

CONTENTS

9.0	NOISE AND VIBRATION	1
9.1	Introduction.....	1
9.2	Legislation, planning policy and guidance.....	1
9.3	Assessment methodology.....	10
9.4	Baseline conditions.....	25
9.5	Development Design and Impact Avoidance.....	29
9.6	Likely Impacts and Effects.....	31
9.7	Mitigation and enhancement measures	56
9.8	Limitations or difficulties.....	59
9.9	Summary of Likely Significant Residual Effects.....	60
9.10	References	63

TABLES

Table 9.1:	Summary of relevant NPS advice regarding Noise and Vibration	4
Table 9.2:	Planning Practice Guidance Noise Advice.....	7
Table 9.3:	Consultation summary table	11
Table 9.4:	Residential Noise Sensitive Receptors.....	13
Table 9.5:	Construction Noise Threshold Values at Residential Dwellings	15
Table 9.6:	Magnitude of Construction Noise Impacts	16
Table 9.7:	Construction Traffic Noise Criteria.....	17
Table 9.8:	Construction Vibration Threshold at Residential Dwellings.....	17
Table 9.9:	Transient Vibration Guide Values for Cosmetic Damage.....	19
Table 9.10:	Magnitude of Impact – Construction Vibration Building Damage	19
Table 9.11:	Magnitude of Impact for Industrial Noise.....	22
Table 9.12:	Sensitivity/Value of Receptors.....	23
Table 9.13:	Classification of Effects	24
Table 9.14:	Baseline Sound Levels (using representative data from Keadby 2 Power Station ES).....	26
Table 9.15:	Receptor Noise Climate Observations.....	27
Table 9.16:	Measured free Field $L_{Aeq, T}$ Noise Levels and associated “ABC” Assessment Category	32
Table 9.17:	Indicative Construction Noise Limits / SOAEL values	32
Table 9.18:	Indicative Free-field Construction Noise Levels During Daytime Main Site Construction Activity.....	35
Table 9.19:	Indicative Construction Noise Predictions for Electrical Connection Construction	36
Table 9.20:	Indicative Construction Noise Predictions for Water Connection Corridor (cofferdam activity) Construction.....	37
Table 9.21:	Indicative Construction Noise Effects of Main Site Construction	37
Table 9.22:	Indicative Construction Noise Effects of Electrical Connection to 132kv Substation Option	39
Table 9.23:	Indicative Water Connection Construction Effects	40
Table 9.24:	Changes in Road Traffic Noise as a Result of Construction of the Proposed Development.....	43
Table 9.25:	Predicted Worst-Case Operational Noise Levels (Indicative Site Layout – Figure 4.1)	45
Table 9.26:	Future background sound levels.....	46
Table 9.27:	Daytime BS4142 Assessment	49

Table 9.28: Night-time BS4142 Assessment	51
Table 9.29: Comparison of Night-time Ambient Sound Levels.....	54
Table 9.30: Comparison of Ambient Sound Levels.....	58
Table 9.31: Summary of Likely Significant Residual Effects	61

9.0 NOISE AND VIBRATION

9.1 Introduction

- 9.1.1 This chapter of the Preliminary Environmental Information (PEI) Report addresses the potential effects of noise and vibration resulting from the Proposed Development on local Noise Sensitive Receptors (NSR).
- 9.1.2 Impacts during the construction, operation and decommissioning periods of the Proposed Development are assessed. In particular, the assessment considers:
- the existing and future baseline conditions;
 - the effects of construction of the Proposed Development on NSRs during the site clearance and construction works including predicted changes in road traffic noise levels on the local road network;
 - the effects of noise and vibration resulting from operation of the Proposed Development; and
 - the effects of noise and vibration resulting from decommissioning of the Proposed Development.
- 9.1.3 The cumulative effects of noise associated with the Proposed Development and other committed developments in the vicinity are described in **Chapter 19: Cumulative and Combined Effects** (PEI Report Volume I).
- 9.1.4 This chapter is supported by **Figure 9.1**, provided in PEI Report Volume III and **Appendix 9A: Construction Noise Appendix** and **Appendix 9B: Operational Noise Appendix** provided in PEI Report Volume II.

9.2 Legislation, planning policy and guidance

- 9.2.1 This section discusses the legislation, planning policy context and standards relevant to assessing the impacts of noise on residential and other human receptors. The legislation, planning policy context and standards applicable to assessment of noise impacts on the relevant ecological and cultural heritage receptors are discussed respectively in **Chapter 12: Water Resources and Flood Risk** and **Chapter 15: Cultural Heritage** (PEI Report, Volume I).

Legislation

Environmental Protection Act 1990

- 9.2.2 The Environmental Protection Act 1990 (EPA) Part 3 identifies that noise (and vibration) emitted from premises (including land) can be prejudicial to health or a give rise to statutory nuisance.
- 9.2.3 Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either the abatement of the nuisance or works to abate the nuisance to be undertaken, or it prohibits or restricts the relevant activity.

Contravention of a notice without reasonable excuse is an offence. Right of appeal to the Magistrates Court exists within 21 days of the service of a noise abatement notice.

- 9.2.4 In determining if a noise complaint amounts to a statutory nuisance, the Local Authority can take account of various guidance documents and existing case law; however, no statutory noise limits exist. Demonstrating the use of 'Best Practicable Means' (BPM) to minimise noise levels is an accepted defence against a noise abatement notice.

Control of Pollution Act 1974

- 9.2.5 Sections 60 and 61 of the Control of Pollution Act 1974 (CoPA) provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the local planning authority with instructions to cease work until specific conditions to reduce noise have been adopted.
- 9.2.6 Section 61 of the CoPA provides a means for applying for prior consent to undertake noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.
- 9.2.7 The CoPA requires that BPM (as defined in Section 72 of CoPA) be adopted for construction noise on any given site. CoPA makes reference to British Standard 5228 (British Standards Institute (BSI), 2014a and b) (herein referred to as 'BS 5228) as BPM.

Environmental Permitting Regulations 2016

- 9.2.8 The Environmental Permitting Regulations require the application of Best Available Techniques (BAT) to activities performed within installations regulated by the legislation in order to manage the impact of these operations on the surrounding environment. The Environmental Permit applies only to the operational and decommissioning periods, not to the construction period.
- 9.2.9 In terms of noise specifically, the selection of BAT will have to be considered and balanced with releases to different environmental media (air, land and water) and to give due consideration to issues such as usage of energy and raw materials. Noise, therefore, cannot be considered in isolation from other impacts on the environment.
- 9.2.10 The definition of pollution includes "*emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment*" (clause 2). BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of BPM to prevent or minimise noise nuisance. In the case of noise, "offence of any human senses" may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases, it may be possible, and desirable, to reduce noise emissions still further at reasonable costs and this may therefore be BAT for the control of noise emissions from an installation. Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

9.2.11 Guidance regarding Environmental Permitting and noise is available in the Environment Agency's Integrated Pollution Prevention and Control (IPPC) H3 document 'Horizontal Guidance for Noise Part 2 - Noise assessment and Control' (Environment Agency, 2002a). However, 'Horizontal Guidance for Noise Part 1 – Regulation and Permitting' (Environment Agency, 2002b), which provided useful guidance relating to noise limits from industrial installations in terms of absolute rating levels and rating levels relative to background sound levels (as defined in BS 4142:1997 (now superseded)) was withdrawn in February 2016. Therefore, industry wide noise limits no longer apply.

Planning Policy Context

National Policy Statements for Energy

9.2.12 Section 5.11 of the Overarching National Policy Statement (NPS) for Energy (EN-1) refers to the Government's policy on noise within the Noise Policy Statement for England (discussed further below) and sets out requirements for noise and vibration assessment for Nationally Significant Infrastructure Projects (NSIP), such as the Proposed Development.

9.2.13 With regards to decision making, NPS EN-1 states:

“The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission.” (paragraph 5.11.8)

9.2.14 Section 9.5 describes the impact avoidance measures identified relevant to the Proposed Development.

9.2.15 The NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2) sets out policy specific to fossil fuel power stations. In paragraph 2.7.1, specific sources of noise are identified. Those that are relevant to the Proposed Development include *‘the gas and steam turbines that operate continuously during normal operation’*. It then reiterates the point made in NPS EN-1, stating that:

“The primary mitigation for noise from fossil fuel generating stations is through good design, including enclosure of plant and machinery in noise-reducing buildings wherever possible and to minimise the potential for operations to create noise’. It goes on to state that ‘Noise from gas turbines should be mitigated by attenuation of exhausts to reduce any risk of low-frequency noise transmission.’” (paragraph 2.7.5)

9.2.16 Table 9.1 provides a summary of the NPS advice regarding noise and vibration and how each has been considered in this chapter.

Table 9.1: Summary of relevant NPS advice regarding Noise and Vibration

Summary of NPS	Consideration within chapter
NPS-EN1	
<p>Paragraph 5.11.4 states: <i>“Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:</i></p> <ul style="list-style-type: none"> • <i>A description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive, tonal, impulsive or low frequency characteristics of the noise;</i> • <i>Identification of noise sensitive premises and noise sensitive areas that may be affected;</i> • <i>The characteristics of the existing noise environment;</i> • <i>A prediction of how the noise environment will change with the proposed development;</i> • <i>In the shorter term such as during the construction period;</i> • <i>In the longer term during the operating life of the infrastructure;</i> • <i>At particular times of the day, evening and night as appropriate;</i> • <i>An assessment of the effect of predicted changes in the noise; and</i> • <i>Measures to be employed in mitigation noise.</i> <p><i>The nature and extent of the noise assessment should be proportionate to the likely noise impact.”</i></p>	<p>Descriptions of noise generating aspects of the Proposed Development, together with assessment of construction and operational noise and vibration impacts are presented in Section 9.6. Noise Sensitive Receptors (NSR) including proximity of any Noise Important Areas (NIA) are identified in Table 9.4.</p> <p>Information relating to the existing noise environment is presented in Section 9.4.</p> <p>The mitigation of construction and operational noise is discussed in Section 9.7.</p>
<p>Paragraph 5.11.5 states: <i>“The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered.”</i></p>	<p>Potential construction related traffic noise effects have been assessed in section 9.6.</p>
<p>Paragraph 5.11.6 states: <i>“Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources</i></p>	<p>Potential operational noise effects on human NSR are presented in section 9.6.</p>

Summary of NPS	Consideration within chapter
<p>may be contained in the technology-specific NPSs. In particular, for...electricity networks (EN-5) there is assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.”</p>	
<p>Paragraph 5.11.7 states: “The applicant should consult EA and Natural England (NE), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account.”</p>	<p>Potential effects of noise on biodiversity and nature conservation are considered in Chapter 11: Biodiversity and Nature Conservation (PEI Report Volume I).</p>
<p>NPS EN-2</p>	
<p>Paragraph 2.7.2 states: “<i>The ES should include a noise assessment as described in Section 5.11 in EN-1.</i>”</p>	<p>A noise assessment is included within this chapter.</p>

National Planning Policy Framework

- 9.2.17 The National Planning Policy Framework (NPPF) (MHCLG, 2019) sets out the Government’s planning policies for England and how these are expected to be applied. The Framework supersedes the previous guidance document Planning Policy Guidance 24 ‘Planning and Noise’ (Office of the Deputy Prime Minister (ODPM), 1994).
- 9.2.18 The NPPF (MHCLG, 2019) is a matter which the Secretary of State is likely to consider both *“relevant and important”* in determining an application for a development consent order (DCO).
- 9.2.19 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.
- 9.2.20 Paragraph 170 states that:

“planning policies and decisions should contribute to and enhance the natural and local environment by:

preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever

possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.”

9.2.21 Paragraph 180 states that:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development - and avoid noise giving rise to significant adverse impacts on health and the quality of life;... [and]
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason”.

9.2.22 With regards to ‘adverse effects’ and ‘significant adverse effects’ the NPPF (MHCLG, 2019) refers to the Noise Policy Statement for England Explanatory Note (NPSE) (Department for Environment, Food and Rural Affairs (Defra), 2010), which is described below.

Noise Policy Statement for England

9.2.23 The NPSE (Defra, 2010) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The NPSE (Defra, 2010) applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

9.2.24 The statement sets out the long-term vision of the government’s noise policy, which is to:

“promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development”.

9.2.25 This long-term vision is supported by three aims:

- *“avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvements of health and quality of life.”*

9.2.26 The long-term policy vision and aims are designed to enable decisions to be made regarding what is an acceptable noise burden to place on society.

9.2.27 The ‘Explanatory Note’ within the NPSE (Defra, 2010) provides further guidance on defining ‘significant adverse effects’ and ‘adverse effects’ using the concepts:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;

- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

9.2.28 The three aims can therefore be interpreted as follows:

- the first aim is to avoid noise levels above the SOAEL;
- the second aim considers situations where noise levels are between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur; and
- the third aim seeks, where possible, to positively improve the health and quality of life through the pro-active management of noise whilst also taking account of the guiding principles of sustainable development. It is considered that the protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

9.2.29 The NPSE (Defra, 2010) recognises that it is not possible to have uniform objective noise-based measures that define the SOAEL, LOAEL and NOEL that are applicable to all sources of noise in all situations. The levels are likely to be different for different noise sources, receptors and times of the day.

Planning Practice Guidance - Noise

9.2.30 The Planning Practice Guidance (PPG) (MHCLG, 2019) was first published on 6th March 2014 to provide a web-based resource with more in-depth guidance to the NPPF (MHCLG, 2019). The PPG aims to make planning guidance more accessible, and to ensure that the guidance is kept up to date. The PPG was last updated in October 2019.

9.2.31 The guidance advises that local planning authorities should take account of the acoustic environment and consider:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

9.2.32 This guidance introduced the additional concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). Full details of the PPG on effects are provided in Table 9.2.

Table 9.2: Planning Practice Guidance Noise Advice

Perception	Examples of outcomes	Effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required

Perception	Examples of outcomes	Effect level	Action
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Local Development Plan Policy – North Lincolnshire Council (NLC)

9.2.33 North Lincolnshire Council does not have a specific policy relating to noise. However, the council adopted its Core Strategy in June 2011 (NLC, 2011) as part of the Local Development Framework and has a Supplementary Planning Document entitled Planning for Health and Wellbeing that was published in November 2016 (NLC, 2016). It recognises that noise is an issue that has an effect on physical and mental health.

9.2.34 Policy 3 of Planning for Health and Wellbeing - "Well Designed Places" - states:

"When considering the detail of development, proposals should:

Seek to reduce noise and air pollution through ensuring planning applications include a Noise Impact Assessment and Air Quality Assessment in areas of concern"

Other Guidance

British Standard 7445-1:2003 and 7445-2:1991

9.2.35 BS 7445 'Description and measurement of environmental noise' (BSI, 1991 and 2003) defines parameters, procedures and instrumentation required for noise measurement and analysis.

British Standard 5228:2009+A1:2014

9.2.36 BS 5228-1 'Code of practice for noise and vibration control on construction and open sites. Noise' (BSI, 2014a) provides a 'best practice' guide for noise control and includes sound power level (L_w) data for individual plant as well as a calculation method for noise from construction activities. BS 5228-2 'Code of practice provides a 'best practice' guide for noise and vibration control on construction and open sites. Vibration' (BSI, 2014b) provides comparable 'best practice' for vibration control, including guidance on the human response to vibration.

British Standard 6472:2008

9.2.37 BS 6472-1 'Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting' (BSI, 2008), presents recommended frequency weighted vibration spectra (for continuous vibration) and vibration dose values (VDV) (for intermittent vibration), above which adverse comment is likely to occur in residential properties.

British Standard 7385:1993

9.2.38 BS 7385-2 'Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration' (BSI, 1993) presents guide values for transient and continuous vibration, above which there is a likelihood of cosmetic damage. The standard establishes the basic principles for carrying out vibration measurements and processing the data, with regard to evaluating vibration effects on buildings.

International Organization for Standardization (ISO) 4866:2010

9.2.39 ISO 4866:2010 'Mechanical Vibration and Shock – Vibration of Fixed Structures – Guidelines for the Measurement of Vibrations and Evaluation of Their Effects on

Structures' (ISO, 2010) establishes the principles for carrying out vibration measurement and processing data with regard to evaluating vibration effects on structures.

British Standard 4142:2014+A1:2019

- 9.2.40 BS 4142 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014c) can be used for assessing the effect of noise of an industrial nature, including mechanical services plant noise. The method compares the difference between 'rating level' of the industrial sound, with the 'background sound level' at the receptor position.

British Standard 8233:2014

- 9.2.41 BS 8233 'Guidance on sound insulation and noise reduction for buildings' (BSI, 2014) defines criteria for noise levels in and around buildings.

ISO 9613-2:1996: Attenuation of Sound during Propagation Outdoors

- 9.2.42 ISO 9613-2:1996 'Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation' (ISO, 1996) specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources.

Calculation of Road Traffic Noise

- 9.2.43 Department for Transport (DfT)/ Welsh Office Memorandum 'Calculation of Road Traffic Noise' (CRTN) (DfT/Welsh Office, 1988) describes procedures for traffic noise calculation and measurement and is suitable for environmental assessments of schemes where road traffic noise may have an effect.

Design Manual for Road and Bridges (2020)

- 9.2.44 The Highways England 'Design Manual for Road and Bridges - LA 111 (Revision 2) Noise and Vibration' (DMRB) (Highways England, 2020) provides guidance on the appropriate approach to be taken when assessing the noise and vibration effects arising from all road projects, including new construction, improvements and maintenance. The guidance is also useful for assessing changes in traffic noise levels as a result of non-road projects such as this.

9.3 Assessment methodology

Consultation

- 9.3.1 The consultation undertaken with statutory consultees to inform this chapter, including a summary of comments raised *via* the formal scoping opinion (**Appendix 1B** of PEI Report Volume II) is summarised in Table 9.3.

Table 9.3: Consultation summary table

Consultee approached	Date and nature of consultation	Summary of comments	Summary of response
The Planning Inspectorate	June 2020 (Scoping Opinion)	The inspectorate agrees with the proposed scope items including that traffic noise due to the workforce of the operational plant should be scoped out.	Traffic noise due to the workforce of the operational plant has been scoped out.
The Planning Inspectorate	June 2020 (Scoping Opinion)	The ES should specify exactly what guidance is being applied to determine significance.	Guidance used in this PEI Report is specified in Section 9.2 and 9.3 and will be included in the ES.
The Planning Inspectorate	June 2020 (Scoping Opinion)	Ecological receptors should be assessed with suitable behavioural response thresholds.	An initial assessment of potential noise disturbance impacts on relevant sensitive ecological receptors is included in Chapter 11: Biodiversity and Nature Conservation . This will be further updated in the ES.
The Planning Inspectorate	June 2020 (Scoping Opinion)	Noise and vibration sensitive receptors should be agreed with NLC. The canal and Keadby Lock should be considered noise sensitive.	Karen Robinson at NLC responded on 27/08/2020 agreeing with the initial selection of sensitive receptors chosen. The selection of receptors reported in this PEI Report has been further extended since that consultation.
The Planning Inspectorate	June 2020 (Scoping Opinion)	The ES should assess underwater noise and vibration impacts on underwater receptors.	The ES will consider noise and vibration impacts on underwater receptors.
Canal and Rivers Trust	Response to PINS Scoping Opinion (June 2020)	Supporting information should be provided to highlight that works in site will not result in adverse vibrations that could	A preliminary assessment of vibration effects associated with the construction phase of the Proposed Development has been undertaken

Consultee approached	Date and nature of consultation	Summary of comments	Summary of response
		<p>damage structures, e.g. the canal wash wall. The Trust advise the scope of the vibration assessment be expanded to ensure appropriate information is submitted to indicate that no adverse vibration effects or damage will occur to the canal or Keadby Lock.</p>	<p>within section 9.6 of this chapter, including Keadby Lock as NSR13. Further assessment will be provided in the ES.</p>
<p>North Lincolnshire Council</p>	<p>Technical engagement (July - August 2020) with Karen Robinson (Environmental Health Officer)</p>	<p>NLC may require that operational noise (rating levels) do not exceed the background sound level by more than +3 dB, when assessed in accordance with BS 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'.</p>	<p>Significant weight has been given to context considerations in the Keadby 2 Power Station ES, including the extent to which residents will have habituated to existing railway and Keadby 1 Power Station noise emissions, and thus the sensitivity of these NSR to noise and use of their properties (indoors and outside). This context assessment has resulted in BS 4142 rating levels of up to 14 dB above the background sound level at night being classified overall as not significant by ERM in the 2016 Keadby 2 Power Station ES. Further consultation will be undertaken with NLC regarding appropriate noise limits and further consideration to the context assessment will be given in the ES to supplement and refine the preliminary assessment in this PEI Report, as necessary.</p>

Study area

9.3.2 The extent of the study area has been defined to include the receptors/ communities in each direction from the Proposed Development Site and those that may be affected by changes in road traffic flows during the construction phase of the Proposed Development. The extent of the study area including the receptors is shown in **Figure 9.1: Noise Sensitive Receptors** (PEI Report Volume III).

Sensitive receptors

9.3.3 The location of potential NSR in proximity to the Proposed Development Site boundary has been considered when assessing the effects associated with noise and vibration levels from the construction, operational and decommissioning phases of the Proposed Development.

9.3.4 Key NSR locations selected are considered representative of the nearest and potentially most sensitive existing receptors in all directions around the Proposed Development. It is considered that if noise and vibration levels are suitably controlled at the key receptors identified, then noise and vibration levels will be suitably controlled at other sensitive receptors in the surrounding area. These NSR are shown in Table 9.4 and illustrated on **Figure 9.1: Noise and Vibration Sensitive Receptors** in PEI Report Volume III.

Table 9.4: Residential Noise Sensitive Receptors

Receptor	Direction from Proposed Development Site	Distance from Proposed Development Site boundary
NSR 1 - Vazon Bridge	South	50m
NSR 2 - Hawthorne House, Chapel Lane	East	15-20m
NSR 3 - Keadby Village	North-east	25m
NSR 4 - Mariners Arms Flats*	East	20m
NSR 5 - Trent Side	South-east	150m
NSR 6 - 9 Queens Crescent	South-east	400m
NSR 7 - Keadby Grange	East	550m
NSR 8 - North Pilfrey Farm	South-west	200m
NSR 9 - Ealand Poultry Farm	West	1.3km
NSR 10 - North Moor Farm	North-east	500m
NSR 11 - North of Keadby Village**	South	120m
NSR 12 - Keadby Lock (scheduled monument/Grade II listed building)***	South of Waterborne Transport Offloading Area	<5m
Distance from the closest point to the Proposed Development Site boundary are reported		

Receptor	Direction from Proposed Development Site	Distance from Proposed Development Site boundary
<p>*NSR 4 is considered representative of the group of properties at Mariners Arms Flats, therefore distances used in calculations are for the closest of any property in this group to the noise source under assessment.</p> <p>**NSR 11 is included for the purposes of assessing impacts relating to the Water Connection Corridor construction.</p> <p>*** NSR12 only sensitive to potential vibration effects (not noise)</p>		

- 9.3.5 The nearest NIA is located in Scunthorpe on the A18 between the A1077 and Scotter Road roundabouts. This is approximately 3km away from the site boundary therefore noise impacts from the Proposed Development at this location are unlikely and no further assessment is required.
- 9.3.6 The key noise sensitive ecological receptors are likely to be salmon, eel, river and sea lamprey, as migratory species using the River Trent (SPA/ Ramsar site/ SSSI) located within the Proposed Development Site boundary.

Baseline sound and vibration surveys

- 9.3.7 The COVID-19 outbreak has presented challenges in obtaining representative baseline sound levels because typical road, air and rail transport usage has been reduced by travel restrictions and social distancing measures. Other sound sources may also have been affected – for example, due to changes in operating patterns at industrial and commercial premises. It was therefore agreed with NLC Environmental Health Officer¹ that use of the baseline sound survey data presented in the Keadby 2 Power Station ES was appropriate, to inform the assessments in this PEI Report.
- 9.3.8 Baseline sound monitoring to inform Keadby 2 Power Station ES was undertaken at key residential NSR by Environmental Resources Management (2016). This comprised both attended and unattended measurements.
- 9.3.9 Initial surveys were completed in June, July and August 2015, while Keadby 1 Power Station was not operational, and a further survey was completed in January 2016 while Keadby I Power Station was operational. Measurement data from those surveys has been reviewed for the purposes of this assessment and it was noted that sound levels were sometimes lower when Keadby 1 Power Station was operational. Due to this, and the likely variable effect of meteorological and other ambient conditions in the area during the 2015 and 2016 surveys, the lower of the ambient and background sound level data obtained by ERM have been used in this assessment to provide a conservative approach.

¹ Telephone conversation with AECOM 28/08/20 in response to AECOM request for technical engagement 30/07/20

Assessment of Construction Noise

- 9.3.10 At this stage in the project design development, before the appointment of a construction contractor, site specific details regarding the construction activities, programme and numbers and types of construction plant are unavailable. Therefore, detailed construction noise predictions have not been undertaken. Nevertheless, indicative construction noise predictions have been undertaken using the calculation methods set out in BS 5228 (BSI, 2014a), based upon construction information from other SSE power station projects.
- 9.3.11 The calculation method provided in BS 5228 (2014a) takes account of factors including the number and types of equipment operating, their associated sound power levels (L_w), their modes of operation (% on-times within the working period), the distance to NSR, and the effects of any intervening ground cover or barrier/ topographical screening. This allows prediction of the magnitude of impact.
- 9.3.12 The subsequent assessment of construction noise effects at residential NSR considers the guidance in ‘example method 1 – the ABC method’ as defined in BS 5228 (BSI, 2014a). Table 9.5 (reproduced from BS 5228-1) provides guidance in terms of appropriate threshold values for residential NSR, based upon existing ambient noise levels.

Table 9.5: Construction Noise Threshold Values at Residential Dwellings

Assessment category and threshold value period	Threshold Value $L_{Aeq,T}$ dB – free-field		
	Category A (a)	Category B (b)	Category C (c)
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Evenings and weekends (d)	55	60	65
Night-time (23:00 – 07:00)	45	50	55
NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. NOTE 3: Applies to residential receptors only.			
(a) Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. (b) Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. (c) Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values. (d) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.			

- 9.3.13 For the appropriate period (day, evening, night, weekend etc.), the ambient noise level is determined and rounded to the nearest 5 dB and the appropriate Threshold Value is then derived. The predicted construction noise level is then compared with this Threshold Value.
- 9.3.14 Based upon the BS 5228 ABC method (BSI, 2014a), the criterion adopted in this assessment for the determination of potentially significant effects is the exceedance of

the $L_{Aeq,T}$ threshold level for the category appropriate to the ambient noise level at each NSR. This is considered to be potentially equivalent to the SOAEL, although as stated in BS 5228, other project-specific factors, such as the number of NSR affected and the duration and character of the impact, should also be considered by the assessor when determining if there is a potentially significant effect.

- 9.3.15 For residential receptors and other high sensitivity human receptors, the criterion for the LOAEL is a predicted construction noise level equal to the existing ambient noise level at each NSR i.e. resulting in a 3 dB increase in noise level when combined with the existing ambient noise level.
- 9.3.16 Note that the criteria for the LOAEL and SOAEL relate to residential NSR only, in line with the ABC method.
- 9.3.17 In accordance with the NPPF (MHCLG, 2019) and NPSE (Defra, 2010), it is important to identify NSR that exceed the LOAEL and ensure significant adverse effects are mitigated and minimised. The assessment focuses on the impact at existing residential NSR.
- 9.3.18 Based upon the above, the magnitude of the impact of construction noise is classified in accordance with the descriptors in Table 9.6.

Table 9.6: Magnitude of Construction Noise Impacts

Magnitude of Impact	Comparison with Threshold Value $L_{Aeq,T}$ dB
High	Exceedance of ABC Threshold Value by $\geq +5$ dB
Medium	Exceedance of ABC Threshold Value by up to +5 dB
Low	Equal to or below the ABC Threshold Value by up to 5 dB
Very low	Below the ABC Threshold Value by ≥ -5 dB

Assessment of Construction Works Traffic on the Public Highway

- 9.3.19 The Proposed Development will affect traffic flows on existing roads in the area within and surrounding the Proposed Development Site during construction. The assessment focuses on the impact at NSR located alongside the local road network.
- 9.3.20 Construction traffic noise has been assessed by considering the increase in traffic flows during the construction works, following the guidance of CRTN (DfT/ Welsh Office, 1988) and DMRB (Highways England, 2020).
- 9.3.21 18-hour (06:00 – 24:00) Annual Average Weekday Traffic (AAWT) data have been obtained for the year 2031 ‘with’ and ‘without’ construction traffic during the peak construction period, in order to determine if any existing roads are predicted to be subject to a potentially significant change in 18-hour traffic flows. Basic Noise Level (BNL) calculations have been undertaken to predict the change in noise level between the ‘with’ and ‘without’ scenarios.
- 9.3.22 The criteria for the assessment of traffic noise changes arising from construction works have been taken from Table 3.17 of DMRB (Highways England, 2020) and are provided in Table 9.7 below.

Table 9.7: Construction Traffic Noise Criteria

Magnitude of impact	Change in traffic noise level $L_{A10,18hr}$ dB
High	≥ 5
Medium	≥ 3 to < 5
Low	≥ 1 to < 3
Very low	< 1

9.3.23 DMRB advises that an increase in road traffic flows of 25% (where the traffic speed and composition remain consistent) equates to an approximate increase in road traffic noise of 1 dB L_A . A doubling in traffic flow would be required for an approximate increase of 3 dB L_A .

9.3.24 The criteria are based on the current guidance on short-term changes in traffic noise levels in DMRB. It is generally accepted that changes in noise levels of 1 dB L_A or less are imperceptible, and changes of 1 to 3 dB L_A are not widely perceptible. Therefore, the SOAEL is set at a change in traffic noise of ≥ 3 dB and the LOAEL at ≥ 1 dB.

Assessment of Construction Vibration

Impacts on Humans - Annoyance

9.3.25 Vibration due to construction activities has the potential to result in adverse impacts at nearby NSR. The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receptor and the activities being undertaken. BS 5228-2: 2009+A1:2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration' (BSI, 2014b) provides data on measured levels of vibration for various construction works, with particular emphasis on piling. Impacts are considered for both damage to buildings and annoyance to occupiers.

9.3.26 Table 9.8 sets out Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of demolition and construction vibration impacts on human receptors, based on guidance contained in BS 5228-2 (BSI, 2014b).

Table 9.8: Construction Vibration Threshold at Residential Dwellings

Peak Particle Velocity (PPV) level	Description	Magnitude of impact
≥ 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High
1.0 to < 10 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Medium

Peak Particle Velocity (PPV) level	Description	Magnitude of impact
0.3 to < 1.0 mm/s	Vibration might be just perceptible in residential environments.	Low
0.14 to < 0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Very low

- 9.3.27 For residential receptors and other high sensitivity receptors, the LOAEL is defined as a PPV of 0.3mm/s (millimetres per second); this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV of 1.0mm/s, this being the level at which construction vibration can be tolerated with prior warning.
- 9.3.28 At receptors above the SOAEL, further consideration of whether an effect is significant is undertaken using professional judgement, taking account of the duration and frequency of the effect, as well as the time of evening/ night that the effect would be experienced.
- 9.3.29 In the absence of specific information on likely construction activities and plant, a qualitative assessment based upon professional judgement has been undertaken at this stage. Given the significant distance from the Main Site to residential NSR (minimum of 475m), no significant vibration (medium or high magnitude impacts) is expected to result from the proposed construction (or demolition) activities at the Main Site and therefore further assessment is scoped out.

Impacts on Buildings

- 9.3.30 In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far in excess of those that may cause annoyance. Consequently, if vibration levels are controlled to those relating to annoyance (i.e. 1.0mm/s), then it is highly unlikely that buildings will be damaged by demolition and construction vibration levels.
- 9.3.31 The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. The principal concern is generally transient vibration, for example due to piling.
- 9.3.32 BS 7385-2: 1993 'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration' (BSI, 1993) provides guidance on vibration levels likely to result in cosmetic damage and is referenced in BS 5228-2: 2009+A1:2014 (BSI, 2014b). Guide values for transient vibration, above which cosmetic damage could occur, are given in Table 9.9.

Table 9.9: Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building. NOTE 2: For un-reinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

9.3.33 BS 7385-2 (BSI, 1993) states that the probability of building damage tends to zero for transient vibration levels less than 12.5mm/s PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.

9.3.34 It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 (ISO, 2010) defines three different categories of building damage:

- cosmetic – formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/concrete block constructions;
- minor – formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/block; and
- major – damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

9.3.35 BS 7385-2 (BSI, 1993) defines that minor damage occurs at a vibration level twice that of cosmetic damage and major damage occurs at a vibration twice that of minor damage. Therefore, this guidance can be used to define the magnitude of impact identified in Table 9.10 below.

Table 9.10: Magnitude of Impact – Construction Vibration Building Damage

Magnitude of impact	Damage risk	Continuous vibration level PPV mm/s
High	Major	30
Medium	Minor	15
Low	Cosmetic	6
Very low	Negligible	<6

- 9.3.36 BS 7385-2:1993 (BSI, 1993) states that the probability of building damage tends to zero for transient vibration levels less than 12.5mm/s PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.
- 9.3.37 These values for construction vibration building damage will apply to relevant structures including the canal and infrastructure in the vicinity of Keadby Lock.
- 9.3.38 In the absence of specific information on likely construction activities and plant, a qualitative assessment based upon professional judgement has been undertaken at this stage. Again, given the significant distance to residential receptors, no significant vibration is expected to result from the proposed construction at nearby residential buildings and therefore further assessment of the effects of vibration on such buildings is scoped out.
- 9.3.39 As the construction of the Proposed Development and the use of many of the existing buildings within the Keadby Power Station site are both within the control of the Applicant, any identified issues can be effectively managed by the Applicant and their contractor. Potential measures to ensure that appropriate mitigation is in place during the works are discussed in **Section 9.5**.

Construction Vibration Impacts (Disturbance) on Ecological Receptors

- 9.3.40 Where construction works take place at locations close to, or within, the River Trent SPA/ Ramsar site/ SSSI, there is potential for vibration impacts on ecological receptors. This will be considered further within the ES and controlled by the Construction Environmental Management Plan (CEMP); a Framework CEMP will be provided to accompany the DCO Application.

Assessment of Operational Noise Impacts on Human Beings (NSR)

- 9.3.41 The assessment of operational sound levels has been based upon calculations using plant emissions data available at this stage, including: proposed plant equipment (refer to **Appendix 9B**: Operational Noise Appendix in PEI Report Volume II), sound power level (L_w) relating to the proposed plant, distance between the proposed plant and NSR and the acoustic screening offered by the existing landscape and existing Keadby 1 and 2 Power Station buildings.
- 9.3.42 A noise propagation model has been developed using the noise modelling software CadnaA 2019_MR2 to assess the current layout options for the Proposed Development. CadnaA implements the noise prediction method ISO 9613-2: 1996 'Attenuation of sound during propagation outdoors' (ISO, 1996), which has been employed to calculate sound levels at surrounding NSR due to operations at the Main Site (from both proposed external plant and breakout of sound from plant within buildings).
- 9.3.43 The noise model consists of a three-dimensional representation of the Proposed Development and the surrounding area. The Proposed Development will have a CCGT plant which is broadly similar to Keadby 2 Power Station and therefore operational noise modelling has been based on plant and sound power data provided by Siemens for the Keadby 2 Power Station ES.
- 9.3.44 The CCGT plant data provided by Siemens for the Keadby 2 Power Station has been supplemented with sound level data available from similar CCGT/CCP projects to allow

modelling of the combined key sound sources (i.e. CCGT and CCP) at the Proposed Development, based upon the Indicative Layout of the Proposed PCC Site – see **Figure 4.1** (PEI Report Volume III). The CCP plant will be designed so that it does not exceed a maximum sound pressure level (A-weighted) of 85 dB at 1m, assumed to be a level of 85 dB at 1m external to each CCP building or external plant item.

- 9.3.45 Topographical features and buildings that may influence the transmission of sound from the Proposed Development to NSR are included in the noise model. A digital terrain model created using ground elevation spot height data has been used to position buildings and other noise sources at the proposed heights relative to ground. Areas of acoustically soft and hard ground have been identified from the Ordnance Survey MasterMap Topographic Layer and modelled accordingly.
- 9.3.46 The prediction method assumes that the prevailing wind direction is always from source to receiver, which is likely to overestimate the noise effects associated with the Proposed Development for at least some of the time.
- 9.3.47 Based upon the predicted noise levels from the noise model, an assessment of potential noise impact at nearby NSR has been undertaken using the guidance in BS 4142: 2014+A1:2019 ‘Methods for rating and assessing industrial and commercial sound’ (BSI, 2014c).
- 9.3.48 A key aspect of the BS 4142 (BSI, 2014c) assessment procedure is a comparison between the background sound level in the vicinity of residential locations and the rating level of the sound source under consideration. The relevant parameters in this instance are as follows:
- Background sound level – $L_{A90,T}$ – defined in the Standard as the “A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels”;
 - Specific sound level – $L_s (L_{Aeq,Tr})$ – the “equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr”; and
 - Rating level – $L_{Ar,Tr}$ – the “specific sound level plus any adjustment made for the characteristic features of the sound”.
- 9.3.49 BS 4142: 2014 (BSI, 2014c) allows for corrections to be applied based upon the presence or expected presence of the following:
- tonality: up to +6 dB penalty;
 - impulsivity: up to +9 dB penalty (this can be summed with tonality penalty); and
 - other sound characteristics (neither tonal nor impulsive but still distinctive): +3 dB penalty.
- 9.3.50 Once any adjustments have been made, the background sound level and the rating level are compared. The standard states that:
- *“Typically, the greater the difference, the greater the magnitude of impact.”*

- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.”*

9.3.51 Importantly, as suggested above, BS 4142:2014 (BSI, 2014c) requires that the rating level of the noise source under assessment be considered in the context of the environment when defining the overall significance of the impact.

9.3.52 BS 4142:2014 (BSI, 2014c) suggests that a one-hour assessment period is considered during the day and a 15-minute assessment period at night.

9.3.53 Table 9.11 illustrates the adopted magnitude of impact scale used in this assessment based upon the numerical level difference. For BS 4142:2014 (BSI, 2014c) assessment purposes, the SOAEL is set at a rating level above the background sound level of +10 dB, and the LOAEL at +5 dB, although it should be remembered that the context assessment (including the absolute level of the sound under consideration) can vary the overall classification of effects.

Table 9.11: Magnitude of Impact for Industrial Noise

Magnitude of impact	BS 4142 descriptor	Rating level minus background sound level (dB)
High	No BS 4142 descriptor for this magnitude level	>15
Medium	Indication of a significant adverse impact, depending upon context	+10 approx.
Low	Indication of an adverse impact, depending upon context	+5 approx.
Very low	Indication of low effect, depending upon context	≤ 0

Assessment of Operational Vibration Impacts on Human Beings

9.3.54 The operational equipment on the Proposed PCC Site will comprise precision rotating machinery, which will be monitored and maintained in a high state of balance. This type of equipment therefore does not pass significant levels of vibration into the ground. Taking this into account, and the distances between the proposed indicative locations of equipment and residential receptors, it is anticipated that vibration levels will not be significant. Therefore, further assessment of operational vibration from the Proposed PCC Site is scoped out of this assessment.

9.3.55 No significant sources of vibration are likely outside of the Proposed PCC Site and therefore, again, further assessment of operational vibration is scoped out of this assessment.

Operational Noise and Vibration Impacts on Ecological Receptors

9.3.56 Noise and vibration impacts on ecological receptors, including the River Trent, resulting from operation of the Proposed Development on the Main Site are not expected to be significant due to the distances involved (at least 1 km) and the control of noise and vibration under the Environmental Permit for the Proposed Development. Further assessment is therefore scoped out.

Receptor Sensitivity

9.3.57 Effects are classified based on the magnitude of the impact (as outlined above for the various potential impacts during construction and operation) and the sensitivity or value of the affected receptor. A scale of receptor sensitivity is presented in Table 9.12.

Table 9.12: Sensitivity/Value of Receptors

Sensitivity/ value of resource/ receptor	Description	Examples of receptor usage
Very high	Receptors where noise or vibration will significantly affect the function of a receptor	Auditoria/studios Specialist medical/teaching centres, or laboratories with highly sensitive equipment
High	Receptors where people or operations are particularly susceptible to noise or vibration. Sensitive ecological receptors known to be vulnerable to the effects of noise or vibration.	Residential Quiet outdoor areas used for recreation Conference facilities Schools/educational facilities in the daytime Hospitals/residential care homes Libraries Ecologically sensitive areas for example Special Protection Areas (SPA)
Medium	Receptors moderately sensitive to noise or vibration where it may cause some distraction or disturbance	Offices Restaurants/retail Sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf)
Low	Receptors where distraction or disturbance of people from noise or vibration is minimal	Residences and other buildings not occupied during working hours Factories and working environments with existing high noise levels Sports grounds when spectator or noise is a normal part of the event

Classification of Effects

9.3.58 The following terminology has been used in the assessment to define effects:

- *adverse – detrimental or negative effects to an environmental resource or receptor;*
- *neutral – effects to an environmental resource or receptor that are neither adverse nor beneficial; or*
- *beneficial – advantageous or positive effect to an environmental resource or receptor.*

9.3.59 The effect resulting from each individual potential impact type above is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 9.13 below, but where necessary also considering the context of the acoustic environment.

Table 9.13: Classification of Effects

Sensitivity/ value of resource/ receptor	Classification of effect			
	High	Medium	Low	Very low
Very high	Major	Major	Moderate	Minor
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

9.3.60 For the purposes of this assessment, negligible and minor effects are considered to be not significant, whereas moderate and major effects are considered to be significant.

Data sources

9.3.61 The following sources of information have been reviewed and form the basis of the assessment of likely significant effects of noise and vibration presented in this chapter:

- construction plant and equipment from similar power and linear infrastructure projects;
- Indicative Layout Plan for the Proposed PCC Site (**Figure 4.1** in PEI Report Volume III);
- sound power level data from Keadby 2 Power Station ES;
- sound power level data from Karsto CCS FEED study, Norway;
- AAWT traffic data from the Transport Assessment (TA) for the construction phase of the Proposed Development (see Appendix 10A: Transport Assessment, PEI Report Volume III); and
- Ordnance Survey (OS) mapping of the Proposed Development and surrounding area; and
- Topographical data (LIDAR data) and aerial photography.

Use of Rochdale Envelope

- 9.3.62 The assessment of operational noise and vibration has been undertaken with reference to the Rochdale Envelope (i.e. the maximum parameters for the Proposed Development and its main buildings and structures).
- 9.3.63 The construction assessment has been based on the worst-case assumption of activities occurring at the closest part of the Proposed Development Site to each NSR as shown on **Figure 3.2** (PEI Report Volume III). This includes construction activities within the Main Site, construction laydown areas and the electrical and water connection areas.
- 9.3.64 The operational assessment is based upon the Indicative Layout of the Proposed PCC Site (**Figure 4.1** in PEI Report Volume III), which has been subject to sensitivity testing using a range of alternative positions for the most significant sound sources within the Main Site. The sensitivity testing identifies that specific sound levels are predicted to change by +/- 5 dB $L_{Aeq,Tr}$ compared with those presented in this PEI Report based upon the Indicative Layout. However, further refinement of the operational noise assessment will be undertaken during the EIA and detailed design stages, as discussed further in Section 9.7.
- 9.3.65 The assessment of construction related effects has been based on assuming Main Site fixed plant to be evenly distributed through the Keadby 3 CCGT and CCP areas and mobile plant to be evenly distributed within the Keadby 3 CCGT and CCP areas as well as the Keadby 3 laydown area and the connecting area.
- 9.3.66 In relation to both construction and operational effects, mitigation, if considered necessary, would be integrated into the detailed design, in order to meet noise limits to be agreed at the nearest NSR, in accordance with Requirements of the draft DCO.

9.4 Baseline conditions

Existing Baseline

- 9.4.1 The results from the Keadby 2 Power Station ES baseline sound surveys are provided in Table 9.14. Surveys were undertaken during June, July and August 2015 when Keadby 1 Power Station was not operational and again in January 2016 when Keadby 1 Power Station was operational.
- 9.4.2 The L_{Aeq} values presented in Table 9.14 combine all measurements taken in each time period (e.g. day/night), whilst the L_{AF90} values presented are the 'representative' BS 4142 background sound levels, determined from analysis of the measured values undertaken for the Keadby 2 Power Station ES.

Table 9.14: Baseline Sound Levels (using representative data from Keadby 2 Power Station ES)

Receptor (likely to change)	Time period	Summer 2015 survey (without Keadby 1 Power Station operating)		January 2016 survey (with Keadby 1 Power Station operating)	
		$L_{Aeq,T}$ dB	$L_{AF90,15min}$ dB	$L_{Aeq,T}$ dB	$L_{AF90,15min}$ dB
NSR 1 - Vazon Bridge	Daytime	59	37	58	39
	Night-time	39 (periods without trains) 59 (periods with trains)	36	39 (periods without trains) 60 (periods with trains)	38
NSR 2 - Hawthorne House, Chapel Lane	Daytime	45	37	45	39
	Night-time	36	33	41	40
NSR 3 - Keadby Village	Daytime	45	35	44	39
	Night-time	36	30*	41	38
NSR 4 - Mariners Arms Flats	Daytime	45	35*	44	39
	Night-time	36	30*	41	38
NSR 5 - Trent Side	Daytime	45	35*	44*	39
	Night-time	36	30*	41*	38
NSR 6 - 9 Queens Crescent	Daytime	45	35*	44*	39
	Night-time	36	30*	41*	38
NSR 7 - Keadby Grange	Daytime	45 [#]	35*	44 [#]	39*
	Night-time	36 [#]	30*	41 [#]	38*
NSR 8 - North Palfrey Farm	Daytime	45 [#]	35*	44 [#]	39*
	Night-time	36 [#]	30*	41 [#]	38*
NSR 9 - Ealand Poultry Farm	Daytime	45 [#]	35*	44 [#]	39*
	Night-time	36 [#]	30*	41 [#]	38*
NSR 10 - North Moor Farm	Daytime	45 [#]	35*	44 [#]	39*
	Night-time	36 [#]	30*	41 [#]	38*
NSR 11 – North of Keadby Village	Daytime	45 [#]	35*	44 [#]	39*
	Night-time	36 [#]	30*	41 [#]	38*

* Keadby Village data used prior to baseline sound surveys being repeated
[#] Lowest measured levels from Keadby 2 Power Station ES used in proxy of representative baseline sound survey data being available due to COVID-19 restrictions, to enable this NSR to be incorporated into the assessment

9.4.3 The observations shown in Table 9.15 are taken from the Keadby 2 Power Station ES regarding the general baseline sound environment at each monitoring location.

Table 9.15: Receptor Noise Climate Observations

Receptor	Noise Climate Observations
NSR 1 - Vazon Bridge	<p><i>“Passing trains exhibit high levels of noise for a short period with L_{Amax} levels in the range 75-85dB, but they have little effect on the background L_{90} levels. Consequently during the day the noise climate at Vazon Bridge House is dynamic, with L_{eq} levels approximately 59dB and L_{90} levels 37dB. This pattern continues at night except between about 0100 and 0400 at weekends and on some weekdays when there are no trains and L_{eq} noise levels drop. This dynamic noise environment is important to the noise assessment because it influences the way in which new noise from the power station will be perceived. Importantly the railway lies between the house and the power plant site, so the rooms that will experience new noise from the extended power station are the same rooms that currently experience train noise levels of L_{Amax} 75-85dB at least four times an hour, 21 hours a day. It is reasonable to assume that the occupiers of the house cope with these levels of train noise day and night, and as a consequence are considerably less likely to be affected by an increase in background noise than if there was no train noise present.”</i></p>
NSR 2 - Hawthorne House, Chapel Lane	<p><i>“(Red House) is situated on the northeast corner of Chapel Lane. Noise from trains is also audible here with industrial noise sources and some noise from wind turbines creating a less dynamic noise climate than NSR1. During the January 2016 survey, noise from Keadby 1 operating was audible and contributing to the noise levels.”</i></p> <p><i>“(NSR 2) is on Chapel Lane. The noise climate is similar to Red House.”</i></p>
NSR 3 - Keadby Village	<p><i>“... is 45A Chapel Lane, approximately 30 metres northeast of Keadby water tower. During the day, noise from people in the village elevates L_{eq} levels above background but at night these sources drop away to a less dynamic environment. During the January 2016 survey noise from Keadby 1 operating was audible and contributing to the noise levels.”</i></p> <p>In this PEI Report a different NSR 3 has been selected to represent Keadby Village at 74 Chapel Lane as this location was closer to the Main Site. This is approximately 150m from 45A Chapel, although is likely to comprise a similar baseline sound environment.</p>
NSR 4 - Mariners Arms Flats	<p><i>“(NSR 4) is Mariners Arms Flats terrace. The noise climate in this location is similar at NML4 (NSR 3), both being near Keadby Village.”</i></p>

Receptor	Noise Climate Observations
NSR 5 - Trent Side	<i>“Trent Side (NSR 5) and South Bank ... are located on the roads Trent Side and South Bank respectively. The noise levels are similar to those at Keadby Village and Mariners Arms Flats.”</i>
NSR 6 - 9 Queens Crescent (South Bank data)	<i>“Trent Side (NSR 5) and South Bank ... are located on the roads Trent Side and South Bank respectively. The noise levels are similar to those at Keadby Village and Mariners Arms Flats.”</i> In this PEI Report a different NSR 6 has been selected to represent the properties on the south bank of Three Rivers at 9 Queens Crescent as this location was closer to the Keadby 3 Main Site. This is approximately 100m from South Bank, although is likely to comprise a similar baseline sound environment.
NSR 7 - Keadby Grange	No observations available from the Keadby 2 Power Station ES. However, the railway line is 450m away and so likely to be audible intermittently, and the A18 and distant M180 are likely to be sources of sound contributing to the ambient and background sound levels.
NSR 8 - North Piffrey Farm	No observations available from the Keadby 2 Power Station ES. However, the NSR is approximately 40m from the railway line therefore likely to have a similar character to the baseline sound environment as Vazon Bridge, albeit with a different level of sound contribution from Keadby 1 Power Station.
NSR 9 - Ealand Poultry Farm	No observations available from the Keadby 2 Power Station ES. Likely to be a combination of commercial/industrial, residential, transportation sound sources.
NSR 10 - North Moor Farm	No observations available from the Keadby 2 Power Station ES. Likely to be a combination of distant commercial/industrial and transportation sound sources.

9.4.4 In the January 2016 baseline sound survey undertaken with Keadby 1 operating, higher background sound levels ($L_{A90,T}$) were measured in the daytime (2-4 dB higher) and in the night-time (2-8 dB) higher when compared to the 2015 survey. Daytime ambient sound levels ($L_{Aeq,T}$) at all NSR were within 1 dB of the 2015 survey data and at night were the same at NSR 1 but 5 dB higher at other NSR.

Additional Surveys Proposed

9.4.5 Taking into account prevailing restrictions relating to the COVID-19 pandemic which are expected to continue throughout 2020, it is proposed that additional baseline sound level data will be collected, if reasonably practicable in 2021, both to cover gaps in the baseline data collected and to verify the data collected in 2015/2016.

Future Baseline

9.4.6 In 2022, construction and commissioning of Keadby 2 Power Station is expected to be complete and it will become operational. Condition 28 of the final Section 36 consent (BEIS, 2019) for Keadby 2 Power Station relates to control of noise:

28) Notwithstanding the noise levels approved by the Borough Council pursuant to Condition (27) the noise levels when measured at one metre in front of the nearest residential properties in Chapel Lane, Trentside and the Mariners Arms, Keadby shall be within 5 db (A) of the ambient noise levels approved pursuant to Condition (25) as assessed by British Standard 4142 and exhibit no tonal content, except at the Vazon Bridge dwelling where the plant should not exceed $L_{Aeq,T}$ 50dB free-field, while also exhibiting no tonal content.

- 9.4.7 Taking into consideration these consent limits, an increase in background and ambient sound levels in the vicinity of the Proposed Development Site may occur in the short-term once Keadby 2 Power Station becomes operational. To account for this increase in the assessment of operational noise for the Proposed Development, adjustments to the measured background sound level have been made, based upon predicted sound levels from Keadby 2 Power Station. This is shown in Table 9.26.
- 9.4.8 Keadby 1 Power Station began commercial operation in 1996. The gas-fired power station has a contract to provide capacity to the grid until September 2022 and will have opportunities to secure further agreements in future auctions. Future plans for Keadby 1 Power Station will be confirmed by the Applicant in due course.
- 9.4.9 It is recognised that it is likely that Keadby 1 Power Station would not be in operation concurrently with the Proposed Development. However, uncertainty regarding plans for the timing of future closure of Keadby Power Station mean that the removal of Keadby 1 Power Station has not been considered in the assessment in this chapter. As part of the future baseline it is therefore predicted that structures associated with Keadby 1 Power Station will continue to be present on-site. Future baseline ambient and background sound levels may reduce at NSRs in the vicinity of the Keadby 1 Power Station, once decommissioned, although it has not been possible to quantify the potential reduction at this stage.
- 9.4.10 Additionally, in the absence of the Proposed Development, future baseline sound levels at NSR will also be influenced by traffic flows on surrounding road and rail networks, and the future operations at other industrial and commercial premises in the area.

9.5 Development Design and Impact Avoidance

Construction Noise and Vibration

- 9.5.1 Measures to mitigate noise will be implemented during the construction phase of the Proposed Development in order to minimise impacts at local residential receptors and ecological receptors, particularly with respect to activities required outside of core working hours. Mitigation (to be included in a Construction Environmental Management Plan (CEMP)) shall include, but not be limited to:
- abiding by agreed construction noise limits at locations to be agreed with North Lincolnshire Council;
 - ensuring that processes are in place to minimise noise before works begin and ensuring that BPM are being achieved throughout the construction programme, including the use of localised screening around significant noise producing plant and activities;

- ensuring that modern plant is used, complying with applicable UK noise emission requirements, and selection of inherently quiet plant where possible;
- hydraulic techniques for breaking to be used, where breaking is required, in preference to percussive techniques where reasonably practicable;
- use of lower noise piling (e.g. rotary bored or hydraulic jacking) rather than driven piling techniques, where reasonably practicable;
- off-site pre-fabrication for components of the Proposed Development, where reasonably practicable;
- all plant and equipment being used for the works to be properly maintained, silenced where appropriate, operated to prevent excessive noise and switched off when not in use;
- all contractors to be made familiar with current legislation and the guidance in BS 5228 (Parts 1 and 2) (BSI, 2014a and b), which should form a prerequisite of their appointment;
- loading and unloading of vehicles, dismantling of site equipment such as scaffolding or moving equipment or materials within the Proposed Development Site to be conducted in such a manner as to minimise noise generation, as far as reasonably practicable;
- appropriate routing of construction traffic on public roads and along access tracks, to reduce construction traffic noise, as far as reasonably practicable (see **Chapter 10: Traffic and Transportation**);
- provision of information to North Lincolnshire Council and local residents to advise of potential noisy works that are due to take place; and
- monitoring of noise complaints and reporting to the Applicant for immediately investigation.

9.5.2 Method statements regarding construction management, traffic management, and overall site management will be prepared in accordance with best practice and relevant British Standards, to help to reduce impacts of construction works. One of the key aims of such method statements will be to minimise noise disruption to local residents during the construction phase as far as reasonably practicable.

9.5.3 Consultation and communication with the local community throughout the construction period will also serve to publicise the works schedule, giving notification to residents regarding periods when higher levels of noise may occur during specific operations, and providing lines of communication where complaints can be addressed.

9.5.4 The selected contractor would be encouraged to be a member of the 'Considerate Constructors Scheme', which is an initiative open to all contractors undertaking building work.

9.5.5 As mentioned above, a CEMP will be prepared, including setting out provisions to ensure that the noise and vibration impacts relating to construction activities are reduced, as far as reasonably practicable, based on the measures outlined above. A framework CEMP will be included with the final ES to support the DCO application.

- 9.5.6 To assist in the preparation of the final CEMP, a detailed noise and vibration assessment will be undertaken once the contractor is appointed and further details of construction methods are known in order to identify specific mitigation measures for the Proposed Development (including construction traffic).
- 9.5.7 The control and monitoring of noise during construction is proposed to be secured by a Requirement of the draft DCO.
- 9.5.8 Measures to mitigate noise associated with CO₂ venting during commissioning will include those listed above for construction.
- 9.5.9 As more significant CO₂ venting would only take place during emergency scenarios, it is not considered that any further consideration / potential mitigation is required within this noise assessment.

Operational Noise and Vibration

- 9.5.10 The selection of the Proposed PCC Site and development of the indicative concept layout have already included consideration of potential noise effects and proximity to NSR, with plant being located close to the existing Keadby Power Station in order to increase the distance between plant and the NSR. During the detailed design stage, further options to reduce potential significant noise effects by design will be explored (see Section 11.7).
- 9.5.11 Several options for configuration of the CCGT and CCP plant and equipment have been considered within the Rochdale Envelope assessed as part of the on-going design of the Proposed Development. The preliminary modelling undertaken for this PEI Report will be updated prior to submission of the DCO considering the options that are available and capable of meeting the applicable threshold noise levels.
- 9.5.12 The Proposed Development will be operated in accordance with an Environmental Permit, issued and regulated by the Environment Agency. This will require operational noise from the generating station to be controlled through the use of BAT, which will be determined through the Environmental Permit application. It is proposed that operational noise limits will also be secured by a Requirement of the draft DCO.

Decommissioning

- 9.5.13 During the decommissioning phase similar measures to the construction phase would be applied, including a Decommissioning Environmental Management Plan (DEMP) to control noise effects.

9.6 Likely Impacts and Effects

Construction Noise and Vibration Effects

- 9.6.1 Based upon the analysis and summary of the results of the existing free-field baseline ambient sound surveys undertaken for the Keadby 2 Power Station ES, Table 9.16 sets out the BS 5228 'ABC' noise threshold categories (BSI, 2014) at each NSR for the day, evening and night-time periods as set out in Table 9.6.

Table 9.16: Measured free Field $L_{Aeq, T}$ Noise Levels and associated “ABC” Assessment Category

Receptor	Weekday daytime 07:00 – 19:00		Weekday evening 19:00 – 23:00		Night-time 23:00 – 07:00	
	$L_{Aeq, T}$ dB	ABC	$L_{Aeq, T}$ dB	ABC	$L_{Aeq, T}$ dB	ABC
NSR 1 - Vazon Bridge	59	A	59	C	39/59*	A/C
NSR 2 - Hawthorne House, Chapel Lane	45	A	41	A	36	A
NSR 3 - Keadby Village	45	A	45	A	36	A
NSR 4 - Mariners Arms Flats	45	A	45	A	36	A
NSR 5 - Trent Side	45	A	45	A	36	A
NSR 6 - 9 Queens Crescent (South Bank data)	45	A	45	A	36	A
NSR 7 - Keadby Grange	45	A	41	A	36	A
NSR 8 - North Pilfrey Farm	45	A	41	A	36	A
NSR 9 - Ealand Poultry Farm	45	A	41	A	36	A
NSR 10 - North Moor Farm	45	A	41	A	36	A
NSR 11 - North of Keadby Village	45	A	41	A	36	A

*This is the value for periods without/with trains on the nearby railway line. Both are used in assessment of construction noise effects.

9.6.2 Construction noise limits have been derived for each NSR in Table 9.17 below using the BS 5228 ABC methodology (described in Table 9.6). Where baseline sound level data are not available for an NSR, limits have been assigned using conservative assumptions (i.e. assuming the lowest measured sound level for the given time period from other representative measurement locations). In addition, until further baseline sound surveys are undertaken, indicative weekend noise limits are based upon the most conservative Category A values.

Table 9.17: Indicative Construction Noise Limits / SOAEL values

Receptor	Construction noise limit $L_{Aeq, T}$ dB (Free-field) / SOAEL values					
	Weekday daytime 07:00 – 19:00	Weekday evening 19:00 – 23:00	Night 23:00 – 07:00	Saturday 07:00 – 13:00	Saturday 13:00 – 23:00	Sunday 07:00 – 23:00
NSR 1 - Vazon Bridge	65	65	45/55	65	55	55

Receptor	Construction noise limit $L_{Aeq,7}$ dB (Free-field) / SOAEL values					
	Weekday daytime 07:00 – 19:00	Weekday evening 19:00 – 23:00	Night 23:00 – 07:00	Saturday 07:00 – 13:00	Saturday 13:00 – 23:00	Sunday 07:00 – 23:00
NSR 2 - Hawthorne House, Chapel Lane	65	55	45	65	55	55
NSR 3 - Keadby Village	65	55	45	65	55	55
NSR 4 - Mariners Arms Flats	65	55	45	65	55	55
NSR 5 - Trent Side	65	55	45	65	55	55
NSR 6 - 9 Queens Crescent (South Bank data)	65	55	45	65	55	55
NSR 7 - Keadby Grange	65	55	45	65	55	55
NSR 8 - North Pilfrey Farm	65	55	45	65	55	55
NSR 9 - Ealand Poultry Farm	65	55	45	65	55	55
NSR 10 - North Moor Farm	65	55	45	65	55	55
NSR 11 - North of Keadby Village	65	55	45	65	55	55

Construction Noise Effects

9.6.3 This section discusses the potential noise and vibration effects on NSR arising during the construction phase of the Proposed Development.

- 9.6.4 Noise levels experienced by local receptors during such works depend upon several variables, the most significant of which are:
- the noise generated by plant or equipment used on site, generally expressed as sound power levels (L_w) or the vibration generated by the plant;
 - the periods of use of the plant on site, known as its on-time;
 - the distance between the noise/ vibration source and the receptor;
 - the noise attenuation due to ground absorption, air absorption and barrier effects;
 - in some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
 - the time of day or night the works are undertaken.
- 9.6.5 The preliminary construction noise predictions have been undertaken using noise data for plant items and calculation methodologies from BS 5228 (2014a). For the construction on the Main Site, fixed plant has been assumed to be evenly distributed through the CCGT and CCP areas. Mobile plant has been assumed to be evenly distributed within the CCGT and CCP areas as well as the Indicative Laydown Areas and the K2/ K2 Turnaround Area and Keadby 2 Operational/ Laydown/ Carbon Capture Readiness (CCR) area (**Figure 3.2**).
- 9.6.6 Construction will also take place in the Electrical Connection to the 132kV Substation and Water Connection Corridors. For these areas, construction is been assumed to be undertaken at the closest point to the NSR.
- 9.6.7 Subject to being granted development consent and following a final investment decision, it is anticipated that construction could commence after Quarter 3 2023, and last for approximately three years, followed by a period of commissioning. Similarly, due to the period over which consent is being sought, construction could start in 2029 and continue until 2031.
- 9.6.8 Construction activities will typically be undertaken during weekday daytimes (07:00 to 19:00) and Saturdays (08:00 to 13:00). As detailed in **Chapter 5: Construction Programme and Management** (PEI Report Volume I), some works may need to take place outside of core working hours, in particular regarding control of noise and traffic in accordance with the relevant requirements which would be secured by the draft DCO.
- 9.6.9 As only indicative construction activities are known at this early stage of assessment, indicative predicted noise levels for construction of the Proposed Development have been based on construction methods used for similar power stations in the UK. This gives an indication of where, at what stage and during which construction activities construction noise is at risk of leading to potentially adverse and significant adverse effects by comparison with construction noise LOAEL and SOAEL for residential NSR.
- 9.6.10 The predicted levels apply to core weekday daytime (07:00 – 19:00) working, although could approximate to other time periods where working at the same rate and intensity is proposed. These assume constant operation of equipment throughout the 07:00 – 19:00 core working hours which is a conservative worst-case assumption. Details regarding the noise prediction methodology, including a full list of indicative construction plant and associated sound power levels (L_w) for each construction phase,

are presented in **Appendix 9A: Construction Noise Assessment Methodology** (PEI Report Volume II).

- 9.6.11 A summary of indicative noise predictions at the NSR locations for construction activities associated with the Main Site (i.e. CCGT and CCP/ associated development) are presented in Table 9.18.
- 9.6.12 As advised by BS 5228, noise levels predicted at distances over 300m should be treated with caution due to the increasing importance of meteorological effects. There are no NSR within 300m of the Main Site. The closest NSR to construction activities at the Main Site is NSR1 – Vazon Bridge at approximately 475m from the Main Site.

Table 9.18: Indicative Free-field Construction Noise Levels During Daytime Main Site Construction Activity

Receptor	Indicative free-field construction noise levels during daytime construction activity (dB $L_{Aeq,12h}$)		
	Site preparation	Main civil works (including piling and foundations)	Plant Installation
NSR 1 - Vazon Bridge	59	61	57
NSR 2 - Hawthorne House, Chapel Lane	50	58	52
NSR 3 - Keadby Village	47	52	48
NSR 4 - Mariners Arms Flats	44	50	46
NSR 5 - Trent Side	39	44	38
NSR 6 - 9 Queens Crescent (South Bank data)	40	45	40
NSR 7 - Keadby Grange	50	53	48
NSR 8 - North Pilfrey Farm	53	56	50
NSR 9 - Ealand Poultry Farm	42	45	40
NSR 10 - North Moor Farm	50	54	51
Values above the daytime threshold (and SOAEL) of 65 dB $L_{Aeq,12h}$ are shown in bold			

- 9.6.13 Electricity transmission infrastructure will be required to connect the Proposed Development to the National Grid electricity transmission system. An option to connect the Proposed Development into the existing Northern Powergrid 132 kV Substation on Chapel Lane to supply power to the Proposed PCC Site plant and equipment during start-up is under consideration. There are two possible routes for an underground cable (refer to **Figure 3.2** in PEI Report Volume III). For the purposes of assessment, construction has been assumed to be undertaken at the closest point to either of these potential connection routes as a worst-case assumption, when undertaking predictions at each NSR. As it is assumed that cabling would be underground, predictions have

been made for topsoil striping as the potentially most significant noise source during this activity. Noise predictions are shown in Table 9.19.

Table 9.19: Indicative Construction Noise Predictions for Electrical Connection Construction

Receptor	Indicative free-field construction noise levels during daytime electrical connection construction activity (dB $L_{Aeq,12h}$)
NSR 1 - Vazon Bridge	53
NSR 2 - Hawthorne House, Chapel Lane	59
NSR 3 - Keadby Village	48
NSR 4 - Mariners Arms Flats	55
NSR 5 - Trent Side	55
NSR 6 - 9 Queens Crescent (South Bank data)	50
NSR 7 - Keadby Grange	42
NSR 8 - North Pilfrey Farm	49
NSR 9 - Ealand Poultry Farm	36
NSR 10 - North Moor Farm	39
Values above the daytime threshold (and SOAEL) of 65 dB $L_{Aeq,12h}$ are shown in bold	

- 9.6.14 Within the Water Connection Corridor, construction of a water abstraction and discharge point will be required. Two options are currently under consideration for the cooling water abstraction – either a preferred abstraction from the Stainforth and Keadby Canal, or if this is not feasible, utilising/ upgrading the existing abstraction infrastructure for Keadby 1 Power Station within the River Trent.
- 9.6.15 If the River Water Abstraction Corridor is selected, some of the existing pipework may be able to be re-used but this will need to be extended to the PCC Site. There may also need to be upgrade works to other buried pipelines e.g. the water discharge corridor, however, it is envisaged that these works will be relatively minor. The installation of cofferdams for the selected abstraction point would be expected to produce the highest noise levels at the NSR during the construction works within the Water Connection Corridor.
- 9.6.16 Noise levels at NSR resulting from installation of the cofferdam have been predicted using sheet piling, as this activity would be expected to result in the highest noise levels during cofferdam installation and removal. Construction has been assumed to be through the full working day, as a conservative assumption.
- 9.6.17 For the purposes of works within the Water Connection Corridors, an additional NSR 11 has been included in Table 9.20 to provide representative predictions for those residences in the north of Keadby village.

Table 9.20: Indicative Construction Noise Predictions for Water Connection Corridor (cofferdam activity) Construction

Receptor	Indicative free-field construction noise level for daytime water connection construction activity (dB $L_{Aeq,12h}$)
NSR 1 - Vazon Bridge	64
NSR 2 - Hawthorne House, Chapel Lane	47
NSR 3 - Keadby Village	53
NSR 4 - Mariners Arms Flats	75
NSR 5 - Trent Side	56
NSR 6 - 9 Queens Crescent (South Bank data)	52
NSR 7 - Keadby Grange	42
NSR 8 - North Pilfrey Farm	34
NSR 9 - Ealand Poultry Farm	30
NSR 10 - North Moor Farm	45
NSR 11 – North of Keadby Village	63
Values above the daytime threshold (and SOAEL) of 65 dB $L_{Aeq,12h}$ are shown in bold	

Noise Effects of Main Site Construction

9.6.18 The predicted daytime construction noise levels (as presented in Table 9.18) have been assumed as a conservative approach to be equivalent to weekday daytime, evening and night-time noise levels. The predicted effects during time period have been classified by considering the relevant ABC noise limit values given in Table 9.17, and using the semantic scales in Table 9.6, Table 9.12 and Table 9.13. These effects are summarised in Table 9.21.

Table 9.21: Indicative Construction Noise Effects of Main Site Construction

Receptor	Time Period	Construction of the Proposed Development		
		Site preparation	Main civil works (including piling and foundations)	Plant Installation
NSR 1 - Vazon Bridge	Daytime	Negligible adverse	Minor adverse	Negligible adverse
	Evening	Negligible adverse	Minor adverse	Negligible adverse
	Night-time	Major adverse/ Moderate adverse*	Major adverse/ Major adverse *	Major adverse/ Moderate adverse*

Receptor	Time Period	Construction of the Proposed Development		
		Site preparation	Main civil works (including piling and foundations)	Plant Installation
NSR 2 - Hawthorne House	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Minor adverse	Moderate adverse	Minor adverse
	Night-time	Moderate adverse	Major adverse	Major adverse
NSR 3 - Keadby Village	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Minor adverse	Negligible adverse
	Night-time	Moderate adverse	Major adverse	Moderate adverse
NSR 4 - Mariners Arms Flats	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Minor adverse	Negligible adverse
	Night-time	Minor adverse	Moderate adverse	Moderate adverse
NSR 5 - Trent Side	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	Negligible adverse	Minor adverse	Negligible adverse
NSR 6 - 9 Queens Crescent (South Bank data)	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	Minor adverse	Minor adverse	Minor adverse
NSR 7 - Keadby Grange	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Minor adverse	Minor adverse	Negligible adverse
	Night-time	Moderate adverse	Major adverse	Moderate adverse
NSR 8 - North Pilfrey Farm	Daytime	Negligible adverse	Minor adverse	Minor adverse
	Evening	Minor adverse	Moderate adverse	Minor adverse
	Night-time	Major adverse	Major adverse	Moderate adverse
NSR 9 - Ealand Poultry Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Negligible adverse	Negligible adverse	Negligible adverse
	Night-time	Minor adverse	Minor adverse	Minor adverse

Receptor	Time Period	Construction of the Proposed Development		
		Site preparation	Main civil works (including piling and foundations)	Plant Installation
NSR 10 - North Moor Farm	Daytime	Negligible adverse	Negligible adverse	Negligible adverse
	Evening	Minor adverse	Minor adverse	Minor adverse
	Night-time	Moderate adverse	Major adverse	Major adverse
Daytime (07:00 – 19:00 weekdays) also represents Saturday mornings (07:00 – 13:00) Evening (19:00 – 23:00 weekdays) also represents Saturday afternoons (13:00 – 23:00) and Sundays (07:00 – 23:00) Night-time (23:00 – 07:00 all week) *At NSR 1 during the night-time, the significance of effect assigned is based upon the ambient sound levels without/with train passbys on the nearby railway line				

- 9.6.19 Construction noise effects at all residential NSR during construction of the Main Site within core daytime hours and Saturday mornings are predicted to be minor adverse/negligible (not significant) due largely to the distances between the works and NSR.
- 9.6.20 It may be necessary for some construction activities to take place continuously over day, evening and night periods during peak construction times of the Proposed Development, although the exact nature of the works is unknown at this stage.
- 9.6.21 Comparison of the predicted daytime noise levels for construction on the Main Site against the lower limit values for the evening, Saturday afternoon and Sunday all day periods indicate the potential for moderate adverse (significant) effects at two of the 10 NSR during at least one construction phase if the same intensity of working as for the daytime is assumed. During night-time the potential for moderate/major adverse (significant) effects is predicted at seven of the 10 NSR during at least one construction phase if the same intensity of working as for the daytime is assumed.

Noise Effects of Electrical Connection Construction

- 9.6.22 The predicted effects of the electrical connection construction noise levels are shown in Table 9.22.

Table 9.22: Indicative Construction Noise Effects of Electrical Connection to 132kv Substation Option

Receptor	Daytime	Evening	Night-time
NSR 1 - Vazon Bridge	Negligible adverse	Negligible adverse	Major adverse/ Minor adverse *
NSR 2 - Hawthorne House	Negligible adverse	Moderate adverse	Major adverse
NSR 3 - Keadby Village	Negligible adverse	Negligible adverse	Moderate adverse

Receptor	Daytime	Evening	Night-time
NSR 4 - Mariners Arms Flats	Negligible adverse	Minor adverse	Major adverse
NSR 5 - Trent Side	Negligible adverse	Minor adverse	Major adverse
NSR 6 - 9 Queens Crescent (South Bank data)	Negligible adverse	Minor adverse	Major adverse
NSR 7 - Keadby Grange	Negligible adverse	Negligible adverse	Minor adverse
NSR 8 - North Pilfrey Farm	Negligible adverse	Negligible adverse	Moderate adverse
NSR 9 - Ealand Poultry Farm	Negligible adverse	Negligible adverse	Negligible adverse
NSR 10 - North Moor Farm	Negligible adverse	Negligible adverse	Negligible adverse
Daytime (07:00 – 19:00 weekdays) also represents Saturday mornings (07:00 – 13:00) Evening (19:00 – 23:00 weekdays) also represents Saturday afternoons (13:00 – 23:00) and Sundays (07:00 – 23:00) Night-time (23:00 – 07:00 all week) *At NSR 1 during the night-time, the significance of effect assigned is based upon the ambient sound levels without/with train passbys on the nearby railway line			

9.6.23 During the daytime core hours and Saturday mornings, predicted noise effects during topsoil stripping for laying the cable to the existing Northern Powergrid 132 kV Substation are assessed as negligible adverse (not significant). Should it be necessary to undertake works in the evening/ night-time or other weekend periods at the same intensity as daytime works, moderate effects are predicted at one of the 10 NSRs potential, and at night moderate or major adverse (significant) effects are predicted at seven of the 10 NSR.

Noise Effects of Water Connection Construction

9.6.24 The effects of the predicted water connection construction noise levels are shown in Table 9.23.

Table 9.23: Indicative Water Connection Construction Effects

Receptor	Daytime	Evening	Night-time
NSR 1 - Vazon Bridge	Minor adverse	Minor adverse	Major adverse/ Major adverse*
NSR 2 - Hawthorne House	Negligible adverse	Negligible adverse	Moderate adverse
NSR 3 - Keadby Village	Negligible adverse	Minor adverse	Major adverse

Receptor	Daytime	Evening	Night-time
NSR 4 - Mariners Arms Flats	Major adverse	Major adverse	Major adverse
NSR 5 - Trent Side	Negligible adverse	Moderate adverse	Major adverse
NSR 6 - 9 Queens Crescent (South Bank data)	Negligible adverse	Minor adverse	Major adverse
NSR 7 - Keadby Grange	Negligible adverse	Negligible adverse	Minor adverse
NSR 8 - North Pilfrey Farm	Negligible adverse	Negligible adverse	Negligible adverse
NSR 9 - Ealand Poultry Farm	Negligible adverse	Negligible adverse	Negligible adverse
NSR 10 - North Moor Farm	Negligible adverse	Negligible adverse	Minor adverse
NSR 11 – North of Keadby Village	Minor adverse	Major adverse	Major adverse
Values above daytime thresholds are shown in bold *At NSR 1 during the night-time, the significance of effect assigned is based upon the ambient sound levels without/with train passbys on the nearby railway line			

9.6.25 Should works on the River Water Abstraction Option be undertaken, effects could be major adverse (significant) during the daytime, evening and night-time periods at NSR represented by NSR 4. This effect would be short-term and is predicted due to the short distance between the closest of the properties in this NSR group to the river water abstraction point. Should the preferred Canal Water Abstraction Option be selected, the closest property in this receptor group would be approximately 600m from the works area and effects would be unlikely to be significant at NSR 4 receptors.

9.6.26 Comparison of the predicted daytime noise levels against the lower limit values, moderate or major adverse (significant) effects are predicted at three of the remaining 10 NSR during the evening and at seven of the remaining 10 NSR at night, assuming the same work intensity as the daytime, due to Water Connection Corridor construction.

Summary of Evening/ Night-time Construction Effects

9.6.27 In view of the potential for significant adverse effects at the evening/night-time (and weekend) periods, construction activities taking place outside core working hours will need to be planned, managed and controlled appropriately so they do not exceed the SOAEL threshold values, as provided in Table 9.17, and reduce levels towards the LOAEL (or less) where practical. Provided the SOAEL threshold values are not exceeded, construction activities outside core working hours can be considered as having a minor adverse effect or less (not significant). Potential measures to ensure that appropriate mitigation is in place during the works are as set out in Section 9.5.

Construction Vibration Effects

- 9.6.28 The level of impact at different receptors will be dependent upon a number of factors, including distance between the works and receptors, ground conditions, the nature and method of works required close to receptors and the specific activities being undertaken at any given time.
- 9.6.29 However, due to large distances (minimum of 475m) between residential receptors and the static plant that is likely to produce higher levels of vibration (e.g. piling rigs) on the Main Site, vibration effects on both humans and buildings are likely to be negligible (not significant).
- 9.6.30 NSR 2 is the closest receptor to the mobile construction plant likely to be associated with the Main Site, being 20m away from a potential option for a laydown area (refer to **Figure 3.2** in PEI Report Volume III). However, these types of mobile plant are unlikely to produce levels of vibration which would significantly affect humans or buildings and would therefore be classified as minor adverse (not significant) or less.
- 9.6.31 The Stainforth and Keadby Canal lies approximately 300m to the south of the Main Site, whilst Keadby Lock is over 1km from any vibration sources on the Main Site. Given these distances, vibration effects on canal infrastructure due to Main Site works are likely to be negligible (not significant).

Construction Vibration Water Connections

- 9.6.32 On the basis that sheet piling may be required during the construction of cofferdam(s) in the Water Connection Corridor, a potential source of significant vibration would be located less than 20m from the nearest residential NSR (NSR 4 - Mariners Arms Flats - a group of properties) (refer to Table 9.4) if the River Water Option was selected. There is the potential for some vibration impacts upon humans and buildings during such sheet piling. Whilst it is considered unlikely that most typical construction working routines would generate levels of vibration above which building damage would be expected to be sustained (subject to final plant and working requirements), there is the potential that vibration impacts could cause annoyance to occupants and exceed the LOAEL and SOAEL set out in Section 11.3 unless appropriate control measures are applied.
- 9.6.33 Where piling or other significant vibration producing operations are proposed in close proximity to any sensitive NSR or buildings, during Water Connection Corridor construction works, further consideration will be given to potential effects and the assessment will be updated as part of the ES which will accompany the DCO application. Potential measures to ensure that appropriate mitigation is in place during the works are discussed in Section 9.5.

Construction Traffic Noise Effects

- 9.6.34 For the purposes of assessment, it is assumed that construction traffic access to the proposed construction area will be via A18. Data have been provided from the Transport Assessment (see **Appendix 10A**: Transport Assessment, PEI Report Volume II) for the traffic scenario 'without' and 'with' Proposed Development construction traffic in 2031 for the roads within the scope of the transport assessment, as follows:

- scenario 1 – ‘without’ Proposed Development construction: 2031 Base + Committed development; and
- scenario 2 – ‘with’ Proposed Development construction: 2031 Base + Committed development + Proposed Development construction traffic.

9.6.35 It has been assumed as a worst case approach that traffic speeds will remain the same for both scenarios although it is recognised that temporary speed restrictions may be used (as have been in place for the Keadby 2 Power Station construction) to reduce speeds from 60mph to 40mph in the vicinity of the Proposed Development access from the A18.

9.6.36 The potential changes in road traffic noise from these roads as a result of the Proposed Development have been considered by calculating the CRTN BNL at 10m from the road and comparing the change. Table 9.24 presents the results of the assessment.

Table 9.24: Changes in Road Traffic Noise as a Result of Construction of the Proposed Development

Link	Scenario 1 ‘Without’ Proposed Development construction traffic			Scenario 2 ‘With’ Proposed Development construction traffic			Change in BNL, dB (Scenario 2 minus Scenario 1)	Classification of effect
	AAWT	%HGV	Speed (km/h)	AAWT	%HGV	Speed (km/h)		
A18 (west of Proposed Development Site access)	9,543	9.9	55	10,445	9.9	55	+0.4	Negligible adverse
A161 (between A18 and M180 Jct 2)	6,715	14.5	48	7,449	14.5	48	+0.5	Negligible adverse
A18 Station Road (west of Keadby Bridge)	17,326	7.4	33	17,660	7.4	33	+0.1	Negligible adverse
B1392 (north of Keadby Power Station site entrance)	1,860	8.1	32	1,860	8.1	32	0.0	Negligible adverse
B1392 (south of Keadby Power Station site entrance)	3,099	11.0	21	3,099	11.0	21	0.0	Negligible adverse

9.6.37 Table 9.24 shows either no change or very low change in road traffic noise due to traffic flows along the construction traffic routes of the Proposed Development. This will result in negligible adverse effects (not significant) at local residential NSR. Based upon the above, no further specific mitigation measures are required beyond those listed in Section 9.5.

9.6.38 In addition to the road traffic related to the Proposed Development construction, Abnormal Indivisible Loads (AIL), which arrive at the Waterborne Transport Off-Loading Area, would be offloaded using existing lifting equipment and enter the Proposed Development Site via the Additional AIL Route. This is consistent with use of this land and route for AIL delivery during Keadby 2 Power Station construction. Details regarding the number of AIL movements will not be known until the contractor is appointed, but it is considered that road traffic noise from this potential source, in addition to noise from works already on-going, will be minor or negligible adverse (not significant).

Construction Noise and Vibration Effects on Sensitive Ecological Receptors

9.6.39 **Chapter 11:** Biodiversity and Nature Conservation provides a preliminary assessment of potential impacts on ecological receptors in the context of the species likely to be present and their sensitivity to such disturbance effects. The Proposed Development is located at a location along the River Trent where construction impacts could have a substantive but temporary effect on the ability of lamprey (and other migratory fish) species to access breeding habitats in the wider River Trent catchment as a whole, and to return to the Humber Estuary from these habitats. The most likely potential mechanisms for such an impact are through either direct barriers to lamprey movement from any cofferdam(s), or indirect barriers to movement from noise and vibration disturbance (e.g. during piling operations).

9.6.40 Agreement of appropriate sensitive timings for any cofferdam installation and removal would be effective at avoiding potential for migrating river and sea lamprey and other fish to be affected. Given this, and the provision of a Fish Management Plan to support the relevant permitting for these works, significant adverse effects on the conservation status of lamprey species are unlikely as a result of direct and indirect barriers to migratory movements.

9.6.41 The potential for injury or mortality of fish and the extent to which intense underwater sound might cause an adverse environmental impact in particular fish species due to noise and vibration from piling has been considered in **Chapter 11:** Biodiversity and Nature Conservation (PEI Report Volume 1). Previous studies indicate that lamprey species are unlikely to experience injurious impacts from piling at distances of greater than 5m from the noise/ vibration source. Therefore, in the context of a watercourse the size of the River Trent, and the proposed timing of works in the summer months, outside the main migration period, it is considered that the likelihood of lamprey species experiencing injurious noise and vibration is very limited. Given these considerations, and due to the need to comply with all relevant legislative and regulatory requirements, it is considered that piling and other construction works of limited extent and duration would be unlikely to adversely affect the conservation status of river and sea lamprey. Further assessment will be provided with the DCO Application and measures to control effects will be included in the accompanying Framework CEMP.

[Carbon Dioxide and other venting](#)

9.6.42 A CO₂ venting system will be designed to collect and safely disperse abnormal CO₂ releases generated in the Proposed Development and needing to be discharged for safety reasons, for example due to plant overpressurisation situations or due to maintenance activities. This venting system will comprise:

- small individual vents for minor emissions from equipment e.g. during routine maintenance;
- larger vents sized to safely dispose of larger volume emissions in an emergency scenario. The sizing of these vents is subject to ongoing work and would be confirmed at detailed design stage; and
- venting of steam lines and traps.

9.6.43 No planned operational venting of CO₂ or steam lines is expected during normal operation of the process and it is considered that noise associated with minor CO₂ venting from the Proposed Development would be not significant and controlled by the Environmental Permit.

Operational Noise Effects

9.6.44 The preferred configuration of the Proposed Development is yet to be decided. Therefore, noise modelling has been undertaken based upon the indicative locations of operational equipment taken from **Figure 4.1** (PEI Report Volume III), and supplemented by a number of different potential operational scenarios of plant configuration, in order to give a view of the range of sound levels that could be produced by various unmitigated and mitigated options for the purposes of determining a representative worst-case.

9.6.45 Further details of the sound source sound power level (L_w) data, the settings used in the noise modelling software and the list of assumptions used are presented in **Appendix 9B: Operational Noise Information** (PEI Report Volume II).

9.6.46 In the absence of additional mitigation, the predicted free-field operational specific sound levels at the NSR around the Proposed Development Site are presented in Table 9.25.

9.6.47 The NSR presented represent the worst affected within the Study Area. The plant is designed to operate flexibly during its lifetime with varying electricity prices. Given the anticipated load regimes (baseload and dispatchable) for the generating station, the predicted noise levels could apply to both the 1-hour daytime or 15-minute night-time BS 4142 assessment periods.

Table 9.25: Predicted Worst-Case Operational Noise Levels (Indicative Site Layout – Figure 4.1)

Receptor	Predicted operational specific sound level $L_{Aeq,1h}$ dB
NSR 1 - Vazon Bridge	47
NSR 2 - Hawthorne House, Chapel Lane	43
NSR 3 - Keadby Village	41
NSR 4 - Mariners Arms Flats	39
NSR 5 - Trent Side	36
NSR 6 - 9 Queens Crescent	37
NSR 7 - Keadby Grange	44

Receptor	Predicted operational specific sound level $L_{Aeq,1h}$ dB
NSR 8 - North Pilfrey Farm	41
NSR 9 - Ealand Poultry Farm	38
NSR 10 - North Moor Farm	44

9.6.48 The representative background sound levels are presented in Table 9.26. Adjustments have been made to the background sound levels to determine future background sound levels accounting for the increase in sound level when Keadby 2 Power Station becomes operational. With the exception of NSR 1 during the daytime, it is assumed that the background sound level will increase by the same amount as the ambient sound level, as a result of the operation of Keadby 2 Power Station.

9.6.49 At NSR 1 during the daytime the predicted Keadby 2 Power Station specific sound level has been summed with the Keadby 2 ES representative background sound level to determine the representative future background sound level. This is because the sound level from Keadby 2 Power Station once operational will be dominant compared with existing sources of background sound. The derived future background sound level also correlates with the $L_{Aeq,T}$ 50dB free-field limit at Vazon Bridge (NSR1) as set out in Condition 28 of the final Section 36 consent (BEIS, 2019) for Keadby 2 Power Station.

Table 9.26: Future background sound levels

Receptor	Time period	Keadby 2 Power Station ES representative background sound level ($L_{A90,T}$), dB	Representative future background sound level ($L_{A90,T}$), dB
NSR 1 - Vazon Bridge	Daytime	37	50
	Night-time	36	50
NSR 2 - Hawthorne House, Chapel Lane	Daytime	37	38
	Night-time	33	39
NSR 3 - Keadby Village	Daytime	35	36
	Night-time	30	34
NSR 4 - Mariners Arms Flats	Daytime	35	35
	Night-time	30	32
NSR 5 - Trent Side	Daytime	35	36
	Night-time	30	33
NSR 6 - 9 Queens Crescent (South Bank data)	Daytime	35	36
	Night-time	30	33
NSR 7 - Keadby Grange	Daytime	35	35*
	Night-time	30	32*

Receptor	Time period	Keadby 2 Power Station ES representative background sound level ($L_{A90,T}$), dB	Representative future background sound level ($L_{A90,T}$), dB
NSR 8 - North Piffrey Farm	Daytime	35	35*
	Night-time	30	31*
NSR 9 - Ealand Poultry Farm	Daytime	35	35*
	Night-time	30	30*
NSR 10 - North Moor Farm	Daytime	35	36*
	Night-time	30	33*
*For NSR 7-10 Keadby 2 Power Station specific sound levels are not available in the Keadby 2 Power Station ES. Therefore, the predicted values presented are from the remodelling of Keadby 2 Power Station in-situ, as set out in paragraph 9.3.43.			

BS4142 Assessment Results

- 9.6.50 The daytime BS 4142 assessments are presented in Table 9.27 and the night-time BS 4142 assessments are presented in Table 9.28
- 9.6.51 The magnitude of impact and effect classification has been included in the tables, to provide context for the BS 4142 assessment outcomes, with reference to the semantic scales in Table 9.11, Table 9.12 and Table 9.13.
- 9.6.52 The values presented are the differences between the representative background sound level at each NSR (Table 9.14) and the predicted rating level (the Specific Sound Level $L_{Aeq,T}$ plus the character correction). Positive values in the table indicate an excess of the rating level over the background sound level.
- 9.6.53 The assessment has assumed that potential noise of a tonal, impulsive or intermittent nature will be designed out of the Proposed Development during the detailed design phase by the selection of appropriate plant, building cladding, louvres and silencers/attenuators as necessary. This is consistent with the Keadby 2 Power Station ES. However, inclusion of a +3 dB correction for other distinctive character has been included at this stage as a conservative approach for NSR with the potential to identify the new sound source in their existing acoustic environment.

Table 9.27: Daytime BS4142 Assessment

Receptor	NSR 1 Vazon Bridge	NSR 2 Hawthorne House, Chapel Lane	NSR 3 Keadby Village	NSR 4 Mariners Arms Flats	NSR 5 Trent Side	NSR 6 Queens Crescent	NSR 7 Keadby Grange	NSR 8 North Pilfrey Farm	NSR 9 Ealand Poultry Farm	NSR 10 North Moore Farm
Specific sound level $L_s (L_{Aeq,T})$, dB	52*	43	41	39	36	37	44	41	38	44
Acoustic feature correction, dB	0*	+3	+3	+3	+3	+3	+3	+3	+3	+3
Rating level ($L_{Ar,T}$), dB	52*	46	44	42	39	40	47	44	41	47
Representative future background sound level ($L_{A90,T}$), dB	50*	38	36	35	36	36	35	35	35	36
Excess of rating level over background sound level ($L_{Ar,T} - L_{A90,T}$), dB	+2*	+8	+8	+7	+3	+4	+12	+9	+6	+11
BS 4142:2014 effect category	Low/ Adverse	Adverse/ Significant Adverse	Adverse/ Significant Adverse	Adverse/ Significant Adverse	Low/ Adverse	Adverse	Significant Adverse	Significant Adverse	Adverse	Significant Adverse
Magnitude of impact (assigned from Table 9.11)	Very Low/Low	Low/ Medium	Low/ Medium	Low/ Medium	Very Low/Low	Low	Medium/ High	Medium	Low	Medium

Receptor	NSR 1 Vazon Bridge	NSR 2 Hawthorne House, Chapel Lane	NSR 3 Keadby Village	NSR 4 Mariners Arms Flats	NSR 5 Trent Side	NSR 6 Queens Crescent	NSR 7 Keadby Grange	NSR 8 North Pilfrey Farm	NSR 9 Ealand Poultry Farm	NSR 10 North Moor Farm
Initial classification of effect (assigned from Table 9.13)	Negligible / Minor adverse	Minor/ Moderate adverse	Minor/ Moderate adverse	Minor/ Moderate adverse	Negligible / minor adverse	Minor adverse	Moderate / Major adverse	Moderate adverse	Minor adverse	Moderate adverse
<p>*See further information in context discussion</p> <p>Uncertainty: Given the use of sound level data from surveys undertaken for Keadby 2 Power Station EIA, significantly different ‘representative’ background and ambient sound level values could be obtained using updated baseline data and using different statistical analysis methods. Additionally, background/ ambient sound level data measured at a small number of NSR is assumed to be representative of conditions at other NSR, this is discussed in Table 9.26: Future background sound levels.</p>										

Table 9.28: Night-time BS4142 Assessment

Receptor	NSR 1 Vazon Bridge	NSR 2 Hawthorn e House, Chapel Lane	NSR 3 Keadby Village	NSR 4 Mariners Arms Flats	NSR 5 Trent Side	NSR 6 Queens Crescent	NSR 7 Keadby Grange	NSR 8 North Pilfrey Farm	NSR 9 Ealand Poultry Farm	NSR 10North Moor Farm
Specific sound level $L_s (L_{Aeq,T_r})$, dB	47	43	41	39	36	37	44	41	38	44
Acoustic feature correction, dB	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3
Rating level (L_{Ar,T_r}) , dB	50	46	44	42	39	40	47	44	41	47
Representative future background sound level $(L_{A90,T})$, dB	47	39	34	32	33	33	32	31	30	33
Excess of rating level over background sound level $(L_{Ar,T_r} - L_{A90,T})$, dB	+3	+7	+10	+10	+6	+7	+15	+13	+11	+14

Receptor	NSR 1 Vazon Bridge	NSR 2 Hawthorn e House, Chapel Lane	NSR 3 Keadby Village	NSR 4 Mariners Arms Flats	NSR 5 Trent Side	NSR 6 Queens Crescent	NSR 7 Keadby Grange	NSR 8 North Pilsfry Farm	NSR 9 Ealand Poultry Farm	NSR 10 North Moor Farm
BS 4142:2014 assessment outcome	Low/ Adverse	Adverse/ Significant adverse effect	Significant Adverse	Significant Adverse	Adverse	Adverse/ Significant adverse	Significant adverse	Significant adverse	Significant adverse	Significant adverse
Magnitude of impact (assigned from Table 9.11)	Very Low/ Low	Low/ Medium	Medium	Medium	Low	Low/ Medium	Medium/ High	Medium/ High	Medium	Medium/ High
Initial classification of effect (assigned from Table 9.13)	Negligible /Minor adverse	Minor/ Moderate adverse	Moderate adverse	Moderate adverse	Minor adverse	Minor/ Moderate adverse	Moderate/ Major adverse	Moderate/ Major adverse	Moderate adverse	Moderate/ Major adverse

*See further information in context discussion

Uncertainty: Given the use of sound level data from surveys undertaken for Keadby 2 EIA, significantly different ‘representative’ background and ambient sound level values could be obtained using updated baseline data and using different statistical analysis methods. Additionally, background/ambient sound level data measured at a small number of NSRs is assumed to be representative of conditions at other NSRs, this is discussed in Table 9.26: Future background sound levels.

9.6.54 In accordance with Table 9.13, the values presented in Table 9.28 and 9.29, for the worst-case scenario produce a range of impact magnitudes from low to high adverse at the 10 NSR. This would result in effects between minor adverse (not significant) to major adverse (significant), subject to consideration of context.

Consideration of Context

9.6.55 Keadby 1 Power Station has been a continuously operating industrial source in the study area since 1996 and background sound levels measured for the Keadby 2 Power Station ES (whilst Keadby 1 Power Station was operational) were 2-4 dB higher in the daytime and 2-8 dB higher at night. This is likely to mean that residents at all NSR are already accustomed to an industrial source. As Keadby 2 Power Station will be operational before the Proposed Development and will operate at the same times, it is reasonable to assume that local residents may become further accustomed to an industrial noise source before the Proposed Development is operational.

9.6.56 At NSR 1 during the day, no correction for other distinctive character has been applied to the rating level. This is because sound from Keadby 2 Power Station is predicted to be 3 dB higher at this NSR than Keadby 3 Power Station, and as these operate at the same time, sound from the Proposed Development is likely to not be significantly identifiable. Also, a specific sound level and rating level of 52 dB $L_{Aeq,1h}$ has been used during the day, rather than the 47 dB $L_{Aeq,1h}$ as presented in Table 9.25. The higher rating level provides what is deemed a more representative outcome from the BS 4142 assessment, in the context of noise from the future operational of Keadby 2 Power Station at NSR1. The +2 outcome represents the change in the excess of rating level over the future background sound level once Keadby 2 Power Station becomes operational (see further demonstration in Table 9.29 below).

9.6.57 At NSR 1, where negligible/minor adverse effects are predicted during the day and night-time assessments, it is reasonable to assume that residents may already be accustomed to noise from the railway approximately 15m to the north and in particular, adjusted to effects of noise, particularly when using rooms of the property facing the Proposed Development. It is noted that as part of the Keadby 2 Power Station Project, enhancements were made to the property, including additional glazing, meaning residents will be further protected to the effects of noise when residing within the building.

9.6.58 Table 9.29 below presents existing and future predicted ambient sound levels (assuming constant operation through the night of both Keadby 2 Power Station and the Proposed Development) and compares them to the BS8233:2014 recommended indoor ambient sound levels for sleeping. The recommended internal criterion is 30 dB $L_{Aeq,8h}$, which would be equivalent to an external criteria of 45 dB $L_{Aeq,8h}$ assuming open bedroom windows for ventilation.

9.6.59 As shown in Table 9.29 the only NSR to exceed the BS8233:2014 criteria is NSR 1, where the specific sound level predicted for the Proposed Development is 3 dB lower than for Keadby 2 Power Station. The sound from the Proposed Development is therefore likely to be less disturbing than the sound from the consented Keadby 2 Power Station at NSR 1.

Table 9.29: Comparison of Night-time Ambient Sound Levels

Receptor	Proposed Development predicted operational specific sound level ($L_{Aeq,1h}$ dB)	Keadby 2 Power Station ES - predicted Keadby 2 operational specific sound level ($L_{Aeq,1h}$ dB)	Night-time Ambient measured before Keadby 2 and the Proposed Development ($L_{Aeq,8h}$ dB)	Night-time future ambient predicted with Keadby 2 Power Station in operation ($L_{Aeq,8h}$ dB)	Night-time future ambient predicted with the Proposed Development in operation ($L_{Aeq,8h}$ dB)	Change in Night-time future ambient due to the Proposed Development (dB)
NSR 1 - Vazon Bridge	47	50	39	50	52	+2
NSR 2 - Hawthorne House, Chapel Lane	43	39	36	41	45	+4
NSR 3 - Keadby Village (slightly different locations)	41	34	36	38	43	+5
NSR 4 - Mariners Arms Flats	39	31	36	40	43	+3
NSR 5 - Trent Side	36	33	36	38	42	+4
NSR 6 - 9 Queens Crescent (slightly different locations)	37	33	36	40	41	+1
NSR 7 - Keadby Grange	44	33*	36**	38	45	+7
NSR 8 - North Pilfrey Farm	41	31*	36**	37	43	+6
NSR 9 - Ealand Poultry Farm	38	30*	36**	36	40	+4
NSR 10 - North Moor Farm	44	35*	36**	39	45	+6

Receptor	Proposed Development predicted operational specific sound level ($L_{Aeq,1h}$ dB)	Keadby 2 Power Station ES - predicted Keadby 2 operational specific sound level ($L_{Aeq,1h}$ dB)	Night-time Ambient measured before Keadby 2 and the Proposed Development ($L_{Aeq,8h}$ dB)	Night-time future ambient predicted with Keadby 2 Power Station in operation ($L_{Aeq,8h}$ dB)	Night-time future ambient predicted with the Proposed Development in operation ($L_{Aeq,8h}$ dB)	Change in Night-time future ambient due to the Proposed Development (dB)
<p>Those above BS8233:2014 external criteria of 45 dB $L_{Aeq,8h}$ are in bold</p> <p>*NSR 7-10 were not used for the Keadby 2 Power Station ES so the lowest ambient data measured has been used</p> <p>**For NSR 7-10 no prediction of Keadby 2 Power Station sound levels are available in the Keadby 2 Power Station ES, so predicted values from the re-creation of Keadby 2 Power Station in-situ have been used</p>						

- 9.6.60 As seen in Table 9.29 at NSR 2 to NSR 10, whilst ambient sound levels increase due to the predicted levels from the Proposed Development, they are all below the BS8233:2014 external criterion, which would give ambient sound levels below the guideline internal values with windows open. At NSR 1, ambient levels are currently above the guideline external value, however, and noise from the Proposed Development in addition to the Keadby 2 Power Station will result in only a minor increase (+2 dB). With windows closed, internal noise levels would be below the recommended internal criterion at all NSR, with respect to noise from the existing Keadby 1 and 2 Power Stations and the Proposed Development combined.
- 9.6.61 It is noted from preliminary consultation with NLC that they 'usually require that operational noise (rating levels) do not exceed the background sound level by more than +3 dB'. This typical requirement is not met by the initial (numerical) outcomes of the BS 4142 indicative predictions, although the further assessment above demonstrates that, with context, the effects are likely to be lower than the initial BS 4142 (numerical) outcomes might suggest.
- 9.6.62 Nevertheless, on the basis of the above and the potential desire to reduce noise levels to the LOAEL (no greater than +5 dB excess of rating level over background sound level) or below, potential mitigation options to reduce sound levels have been considered and are discussed in Section 9.7 (Mitigation and Enhancement Measures).

Decommissioning Noise Effects

- 9.6.63 The potential impacts and effects would require further consideration at the decommissioning stage of the Proposed Development, but potential measures to ensure that appropriate mitigation is in place during such works are detailed in **Section 9.5**.
- 9.6.64 The effects of eventual decommissioning are considered to be comparable to, or less than, those assessed for construction activities and are therefore considered to be not significant for the Main Site or Electrical connections during day-time working. Up to Major adverse (significant) effects may result from the temporary works required to decommission plant and equipment within the Water Connection Corridor during the daytime at NSR 4 – this effect primarily relates to the short distance to the River Water Abstraction option where works may be required. This means there is potential for short term significant effects of Water Connection Corridor decommissioning works, in the absence of mitigation.
- 9.6.65 Decommissioning would require submission of a DEMP to the relevant planning authority for its approval, secured by a Requirement of the draft DCO. Appropriate best practice mitigation measures will be applied during any decommissioning works, as described in section 9.5, and documented in a DEMP; no additional mitigation for decommissioning of the Proposed Development beyond such best practice specified in BS 5228 and section 9.5 mitigation is considered necessary to specify at this stage.

9.7 Mitigation and enhancement measures

Construction

- 9.7.1 This preliminary assessment has identified no more than negligible/ minor adverse (not significant) noise effects at all but one residential NSR (NSR 4) during construction

works during daytime or Saturday morning working hours and up to moderate/ major adverse (significant) noise effects if work were to take place at the same intensity during evenings/ night-time and/or other weekend periods.

- 9.7.2 In the event that construction activities are required during evening/ night-time periods, levels in excess of the SOAEL for night-time could occur at all but NSR 9, (depending on the nature of activities undertaken and intensity of working). This could result in a moderate/ major adverse (significant) noise effect at these NSR in the absence of additional mitigation. Measures would therefore be put in place to control activities during evenings/ night-time so as not to exceed the SOAEL or relevant noise limit at locations to be agreed with NLC. Control of construction noise and vibration is proposed to be secured by a Requirement of the draft DCO.
- 9.7.3 The preferred approach for controlling construction noise and vibration is to reduce levels at source, where reasonably practicable. Sometimes a greater noise or vibration level may be acceptable if the overall construction time, and therefore length of disruption, is reduced.
- 9.7.4 The list of noise control measures presented within Section 9.5 of this chapter provides a detailed but not exhaustive list of construction noise management measures. The measures listed will be implemented and supplemented as necessary with further bespoke measures identified through further detailed assessment as part of the ES which will accompany the DCO Application.
- 9.7.5 Residual effects after mitigation are described in Section 11.9.

Operational Noise

- 9.7.6 The operational assessment has assumed that potential sound of a tonal, impulsive or intermittent nature (according to BS4142: 2014) will be designed out of the Proposed Development during the detailed design phase through the selection of appropriate plant, building cladding, louvres and silencers/ attenuators as necessary. However, a +3 dB correction for distinctive character has been applied to the specific sound levels predicted from the Proposed Development, for NSR with the potential to identify the new sound source in their existing acoustic environment.
- 9.7.7 Based on the worst-case results presented in Table 9.28 and Table 9.29, mitigation would be required to achieve operational sound levels below the SOAEL and LOAEL at the following NSR:
- NSR2, NSR3, NSR4, NSR7, NSR8, NSR9 and NSR10 during the day-time; and
 - NSR2, NSR3, NSR4, NSR5, NSR6, NSR7, NSR8, NSR9 and NSR10 during the night-time.
- 9.7.8 Table 9.30 outlines the overall range of attenuation required to achieve the daytime and night-time LOAEL criterion of rating level no greater than +5 dB above the defined representative background sound level at each NSR, or the NLC potential rating level requirement of no greater than +5 dB above the defined representative background sound level at each NSR.

Table 9.30: Comparison of Ambient Sound Levels

NSR	Attenuation required to achieve LOAEL (daytime) dB $L_{Aeq,T}$	Attenuation required to achieve LOAEL (night-time) dB $L_{Aeq,T}$
1 - Vazon Bridge	-	-
2 - Hawthorne House, Chapel Lane	3-5	2-4
3 - Keadby Village	3-5	5-7
4 - Mariners Arms Flats	2-4	5-7
5 - Trent Side	-	1-3
6 - Queens Crescent	-	2-4
7 - Keadby Grange	7-9	10-12
8 - North Pilfrey Farm	4-6	8-10
9 - Ealand Poultry Farm	1-3	6-8
10 - North Moor Farm	6-8	9-11

9.7.9 In light of the required attenuation to achieve the defined noise criteria, further appraisal by plant engineers will be undertaken and the result will be reported in the ES. The assessment will focus on the attenuation options for the modelled sources that make the largest contribution to the specific sound level, and therefore require mitigation to meet the LOAEL. These include, but may not be limited to, the:

- CCP compressor;
- CCP absorber; and
- gas turbine intake.

9.7.10 In addition, other potential mitigation measures and general principals may include, but not be limited to, the following depending upon potential benefits achieved from such measures:

- reducing the breakout noise from plant through use of enhanced enclosures, or potentially containing them within a building;
- reducing air inlet noise emissions by addition of further in-line attenuation;
- reducing stack outlet noise emissions by addition of silencers or sound proofing panels;
- reducing fin fan cooler noise emissions by screening, re-sizing, fitting low noise fans or attenuation;
- screening or enclosing the transformers or other equipment;
- use of screening or bunding to shield receptors from noise sources; or
- orientation of plant within the Site to provide screening of low-level noise sources by other buildings and structures, or orientating fans and the air inlets away from sensitive receptors.

- 9.7.11 For the purposes of this assessment, the CCP compressor and absorber have been assumed to produce a sound level (A-weighted) of 85 dB at 1 m external to the building, although clarifications may confirm that sound emissions from the absorber are significantly less. This would be taken into account in the EIA. The CCP plant will require additional mitigation to reduce sound levels towards the LOAEL.
- 9.7.12 Residual effects after mitigation are described in Section 11.9 and are not considered to be significant if noise levels are reduced to the LOAEL (no greater than +5 dB excess of rating level over the background sound level).

9.8 Limitations or difficulties

Baseline Sound Surveys

- 9.8.1 The COVID-19 outbreak presents challenges in obtaining representative baseline sound levels because typical road, air and rail transport usage have been reduced by travel restrictions and social distancing measures. Other sound sources may also be affected – for example, due to changes in operating patterns at industrial and commercial premises. Therefore, sound level data from the 2015 and 2016 sound surveys undertaken as part of the Keadby 2 Power Station ES has been used to inform the assessments in this chapter.
- 9.8.2 It is considered that this data is likely to still be representative of the current noise climate at the monitoring locations for which data are available, with any new surveys for the ES unlikely to yield significantly different background and ambient levels to those reported in this chapter. However, additional baseline measurements would help confirm assumptions regarding baseline used from the Keadby 2 Power Station ES for NSRs not assessed in the Keadby 2 Power Station ES.

Construction

- 9.8.3 Detailed construction information is not yet available (given that the construction contractor has not yet been appointed) and therefore this assessment draws upon the experience and assessments undertaken for other similar projects.
- 9.8.4 The assessment is quantitative, but indicative, although it is considered to be reasonable. However, construction noise thresholds (limit values) are based upon existing ambient sound levels at NSR. Further assessment has been identified as being required pre-construction, to ensure that appropriate mitigation measures are developed to achieve the ABC threshold noise values once the contractor is appointed. This and other mitigation measures detailed in Section 9.5 and Section 9.7 will be included in the CEMP to minimise construction noise and vibration effects.

Operation

- 9.8.5 Assumptions made during the noise modelling and assessment of the Proposed Development are as presented in **Appendix 9B: Operational Noise Information** (PEI Report Volume II). It is considered that the assumptions made result in the assessment being conservative.
- 9.8.6 Sound emission data for key sound emitting plant/ buildings within the Proposed Development (including turbine halls, Heat Recovery Steam Generator (HRSG),

peaking plant) have been taken from the Keadby 2 Power Station ES data. Detailed cladding specifications for the Keadby 2 Power Station buildings have been predicted by modelling the Keadby 2 Power Station in-situ, and making adjustments to the sound source data for different plant items (to represent the potential sound reduction provided by building cladding) until the predicted sound levels at nearby NSR was in line with those reported in the Keadby 2 Power Station ES.

- 9.8.7 Sound level data for the CCP plant has been taken from the Karsto CCS project or has been assumed to be a sound pressure level of 85dB(A) at 1m external to the CCP buildings/plant out shells for the compressor and absorber. A sound intensity level of 66 dB(A) a 1m from the absorber shell is referenced in the Karsto report, but due to some uncertainties about this value, a conservative assumption has been made that the sound pressure level at 1m from the absorber shell is 85dB(A). Further clarifications will be sought and included within the EIA. Values used for the hybrid cooling were for an already mitigated option with low noise fans, fan silencers and acoustic attenuators on air intakes leading to significantly lower sound power.
- 9.8.8 The preferred configuration of the Proposed Development is yet to be decided. Therefore, the operational noise modelling undertaken has considered a representative worst-case, assessing both unmitigated and mitigated scenarios. Given the requirement for additional mitigation measures, further assessment will be undertaken prior to submission of the ES and again at the detailed design stage, to control noise emissions in order to meet the appropriate noise limits to be included in the DCO at nearby NSR.
- 9.8.9 With respect to deriving representative background sound levels for use in the BS4142 assessment, consideration should be given to wind direction in order to accord with the predicted operational sound levels derived from ISO 9613 method, which assumes gentle downwind conditions. The predicted levels presented in this assessment will only actually be experienced at each NSR when it is downwind of the Proposed PCC Site. Consequently, it is appropriate to compare these predicted levels with background sound levels measured in similar conditions.
- 9.8.10 There is no reliable method of predicting upwind propagation as there are too many variables. However, the upwind sound levels from an individual sound source will generally be 10-15 dB lower than the downwind sound levels. The difference between the upwind and downwind background sound levels at the receptors was smaller than this (at 1-5 dB) as they have contributions from sources located all around them. So, the potential impact of the Proposed Development would be at its greatest in downwind conditions. This will be considered further in the finalisation of this assessment.

9.9 Summary of Likely Significant Residual Effects

- 9.9.1 A summary of the likely significant residual effects, assuming the implementation of appropriate mitigation to reduce noise and vibration during construction, operation and decommissioning phases, is presented in Table 9.31 below.

Table 9.31: Summary of Likely Significant Residual Effects

Development stage	Predicted Impact	Classification of effect prior to mitigation	Mitigation/ enhancement (if identified)	Residual effect	Nature of effect(s) (Lt/ Mt/ St and P/ T and D/ In)
Construction	Noise effects on residential NSR during construction on the Main Site and Electrical Connection to 132kv Substation Option and Water Connection Corridor (daytime) – except NSR4 (see below)	Negligible/ Minor adverse (not significant)	Not required	Negligible/ Minor adverse on the basis that BS 5228 and section 9.5 mitigation guidance is followed. (not significant)	St, T, D
	Noise and vibration effects on residential NSR4 group receptor during construction on Water Connection Corridor (daytime and night-time) – if Option selected	Up to Major adverse (significant)	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Minor adverse (not significant)	St, T, D
	Noise effects on residential NSR during construction on the Main Site and Electrical Connection to 132kv Substation Option (evening/ night-time)	Negligible adverse (not significant) to Major adverse (significant)	Further detailed assessment and CEMP once contractor appointed, particularly regarding working outside of daytime working hours.	Minor adverse (not significant)	St, T, D
Construction	Noise effects due to construction traffic	Negligible adverse (not significant)	Not required	Negligible adverse (not significant)	St, T, D
Construction	Vibration effects on sensitive receptors from works in Main Site (humans and buildings)	Negligible adverse (not significant)	Not required	Negligible adverse (not significant)	St, T, D
Construction	Noise and vibration effects on ecological receptors within River Trent	Negligible/ Minor adverse or less (not significant)	Agreement of appropriate sensitive timings for any cofferdam installation and	Negligible/ Minor adverse or less	St, T, D

Development stage	Predicted Impact	Classification of effect prior to mitigation	Mitigation/ enhancement (if identified)	Residual effect	Nature of effect(s) (Lt/ Mt/ St and P/ T and D/ In)
			removal taking into account potential for migrating river and sea lamprey and other fish. Provision of a Fish Management Plan to support the relevant permitting for these works.		
Operation	Operational effects on residential NSR	Minor adverse (not significant) to Major adverse (significant).	Application of practical sound mitigation to reduce relevant noise at source (CCP compressor, CCP absorber and gas turbine intake) Further assessment of these scenarios in the ES.	Negligible/ minor adverse (not significant)	Lt, P, D
Decommissioning	Noise effects during daytime decommissioning of the Main Site/ Electrical connections and Water Connection Corridor (except NSR4)	Negligible/ Minor adverse	Not required	Negligible/ Minor adverse	St, T, D
Decommissioning	Noise effects during decommissioning of the Water Connection Corridor (if River Water Abstraction Option selected)	Up to Major adverse (NSR4) (significant)	As this effect is primarily related to the distance between this NSR and the works, no additional mitigation for decommissioning of the Proposed Development is considered necessary to specify at this stage.	Minor adverse on the basis that BS 5228 and section 9.5 mitigation guidance is followed	St, T, D

Note: Lt = long term, Mt = medium term, St = short term, P = permanent, T = temporary, D = direct and In = indirect.

9.10 References

- Bechtel Overseas Corporation (2019) CO₂ Capture Facility at Karsto, Norway FEED Study report
- British Standards Institute (1991) BS 7445-2 – Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use
- British Standards Institute (1993) BS 7385-2 – Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration
- British Standards Institute (2003) BS 7445-1 – Description and measurement of environmental noise. Guide to quantities and procedures
- British Standards Institute (2008) BS 6472-1 – Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting
- British Standards Institute (2014a) BS 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 1: Noise
- British Standards Institute (2014b) BS 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration
- British Standards Institute (2014c) BS 4142+A1:2019 – Methods for rating and assessing industrial and commercial sound
- Department of Energy and Climate Change (2011a) Overarching National Policy Statement for Energy EN-1
- Department for Energy and Climate Change (2011b)
- Department for Environment, Food and Rural Affairs (2010) Noise Policy Statement for England (NPSE)
- Department of Transport/ Welsh Office (1988) Calculation of Road Traffic Noise (CRTN)
- Environment Agency (2002a) Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 2 - Noise assessment and Control
- Environment Agency (2002b) Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 1 – Regulation and Permitting
- Environmental Resources Management (2018) Keadby 2 Environmental Statement Chapter 8 – Noise
- Environmental Resources Management (2018) Keadby 2 Environmental Statement Annex-F
- Highways Agency (2020) Design Manual for Road and Bridges LA111 (Revision 2) Noise and Vibration
- International Organization for Standardization (1996) ISO 9613 Acoustics - Attenuation of sound during propagation outdoors.

International Organization for Standardization (2010) ISO 4866: 2010 Mechanical vibration and shock - Vibration of fixed structures - Guidelines for the measurement of vibrations and evaluation of their effects on structures

Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework

Ministry of Housing, Communities and Local Government (2019) Planning Practice Guidance

Planning Inspectorate (2017) *Planning Inspectorate Advice Note Seven (Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping)*. Version 7 May 2020