2	0
	Erection of buildings/structures	90	2	0
	Equipment installation works	85	2	0
	Hardstanding and access roads	130	3	0
Compounds	Use of construction compounds	65	1	2

12.7.5 Table 12.12 identifies the number of receptors that are predicted to experience night-time noise levels in excess of 45 dB L_{Aeq,T} as a result of the trenchless crossings.

Table 12.12: Number of properties exceeding threshold criteria - night-time work

Work phase	Construction activity	45 dB L _{Aeq,T} threshold setback distance (m)	Number of receptors exceeding night-time criteria	
			High sensitivity receptor	Medium sensitivity receptor
Pipelines	HDD	575	236	4
	Micro tunnelling/auger boring	300	27	7

- 12.7.6 It can be seen from Table 12.11 that the 65 dB $L_{Aeq,T}$ threshold criteria would be exceeded at a limited number of receptors as a result of the daytime construction works. The highest number of exceedances occur while the 'haul road construction' and 'backfilling/reinstatement' works are taking place, during which there is potential for 27 high sensitivity receptors and eight medium sensitivity receptors potentially affected by the transient works. The duration of the works is expected to exceed the temporal criteria set out in Note 2 of Table 12.6.
- 12.7.7 During the trenchless crossing works which are scheduled to take place on a 24-hour basis, the number of receptors that are predicted to experience noise levels above the 45 dB $L_{Aeq,T}$ threshold criteria are up to 263 high sensitivity receptors and 11 medium sensitivity receptors.
- 12.7.8 The significant increase in affected receptors during the night is a result of the acoustic criterion for the period, which is significantly more stringent than that for the daytime. A substantial proportion of the affected receptors during the night-time period are associated with the River Trent trenchless crossing works; this is due to the proximity of the works to East Butterwick and West Butterwick to the north.
- 12.7.9 Based on the assessment, additional mitigation measures are required to control the noise emissions from the works in certain areas. Refer to Section 12.8: Mitigation and enhancement measures below.

Construction Vibration

- 12.7.10 The following tables present the predicted construction induced vibration levels associated with vibratory compaction works (Table 12.13), vibratory piling works (Table 12.14) and tunnelling (Table 12.15).

Table 12.13: Vibration generated by vibratory compaction plant

Activity	Scaling factor & probability of exceedance	PPV at a range of setback distances, mm/s						
		10 m	20 m	30 m	40 m	50 m	75 m	100 m
Vibratory compaction	Ks = 276 (5%)	7.5	3.1	1.7	1.2	0.8	0.5	0.3
	Ks = 143 (33.3%)	3.9	1.6	0.9	0.6	0.4	0.2	0.2
	Ks = 75 (50%)	2.0	0.8	0.5	0.3	0.2	0.1	0.1

Calculation Parameters

- Bomag BW 216 DH-5 single drum roller (17.9 tonne gross weight), operating at the lower range compaction amplitude, equating to an amplification value of 1.1 mm
- Calculations based on steady state compaction rather than start up and run-down condition
- No allowance made for external to internal transfer function

Table 12.14: Vibration generated by vibratory piling activities

Activity	Scaling factor & probability of exceedance	PPV at a range of setback distances, mm/s						
		10 m	20 m	30 m	40 m	50 m	75 m	100 m
	Kv = 266 (5%)	13.3	5.4	3.2	2.2	1.6	1.0	0.7

Activity	Scaling factor & probability of exceedance	PPV at a range of setback distances, mm/s						
		10 m	20 m	30 m	40 m	50 m	75 m	100 m
Vibratory piling	Kv = 126 (33.3%)	6.3	2.6	1.5	1.0	0.8	0.5	0.3
	Kv = 60 (50%)	3.0	1.2	0.7	0.5	0.4	0.2	0.2

Calculation Parameters

- Calculations based on 'all operations', rather than 'steady state operation' or 'start up and run-down' conditions
- No allowance made for external to internal transfer function

Table 12.15: Groundborne vibration generated by tunnelling works

Activity	PPV at a range of setback distances, mm/s						
	10 m	20 m	30 m	40 m	50 m	75 m	100 m
Tunnelling (groundborne vibration)	9.0	3.7	2.2	1.5	1.1	0.7	0.5

Calculation Parameters

- Setback distances are measured along the ground surface
- No allowance made for external to internal transfer function

- 12.7.11 Based on the predicted vibration levels for the most onerous scaling factor (where applicable), the setback distance at which a PPV level would exceed the 1 mm/s threshold criterion is 45 m for vibratory compaction, 75 m for vibratory piling work associated with the trenchless crossings and 55 m for tunnelling works.
- 12.7.12 Table 12.16 identifies the number of residential receptors that are predicted to experience vibration levels in excess of the 1 mm/s PPV threshold level as a result of the construction works. The list of affected receptors is provided in Appendix 12.4 (Volume III).

Table 12.16: Number of properties exceeding vibration criteria

Construction activity	1 mm/s PPV threshold setback distance (m)	Number of residential receptors exceeding criterion	Closest residential receptor setback distance (m)
Vibratory compaction – AGI sites	45	1	17
Vibratory compaction – Pipelines	45	5	17
Vibratory compaction – Temporary Compounds	45	1	25
Trenchless crossings – Piling	75	0	>75
Trenchless crossings – Tunnelling	55	0	>55

- 12.7.13 It can be seen from Table 12.16 that the 1 mm/s PPV threshold criterion would be exceeded at a limited number of receptors throughout the construction works. Based on the closest setback distance for the vibratory compaction works, the resultant PPV vibration level is predicted to be 3.8 mm/s.
- 12.7.14 The potential impacts for noise and vibration associated with the construction phase are provided in Table 12.17.

Table 12.17: Construction phase - preliminary assessment of potential impacts

Resource/receptor	Sensitivity of resource/receptor	Description of potential impact/change
Occupants of residential properties	High	High daytime noise levels generated by the construction phase activities resulting in potential disturbance or interference with activities.
Occupants of residential properties	High	High night-time noise levels generated by the trenchless crossing activities resulting in potential sleep disturbance.
Occupants of residential properties	High	Vibration generated by the construction phase activities resulting in potential disturbance or interference with activities.

Operation

- 12.7.15 As noted above, the location and configuration of the Pump Facility have not been defined at this stage and therefore the details of noise emitting plant/equipment associated with the Pump Facility is not currently available to inform operational phase noise predictions.
- 12.7.16 Table 12.18 presents the BS 4142 (Ref 12.12) rating noise limits for the impact magnitude categories set out in Table 12.6. The rating limits are provided for the four baseline monitoring positions carried out at residential receptors (positions P1 to P4).

Table 12.18: Operational phase magnitude of impact criteria

Ref.	Receptor	Time period	Representative background sound level, (dB L _{A90,T})	Rating noise level criteria (dB L _{A,r,Tr})			
				Negligible	Low	Medium	High
P1	Spring Farm Bungalow	Daytime	35	<30	30 – 40	>40 – 45	>45
		Night-time	33	<28	28 – 38	>38 – 43	>43
P2	Southfield Farm	Daytime	37	<32	32 – 42	>42 – 47	>47
		Night-time	34	<29	29 – 39	>39 – 44	>44
P3	Sunnybank	Daytime	31	<26	26 – 36	>36 – 41	>41
		Night-time	29	<24	24 – 34	>34 – 39	>39
P4	Two Hoots	Daytime	37	<32	32 - 42	>42 – 47	>47
		Night-time	33	<28	28 – 38	>38 – 43	>43
Negligible impact - In excess of 5 dB(A) below background sound level							
Low impact - In the range of 5 dB(A) below and 5 dB(A) above background sound level							
Medium impact - Between 5 and 10 dB(A) above background sound level							
High impact - In excess of 10 dB(A) above background sound level							

- 12.7.17 To avoid a significant adverse effect at the surrounding residential receptors, the rating noise levels generated by the Pump Facility will need to fall within the 'Negligible' or 'Low' impact magnitude criteria as defined in Table 12.18.

Decommissioning

- 12.7.18 During the decommissioning phase of the Project, the resultant noise levels are expected to be broadly similar to those generated during the construction phase, albeit localised to the AGIs. The decommissioning phase activities at the various AGI sites would be undertaken during core daytime hours, consistent with the construction phase.
- 12.7.19 During the construction of the AGIs, the assessment has identified that there is potential that the resultant noise levels could give rise to temporary significant adverse effects at a limited number of off-site receptors. The number of affected receptors is defined in Table 12.11, with the affected receptors details listed in Appendix 12.4 (Volume III).
- 12.7.20 Based on the potential for significant impacts at a limited number of AGI sites, additional specific mitigation measures would be required to control the noise emissions from the works in certain areas. Refer to the Mitigation and enhancement measures section below.
- 12.7.21 The potential noise and vibration impacts associated with the decommissioning phase are provided in Table 12.19.

Table 12.19: Decommissioning phase -preliminary assessment of potential impacts

Resource/receptor	Sensitivity of resource/receptor	Description of potential impact/change
Occupants of residential properties	High	High noise levels generated by the decommissioning phase activities resulting in potential disturbance or interference with activities.

12.8 Mitigation and enhancement measures

- 12.8.1 This Section sets out the preliminary avoidance, mitigation and compensation measures which are likely to be required to address the potential impacts as assessed in Section 12.7.

Construction

Temporary noise barriers and enclosures

- 12.8.2 Construction phase noise levels above the daytime threshold criterion have been predicted at a limited number of receptors. To address this, specific mitigation measures would be included in the Construction Environmental Management Plan (CEMP) and secured through the Register of Commitments.
- 12.8.3 To minimise the impact of daytime construction noise levels at the most exposed receptors, temporary acoustic barriers would be installed at the boundary of the work areas at strategic locations. The barriers would be situated to ensure that an enhanced level of noise attenuation is provided to the most exposed receptors.
- 12.8.4 Temporary noise barriers typically comprise earth bunds, solid fencing, or proprietary acoustic screening systems. BS 5228-1 (Ref 12.13) states that the approximate acoustic attenuation provided by a barrier would be 5 dB when the top of the plant is just visible to the receiver over the noise barrier and 10 dB when the barrier completely hides the noise sources from the receiver.
- 12.8.5 For the trenchless crossings which require construction work to be carried out beyond the core daytime hours, an enhanced level of noise attenuation would be required to minimise the potential for sleep disturbance during the night. Specific mitigation measures would be included in the CEMP and secured through the Register of Commitments. At this stage, it is anticipated that the mitigation measures will comprise:
- The erection of temporary noise barriers where the noise level exceedances are within 10 dB of the 45 dB $L_{Aeq,T}$ acoustic criterion; and
 - The erection of temporary acoustic enclosures around the HDD drilling rig where the exceedances are in excess of 10 dB above the 45 dB $L_{Aeq,T}$ acoustic criterion.

Vibratory compaction plant

- 12.8.6 To address the potential exceedances of the vibration criterion in a limited number of areas, specific mitigation measures may need to be introduced. At this stage, it is expected that vibration would be controlled through the selection of vibratory compaction plant which generate lower levels of vibration. This is likely to be necessary when working within 45 m of off-site residential properties. This may dictate the use of smaller plant items which compact material in thinner layers.
- 12.8.7 The vibration control measures would be included in the CEMP and secured through the Register of Commitments.

Community liaison

- 12.8.8 To reduce the likelihood of complaints being received, community liaison and communication throughout the construction phase would be undertaken to provide

information to people residing in properties located in the vicinity of the Proposed Order Limits. At this stage, this is expected to encompass sensitive receptors located within 150 m of the daytime construction works, extending up to 400 m for night-time construction works.

- 12.8.9 The level of engagement required would vary during the construction period, depending upon the likely impacts experienced by individual receptors due to the construction works.
- 12.8.10 Details relating to liaison with the local community would be managed by the Main Works Contractor (and others). It is envisaged that community liaison would provide local residents with the following information in relation to the construction works:
- The nature of the works being undertaken;
 - The expected duration of the works and the contractor's working hours;
 - The contractor's working hours;
 - Mitigation measures that have been adopted to minimise noise and vibration; and
 - Contact details in the event of a noise disturbance.
- 12.8.11 The Community Liaison Plan would be secured through the Register of Commitments.

Decommissioning

- 12.8.12 The decommissioning phase activities taking place at the AGI sites have the potential to generate noise levels that would exceed the daytime threshold criterion at a limited number of receptors. To address this, specific mitigation measures would be introduced; this would typically comprise the introduction of temporary acoustic barriers at strategic locations.
- 12.8.13 These measures would be included in the Decommissioning Environmental Management Plan (DEMP) and secured through the Register of Commitments, and subsequently implemented by the Main Works Contractor (and others).

12.9 Summary of the preliminary assessment of potential significant effects

- 12.9.1 Table 12.20 below summarises the preliminary assessment of potential effects associated with the Project.

Table 12.20: Summary of the preliminary assessment of potential significant effects

Resource/receptor	Stage	Sensitivity of resource/receptor	Description of potential impact/change	Mitigation	Potential significant effects
Occupants of residential properties	Construction	High	High daytime noise levels generated by the construction phase activities resulting in potential disturbance or interference with activities.	Introduction of noise barriers, acoustic enclosures.	Short term Not significant
Occupants of residential properties	Construction	High	High night-time noise levels generated by the trenchless crossing activities resulting in potential sleep disturbance.	Introduction of noise barriers, acoustic enclosures.	Short term Significant
Occupants of residential properties	Construction	High	Vibration generated by certain construction activities resulting in potential disturbance or interference with activities.	Alternative plant selection which generates lower levels of vibration.	Short term Not significant

Resource/receptor	Stage	Sensitivity of resource/receptor	Description of potential impact/change	Mitigation	Potential significant effects
Occupants of residential properties	Decommissioning	High	High noise levels generated by the decommissioning phase activities resulting in potential disturbance or interference with activities.	Introduction of noise barriers	Short term Not significant

12.10 Next steps

Engagement

12.10.1 The following elements will be subject to ongoing consultation and engagement:

- The outcome of the operational phase assessment for the Pump Facility including the mitigation measures to be adopted where necessary;
- The committed developments to be considered as part of a cumulative effects assessment; and
- The vibration criteria to be adopted for infrastructure assets within the Proposed Order Limits.

Surveys

12.10.2 At this stage, no further surveys are anticipated.

Assessment

Construction

12.10.3 The following construction phase elements will either be undertaken or refined for the ES:

- Assessment of noise and vibration levels generated by the Humber tunnelling works;
- Assessment of traffic flow fluctuations on the public highway (and private roads) during the various construction phases of the Project. This will be calculated using the methodology set out in the CRTN publication (Ref 12.18), using flow data provided by the Project traffic consultant;
- Assessment of construction traffic on the various temporary site access routes using the haul route method outlined in Section F.2.5 of BS 5228-1 (Ref 12.13). The assessment will consider the flow data provided by the Project traffic consultant;
- Refinement of the construction noise and vibration assessment where applicable to reflect additional information made available from the Project team. If appropriate, this will include an assessment of construction activities of an impulsive nature against shorter $L_{Aeq,T}$ averaging periods in line with Section 8.5.2.5 of BS 5228-1 (Ref 12.13);
- Appraisal of construction induced vibration affecting infrastructure assets, including those highlighted by the Canal & River Trust;
- Consideration of potential cumulative effects as a result of the Project in combination with other committed developments; and
- The outline scope of construction phase compliance monitoring.

Operation

12.10.4 The following operational phase elements will be undertaken as part of the ES:

- Preparation of a noise prediction model for the Pump Facility which will account for the proposed site layout, noise emitting plant/equipment to be introduced and any embedded acoustic mitigation measures;
- An operational phase noise assessment for the Pump Facility undertaken in accordance with the methodology outlined in BS 4142 (Ref 12.12). This will identify the requirement for secondary mitigation measures; and
- Consideration of potential cumulative effects as a result of the Project in combination with other committed developments.

12.11 References

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