

Havant Thicket Reservoir Project

Environmental Statement Volume 2 - Main Report **Revised** Chapter 12 Noise and Vibration

Portsmouth Water Ltd.

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Document history

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Contents

Chapter	Page
12. Noise and Vibration	5
Competent expert evidence	5
Legislative and policy framework	6
Study area	8
Assessment methodology	8
Assessment assumptions and limitations	15
Baseline conditions including value/sensitivity of resources and receptors	16
Potential impacts	20
Design, mitigation and enhancement measures	31
Assessment of effects	35
Noise Monitoring	38
Summary	39

Tables

Table 12-1 - Summary of legislation and policy	6
Table 12-2 - Threshold of significant effects at dwellings	9
Table 12-3 - Guidance on effects of vibration levels	10
Table 12-4 - Transient vibration guide values for cosmetic damage	10
Table 12-5 - Classification of magnitude of noise impacts from road traffic	11
Table 12-6 - Perceptibility and significance relation to impact magnitude	11
Table 12-7 - Pipeline assessment sections	13
Table 12-8 - Arup short term baseline noise measurements (2008) – daytime only	17
Table 12-9 - Arup long term baseline noise measurements (2008)	17
Table 12-10 - SP1 - High Lawn Way Noise Measurements	18
Table 12-11 - SP2 - Purbrook Way Noise Measurements	18
Table 12-12 - SP3 - 93 Barncroft Way Noise Measurements	18
Table 12-13 – SP4 – Bidbury Preschool Noise Measurements	19
Table 12-14 - Baseline noise levels	20
Table 12-15 - Assessment receptors	20
Table 12-16 - Thresholds of potential impacts	21
Table 12-17 - Calculated noise levels	21
Table 12-18 - Noise impacts around pipeline corridor	22
Table 12-19 - Trenchless construction – sensitive receptors affected by daytime works	24
Table 12-20 - Trenchless construction – sensitive receptors affected by night-time works	24
Table 12-21 - Open trench construction and above ground works – sensitive receptors affected by daytime works	25
Table 12-22 – Culvert works, Bedhampton building modification works and Plant installation – sensitive receptors affected by daytime works	25
Table 12-23 – Sensitive receptors affected by construction vibration	27
Table 12-24 – BS 4142 assessment of equipment noise at Bedhampton Compound	30
Table 12-25 – BS 4142 assessment of equipment noise at Bedhampton Compound	31
Table 12-26 - Location of temporary noise barriers	33

Figures

Figure 12-1 – Sensitive receptors around Bedhampton Compound (indicative boundary shown in blue) 30

12. Noise and Vibration

- 12.1. This chapter forms part of a revision to the original Havant Thicket Reservoir Environmental Statement (ES) which accompanied the Havant Thicket Reservoir hybrid planning application and outline planning application for the associated pipeline, between the reservoir and Bedhampton springs and pumping station, approved on 15th October 2021 (Approved Scheme).
- 12.2. A new pipeline route and design have been identified, which needs a new planning approval. A new full planning application has been prepared for the revised pipeline route supported by the revision to the original ES (2020 ES).
- 12.3. Chapters 1 to 6 provide more information on the context for this addendum, the revised scheme description, the need for the scheme (which hasn't changed) and the alternatives, the methodology and the consultation undertaken.
- 12.4. To make it easier for the reader, this chapter still includes the noise and vibration assessment of the reservoir but also includes the new or updated baseline, impact assessment and mitigation for the dual pipeline. The changes from the original ES Chapter are shown in this green text.

Changes to the Approved Scheme

- 12.5. Following planning permission in 2021, further design work and extensive ground investigations have been undertaken which has resulted in changes to the reservoir scheme including a reduction in the reservoir embankment slope angle and relocation of the valve tower from inside the main embankment into the reservoir. The height of the embankment crest level would not change from the 2020 ES, but the position of the embankment crest would move up to 100m to the north.
- 12.6. An application to amend the reservoir scheme was submitted in April 2024 under Section 73 (S73) of the Planning Act 1990. An ES Addendum was prepared to support the S73 application to present an assessment of any new or different significant effects that could result from these changes. The ES Addendum has been considered within this Revised ES and also forms part of the Revised ES submitted alongside the new pipeline application.
- 12.7. The ES Addendum Noise and Vibration relating to these changes has been reviewed and the findings are incorporated within this revised chapter.

Competent expert evidence

- 12.8. This chapter of the ES Volume 2, Chapter 12 Noise and Vibration, has been prepared by the following individuals who have used their knowledge and professional judgement to undertake this assessment:
 - An Acoustician (MSc in Mechatronics and Acoustic Engineering and a Member of the Institute of Acoustics (IOA)), with 10 years' experience in acoustics and noise control;
 - An Acoustician (BSc (Hons) in Music Systems Engineering and a Member the Institute of Acoustics (IOA)), with 10 years' experience of environmental acoustic assessment;
 - An Associate (BEng (Hons) in Acoustics, CEng through the IOA, and is a Fellow of the IOA) with over 25 years' experience of environmental acoustic assessment;
 - A Practice Manager (BEng (Hons) in Civil and Structural Engineering, Diploma in Acoustics & Noise Control, PhD in 'Road Traffic Noise Barrier Design: Measurements and Models Concerning Multiple-Walls and Augmented Earth Mounds' and is a Member of the IOA) with over 20 years' experience in environmental acoustic assessment;
 - An Associate (BSc (Hons) in Audio Technology, MSc in Acoustics and Noise Control and is a Member of the IOA) with over 20 years' experience of environmental acoustic assessment; and
 - An Associate (MEng Mechanical Engineering (Sound & Vibration), MSc in Sound & Vibration and is a Member of the IOA) with over 20 years' experience of environmental acoustic assessment.

Legislative and policy framework

12.9. The following legislation and policies govern the assessment of noise and vibration and have been consulted in preparing this chapter, with the relevant sections summarised in Table 12-1 below.

Table 12-1 - Summary of legislation and policy

Legislation/ Regulation/ Policy	Summary of requirements
National	
National Planning Policy Framework (NPPF, 2023)	The National Planning Policy Framework (NPPF) 2023 includes statements relating to noise and the requirement to take it into account in the planning process. Section 174 indicates that the planning system should contribute to and enhance the natural and local environment: <i>‘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;’</i> Section 185 is specifically related to noise, requiring planning policy decisions to: - mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life; - identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.
Noise Policy Statement for England (2010)	Published in March 2010, the Noise Policy Statement for England (NPSE) sets out the Government’s guiding principles and noise policy aims. <i>“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:</i> <i>Avoid significant adverse impacts on health and quality of life.</i> <i>Mitigate and minimise adverse impacts on health and quality of life.</i> <i>Where possible, contribute to the improvement of health and quality of life.”</i> The NPSE uses two established concepts from toxicology currently applied to noise impacts, which are as follows: - No Observed Effect Level (NOEL) - the level below which there is no detectable effect on health and quality of life due to the noise. - Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected. The NPSE extends these to the concept of a Significant Observed Adverse Effect Level (SOAEL): - SOAEL - The level above which significant adverse effects on health and quality of life occur. The Government’s Planning Practice Guidance (Noise PPG) 2019 on noise provides guidance on the effects of noise exposure. The Noise

Legislation/ Regulation/ Policy	Summary of requirements
	PPG sets out that peoples' sensitivity to noise is proportional to the level of noise they are already exposed to. The PPG sets out the context of NOEL and, as exposure increases, LOAEL and SOAEL. These are described in the PPG as follows: <u>LOAEL Definition</u> <i>"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."</i> <u>SOAEL Definition</u> <i>"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."</i> The NPSE notes that it is not possible to implement a single noise threshold that defines SOAEL that is applicable to all sources of noise in all situations. The application of the SOAEL threshold should be specific to the noise source being considered, taking account of different sources of exposure, receptor sensitivity and context. The first aim of the NPSE, which is to avoid significant adverse effects on health and quality of life, states that: <i>"...significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development..."</i> The second aim of the NPSE, which is to mitigate and minimise adverse impacts on health and quality of life, refers to the situation where such impacts lie somewhere between LOAEL and SOAEL: <i>"...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into account the guiding principles of sustainable development...This does not mean that such adverse effects cannot occur."</i>
The Environmental Noise (England) Regulations 2006 (as amended)	These regulations implement the European Commission Directive 2002/49/EC, which requires strategic noise maps and noise action plans to be produced for all sources of environmental noise every five years, including that from road traffic using major roads. England's Noise Action Plans, published by Defra, have identified 'Important Areas' at which measures to address environmental noise must be investigated, and those 'Important Areas with First Priority Locations' to be investigated as a priority.
The Control of Pollution Act 1974	The Control of Pollution Act 1974 sets out the framework for the legislative control of construction noise and vibration on any given site. It also sets out the principle of 'best practicable means' (as defined in Section 72 of the Act) and how that should be applied to construction activity noise. The Act refers to approved Codes of Practice, which

Legislation/ Regulation/ Policy	Summary of requirements
	include BS 5228 Part 1 and Part 2, as being relevant for the purposes of determining the 'best practicable means'. Section 61 of the Act states that construction works may require consent from the relevant local authorities prior to the construction works commencing. If this is required, the relevant local authorities will need to be provided with information about the proposed construction works and how construction noise will be managed, including the use of 'best practicable means'.

Study area

Construction

- 12.10. Annex F of BS 5228 Part 1 states that:

"At distances over 300 m noise predictions have to be treated with caution, especially where a soft ground correction factor has been applied, because of the increasing importance of meteorological effects."

- 12.11. Based on this, the assessment of construction impacts uses a study area of 300 m around construction works. Construction traffic impacts have been assessed using the same study area as for the operational traffic assessment.

Operation

- 12.12. Traffic flows have been provided by the traffic team and the roads included in the traffic model cover a large proportion of Havant. All of the traffic network identified within the traffic model provided has been assessed.
- 12.13. Following the advice in the Design Manual for Roads and Bridges LA 111 (DMRB LA 111) for changes in traffic on existing road networks, where a road is identified as having an impact of at least 1 dB LA_{10,18h} in relation to the Scheme, counts of receptors within 50 m are undertaken. The study area for traffic noise assessments is a distance of 50 m from the roads considered in the traffic model.
- 12.14. This is considered appropriate for this assessment as the area is suburban and impacts would be limited to receptors adjacent to the road. Receptors further back from the road would be expected to benefit from a certain degree of screening from existing buildings.
- 12.15. Figure 13.1 Key highway links in ES Volume 3 shows the extents of the traffic model.

Assessment methodology

Standards and guidelines

- 12.16. BS 5228 provides guidance on the prediction and assessment of construction noise and vibration. Calculation of Road Traffic Noise (CRTN) and the DMRB [LA111](#) provide guidance on the prediction and assessment of road traffic noise, used for both construction traffic and operational traffic. [BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature.](#)

[BS 5228, \(2009\) + A1 \(2014\): Code of practice for noise and vibration control on construction and open sites Part 1: Noise](#)

- 12.17. BS 5228 Part 1 provides guidance on the prediction and assessment of construction noise. Calculation procedures are set out in Annex F of BS 5228 Part 1 for predicting the likely noise levels from specific construction activities at receptors, [considering](#) distance, ground absorption, screening, reflections and the percentage on-time for an activity. Annexes C and D Annex F of BS 5228 Part 1 provide generic noise data for various items of plant which can be used for undertaking predictions where no specific information is available.

- 12.18. Annex E of BS 5228 Part 1 sets out the need for a pragmatic approach to be taken when assessing the noise effects of a construction project. It goes on to describe example methods for identifying the likely significance of noise levels from construction activity based on a combination of fixed noise thresholds and noise change criteria.
- 12.19. For this assessment, the significance of noise changes on human receptors has been assessed using the ABC Method described in Table E.1 of Annex F of BS 5228 Part 1, using the associated levels of significance shown in Table 12-2.
- 12.20. For this assessment, it is assumed that non-residential noise sensitive buildings have the same sensitivity to noise and vibration as residential buildings.

Table 12-2 - Threshold of significant effects at dwellings

Assessment category and threshold value period	Threshold value, in decibels ($L_{Aeq,T}$ dB)		
	Category A ^{A)}	Category B ^{B)}	Category C ^{C)}
Night (23:00 – 07:00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07:00 – 19:00) and Saturday (07:00 – 13:00)	65	70	75

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 Applied 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 and 07.00–23.00 Sundays.

- 12.21. For the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB.
- 12.22. Table 12-2 is used to determine a threshold category which signifies the total site noise level in L_{Aeq} which should not be exceeded for the appropriate period. If the site noise level exceeds the appropriate category, then a potential significant effect is indicated, depending on the context, such as duration of works.
- 12.23. For there to be significant effects, noise levels must exceed, or be predicted to exceed, the relevant threshold for a period of 10 or more days of working in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months.
- 12.24. Section E.4 and Table E.2 of the BS 5228 standard goes on to provide example time periods and noise trigger levels at which additional noise insulation, should be offered, where it is applied for by the owners or occupiers of a permanent dwelling. For construction works between 08:00 and 18:00 on weekdays and between 08:00 and 13:00 on Saturdays, the threshold is the higher level of either:
- 5 dB above the pre-existing ambient level; or
 - 75 dB L_{Aeq}
- 12.25. Section E.4 of the BS 5228 standard also provides example time periods and noise trigger levels at which temporary rehousing, should be offered, where it is applied for by the owners or occupiers of a permanent dwelling. For construction works between 08:00 and 18:00 on weekdays and between 08:00 and 13:00 on Saturdays, the threshold is the higher level of either:
- 10 dB above the pre-existing ambient level; or
 - 85 dB L_{Aeq}
- 12.26. For both noise insulation and temporary rehousing, noise levels must exceed, or be predicted to exceed, the relevant threshold for a period of 10 or more days of working in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months.

BS 5228, Part 2 (2009) + A1 (2014): Code of practice for noise and vibration control on construction and open sites Part 2: Vibration

- 12.27. BS 5228 Part 2 provides guidance on vibration levels that could be used to assess the likely impacts of construction activities, including compaction and tunnelling, on the environment and people. The main vibration impacts could arise from these activities or heavy construction vehicle movements near sensitive receivers (typically within 20 m). Annex B of BS 5228 Part 2 gives guidance on the significance of vibration effects in terms of human response to vibration (shown in Table 12-3) and structural response to vibration (shown in Table 12-4).

Table 12-3 - Guidance on effects of vibration levels

Vibration level	Effect
0.14 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
0.3 mm/s	Vibration might be just perceptible in residential environments
1.0 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
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Table 12-4 - Transient vibration guide values for cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pules	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures	50 mm/s at 4Hz and above	50 mm/s at 4Hz and above
Industrial and heavy commercial buildings		
Unreinforced or light framed structures	15 mm/s at 4Hz increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz increasing to 50 mm/s at 40Hz and above
Residential or light commercial buildings		

Calculation of Road Traffic Noise (1988)

- 12.28. The Calculation of Road Traffic Noise (CRTN) is a technical memorandum that describes procedures for road traffic noise measurements and calculations using the [LA10,18 hr](#) noise index. CRTN is suitable for environmental assessments of schemes where road traffic noise may have an impact.
- 12.29. Using the prediction methodology detailed in CRTN, the Basic Noise Level (BNL) can be calculated for an 18-hour period (06:00 to 00:00) at 10 m from the kerb of a road link using the following information:
- Annual Average Weekly Traffic flow (18-hour traffic flows);
 - Average traffic speed; and
 - Traffic composition, namely the proportion of heavy goods vehicles comprising the traffic flow.
- 12.30. The Basic Noise Level is then corrected for road gradient, road surface, distance to the noise sensitive receptors, angle of view, reflections and the presence of screening, to arrive at a final noise level for each noise sensitive receptor of interest.

Design Manual for Roads and Bridges (DMRB LA 111)

- 12.31. Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration Revision 2 (referred to as **DMRB LA 111** throughout) provides guidance on the environmental assessment of noise and vibration impacts from road schemes. It contains advice and information on assessing both construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing noise and vibration impacts.
- 12.32. The assessment of operational noise impacts follows the DMRB LA 111 approach focussing on changes in noise on the road network within the study area. The level of detail included is proportionate to the information available.
- 12.33. DMRB LA 111 gives the descriptions for different changes in noise level and provides the following classifications for the magnitude of noise impacts as set out in Table 12-5.

Table 12-5 - Classification of magnitude of noise impacts from road traffic

Change, $L_{A10,18h}$	Magnitude of impact (Short Term)	Magnitude of impact (Long Term)
0	No change	No change
0.1 - 0.9	Negligible	Negligible
1 - 2.9	Minor	Negligible
3 - 4.9	Moderate	Minor
5 - 9.9	Major	Moderate
10 +	Major	Major

- 12.34. From this classification 'minor', 'moderate' and 'major' changes in noise are perceptible, whereas 'negligible' changes are not perceptible.

Significance of change in noise level

- 12.35. Changes in noise level classed as significant are based on the assessment scale from DMRB LA 111 shown in Table 12-5 and expanded on in Table 12-6, to show the classification of perceptibility and significance. For this assessment, both short-term and long-term changes in noise that are 'moderate' or 'major' are regarded as significant.

Table 12-6 - Perceptibility and significance relation to impact magnitude

Magnitude of impact	Perceptibility and Significance
No change	Not perceptible and not significant
Negligible	Not perceptible and not significant
Minor	Perceptible but likely not significant
Moderate	Perceptible and likely significant
Major	Perceptible and significant

BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

- 12.36. BS 4142:2014+A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.
- 12.37. The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed new or modified sound sources; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of sound amounting to a nuisance is beyond the scope of the standard.

- 12.38. The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level ($L_{A90,T}$) and the context in which the sound occurs.
- 12.39. The reference time interval for the specific sound source 'T_r' is 60 minutes during the daytime and 15 minutes during the night. The reduced reference time at night reflects the increased sensitivity to sound during this period. The relevant time periods for daytime and night-time are as follows:
- Daytime – 07:00 to 23:00 hours; and
 - Night-time – 23:00 to 07:00 hours.
- 12.40. The assessment method considers the characteristics of the sound, such as tonality, impulsivity, and intermittency. Corrections are applied to the specific sound source to account for these characteristics in order to obtain the rating level; the corrections account for acoustic features which have the potential to increase disturbances.
- 12.41. An initial estimate of the impact of the sound source is obtained by subtracting the measured background sound level from the rating level and considering the following:
- Typically, the greater this difference, the greater the magnitude of the 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; and
 - The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source 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.
- 12.42. Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, the standard adds a character correction to the specific sound level to obtain the rating level. Character corrections can be included for tonality, impulsivity, other sound characteristics that make it “readily distinctive”, and intermittency.
- 12.43. Where the initial estimate of impact needs to be modified due to the context, then the following additional factors should also be taken into consideration:
- The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low. Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background;
 - The character and level of the residual sound compared to the character and level of the specific sound; and
 - The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

Construction noise

- 12.44. A methodology for construction noise assessment is provided by BS 5228 Part 1. This standard gives recommendations for basic methods of noise control relating to construction and open sites and gives guidance concerning methods of predicting and measuring noise and assessing its impact. The standard also provides a database of measured noise levels from typical construction plant items - annexes C and D provide generic source noise data for various items of plant used on open sites which can be used in prediction.
- 12.45. A full list of plant and associated noise levels used in the calculations are provided in Appendix A12 in ES Volume 4.

Reservoir site

- 12.46. The construction noise assessment for the reservoir has been undertaken using NoiseMap 5 modelling software which implements the calculations as defined in BS 5228 Part 1.
- 12.47. For the main reservoir site, including the access roads, results have been calculated for sample receptors within the study area. These receptors all face towards the reservoir site and therefore represent a worst case as they do not benefit from any screening from other buildings.
- 12.48. The construction programme is split into quarters for each year, covering the following months:
- Q1 – January, February and March;
 - Q2 – April, May and June;
 - Q3 – July, August and September; and
 - Q4 – October, November and December.
- 12.49. Under normal conditions, night-time works are not proposed for the reservoir site. However, in some very exceptional circumstances, there is potential for night-time working. Where the impacts of noise and vibration cannot be effectively mitigated, night-time working will not be carried out on the reservoir site.
- 12.50. The assessment of night-time impacts is therefore presented for completeness, although it is noted that these impacts are not expected under normal conditions.

Pipeline corridor

- 12.51. For the assessment of construction noise related to the pipeline corridor, noise levels have been calculated for each activity based on data within Annex C of BS 5228 Part 1 or data provided by the contractor with estimated percentage on-times. This noise level has then been used to determine the distance within which noise levels would be above the threshold for potential significant effects in the daytime and, where applicable, night-time.
- 12.52. The installation of the pipeline uses **three** construction methods; trenchless, **open cut trenches and above ground pipe laying**. These methods have been assessed separately.
- 12.53. The pipeline corridor has been split into segments for assessment as detailed in Table 12-7.

Table 12-7 - Pipeline assessment sections

Pipeline section	Construction method	British National Grid Co-ordinates	
		Start	End
Bedhampton (P0)	Above ground pipelaying and open cut trench	470502.1, 106269.8 (Bedhampton 2)	470679.5, 106471.0 (Shaft 1)
Section P1	Trenchless	470679.5, 106471.0 (Shaft 1)	470718.4, 106883.6 (Shaft 2)
Section P2	Open cut trench	470718.4, 106883.6 (Shaft 2)	470858.2, 107169.3 (Shaft 3)
Section P3	Trenchless	470858.2, 107169.3 (Shaft 3)	471120.6, 107336.0 (Shaft 4)
Section P4	Trenchless	471120.6, 107336.0 (Shaft 4)	471018.4, 107549.2 (Shaft ED)
Section P5	Trenchless	471018.4, 107549.2 (Shaft ED)	471204.0, 107792.8 (Shaft 5)
Section P6	Trenchless	471204.0, 107792.8 (Shaft 5)	471278.4, 108162.3 (Shaft 6)
Section P7	Trenchless	471278.4, 108162.3 (Shaft 6)	471597.5, 108298.0 (Shaft 7)

Pipeline section	Construction method	British National Grid Co-ordinates	
		Start	End
Section P8	Trenchless	471597.5, 108298.0 (Shaft 7)	471804.2, 108722.4 (Shaft 8)
Section P9	Open cut trench	471804.2, 108722.4 (Shaft 8)	471440.2, 109096.6 (the contractual boundary interface)
Section P10 Reservoir Pipeline – Fill	Open cut trench	471440.2, 109096.6 (the contractual boundary interface)	471390.7, 109955.4 (reservoir)

- 12.54. Typically works would be undertaken during daytime hours; however, the tunnelling works underneath the railway track, north of Shaft 1, may need to be undertaken 24 hours a day. The noise impact of the under track crossing would be perceived at Shaft 2, the launch shaft for the under track crossing. The night-time impacts will be short term in nature and is limited to a maximum of 7 days for each pass of tunnel boring machine.
- 12.55. A generator to operate dewatering pump could be operational at each of the worksite throughout the day.
- 12.56. No night-time works, other than the under track crossing and 24/7 operational of a generator/ dewatering pump, are planned during the pipeline construction. However, during rare occasions, stopping tunnelling work at the end of the day shift may not be possible due to geological conditions and various unfavourable tunnelling parameters. During such scenarios, the tunnelling works will be continued until a favourable situation is encountered to stop the tunnelling works. The noise sources for such works would be the support equipment located at the launch shaft.

Construction vibration

- 12.57. BS 5228 Part 2 provides guidance for assessing the impacts of any types of construction vibration at nearby properties, including methods for measuring vibration and how to assess its effects on people and the environment. The main vibration impacts are likely to arise from piling activities, compaction, tunnelling operations or heavy vehicle construction movements near properties. BS 5228 Part 2 Annex E gives empirical formulae for the prediction of the resultant peak particle velocity (PPV) vibration levels in mm/s for various activities. The formulae found in Annex E can be used to estimate the vibration levels when detailed information about the construction method is known.
- 12.58. Based on the information available, the construction works that have potential to cause perceptible vibration at receptors are:
- Earth Compaction – at the reservoir site;
 - Earth Compaction – along the open cut trench sections of the pipeline and shaft backfilling;
 - Piling – at the emergency discharge and culvert location; and
 - Tunnelling sections of the pipeline.
- 12.59. As these works are only proposed to be of short duration within close proximity to sensitive receptors, and from previous project experience, it is considered that vibration levels of up to PPV of 3 mm/s would be acceptable provided advance notice is given to residents.
- 12.60. The assessment calculates the distance within which PPV levels would have a 33.3% probability of exceeding 3.0 mm/s for each section of pipeline. The number of sensitive receptors within this distance is then reported.

Operational noise

- 12.61. Since the pipeline is underground, it has been assumed that there would be no operational noise impacts from the pipeline once it is operational. However, additional mechanical and electrical plant installed within the Bedhampton compound has potential to cause operational noise impacts at nearby noise sensitive receptors.

- 12.62. Noise from these plant are industrial in nature; therefore, impacts will be assessed based on the methodology within the BS 4142 Standard. Rating levels of the noise sources at a noise sensitive receptor will be compared with the background noise to determine the significance.
- 12.63. It has been assumed that, once complete, there would be no noise generated by the reservoir itself. On this basis operational noise from the Scheme has been scoped out from further assessment except from an assessment of changes in road traffic noise from vehicles accessing the reservoir site.
- 12.64. Assessment of noise from traffic movements during the construction and operational phases has been undertaken using traffic flows and percentage of heavy duty vehicles as provided by the traffic assessment. Speeds have been derived using the road classification according to CRTN.
- 12.65. BNLs have been calculated for each road link and then comparisons between scenarios have been made to determine the noise impact. Impacts are then classified as per Table 12-5.
- 12.66. The scenarios considered are:
- 2023 Base (i.e. traffic without the Scheme);
 - Construction;
 - 2029 Base (i.e. traffic without the Scheme); and
 - 2029 Operational.
- 12.67. The following comparisons between these scenarios have been made:
- 2023 Base to 2029 Base – to determine the impact of traffic growth without the Scheme;
 - 2023 Base to Construction – to determine the impact of construction traffic;
 - 2023 Base to 2029 Operational – to determine the combined impact of traffic growth and the operation of the Scheme; and
 - 2029 Base to 2029 Operational – to determine the impact of the operation of the Scheme alone.
- 12.68. Impacts would be negligible where changes in noise are predicted to be below 1 dB $L_{A10,18h}$ between scenarios.

Assessment assumptions and limitations

- 12.69. For the construction noise assessment, a plant list has been obtained and agreed with project engineers. The appropriate plant noise levels selected from tables in BS 5228 Part 1 Annex C or where representative plant data is not available in the standard, data from manufacturer's plant specification has been used.
- 12.70. For each period of the construction noise assessment, it is assumed that all plant would be operating simultaneously. The calculations do not include the effects of any site hoardings or acoustic screens that may be erected during the works. Based on these, this assessment can be considered as a worst case.
- 12.71. The traffic assessments are based on the traffic data provided by the transport assessment team.
- 12.72. It has been assumed that the propagation of sound is over hard ground, meaning that there is no absorption of sound into the ground.
- 12.73. The empirical equations provided in the BS5228-2 for the assessment of vibration noise are based on large tunnel boring machines which is not applicable for the micro tunnel boring machine being assessed in this project. Therefore, the assessment of the micro-tunnel boring machine is undertaken based on data available in literature, research papers, and professional judgement.
- 12.74. Vibration assessment for tunnelling activity is based on horizontal distance between the pipeline alignment and the receptor location. The depth of the pipeline is not considered for the impact prediction.
- 12.75. The vibration assessment within this document does not include assessment of potential risk of ground settlement.

Baseline conditions including value/sensitivity of resources and receptors

- 12.76. The baseline conditions in proximity to the reservoir were determined using baseline noise survey data collected by Arup during 2008 as part of an initial assessment for the Scheme. In the EIA Scoping Addendum (HTR-ATK-ZZ-ZZ-RP-Z-0001), Atkins had proposed undertaking further noise surveys to update the data obtained by Arup, however, due to the outbreak of COVID-19 in the UK and subsequent lockdown measures implemented, it has not been possible to undertake representative noise measurements during 2020 when the Environmental Statement was prepared. This is because of atypical conditions characterised by decreased traffic movements.
- 12.77. The Institute of Acoustics and Association of Noise Consultants published guidance¹ on determining baseline conditions during the COVID-19 restrictions. The guidance includes recommendations on using existing noise survey data as well as Strategic Noise Mapping carried out by Defra or the devolved administrations.
- 12.78. Following this guidance, this baseline assessment for the reservoir site is based on the existing Arup survey data and the DEFRA Strategic Noise Maps. This approach was agreed with East Hampshire District Council and Havant Borough Council in June 2020.
- 12.79. For the assessment of the revised pipeline corridor, a noise survey was carried out on the 10th and 11th January 2023 after COVID-19 restrictions had ceased. The baseline daytime noise levels were based on the survey results and the night-time noise levels were based on the DEFRA Strategic Noise Maps.

DEFRA strategic noise maps for England

- 12.80. The Strategic Noise Maps for England were produced by DEFRA and published in 2019 as part of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended) and provide a snapshot of the estimated noise from major road and rail sources across England in 2017.
- 12.81. Figure 12.2 Baseline daytime noise contours and measurement locations in ES Volume 3 shows the daytime strategic noise map and Figure 12.3 Baseline night-time noise contours and measurement locations in ES Volume 3 shows the night-time strategic noise map.
- 12.82. A review of these maps for the area around the reservoir site shows that the major transport noise source is the A3(M). The lower threshold for the strategic noise maps is 55 dB LAeq for daytime (07:00-23:00) and 50 dB Lnight for night-time (23:00-07:00). The maps show that noise levels from the A3(M) are below these thresholds for the majority of Havant, however, the data does not include noise generated by local roads or other sources of community noise. A review of the Defra noise map shows noise levels surrounding Bedhampton rail station reach 60 dB LAeq for daytime (07:00-23:00) and 55 dB Lnight for night-time (23:00-07:00) immediately adjacent to Shaft 1.

Baseline noise survey – reservoir site

- 12.83. As part of the 2008 baseline noise assessment undertaken by Arup, surveys were undertaken at a total of 10 locations which included 8 short-term and 2 long-term measurements. Short-term measurements consist of 3 attended 10-minute measurements taken over contiguous hours between 10:00 and 17:00. All short-term measurements were completed on 19th and 20th November 2008. Long-term measurements consisted of unattended measurements, taken in continuous 15-minute intervals over a period of 15 days. All long-term measurements were taken between 19th November and 4th December 2008. Details of the entire survey and the full measurement data are included in the Arup document 'Baseline Noise Survey' AAc/123755/R01. Table 12-8 summarises the levels measured during the short-term survey.

¹ Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments

Table 12-8 - Arup short term baseline noise measurements (2008) – daytime only

Measurement Location	L _{A90}		L _{A10}		L _{Amax}		L _{Aeq}	
	Range	Typical	Range	Typical	Range	Typical	Range	Typical
1	41.0 - 43.2	42.0	44.4 - 49.6	46.7	60.1 - 63.6	63.6	43.2 - 48.1	45.8
2	45.2 - 48.4	46.3	48.0 - 51.4	49.5	58.8 - 66.1	66.1	47.0 - 50.3	48.7
3	47.8 - 50.0	49.0	53.6 - 56.2	55.1	63.7 - 65.9	65.9	52.0 - 53.5	52.9
4	49.8 - 51.0	50.5	53.2 - 53.8	53.5	59.0 - 67.0	67	51.8 - 52.7	52.2
5	38.0 - 49.8	42.2	56.6 - 66.6	60.3	68.0 - 72.6	72.6	52.5 - 62.9	59.0
6	41.8 - 49.8	46.7	51.0 - 59.4	56.5	61.4 - 65.7	65.7	48.3 - 57.0	55.1
7	52.0 - 58.4	54.4	71.4 - 72.6	72.1	77.4 - 80.3	80.3	66.7 - 68.8	68.0
8	41.0 - 43.2	42.0	44.4 - 49.6	46.7	60.1 - 63.6	63.6	43.2 - 48.1	45.8

12.84. Table 12-9 summarises the levels measured during the long-term survey.

Table 12-9 - Arup long term baseline noise measurements (2008)

			Location	
			9	10
Day 07:00 - 23:00	L _{Aeq}	Range	38.3 - 78.2	34.5 - 65.5
		Typical	63.6	48.3
	L _{A10}	Range	41.5 - 79.5	35.5 - 63.5
		Typical	51.5	47.4
	L _{A90}	Range	31.0 - 54.0	30.0 - 56.0
		Typical	45.0	43.6
Night 23:00 - 07:00	L _{Aeq}	Range	29.5 - 54.9	25.3 - 55.9
		Typical	43.9	43.9
	L _{A10}	Range	29.5 - 57.0	27.5 - 58.0
		Typical	42.9	41.6
	L _{A90}	Range	23.0 - 52.5	22.0 - 52.5
		Typical	34.7	35.6

Baseline noise survey – pipeline corridor

12.85. A daytime baseline noise survey was carried out on the 10th and 11th January 2023. Attended measurements were undertaken at locations that were considered to be representative of prevailing noise climate in the area. The methodology and measurement positions were agreed with the Environmental Health Officer at Havant Borough Council prior to the survey taking place.

- 12.86. The attended measurements consisted of 15-minute measurement intervals during a weekday daytime period, and one 3-hour measurement at the quietest location (SP3 - 93 Barncroft Way). The measurement times are considered to be representative of the likely construction hours. Noise measurements were undertaken at 85 High Lawn Way, 195 Purbrook Way, 93 Barncroft Way, and Bidbury Pre-School on Fraser Road, as shown in Figure 12.2. These locations were chosen to assess the potential variation in noise levels around the perimeter of the Site.
- 12.87. All measurements were undertaken in free-field conditions and at a height of 1.2 metres above ground level using a Fusion 01dB sound level meter, which conforms to the specifications for sound level meters of Class 1 as given by BS EN 61672-1:2013. The sound level meters were field calibrated using an acoustic calibrator, both before and on completion of the survey. No significant drift in sensitivity was observed. Calibration certificates can be provided on request.
- 12.88. At each measurement position, multiple noise level metrics were recorded, however, the following are presented in this report:
- $L_{Aeq,T}$ The A-weighted equivalent continuous noise level over the measurement period;
 - $L_{A90,T}$ The A-weighted noise level exceeded for 90% of the measurement period and is considered to represent the background noise level at the measured location; and
 - $L_{AF,max}$ The maximum A-weighted noise level during the sample period, measured using a fast time weighting.
- 12.89. During the survey period, the weather was generally overcast on 10th January, with clear sky on 11th January. Wind speeds were generally less than 5m/s and flowed in a southern/ south westerly direction.
- 12.90. The tables below present the results for the noise monitoring locations that are considered representative of the nearest sensitive receptors.

Table 12-10 - SP1 - High Lawn Way Noise Measurements

Date	Start Time	Duration	$L_{Aeq,T}$ dB	$L_{A10,T}$ dB	$L_{A90,T}$ dB	$L_{AF,max}$ dB
10/01/2023	11:15	15 minutes	51.7	52.1	47.9	69.2
	13:19	15 minutes	51.8	53.2	48.2	61.9
	15:17	15 minutes	55.1	56.5	50.9	71.2
	Average		53.2	53.9	49.0	71.2

- 12.91. The dominant noise source at High Lawn Way was local traffic noise. Other noise sources that were noted were natural noise sources such as birds and wind in nearby trees, as well as local pedestrian traffic.

Table 12-11 - SP2 - Purbrook Way Noise Measurements

Date	Start Time	Duration	$L_{Aeq,T}$ dB	$L_{A10,T}$ dB	$L_{A90,T}$ dB	$L_{AF,max}$ dB
10/01/2023	11:42	15 minutes	57.9	52.7	52.7	72.7
	13:45	15 minutes	58.3	51.5	51.5	77.9
	15:58	15 minutes	65.0	55.1	55.1	73.2
	Average		59.1	60.4	53.1	77.9

- 12.92. The dominant noise source at Purbrook Way was local traffic noise. Other noise sources that were noted were natural noise sources such as birds.

Table 12-12 - SP3 - 93 Barncroft Way Noise Measurements

Date	Start Time	Duration	$L_{Aeq,T}$ dB	$L_{A10,T}$ dB	$L_{A90,T}$ dB	$L_{AF,max}$ dB
10/01/2023	12:24	15 minutes	51.8	52.6	48.0	69.4

Date	Start Time	Duration	L _{Aeq,T} dB	L _{A10,T} dB	L _{A90,T} dB	L _{AF,max} dB
	14:10	15 minutes	50.1	50.0	47.5	69.6
	16:30	15 minutes	53.6	55.3	49.0	72.1
	Average		52.1	52.6	48.2	72.1
11/01/2023	10:00	3 hours	50.9	53.4	47.7	65.5

- 12.93. The dominant noise source at Barncroft Way was pedestrians on the walkway and natural noises such as birdsong and wind in nearby vegetation.

Table 12-13 – SP4 – Bidbury Preschool Noise Measurements

Date	Start Time	Duration	L _{Aeq,T} dB	L _{A10,T} dB	L _{A90,T} dB	L _{AF,max} dB
11/01/2023	13:25	15 minutes	56.4	57.7	55.1	65.4
	14:25	15 minutes	59.1	60.5	56.0	74.9
	16:05	15 minutes	58.1	58.6	51.2	75.7
	Average		58.0	58.9	54.1	75.7

- 12.94. The dominant noise source at Bidbury Preschool was local traffic noise. Other noise sources that were noted were school noise with children playing, and distant venue noise such as music and patron sounds.

Review of baseline conditions

- 12.95. Reviewing the measurement positions, the majority of the Scheme is located outside the extents of the Defra strategic mapping. However, measurements 3 and 4 from the Arup survey are the closest to extents of the strategic noise maps in proximity to the reservoir site. The measured levels at these two locations range between 51.8 dB L_{Aeq,T} and 53.5 dB L_{Aeq,T}. Comparing these levels to the daytime strategic noise map, and applying professional judgement, it is suggested that the noise climate in the area has not changed significantly between 2008 and 2017, and therefore the survey data collected in 2008 can be considered to be broadly representative of current noise levels.
- 12.96. Following this, the baseline noise levels for receptors in Havant, close to the reservoir site, are represented by measurements 1, 2, 3 and 10. Receptors in Rowland's Castle, close to the reservoir site, are represented by measurements 5, 6, 7 and 9. This gives conservative baseline levels for Havant as 50 dB L_{Aeq,T} (daytime) and 45 dB L_{Aeq,T} (night time), and in Rowland's Castle, levels of 60 dB L_{Aeq,T} (daytime) and 45 dB L_{Aeq,T} (night time). There is a degree of uncertainty in these noise levels due to the age of the measured baseline noise data and sources included in strategic noise mapping.
- 12.97. Along the route of the pipeline corridor, daytime ambient noise levels ranged from 50.9 to 61.3 dB L_{Aeq}. The main source of noise during the measurements near the reservoir and the pipeline corridor was noted as being road traffic. Where receptors were close to heavy traffic for example along Purbrook Way and Bidbury Preschool, the noise levels were higher. Where receptors were shielded or further away from road noise such as High Lawn Way and Barncroft Way, the baseline levels were lower.

Summary of baseline conditions

- 12.98. Atkins have undertaken a review of existing daytime noise measurements and Defra strategic noise mapping to determine the baseline noise levels at receptors near the proposed Havant Thicket Reservoir and pipeline corridor.
- 12.99. From the data available, it is determined that the baseline levels are as follows in Table 12-14.

Table 12-14 - Baseline noise levels

Area		Time Period	Data Source	Baseline noise level, dB L _{Aeq}
Reservoir site	Havant	Daytime	Arup baseline noise survey	50
		Night-time		45
	Rowland's Castle	Daytime		60
		Night-time		45
Pipeline corridor	High Lawn Way	Daytime	Atkins baseline noise survey	53
	Purbrook Way			59
	Barncroft Way			52
	Bidbury Preschool			58
	Bedhampton	Night-time	DEFRA Strategic Noise Map	50-55

- 12.100. For the assessment of construction noise, all receptors would be in Category A for daytime construction works. Sensitive receptors located close to the reservoir site are assigned Category B threshold noise levels for night-time works, whereas sensitive receptors along the pipeline corridor are assigned Category C values at night.

Potential impacts

Construction noise

Reservoir site

- 12.101. The following receptors in Table 12-15 are considered to be representative of the worst-case effects from noise arising from construction activities on the main reservoir site and access roads: Figure 12.1 Sample receptor location map for reservoir site in ES Volume 3 shows the locations of these receptors.

Table 12-15 - Assessment receptors

Receptor ID	Address
A	Mulberry Cottage, 2, Manor Lodge Road, Rowland's Castle, PO9 6BA
B	The Former Rectory, 74, Manor Lodge Road, Rowland's Castle, PO9 6BA
C	1, Durrants Road, Rowland's Castle, PO9 6BE
D	50A, Durrants Road, Rowland's Castle, PO9 6BG
E	93, Winterslow Drive, Havant, PO9 5DZ
F	35, Well Meadow, Havant, PO9 4LW
G	1, Stratfield Gardens, Havant, PO9 4LS
H	2, Abbas Green, Havant, PO9 4EP
I	101, Swanmore Road, Havant, PO9 4EU

- 12.102. As detailed in the baseline conditions section, all receptors are considered to be in BS 5228 Part 1 Category A for daytime works and Category B for night-time works. Therefore, the threshold for potential impacts are as follows in Table 12-16, subject to the duration of works:

Table 12-16 - Thresholds of potential impacts

Assessment period	Threshold value (dB L _{Aeq}) for potential impacts	Duration of works for potential impacts
Night-time	50	10 days in a 15-day period or 40 days in a 6-month period
Daytime	65	

- 12.103. Night-time works are not proposed **at the reservoir site**, however there is potential for works at night during exceptional circumstances.
- 12.104. Construction noise levels have been calculated for each quarter year of the construction period.
- 12.105. Table 12-17 presents the range of construction noise levels predicted at each receptor in each year of the construction period. A table showing the construction noise levels in each quarter is included in Appendix A12.3 Reservoir noise modelling results in ES Volume 4.

Table 12-17 - Calculated noise levels

Receptor	2021	2022	2023	2024	2025	2026	2027	2028	2029
Mulberry Cottage, 2, Manor Lodge Road, Rowland's Castle, PO9 6BA	46 to 50	51 to 57	53 to 54	53 to 54	53 to 54	53 to 54	-	-	-
The Former Rectory, 74, Manor Lodge Road, Rowland's Castle, PO9 6BA	45 to 47	46 to 56	59 to 60	59 to 60	59 to 60	59 to 60	-	-	-
1, Durrants Road, Rowland's Castle, PO9 6BE	44 to 47	46 to 53	55 to 56	55 to 56	55 to 56	55 to 56	-	-	-
50A, Durrants Road, Rowland's Castle, PO9 6BG	45 to 48	45 to 51	53 to 54	53 to 54	53 to 54	53 to 54	-	-	-
93, Winterslow Drive, Havant, PO9 5DZ	51 to 54	54 to 60	58 to 59	58 to 59	58 to 59	57 to 59	-	-	-
35, Well Meadow, Havant, PO9 4LW	54 to 57	54 to 61	58 to 59	58 to 59	58 to 59	58 to 59	-	-	-
1, Stratfield Gardens, Havant, PO9 4LS	49 to 53	54 to 60	58 to 59	58 to 59	58 to 59	58 to 59	-	-	-
2, Abbas Green, Havant, PO9 4EP	47 to 54	55 to 65	64 to 64	64 to 64	64 to 64	64 to 64	-	43 to 44	43 to 44

Receptor	2021	2022	2023	2024	2025	2026	2027	2028	2029
101, Swanmore Road, Havant, PO9 4EU	44 to 65	53 to 64	63 to 64	63 to 64	63 to 64	63 to 64	-	45 to 46	45 to 46

- 12.106. The predicted site noise levels for each period show that noise levels do not exceed the daytime threshold for potential significant effects.
- 12.107. If night-time works are required, most receptors would potentially experience significant effects in at least 10 quarters over the construction period. In most locations, night-time works have potential to be mitigated through the installation of temporary acoustic screens to completely block the line of sight (BS 5228 Part 1:2009 + A1:2014) between the noise source and the receptor.

Pipeline corridor

- 12.108. There are three proposed methods of construction for the pipeline. Open Trench method will be used for Section P2 (along the Rugby Ground), Section P9 (from Shaft 8 to the contractual boundary interface) and Section P10, the reservoir area (from the contractual boundary interface to the reservoir). A combination of open trench and above ground methods will be used within the Bedhampton Pumping Station Compound. Trenchless method will be used in all other areas.
- 12.109. The trenchless construction involves the excavation of two parallel tunnels using tunnel boring machines, one each for the fill and return pipeline.
- 12.110. Construction of pipeline will be undertaken during weekday daytime except for the tunnelling work under the railway track north of Shaft 1, which will be tunnelled 24 hours a day. The night-time tunnelling will be undertaken at the end of the boring along Section P1. Depending upon the requirement, a dewatering pump or a generator may be operational 24 hours a day. No other planned night-time works are scheduled during the pipeline construction; however, during unfavourable tunnelling conditions, the working hours would be extended as a last resort to avoid harm to people and equipment.
- 12.111. As detailed in the baseline conditions section, all receptors are considered to be in BS 5228 Part 1 Category A for daytime works and Category C for night-time works.
- 12.112. Table 12-18 below shows the threshold for potential impacts and the distance within which activity noise levels are predicted to be above the threshold for potential impacts.

Table 12-18 - Noise impacts around pipeline corridor

Assessment location	Threshold value (dB L_{Aeq}) for potential impacts	Construction Activities	Activity Noise Level (dB L_{Aeq}) at 10m	Distances from the activity for a potential impact
Site Compound Construction (Section 0, Bedhampton)	65 dB	Traffic management Fencing Vegetation clearance Topsoil stripping Works access Storage of material and waste Haul Road	72 to 83 dB	22 to 78m
Site Compound Operation	65 dB	Shaft Construction	84 dB	84m
Trenchless (Shaft Location)	65 dB	Storage of materials and waste Tunnelling Centrifuge Bentonite Plant Pipe installation	71 to 83 dB	19 to 76m
	55 dB (night-time)	Tunnelling Centrifuge Bentonite Plant	71 to 83 dB	60 to 235m

Assessment location	Threshold value (dB L_{Aeq}) for potential impacts	Construction Activities	Activity Noise Level (dB L_{Aeq}) at 10m	Distances from the activity for a potential impact
Open Trench / Above Ground	65 dB	Topsoil strip Storage of materials and waste Deliveries Pipe laying watercourse/sewer Reinstatement	68 to 83 dB	14 to 78m
Culvert	65 dB	Laying Culvert and Backfill Piling Surfacing	79 to 83 dB	48 to 78m
Reservoir (P10) pipeline site preparation	65 dB	Fencing Vegetation clearance Topsoil stripping Storage of material and waste Haul Road	78 to 84 dB	45 to 85m
Reservoir (P10) Pipeline construction	65 dB	Interface Pit – excavation and ground preparation Interface Pit – concrete pouring Pipe installation Discharge pipe over embankment crest – excavation and ground preparation Discharge pipe over embankment crest – installation Discharge pipe over embankment crest – concrete pouring Embankment crest to discharge chamber – excavation Embankment crest to discharge chamber – installation and concreting	77 to 85 dB	42 to 98m
Emergency Discharge Chamber	65 dB	Construction of discharge chamber Piling	83 dB	78m
Bedhampton Compound – new plant and building modifications	65 dB	Bedhampton 1 – Compound works and equipment installation Bedhampton 2 - Compound works and equipment installation Building Modification – demolition Building Modification – construction Building Modification – concreting External plant installation (PAC, generator, transformer, surge vessel) – site preparation, concrete pour and installation	73 to 86 dB	24 to 108m

Trenchless

- 12.113. Using the maximum distance in Table 12-18, the number of sensitive receptors affected by daytime construction noise has been calculated and presented in Table 12-19.

Table 12-19 - Trenchless construction – sensitive receptors affected by daytime works

Pipeline shaft	Duration of works (days)	Potential impacts - residential	Potential impacts – non-residential
Shaft 1	213	19	1
Shaft 2	381	21	2
Shaft 3	132	73	0
Shaft 4	429	25	0
Shaft ED	279	45	0
Shaft 5	447	82	1
Shaft 6	185	74	0
Shaft 7	514	58	0
Shaft 8	135	3	0

12.114. Table 12-19 shows that there are 400 residential receptors and 4 non-residential receptors with potential to experience impacts from trenchless construction of the pipeline. Further discussion on the effects of these impacts is provided in the Assessment of effects section (paragraphs 12.198 and 12.205).

12.115. The potential night-time impacts for the tunnelling works under the railway line will primarily be for receptors close to the Shaft 2 location, which is the launch shaft of the tunnel boring machine for this section. Using the maximum night-time distance in Table 12-18, the number of sensitive receptors affected by nighttime construction noise has been calculated and presented in Table 12-20.

Table 12-20 - Trenchless construction – sensitive receptors affected by night-time works

Pipeline section	Duration of works (days)	Potential impacts - residential	Potential impacts – non-residential
Shaft 2	7 (fill pipeline) + 7 (return pipeline)	304	4

12.116. Table 12-20 shows that there are 304 residential receptors and 4 non-residential receptors with potential to experience impacts from trenchless construction of the pipeline. Though a maximum of seven days of work is estimated for each tunnel boring under the railway line, there is a time delay of approximately three months between the fill and return tunnel boring. Further discussion on the effects of these impacts is provided in the Assessment of effects section (paragraphs 12.198 and 12.205).

12.117. The generator used for 24/7 operations including dewatering at sites will be a quiet type and the noise levels are expected to be 55 dBA at 7m. Consequently, the noise levels are unlikely to exceed Category C criteria for night-time at any of the receptors. Therefore, no night-time impacts are expected due to the use of 24/7 generator.

Open cut trench and above ground works

12.118. The number of sensitive receptors that have the potential to be affected by significant levels of construction noise from the open cut trench and above ground works are shown in Table 12-21. As the plant lists for these activities are similar, their impacts are grouped together. The values shown were calculated using the distances presented in Table 12-18.

Table 12-21 - Open trench construction and above ground works – sensitive receptors affected by daytime works

Pipeline Section	Duration of works (days)	Potential impacts – residential	Potential impacts – non-residential
Bedhampton	340	19	1
P2	100	78	2
P9	177	0	0
Reservoir Pipeline section	312	18	0

- 12.119. Table 12-21 shows that there are 115 residential receptors, and 3 non-residential receptors has the potential to experience impacts from the construction of pipeline works in Bedhampton Compound, Section P2, Section P9 and P10, the reservoir pipeline, inclusive. Further discussion on the effects of these impacts is provided in the Assessment of effects section (paragraphs 12.206 to 12.211).

Culvert works, Bedhampton building modification works and Plant installation

- 12.120. The number of sensitive receptors that have the potential to be affected by significant levels of construction noise due to culvert works, Bedhampton building modification works and plant installation are shown in Table 12-22. The values shown were calculated using the distances presented in Table 12-18.

Table 12-22 – Culvert works, Bedhampton building modification works and Plant installation – sensitive receptors affected by daytime works

Pipeline Section	Duration of works (days)	Potential impacts – residential	Potential impacts – non-residential
Culvert Middle Park Way	74	15	0
Culvert Dunsbury Way	68	65	0
Culvert Purbrook Way	88	46	1
Bedhampton 1	146	0	0
Bedhampton 2	158	0	0
Building Modification	55	1	0
Plant Installation	44	2	0

- 12.121. Table 12-22 shows that there are 129 residential receptors and 1 non-residential receptors which has potential to experience impacts from the construction of culvert works, Bedhampton building modification works and plant installation. Further discussion on the effects of these impacts is provided in the Assessment of effects section (paragraphs 12.212 to 12.213).

Construction traffic

- 12.122. Assessment of the impacts from construction traffic to reservoir site shows that only the access roads would have a perceptible impact and there are 13 noise sensitive receptors within 50 m of these access roads.
- 12.123. Whilst there is potential for a perceptible impact at receptors close to the access roads, the forecast flows on the access roads are below the threshold where noise calculations are reliable, and it is unlikely that noise from the access roads would be perceptible above traffic noise from other roads that are closer to the sensitive receptors.
- 12.124. The construction traffic flows along the pipeline corridor indicate an average increase of 27 two-way HGV movements and a peak of 100 two-way HGV movements on A and B roads and an average increase of 16 two-way HGV movements and a peak of 84 two-way HGV movements on local roads

in the Havant region. The maximum peak flows would not be present for more than 4 days on any of the local roads.

- 12.125. Based on the above construction traffic flows, the impacts are likely to be negligible throughout the traffic network except for Swanmore Road, Stockheath Lane and the access roads.
- 12.126. The Swanmore Road and Stockheath Lane may experience minor impacts during the peak period of HGV movements, however, these peaks in HGV movements are expected to last for 4 days or less. The impacts are likely to be negligible during all other periods.
- 12.127. The access roads include Meyrick Road to access Shaft 1 Worksite, a temporary access road from Hooks Farm Way to Shaft 2 worksite, a temporary access road from Stockheath Lane to Shaft 4, and a temporary access road from Purbrook Way to Shaft ED.
- 12.128. The construction traffic noise levels from the access roads are potentially perceptible at the receptors close to the access roads; however, the predicted noise levels at 10m from the access roads are likely to be less than 58 dB L_{Aeq}, much lower than the nearby main roads.
- 12.129. Therefore, it is considered that impact from construction traffic would be negligible and is not significant.
- 12.130. A full table of results showing the impact on all roads included in the assessment is included in Appendix A12.7 Road traffic noise assessment in ES Volume 4.

Construction vibration

- 12.131. Construction related vibration may arise from earth compaction around the main embankment of the reservoir, from earth compaction along the pipeline corridor and from trenchless pipeline construction, and during micro-tunnelling.

Reservoir site and access roads

- 12.132. Earth compaction works are proposed to take place around the main embankment of the reservoir.
- 12.133. As these works are transient and will not be taking place near the receptors for extended periods of time, it is considered that PPV levels up to 3 mm/s would be acceptable provided residents are given advance notice of the works, and the assessment has used a threshold where there is a 33.3% probability that this level may be exceeded.
- 12.134. Calculations of vibration from earth compaction have been based on manufacturer data for a Cat CB10 Tandem Vibratory Roller, with two drums of 1.7 m wide, and a nominal maximum amplitude of vibration of 1.06 mm and a minimum of 0.34 mm.
- 12.135. Based on this, there would be a 33.3% probability of exceeding 3.0 mm/s PPV at receptors within 20 m of the plant when it's operating at its maximum amplitude of vibration, or 5.5 m when it's operating at its minimum amplitude of vibration.
- 12.136. This means that from the main reservoir site, vibrations would not be significant at sensitive receptors, as no works are proposed within 20 m of these receptors.

Pipeline corridor

- 12.137. Calculations for earth compaction along the pipeline corridor have been based on the same plant as used in the reservoir site earth compaction calculations, and therefore, potentially significant impacts are predicted within the same distances as reported in paragraphs 12.132 to 12.136.
- 12.138. Vibratory piling will be deployed at emergency discharge spillway and culvert location to pile metal sheets into the ground. Calculations for sheet piling shows the threshold for significant, 3.0 mm/s PPV, will be exceeded at receptors within 18 m of the piling location.
- 12.139. Sections P1, P3, P4, P5, P6, P7 and P8 are to be constructed using a trenchless method. This involves the use of a micro-tunnel boring machine of diameter up to 2.5 m, which has potential to cause vibration impacts at the sensitive receptors.
- 12.140. Vibration increases as the ground's strength through which the tunnel is bored increases. Tunnelling through clay, silt, and sand causes the lowest vibration levels; gravel produce intermediate vibration levels; and hard rocks produce the highest vibration levels.

- 12.141. The ground along the pipeline corridor tunnel is composed mainly of clay, silt, sand and gravel. Vibration levels measured for a 2.44 m diameter micro-tunnel² along the cobbles and gravel geology indicate vibration levels of less than 0.4 mm/s at 10.0 m from the tunnelling location. Micro-tunnelling of similar dimensions on a more competent sandstone geology indicates vibration levels of 1.0 mm/s at 10.5 m from the tunnelling location. However, these slightly higher levels of vibration are not expected along the dual pipeline corridor, since the route mainly consists of clay, silt, sand and gravel.
- 12.142. No vibration data is available at distances closer than 10 m. Extrapolating the available data and applying professional judgment, properties located more than 5 m from the tunnelling location are unlikely to exceed PPV levels of 3.0 mm/s. Therefore, for the micro-tunnelling, only the properties within 5 m from the tunnelling location are considered to be potentially significant.
- 12.143. Table 12-23 shows the number of sensitive receptors that would potentially be affected from construction vibration during pipeline construction.

Table 12-23 – Sensitive receptors affected by construction vibration

Works Location	Duration of works (days)	Maximum amplitude of vibration		Minimum amplitude of vibration	
		Residential	Non-residential	Residential	Non-residential
Impacts due to earth compaction at tunnel shaft sites					
Shaft 1	5	0	0	0	0
Shaft 2	10	0	0	0	0
Shaft 3	5	0	0	0	0
Shaft 4	10	0	0	0	0
Emergency Discharge Shaft	5	0	0	0	0
Shaft 5	10	2	0	0	0
Shaft 6	5	4	0	0	0
Shaft 7	10	0	0	0	0
Shaft 8	5	0	0	0	0
Impacts due to earth compaction at open cut trench sites					
Bedhampton	32	0	0	0	0
Section P2	32	0	1	0	0
Section P9	10	0	0	0	0
P10, Reservoir Pipeline	21	0	0	0	0
Impacts due to road compaction at culvert crossings					
Middle Park Way	5	0	0	0	0
Dunsbury Way	5	5	0	0	0
Purbrook Way	5	0	0	0	0

² HILLER D. M. and CRABB G. I. Groundborne vibration caused by mechanised construction works. TRL Report 429. Wokingham:TRL, 2000.

Works Location	Duration of works (days)	Maximum amplitude of vibration		Minimum amplitude of vibration	
		Residential	Non-residential	Residential	Non-residential
Impacts due to piling at emergency discharge spillway and culvert crossings					
Emergency Discharge Spillway	5	0	0	N/A	N/A
Middle Park Way	5	0	0	N/A	N/A
Dunsbury Way / Shaft 6	5	6	0	N/A	N/A
Purbrook Way	5	0	0	N/A	N/A
Impacts due to micro-tunnelling					
Section P1	5*	7	1	N/A	N/A
Section P3	5*	2	0	N/A	N/A
Section P4	5*	0	0	N/A	N/A
Section P5	5*	0	1	N/A	N/A
Section P6	5*	0	0	N/A	N/A
Section P7	5*	0	0	N/A	N/A
Section P8	5*	0	0	N/A	N/A

* represents the maximum days TBM may affect a receptor.

- 12.144. Table 12-23 shows, the use of vibratory roller for ground compaction at its maximum amplitude has potential to cause vibration impacts at 11 residential receptors. These impacts are primarily at properties close to Shaft 5, Shaft 6 and the culvert at Dunsbury Way.
- 12.145. When operating at its minimum amplitude of vibration, no potential significant effects are predicted at any of the sensitive receptors.
- 12.146. When the vibratory roller is operating at its maximum amplitude, works would need to be taking place within 4.5 m of a building to cause cosmetic damage. Since no buildings are located at such close range, no cosmetic damage to buildings is expected due to ground compaction.
- 12.147. During sheet piling, Table 12-23 shows potential vibration impacts at Dunsbury Way Culvert / Shaft 6. Six residential receptors around the Dunsbury Culvert / Shaft 6 could be potentially affected by piling. Vibration impacts due to piling are expected to last not more than 5 days.
- 12.148. During tunnelling works, Table 12-23 shows potential vibration impacts at Section P1, P3, and P5. There are 9 residential receptors and 2 non-residential receptors which could be potentially affected during the tunnelling works.
- 12.149. The vibration levels are unlikely to exceed the threshold of cosmetic damage to buildings at distances greater than 2 m from the tunnelling location. There are 2 residential properties along Section P1, 2 residential properties along Section P3, and 1 non-residential property along Section P5 within 2 m from the tunnel route. The closest building is located not closer than 8 m from the piling location, therefore cosmetic damage to building is not expected.
- 12.150. Tunnelling takes place at a depth of more than 5 m at most locations. Given the depth of tunnelling, it is unlikely that the tunnelling works would cause cosmetic damage to buildings. However, mitigation measures specified in the design, mitigation and enhancement measures section should be implemented.
- 12.151. Any vibration impacts from using the micro-tunnel boring machine are limited to weekday daytime (07:00 – 19:00) and Saturday (07:00 – 13:00). Due to the progressing nature of the construction

works, the maximum vibration levels at a receptor are temporary and would last no more than a few hours for each passing of TBM at a given receptor.

Operational noise

Reservoir site and access roads

- 12.152. The assessment of operational traffic impacts looks at the following scenario comparisons:
- 2023 Base to 2029 Base – to determine the impact without the Scheme due to traffic growth;
 - 2023 Base to 2029 Operational – to determine the combined impact of traffic growth and the Scheme; and
 - 2029 Base to 2029 Operational – to determine the impact of the Scheme alone.
- 12.153. A full table of results showing impact on all roads included in the assessment is included Appendix A12.7 Road traffic noise assessment in ES Volume 4.

2023 base to 2029 base

- 12.154. Assessment of the impact between these scenarios shows there is one road link where an impact greater than 1 dB $L_{A10,18h}$ is predicted. This road is part of the development of Dunsbury Park, north of Fitzwygram Way. There are currently no noise sensitive receptors within 50 m of this road.

2023 base to 2029 combined operational and traffic growth

- 12.155. Assessment of the impact between these scenarios shows there are three roads where an impact greater than 1 dB $L_{A10,18h}$ is predicted;
- 12.156. One road is part of the development of Dunsbury Park, north of Fitzwygram Way. This is the same road with an impact in the 2023 Base to 2029 Base comparison.
- 12.157. The other two roads with perceptible impacts are predicted are the reservoir access roads, and this is because they do not exist in the 2023 Base scenario. There are currently 13 noise sensitive receptors within 50 m of these access roads.

2023 base to 2029 operational – reservoir only

- 12.158. Assessment of the impact between these scenarios shows only the two access roads have the potential to give rise to a perceptible impact. There are currently 13 noise sensitive receptors within 50 m of the access roads.

Summary of operational road traffic noise impacts

- 12.159. It should be noted that the forecast flows on the access roads are 210 vehicles per day for the northern access road and 110 per day for the southern access road. These flows are below the threshold where noise calculations are reliable, and it is unlikely that noise from the access roads would be perceptible above traffic noise from other roads closer to the sensitive receptors.
- 12.160. Therefore, it is considered that noise impacts from operational traffic would be negligible.

Pipeline corridor

- 12.161. Once operational, the pipeline is not expected to generate any noticeable noise. There is the potential for noise generation to occur during maintenance or repair of the pipeline, but this is expected to be infrequent and temporary. Therefore, the operational noise impact has not been assessed.

Plant noise at Bedhampton Compound

- 12.162. Upgrades within the Bedhampton Compound include the installation of noisy equipment, including a generator, powdered activated carbon (PAC) equipment, transformer, and surge vessel (including a compressor kiosk).
- 12.163. The transformer and the surge vessel will continuously operate throughout the year. However, the generator will be used as an emergency power backup and will be operational only when mains power fails or during its maintenance. For most years, PAC equipment will be in operation for a week; however, once in twenty years, the equipment may be used up to 112 days during summer. Therefore, the use of the generator and PAC equipment is infrequent and will be rarely used

simultaneously. Table 12-24 below lists the source noise levels of equipment used in Bedhampton Compound.

Table 12-24 – BS 4142 assessment of equipment noise at Bedhampton Compound

Equipment	Source Noise Level
Generator	75 dB(A) at 1m
Powdered Activated Carbon (PAC) equipment	80 dB(A) at 1m
Transformer	70 dB(A) at 1m
Surge vessel	74 dB(A) at 1m
Motor Control Centre	No noise expected

- 12.164. The noise sensitive receptors around the Bedhampton compound are closer to major transportation routes such as the A27, A3, Bedhampton Road and the Bedhampton railway line; hence, the background noise levels are likely to be higher than the measured baseline noise survey for the dual pipeline.
- 12.165. Therefore, based on the baseline noise survey data for the dual pipeline corridor, the background noise level (LA90,T) of the Bedhampton compound and the noise sensitive receptors around it is considered to be 48 dB LA90,T, the lowest of averages at all measured locations.
- 12.166. The Figure 12-1 below shows the location of sensitive receptors around the Bedhampton Compound. The mechanical and electrical plant are located within the Bedhampton Compound.

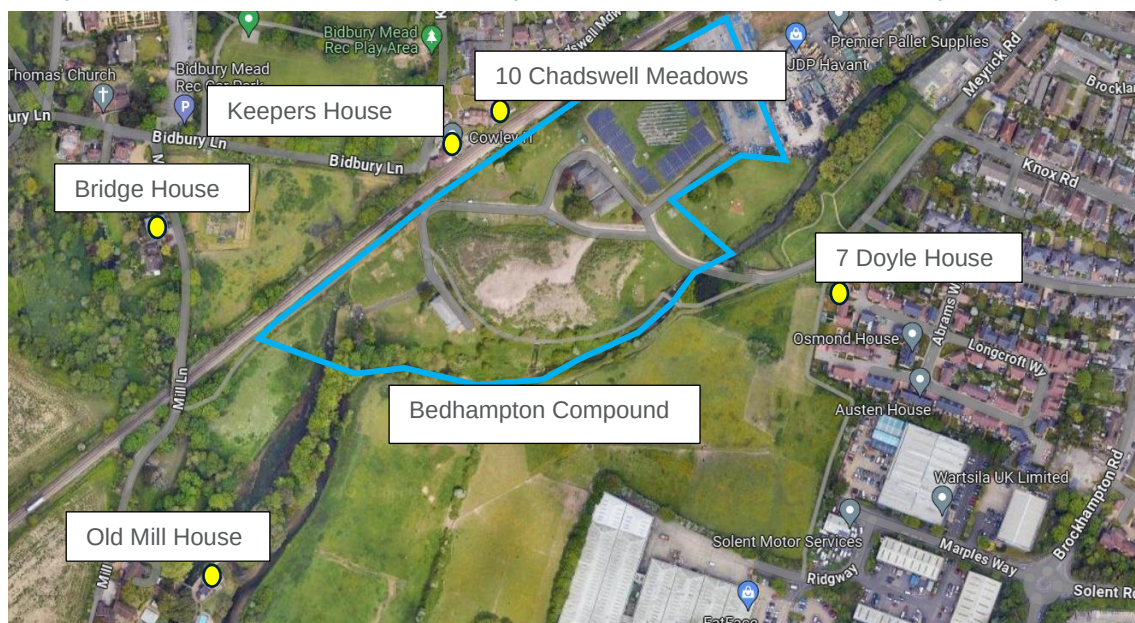


Figure 12-1 – Sensitive receptors around Bedhampton Compound (indicative boundary shown in blue)

- 12.167. For the assessment, 2 dB correction is applied assuming tonal characteristics of the noise source and an additional 3 dB for intermittent use of generator and PAC equipment.
- 12.168. Table 12-25 shows the rating noise level of the noise sources at the noise sensitive receptors around Bedhampton compound.
- 12.169. The difference between rating and background noise levels are used to assign significance at each noise sensitive receptor. The assessment assumes simultaneous operation of all equipment within the Bedhampton compound.

Table 12-25 – BS 4142 assessment of equipment noise at Bedhampton Compound

Receptor Location	Background sound level (LA90, dB)	Distance to closest sound source (m)	Specific sound level (LAeq,T dB)	Rating level (LA _r ,T dB)	Difference (LA _r ,T – LA90) (dB)	Significance
Keepers House	48	55	46	51	+3	Below adverse impact
10 Chadswell Meadows	48	50	46	51	+3	Below adverse impact
Bridge House	48	195	35	40	-8	Low impact
Old Mill House	48	240	33	38	-10	Low impact
7 Doyle House	48	220	35	40	-8	Low impact

- 12.170. The BS 4142 assessment indicates that the rating levels are higher than the background sound level at Keepers House and 10 Chadswell Meadows. However, based on the BS 4142 significance criteria of section 12.41, below adverse impact is predicted at both the noise sensitive receptors.
- 12.171. At all other noise sensitive receptors, rating levels are lower than the background sound level. Therefore, the impacts are expected to be low and are considered not significant.
- 12.172. The major contributor to the rating levels of Table 12-25 are the generator and PAC equipment. These two plant are rarely used, and in the absence of these noise sources, the impacts are expected to be low at all noise sensitive receptors. Therefore, the impacts are not considered to be significant.

Design, mitigation and enhancement measures

Community liaison

- 12.173. An important element of the proactive approach to limiting the potential significance of effects is to ensure that the public and residents are kept fully informed over the scale and nature of the works, when they are to take place, and who to contact if disturbed by the construction activities. To ensure good community consultation for the project, a letter drop will take place in the locality advising residents of the programmed works and when they will take place.

Best practicable means

- 12.174. Throughout any construction programme, the intention should always be to minimise site noise levels whilst having due regard to the practicability and economic implication of any control or mitigation measure. Best Practicable Means will be applied during the construction works to minimise noise at neighbouring residential properties and other sensitive receptors arising from the works.
- 12.175. Best Practicable Means are defined in Section 72 of the Control of Pollution Act 1974 and Section 79 of the Environment Protection Act 1990 as those measures which are 'reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to financial implications'.
- 12.176. The potential noise effects of the construction works can be minimised by use of noise control measures, as suggested by BS 5228 Part 1. General principles for the control of noise and vibration to be employed during the construction works include:

- Only plant which complies with the relevant EU/UK noise limits applicable to that equipment or is in no way noisier than would be expected from the noise levels quoted in BS 5228: 2009+A1:2014 Part 1 will be used. This includes all vehicles and mechanical plant used for the purpose of the works being fitted with effective exhaust silencers and maintained in good and efficient working order;
- All compressors and generators being 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools will be fitted with mufflers or suppressors of the type recommended by the manufacturers and will be kept in a good state of repair;
- Machines in intermittent use being shut down in the intervening periods between work, or where this is impracticable, throttled down to a minimum;
- Where practicable, plant with directional noise characteristics will be positioned so as to minimise noise at adjacent properties;
- The works covered by this application will be planned so as to ensure that as much work as practicable (taking into account the needs to minimise disruption to trains when the pipeline crosses the rail line and ensuring the safety of the public and workforce) takes place during normal daytime working hours;
- Ensuring that all staff and operatives are briefed on the requirement to minimise nuisance from site activities, via **toolbox** talks etc;
- Regular plant maintenance;
- All plant and equipment being examined daily, for defects prior to the start of works and under no circumstances will defective plant be used;
- Where practicable, using a 'dead rolling' method when vibratory rollers are required for compaction activities or road resurfacing close to properties;
- Using vibration-generating equipment at the minimum vibration amplitude;
- **Avoid percussive piling and use low vibration vibratory or push-in (Giken) sheet piling. Use of push-in piling will eliminate vibration impact and the noise levels will be greatly reduced;**
- **If required, use rotary pre-boring to loosen up soil before sheet piling;**
- Use of temporary noise screens or partial enclosures around particularly noisy activities, for example pneumatic breakers used in close proximity to dwellings;
- Avoiding any reversing on site as far as reasonably practicable – if reversing is required, utilising broadband low impact reversing alarms or banksmen; and
- **Space the delivery of material to and from site compounds evenly to minimise the peak noise of construction traffic.**

Acoustic screening

- 12.177. **For the reservoir site**, the Potential impacts section highlighted that there is potential for some significant effects if nighttime works are undertaken due to very exceptional circumstances. If night-time works are required due to exceptional circumstances in these areas, then temporary acoustic screens will be erected to block the line of sight between the plant and receptors and this will mitigate the potential noise effects in most areas.
- 12.178. Acoustic screens are unlikely to sufficiently reduce noise levels from night-time earthworks activities for receptors along Swanmore Road. Therefore, such works will be avoided, as shown in Figure 12.15 Areas that night works should avoid in ES Volume 3.
- 12.179. **For the pipeline corridor**, construction noise impacts are expected at sensitive receptors located in proximity to Shafts 1, 2, 3, ED, 5, 6, and 7. Temporary construction noise barriers should be installed at the compound boundaries at these locations to reduce construction noise levels by 5 to 10 dB. Further information on the positioning of the temporary noise barriers is provided in Table 12-26.

Table 12-26 - Location of temporary noise barriers

Pipeline Shaft	Location of temporary noise barrier
Shaft 1	Towards the north of the Shaft 1 worksite, shielding the properties on Brunswick Gardens and Bedhampton Road.
Shaft 2	Throughout the worksite periphery at Shaft 2 worksite to minimise both daytime and night-time impacts.
Shaft 3	Towards the north and east of Shaft 3 worksite, shielding the properties on Hook's Farm Way and Hook's Lane.
Shaft 4	Towards the South and north of Shaft 4 worksite, shielding the properties along Barncroft Way and St Francis Pl.
Shaft ED	Towards the southwest and north of the Shaft ED worksite, shielding the properties on Priorsdean Crescent, Corhampton Crescent and Hermitage Close. During the construction of spillway, it may not be practicable to install noise barriers to the southwest of the Shaft ED worksite. Therefore, during the construction of spillway, noise should be mitigated by using acoustic shrouds around noisy plant and equipment.
Shaft 5	Throughout the worksite periphery at Shaft 5 worksite. If the temporary noise barrier around the entire periphery of the worksite is unpracticable, acoustic shrouds should be deployed around the noisy plant and construction activity to minimise the impact of the construction noise.
Shaft 6	Throughout the worksite periphery at Shaft 6 worksite. If the temporary noise barrier around the entire periphery of the worksite is unpracticable, acoustic shrouds should be deployed around the noisy plant and construction activity to minimise the impact of the construction noise.
Shaft 7	Towards the south and east of the Shaft 7 worksite, shielding the properties on High Lawn Way.
Shaft 8	Towards the west and South West of the Shaft 8 worksite, shielding the properties on Bondfields Crescent and Bitterne Close.
Bedhampton Pipeline	Due to moving nature of work, a temporary noise barrier on wheels can be deployed, which can be moved around and placed to cut of the direct line of site between the noise source and noise sensitive receptors along the properties on Chadswell Meadows and King's Croft Lane. Alternatively for the locations where temporary noise barriers cannot be deployed, acoustic shrouds can be used around the noisy plant and construction activity to minimise the impact of the construction noise.
Section P2	Due to moving nature of work, a temporary noise barrier on wheels can be deployed, which can be moved around and placed to cut of the direct line of site between the noise source and noise sensitive receptors along the properties on Beaufort Road, Hooks Lane and St Thomas More's Catholic Primary School. Alternatively for the locations where temporary noise barriers cannot be deployed, acoustic shrouds can be used around the noisy plant and construction activity to minimise the impact of the construction noise.
Reservoir Pipeline	Temporary noise barrier (approximately 30 m) on the western end of the reservoir pipeline (where the pipeline bends towards the reservoirs - located approximately 50 m east of the Swanmore road), to shield properties on Swanmore Road between Inkpen Walk and Mewsey Court.
Middle Park Way Culvert	Towards the west of Middle Park Way Culvert worksite, shielding the properties on Bondfields Crescent and Bitterne Close.
Dunsbury Way Culvert	Throughout the worksite periphery at Dunsbury Way Culvert worksite.

Pipeline Shaft	Location of temporary noise barrier
	If the temporary noise barrier around the entire periphery of the worksite is unpracticable, acoustic shrouds should be deployed around the noisy plant and construction activity to minimise the impact from the construction noise.
Purbrook Way Culvert	Throughout the worksite periphery at Purbrook Way Culvert worksite. If the temporary noise barrier around the entire periphery of the worksite is unpracticable, acoustic shrouds should be deployed around the noisy plant and construction activity to minimise the impact from the construction noise.

12.180. Acoustics screens are unlikely to sufficiently reduce noise levels during the night-time trenchless works. However, the works are short term and the implementation of best practicable means will minimise any residual impacts.

12.181. BS 5228 Part 1 gives the following advice about acoustic screens:

"B.4 Acoustic screens

Care is needed in the design, siting and construction of a barrier for screening purposes if it is to be effective. It should be noted also that a barrier may, by reflecting sound, simply transfer a problem from one receiving position to another. On level sites, for maximum effectiveness, a barrier should be brought as close as possible to either the noise source or the receiving positions. In addition, there should be no gaps or openings at joints in the barrier material.

*In design it may be necessary for sound transmitted both through and around the barrier to be considered. However, in most practical situations the overall attenuation will be limited by transmission over and around the barrier, provided that the barrier material has a mass per unit of surface area in excess of about 7 kg/m² and there are no gaps at the joints. When equipment is to be screened for many months, **sandbags** can be useful as they are durable, easy to erect and easy to remove. Ordinary building materials normally stored on site (e.g. bricks, aggregate, timber or **topsoil**) can, if carefully sited, provide noise screening without additional cost. Plywood sheets can be fixed to a scaffold support frame and if constructed in sections provide a portable barrier.*

Some sound will pass round the ends of short straight barriers. As a rough guide, the length of a barrier should be at least five times greater than its height. A shorter barrier should be bent round the noise source. The minimum height of barriers should be such that no part of the noise source will be visible from the receiving point."

12.182. Any temporary acoustic screens need to be fabricated out of impervious boards which have a surface mass of not less than 7 kg/m² minimum. A 15 mm plywood would meet this requirement.

12.183. All screens need to extend to a height such that the 'line of sight' between noise source and receiver is fully obstructed, but in any case, the height will be at least 2 m.

12.184. Subject to safety and access considerations, all screens will be positioned as close to the works as possible. The contractor will ensure that the screen obstructs the direct line of sight between the works and the nearest properties.

12.185. Subject to safety considerations, temporary screens will be mounted on wheels to facilitate onsite relocation. Any gaps between the ground and the bottom of the panel will be less than 100 mm.

Hours of working

12.186. The Potential impacts section notes that there are potentially significant impacts where night-time works are required. For the reservoir site, if night-time working is required, these impacts will be mitigated using acoustic screens in some locations.

12.187. The locations where it is unlikely to be able to fully mitigate night-time working impacts are at receptors along Swanmore Road, Havant. As impacts from night-time works cannot be fully mitigated in this area, night-time earthworks will be avoided around the south-west side of the site.

12.188. The construction of pipeline corridor will be undertaken during weekday daytime (07:00 – 19:00) and Saturday (07:00 – 13:00). The trenchless construction under the railway track is planned to take place 24 hours a day. Though no other night-time works are planned for the pipeline corridor,

during unfavourable tunnelling conditions, the working hours could be extended as a last resort to avoid harm to people and equipment.

Noise insulation or temporary rehousing

- 12.189. Where works are expected to exceed the noise level thresholds for potential impacts for extended periods of time, it may be relevant to offer noise insulation or temporary rehousing to affected residents. BS 5228 Part 1 [Table E.2](#) gives noise level thresholds and durations of works where noise insulation and temporary rehousing may be considered.
- 12.190. There is no statutory obligation to offer these, and any offer will be considered on a case-by-case basis.

Vibration monitoring

- 12.191. Though vibration impacts due to tunnelling works are minimal, it is recommended that vibration monitoring is undertaken at receptors closer than 5 m from the tunnelling location.

Building surveys

- 12.192. Where works causing vibrations are to take place near sensitive receptors, it is prudent to undertake building surveys before and after works to determine if any damage to the structure is caused.

Assessment of effects

Construction noise

Reservoir site and access roads - daytime

- 12.193. All daytime site construction noise levels are predicted to be below the threshold for potentially significant effects and are therefore not considered to be significant.

Reservoir site and access roads – night-time

- 12.194. Night-time works are not routinely expected during the construction of the reservoir, however they may be required in very exceptional circumstances.
- 12.195. If night works are required, then there is potential for site noise levels to be above the threshold for potential impacts at all sample receptors, depending on the activities taking place.
- 12.196. For receptors in Rowland's Castle, these impacts will be mitigated by installing acoustic screens that would block line of sight between the noise source and receptors.
- 12.197. For receptors in Havant, temporary acoustic screens will be used to mitigate potentially significant night-time impact in most locations. Impacts from night-time earthworks at receptors along Swanmore Road would not be sufficiently mitigated by screens and earthwork activities around the south-west of the reservoir will be avoided, as shown in Figure 12.15 Areas that night works should avoid in ES Volume 3.

Pipeline corridor

Trenchless

- 12.198. The assessment of [daytime](#) trenchless construction of the pipeline shows that there is potential for significant daytime impacts at up to [400](#) residential receptors and [4 non-residential receptors](#).
- 12.199. [Implementation of the mitigation measures and best practicable means will ensure the impacts are mitigated as far as reasonably practicable.](#)
- 12.200. [After the implementation of mitigation measures and best practicable means, it is still expected that the below 60 receptors would experience a significant effect:](#)
- [5-6 Brunswick Garden \(two receptors close to Shaft 1\);](#)
 - [11, 19-22, and 25-29 Tarrant Garden \(ten receptors close to Shaft 3\);](#)
 - [9,11,13 and 15 Harestock Road \(four receptors close to Shaft 3\);](#)

- 39, 41, 43, 45 and 47 Corhampton Crescent (five receptors close to Shaft ED);
- 181-191, and 36 Purbrook Way (twelve receptors close to Shaft 5);
- 1, 3, 5, 7, 9, 11, 13, and 15 Ellisfield Road (eight receptors close to Shaft 5);
- 1 and 3 Eversley Crescent (two receptors close to Shaft 5);
- 77-80 Riders Lane (four receptors close to Shaft 6);
- 43 and 45 Dunsbury Way (two receptors close to Shaft 6);
- 220 and 218 Dunsbury Way (two receptors close to Shaft 6);
- Flat on the south facade of Staunton Heights (three receptors close to Shaft 6); and
- 73, 75, 79, 81, 85, and 87 High Lawn Way (six receptors close to Shaft 7).

- 12.201. The assessment of night-time trenchless construction of the pipeline shows that there is potential for significant night-time impacts at up to 304 residential receptors and 4 non-residential receptors.
- 12.202. After implementation of mitigation measures and best practicable means, night-time impacts will still be observed at 11 properties; however, the duration criteria for significant effect “exceedance of threshold for a period of 10 or more days of working in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months” is not met. Therefore, no night-time significant effect is expected.
- 12.203. Significant effects are not predicted due to 24/7 use of generators for dewatering purpose.
- 12.204. As suggested in the paragraph 12.189, contractor may provide noise insulation for properties if the noise levels exceed the criteria of BS 5228 Part 1 Table E.2.
- 12.205. Given the short duration of works, it is likely that the residual impacts can be minimised through effective communication with residents both prior to and during the works and not undertaking works at night unless necessary.

Open trench

- 12.206. The assessment of open trench construction of the pipeline shows that there is potential for significant daytime impacts from sections P2, Bedhampton section (P0) and reservoir pipeline (P10).
- 12.207. Implementation of the mitigation measures and best practicable means will ensure the impacts are minimised as far as reasonably practicable.
- 12.208. After the implementation of mitigation measures and best practicable means, it is expected that the significant effect will be limited to St Thomas More’s Catholic Primary School and 53 Hook’s Farm.
- 12.209. The assessment calculations assume all plant is operating simultaneously at the closest point to the receptor. This is unlikely to happen and therefore noise levels would be lower than those predicted.
- 12.210. Open trench construction can last from 100 to 340 days, including the site setup and de-mobilisation. However, the works would not be taking place in close proximity of any one receptor for the whole of the durations stated and therefore it is unlikely that noise levels at receptors would exceed the relevant thresholds for extended periods of time. For a significant effect to occur, noise levels must exceed, or be predicted to exceed, the relevant threshold for a period of 10 or more days of working in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months.
- 12.211. Though potential significant effect is predicted, given the short duration and the moving nature of works, it is likely that residual impacts can be minimised through effective communication with residents both prior to and during the works and not undertaking works at night unless necessary.

Culvert works, Bedhampton building modification works and Plant installation

- 12.212. The assessment of culvert works at Middle Park Way, Dunsbury Way and Purbrook Way shows potential for significant daytime impacts at all three locations. However, after implementing the mitigation measures and best practicable means, the significant effect will be limited to 193 Purbrook Way, three flats to the south of Staunton Heights, 222, 220 and 218 Dunsbury Way.
- 12.213. The temporary noise barriers / acoustic shrouds implemented to minimise the impacts from open trench works at Bedhampton compound will help mitigate the noise due to building modification and plant installation. With the barriers/ shrouds in place no significant effect is expected due to building modification and plant installations within Bedhampton Compound.

Construction Traffic

- 12.214. The Potential impacts section (paragraphs 12.122 to 12.130) highlights that the only roads with perceptible impacts from construction traffic are the two new reservoir access roads and the access roads to pipeline corridor worksites.
- 12.215. Whilst there is potential for a perceptible impact from the access roads for the reservoir, the forecast flows on the access roads are below the threshold where noise calculations are reliable, and it is unlikely that noise from the access roads would be perceptible above traffic noise from other roads closer to the sensitive receptors.
- 12.216. The construction traffic noise levels from the pipeline worksite access roads are potentially perceptible at the receptors close to the access roads, however predicted noise levels at 10m from the access roads are likely to be less than 58dB LA90,T, much lower than the nearby main roads.
- 12.217. Change in road noise at all other roads due to construction traffic are predicted to be less than 1 dB.
- 12.218. Therefore, it is considered that noise effects from construction traffic would be negligible.

Summary

- 12.219. For daytime construction works the conservative assessment shows that there is potential for significant effects from the trenchless construction, open trench construction of the pipeline and during the construction of the culvert, although these will be minimised through communication and the use of Best Practicable Means. Construction activities at the main reservoir site, access roads and construction traffic would not be significant.
- 12.220. Certain activities would be avoided during the night. If nighttime works are required on the reservoir site due to very exceptional circumstances, then potentially significant impacts will be avoided with temporary acoustic screens. For nighttime trenchless construction works across the railway tracks, potentially significant impacts will be minimised through communication and the use of Best Practicable Means. The use of quite generators during night-time for dewatering purpose will not result in significant effect. Any other night-time works will be undertaken only if the works are not reasonably practicable to be undertaken during daytime. These works will be of short duration, therefore, no significant effects are predicted for night-time works.

Construction vibration

Reservoir site

- 12.221. The Potential impacts section shows that during earth compaction activities in the reservoir site there would be a 33.3% probability of exceeding 3.0 mm/s PPV at receptors within 20 m of the earth compaction plant when it's operating at its maximum amplitude of vibration, or at receptors within 6 m when it is operating at its minimum amplitude of vibration.
- 12.222. This means that from the main reservoir site, vibrations would not be significant at sensitive receptors as no works would be within 20 m of them.

Pipeline corridor

Trenchless pipeline construction (tunnelling)

- 12.223. The potential impacts section shows that there are potential for significant vibration effects at few receptors along Section P1, P3, and P5. However, these impacts are expected to last only for few hours when the tunnelling occurs at the closest distance from the properties. Therefore, no potential impacts are expected at any of the receptors.
- 12.224. It should be noted that residual impacts at any of the receptors would be short term and through good communication with residents and employment of Best Practicable Means, it is likely that impacts can be minimised and therefore not considered to be significant.

Open trench and shaft location (ground compaction)

- 12.225. For the open trench construction of the pipeline, there is potential for significant vibration effects at few of the shaft locations and at Bedhampton. However, if the plant is operated at low amplitude when the distance between the receptor and plant is less than 20m, no impacts are expected. Therefore, there are no significant vibration effects in this area.

Piling at culvert and emergency discharge spillway

- 12.226. During sheet piling at culvert and emergency discharge spillway, there is potential for significant vibration effect at six receptors close to Shaft 6 / Dunsbury Way Culvert. The total duration of piling activity is expected to be less than 5 days; due to moving nature of works, no one receptor will be affected during the entire piling phase. Therefore, considering the short duration of impacts, piling is unlikely to cause significant effect. Implementation of mitigation measures will help minimise the impacts from the sheet piling.

Summary

- 12.227. Vibration effects are not expected from construction activities on the reservoir site or from open trench construction. There are potential for vibration impacts due to tunnelling. However, given the moving nature of work, vibration impacts are expected to occur for not more than a few hours. Impacts are also expected due to piling; however, due to moving nature of work and short duration of piling phase, impacts are unlikely to be significant. Therefore, no significant vibration effects are predicted for tunnelling and piling activity.

Operation

Reservoir site

- 12.228. The Potential impacts section highlights that the only roads with perceptible impacts from operational traffic are the two new reservoir access roads and one other road which is part of the development of Dunsbury Park, north of Fitzwygram Way.
- 12.229. The Dunsbury Park road has an impact both with and without the reservoir development and therefore the change is not considered to be an effect related to the reservoir Scheme.
- 12.230. Whilst there is potential for a perceptible impact from the access roads, the forecast flows on the access roads are below the threshold where noise calculations reliable and it is unlikely that noise from the access roads would be perceptible above traffic noise from other roads closer to the sensitive receptors. Impacts from all other roads are predicted to be less than 1 dB LA10,18h. Therefore, it is considered that effects from operational traffic would be negligible.

Pipeline corridor

- 12.231. Operational noise impacts from the pipeline section are not expected and this has not been assessed.

Plant noise at Bedhampton Compound

- 12.232. An operational noise assessment of the plants installed at Bedhampton Compound shows below adverse impact at the closest two noise sensitive receptor and low impact at all other receptors surrounding the Compound when all the plant are operating simultaneously. Therefore, the operational noise impacts are not considered significant.
- 12.233. The major contributor to the rating levels are the generator and PAC equipment. These two plant are rarely used, and in the absence of these noise sources, the impacts are expected to be low at all noise sensitive receptors. Even during its operation, the noise levels do not result in adverse effects. Therefore, the impacts are not considered to be significant.

Summary

- 12.234. Noise effects from the operation of the reservoir and pipeline are expected to be negligible.

Noise Monitoring

- 12.235. This assessment has shown that impacts from typical construction activities would cause significant effects. Therefore, targeted noise monitoring will be undertaken by the appointed contractor to ensure that noise levels do not regularly exceed the threshold for significant effect.
- 12.236. Where works causing vibration are proposed in close proximity to sensitive receptors, vibration levels will be monitored by the appointed contractor to ensure they do not exceed acceptable levels. It is prudent for the contractor to undertake building surveys at these sensitive receptors before and after works to determine if any damage to the structure is caused. closest to the works is appropriate.

Summary

Construction noise

Reservoir site

- 12.237. Noise levels from the reservoir including the access road construction are not predicted to exceed the threshold for potential impacts during the majority of the construction period. Where levels exceed the thresholds, they can be mitigated through good communication with residents and employment of Best Practical Means.
- 12.238. Night-time works are not routinely expected throughout the construction of the reservoir but may be required in very exceptional circumstances.
- 12.239. If night-time works are required, there would be potential impacts at some sensitive receptors. For receptors in Rowland's Castle and most of Havant, night-time impacts will be mitigated through the use of temporary acoustic screens.
- 12.240. For receptors along Swanmore Road, it may not be possible to completely mitigate night-time impacts from earthworks activities and such activities will be avoided around the South West of the reservoir.

Pipeline corridor

- 12.241. There is potential for significant effects from **the trenchless construction**, open trench construction along the pipeline corridor **and during the construction of culvert**.
- 12.242. The worst-case assessment has been presented. No correction has been made for screening from the existing buildings, which may benefit receptors that are not adjacent to the works. Therefore, the actual number of receptors with potential impacts is likely to be lower than those shown in this report.
- 12.243. Due to the rate of progression of pipeline construction, receptors are only likely to be impacted for short periods of time. The effects of noise are not expected to be significant from open trench.
- 12.244. **For trenchless construction, 60 receptors are likely to experience a significant effect.**
- 12.245. **For open trench construction 2 receptors are likely to experience a significant effect.**
- 12.246. **For culvert construction 7 receptors are likely to experience a significant effect.**
- 12.247. **The mitigation measures and best practicable means will be implemented to minimise the extent of residual significant effect.**
- 12.248. **Given the short duration of works, it is likely that residual impacts can be mitigated through good communication with residents both prior to and during the works and not undertaking works at night unless absolutely necessary.**

Construction traffic

- 12.249. The majority of roads would experience a negligible change in noise from construction traffic and are therefore impacts are not considered to be significant.
- 12.250. There are impacts predicted from the two new reservoir access roads **and the access roads to pipeline worksites**. Whilst there are receptors within 50 m of these new roads, given the low forecast flows, it is unlikely that noise from the access roads would be distinguishable above traffic on existing roads. Therefore, the impacts from the access roads are not considered to be significant.

Construction vibration

Reservoir site

- 12.251. With plant operating at its maximum amplitude of vibration there is potential for significant impacts at receptors within 20 m.
- 12.252. As no vibration inducing works on the reservoir site are proposed within 20 m of receptors, there are no significant effects from vibration.
- 12.253. **This ES Addendum Noise and Vibration has assessed the potential noise and vibration impacts from proposed changes to the main reservoir embankment.**

- 12.254. There has been no significant changes in planning policies or relevant standards that would effect the noise and vibration assessment. There are no changes to the construction methodology.
- 12.255. There has been no identified changes to the receptors and baseline conditions.
- 12.256. The proposed changes for the Scheme move the locations of the main reservoir embankment, reservoir culvert and valve tower further away from any receptors compared to the design at the 2020 ES. The predicted construction noise levels are therefore reduced compared to the 2020 ES.
- 12.257. There are no expected changes in operational noise.
- 12.258. The proposed change has no greater noise and vibration effects compared to those reported in the 2020 ES. Therefore, there are no additional impacts to report and the mitigation measures proposed in the 2020 ES continue to remain appropriate.
- 12.259. The currently consented mitigation and monitoring remain appropriate.

Pipeline corridor

Trenchless construction

- 12.260. Vibration levels that exceed 3.0 mm/s may occur at 11 receptors close to the tunnel route. However, the vibration impacts are expected to occur for not more than a few hours during each pass of TBM and is not significant. Vibration levels are unlikely to cause any cosmetic damage to buildings during the tunnelling phase.
- 12.261. Vibration levels may exceed the 3.0 mm/s at 6 receptors during the piling phase. However, given the moving nature of works and short duration of piling phase, the impacts are unlikely to be significant. Piling is unlikely to cause any cosmetic damage to the buildings.

Open cut trench construction and above ground works

- 12.262. Operation of plant at minimum amplitude close to sensitive receptors would avoid potentially significant vibration impacts from occurring.
- 12.263. No significant vibration effects from open trench construction are predicted.

Operational noise

Reservoir site

- 12.264. The majority of roads would experience a negligible change in noise due to operational traffic and are therefore not considered to be significant.
- 12.265. There are impacts predicted from the two new reservoir access roads. Whilst there are receptors within 50 m of these new roads, given the low forecast flows, it is unlikely that noise from the access roads would be distinguishable above traffic on existing roads. Therefore, the impacts from the access roads are not considered to be significant.

Pipeline corridor

- 12.266. Operational noise impacts from the pipeline section are not expected.

Plant noise at Bedhampton Compound

- 12.267. Operational noise due to operation of plant within Bedhampton Compound is expected to have below adverse impact and is not considered to cause any significant effects.

Overall summary

- 12.268. Construction of the reservoir would not result in significant effects unless works are required at night. If night-time works are required these should be limited to those which can be mitigated with temporary acoustic screens.
- 12.269. Significant effects are predicted at 69 receptors for the construction of the pipeline corridor. These will be minimised with temporary acoustic screens, acoustic shrouds, implementation of best practicable means and through good communication. No significant vibration effects are expected at any of the receptors.
- 12.270. Noise effects from the operation of the reservoir and pipeline are expected to be negligible.

12.271. Operation of plant within Bedhampton Compound is expected to have below adverse impact and is not considered to cause significant effects.



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