Southampton to London Pipeline Project

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Southampton to London Pipeline Project

Esso Petroleum Company, Limited

Appendix 13.3: Noise and Vibration Technical Note

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1 Introduction

1.1.1 This Technical Note considers the potential for the following activities to give rise to noise and vibration effects:

- installation activity within the Order Limits (described in Chapter 3 Project Description), including compounds, site haul routes and trenchless crossings;
- changes to vehicle movements on public highways during installation (described in Appendix 13.1 Traffic and Transportation Technical Note; and
- the operation of the pipeline, including normal pumping operations, maintenance, and inspection.

1.1.2 The European Directive 2002/49/EC relating to the assessment and management of environmental noise defines environmental noise as:

'*unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity.*'

1.1.3 Vibration refers to oscillatory movement within solid objects and structures, which can be transmitted through the air or the ground.

1.1.4 This Technical Note includes a summary of the likely effects associated with each of the activities identified above on human receptors (i.e. dwellings, schools, hospitals, places of worship, recreational areas, and other noise-sensitive locations) to support Chapter 13 People and Communities. Effects of noise and vibration on ecological receptors are considered in Chapter 7 Biodiversity. Effects of noise and vibration on the historic environment are considered in Chapter 9 Historic Environment.

Legislative and Policy Background

1.1.5 Chapter 2 Regulatory and Policy Context sets out the overarching policy relevant to the project including the Overarching National Policy Statement for Energy (EN-1). EN-1 contains the following paragraphs relating to land use which have been considered within this appendix.

1.1.6 Paragraph 5.11.4 states that the nature and extent of the noise assessment should be proportionate to the likely noise impact and '*Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment*:

- *a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;*
- *identification of noise sensitive premises and noise sensitive areas that may be affected;*
- *the characteristics of the existing noise environment;*
- *a prediction of how the noise environment will change with the proposed development;*

- *in the shorter term such as during the construction period;*
- *in the longer term during the operating life of the infrastructure;*
- *at particular times of the day, evening and night as appropriate.*
- *an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and*
- *measures to be employed in mitigating noise*.'

1.1.7 Paragraph 5.11.5 states that '*the noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered*.'

1.1.8 Paragraph 5.11.6 states that '*Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance*.'

1.1.9 In addition, Appendix 2.1 Environmental Legislation and Policy includes legislation and national policy relevant to noise and vibration. Appendix 2.2 Regional and Local Planning Policy provides a review of local policy considerations relevant noise and vibration.

2 Assessment Approach

2.1 Scope of the Assessment

2.1.1 The scope of the noise and vibration assessment has been informed by the Scoping Opinion, provided by the Planning Inspectorate in September 2018, on behalf of the Secretary of State, following the submission of the Scoping Report (Esso, 2018).

2.1.2 Table 13.1 summarises the scope of the assessment for noise and vibration. This table includes the references (for example ID 4.6.1) to the relevant paragraph response from the Planning Inspectorate in the Scoping Opinion. The boxes shaded in grey are the matters that have been scoped out of the assessment following the feedback from the Planning Inspectorate.

Table 2.1: Matters Scoped In and Out of the Assessment (Grey Shading Indicates Matters Scoped Out Following Feedback from the Planning Inspectorate)

Receptor	Matter / Potential Effect	Conclusion in the SR (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
Noise and vibration	Noise from site construction activity (urban and rural areas)	Scoped in	Scoped in
	Vibration from ground compaction (buildings / structures and humans)	Scoped in	Scoped in
	Vibration from trenchless construction (buildings / structures and humans)	Scoped in	Scoped in

Receptor	Matter / Potential Effect	Conclusion in the SR (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
	Noise and vibration from construction vehicles on public highway	Scoped in	(ID 4.11.14) The Environmental Statement (ES) should confirm the anticipated construction vehicle movements and present an assessment of noise and vibration effects of construction vehicle movements on sensitive receptors, where significant effects are likely to occur.
	Noise and vibration from operation of Alton Pumping Station	Scoped in	(ID 4.11.15) The ES should provide a description of the likely works to upgrade and modernise the existing pumping station at Alton. Where changes to noise and vibration emissions and characteristics may result in likely significant effects to sensitive human or ecological receptors, these should be assessed in the ES.
	Noise and vibration from operation of the proposed pigging station at Boorley Green	Scoped in	(ID 4.11.15) The ES should provide a description of the proposed pigging station at Boorley Green. Where changes to noise and vibration emissions and characteristics may result in likely significant effects to sensitive human or ecological receptors, these should be assessed in the ES.
	Noise and vibration as a result of the flow of fuel in the pipeline and the operation of valves	Scoped out	(ID 4.11.15) The Inspectorate agrees that effects of noise and vibration as a result of the flow of fuel in the pipeline and the operation of valves can be scoped out of the ES.

2.1.3 The Scoping Opinion requested that the ES provide details on the works to the proposed pigging station at Boorley Green (ID 4.11.15). Pigging stations allow the insertion and withdrawal of pipeline inspection gauges (PIGs) into and out of the pipeline. A new pigging station would be constructed southwest of Netherhill Lane between Boorley Green and Durley. The pigging station would contain valves, a PIG receiver and a PIG launcher.

2.1.4 These facilities are essentially sections of pipework that enable PIGs to enter and exit the main pipeline. As such, they do not contain any machinery or plant or any other moving parts and are not sources of environmental noise or vibration. The movement of PIGs along buried pipelines, and the entry or exit of PIGs at pigging stations, are quiet activities with no noticeable noise above ground.

2.1.5 Over the lifetime of the existing pipeline, there have been no known instances of perceptible noise or vibration above ground due to pigging operations. Noise and vibration associated with activities at the pigging station during the operation of the pipeline are therefore scoped out and not assessed further in this Technical Note.

2.2 Study Area

2.2.1 For installation activities, the study area comprises all human receptors within a corridor of at least 500m from the Order Limits. No significant noise or vibration effects have the potential to occur outside this area.

2.2.2 For noise and vibration from construction vehicles on public highways, the study area has included receptors near the transport network described in Appendix 13.1 Traffic and Transport Technical Note.

2.2.3 For noise and vibration from the operation of Alton Pumping Station, the assessment has considered the closest receptors, approximately 350m away. No other receptors have the potential to experience significant noise or vibration effects.

3 Baseline Conditions

3.1.1 Baseline noise levels are likely to vary along the pipeline route as it passes through a variety of rural and urban settings. The main factors that affect baseline noise levels are expected to be as follows:

- Higher noise levels would be expected at locations closer to transport infrastructure and industrial activity.
- Diurnal patterns – higher noise levels would be expected at times of peak transport activity and lowest at night.
- Meteorological conditions – noise levels would be at their lowest in the absence of wind and rain.

3.1.2 For the reasons outlined in Section 2 and below, a survey of background noise levels has not been undertaken to support the assessment.

3.1.3 There are no particular sources of ground borne vibration identified along the route other than highways and railways. Existing levels of vibration present at receptors (including those adjacent to highways and railways) would not influence the assessment as they are typically orders of magnitude below levels that would give rise to adverse vibration effects. Therefore a survey of baseline vibration levels has not been undertaken to support the assessment.

3.1.4 The way in which baseline noise is considered in the different assessments presented in this Technical Note is summarised as follows:

- The method for the assessment of noise during installation is based on Annex E.2 of BS 5228-1:2009+A1:2014 (British Standards Institution (BSI), 2014a). This approach is based on absolute thresholds, rather than those set in relation to ambient noise levels. Therefore, existing ambient (baseline) noise levels are not required to inform the assessment of noise during installation.
- The assessment of vibration effects during installation is based on fixed thresholds detailed in BS 5228-2:2009+A1:2014 (BSI, 2014b). Therefore, baseline vibration levels are not required to inform the assessment of vibration during installation.
- The assessment of noise and vibration associated with traffic on public highways during installation is based on a comparison of the traffic flow without the project against the traffic flow with the additional vehicles during installation. Therefore, measurements of baseline traffic noise are not required to inform the assessment of traffic noise during installation.
- The potential noise impacts due to the operation of a replacement pump at Alton Pumping Station have been assessed by comparing predicted pump noise levels to existing levels of traffic noise and fixed noise thresholds from relevant guidance. A review of mapping and aerial photography identified existing noise levels in the vicinity of the pumping facilities at Alton Pumping Station are likely

to be dominated by road traffic noise from the A31 and the Alton line of the South Western main line railway, which passes immediately to the south. Strategic noise mapping of the A31 was undertaken by the Department for Environment, Food and Rural Affairs (Defra) in 2012 to satisfy the requirements of the Environmental Noise Directive. These results (Extrium, 2018) have been used to describe existing traffic noise levels at receptors near Alton Pumping Station.

- There are no other new sources associated with the operation of the pipeline that have the potential to cause a significant adverse operational noise effect, and this Technical Note does not include a noise assessment based on the principles of BS 4142:2014 (BSI, 2014c). A survey of background noise levels has therefore not been undertaken to support the assessment of operational noise.
- There are no new proposed sources of ground borne vibration associated with the project that could have an adverse effect during the operation of the pipeline.

4 Design Basis and Activities

4.1 Noise and Vibration from Pipeline Installation Activity

4.1.1 Noise and vibration from installation plant activity would be associated with the various activities which are described in further detail in Chapter 3 Project Description.

4.1.2 The installation of the pipeline would require use of plant and equipment including air compressors; excavators; excavator mounted breakers; tipper lorries; haulage lorries; angle grinders; vibratory piling rigs; auger units; horizontal directional drilling (HDD) units and concrete pumps.

4.1.3 The earthworks associated with the construction of the pipeline would require use of plant and equipment including: excavators; water pumps; bulldozers; dumper trucks; vibratory rollers; and tipper lorries.

4.1.4 To aid design development and environmental assessment, the route was broken down into eight separate sections (Section A to Section H). The length of pipeline that would be laid per week would be typically 450m in open areas and approximately 90m in urban areas.

Project Commitments Relating to Noise and Vibration

4.1.5 All commitments are listed within the Register of Environmental Actions and Commitments (REAC), which is included within Chapter 16 Environmental Management and Mitigation. Commitments include embedded design measures, good practice measures and mitigation required to reduce a significant effect.

4.1.6 This appendix contains a number of project commitments to reduce impacts on the environment. These are indicated by a reference number like this (G20). Good practice measures are set out in the REAC and secured through DCO requirements such as the Construction Environmental Management Plan (CEMP).

4.1.7 The good practice measures that are most relevant to noise and vibrations are listed in Table 4.1. These are applicable to all areas unless stated otherwise.

Table 4.1: Good Practice Commitments within the REAC

Ref	Commitment Description
G5	Construction would take place during the normal working hours of 07:00 to 19:00 Mondays to Saturday. Sunday or Bank Holiday working is not anticipated as being typical. Exceptions may be required for bank holiday and Sunday working (restricted to 08:00 to 18:00) or night-time working for activities such as the continuous pulling phase for a major crossing using HDD; where daytime working would be excessively disruptive to normal traffic operation; cleaning/testing of the pipeline; or overnight traffic management measures.
G98	Noise and vibration from construction plant and machinery impacts would be mitigated by adopting measures in the following hierarchy: • control at source – for example the selection of quieter equipment; • the choice of location for equipment on site; • control of working hours; and • the provision of acoustic enclosures around equipment or barriers around work sites.
G99	The contractor would be required to produce a Noise and Vibration Management Plan for the approval of the relevant planning authority. The Noise and Vibration Management Plan would, having regard to the approved operational hours, set out where applicable, the best practicable means that would be used to reduce noise and vibration during installation.
G100	The Noise and Vibration Management Plan would include the following details in relation to the project within the relevant local authority area: • description of works pursuant to DCO; • programme; • plant noise and vibration data; • receptors at risk of > 1.0 mm/s peak particle velocity and a protocol for providing prior warning and explanation; • best practicable means (BPM) measures where applicable (as defined in Section 72 of CoPA 1974) for the control of noise and vibration; • predicted noise and vibration levels; and • BPM justification for short term higher noise/vibration levels or out-of-hours working and community communication details.

4.2 Noise and Vibration from Construction Vehicles on Public Highway

4.2.1 This assessment is based on traffic assumptions set out within Appendix 13.1 Traffic and Transportation Technical Note. Vehicle traffic movements on public highways during pipeline installation would be associated with the following:

- delivery of sections of pipe, plant, machinery, welfare and other materials using heavy good vehicles to logistics hubs and construction compounds; and
- daily access to and from construction compounds and work fronts by workers in light vehicles.

4.3 Noise and Vibration from Operation of the Pipeline

4.3.1 The only activity with potential to give rise to noise and vibration effects during operation is the usage of a pump at Alton Pumping Station that would be replaced as part of the project.

4.3.2 There are currently three existing external pumps at Alton Pumping Station. There have been no historical issues or complaints associated with the operation of the existing pumps. As part of the proposed upgrade, one pump would be replaced by

another pump of a similar size and type to the existing pumps. The existing and replacement pumps would operate at any time of the night or day.

4.3.3 The electrical rating of the proposed replacement pump is expected to be up to 600kW.

5 Assessment Methodology

5.1 Noise and Vibration from Pipeline Installation Activity

5.1.1 Noise levels during installation have been calculated at different receptor locations for each of the various activities, in accordance with the procedures outlined in BS 5228-1:2009+A1:2014 (BSI, 2014a). As the activities would steadily progress along the pipeline route, the calculations have adopted the method for mobile plant defined in Section F.2.5 of BS 5228-1:2009+A1:2014 (BSI, 2014a). These calculations have taken the following factors into account:

- the type of plant for each activity;
- the total time the plant is likely to operate during the working day;
- the number of vehicles movements/passages per hour; and
- the speed of plant movement.

5.1.2 Tables 5.1 and 5.2 present noise calculation input data for sections of open cut. The plant selection in these tables is considered to represent a realistic conservative estimate.

5.1.3 Table 5.3 presents noise calculation input data for works that would be located in a particular location for a longer period of time, such as construction compounds, logistics hubs and trenchless crossing locations (as described in Chapter 3 Project Description). These calculations follow the methodology for sound power sources defined in Section F.2.3.2 of BS 5228-1:2009+A1:2014 (BSI, 2014a).

5.1.4 Table 5.4 presents noise calculation input data for activities that may need to be carried out outside the typical working hours.

5.1.5 The estimated number of days that noise from each activity would occur at the closest receptors is provided in Table 5.5. Note that more than one activity could occur near a receptor on any single day.

Table 5.1: Calculation of Average Daily Activity Noise Levels (Typical Rural Open Cut Sections)

Activity	Equipment										Activity L_{Aeq} at 10m, dB
	Project Plant Description	BS 5228 Ref. for Closest Available Substitute Plant	L_{WA}, dB	% On-time	Corrected L_{WA}, dB	No. Passages per Day	Progress (m / day)	No. Passages per Hour	Speed (km/h)	Adjusted L_{Aeq} at 10m, dB	
Fencing	Tractor	C4.75	107	100	107	1	200	0.125	0.025	71	72
	Post rammer	-	113	1	93	1	200	0.125	0.025	57	
	Nail Gun	-	120	1	100	1	200	0.125	0.025	64	
Topsoil strip	Tracked excavator 25t	C2.19	105	100	105	1	100	0.125	0.0125	72	72
Haul road preparation	Delivery dumper	C4.3	104	100	104	80	-	10	5	64	77
	Tracked excavator 7t	C4.12	105	100	105	1	50	0.125	0.00625	75	
	Roller	C5.20	103	100	103	1	50	0.125	0.00625	73	
Pipe stringing	Tractor	C4.75	107	100	107	40	-	5	5	64	73
	Lorry	C2.34	108	100	108	1	250	0.125	0.03125	71	
	Tracked excavator 25t	C2.19	105	100	105	1	250	0.125	0.03125	68	
Pipe welding	Welder	C3.31	101	50	98	1	50	0.125	0.00625	68	70
	Welding generator	C3.33	85	100	85	1	50	0.125	0.00625	55	
	Angle grinder	C4.93	108	5	95	1	50	0.125	0.00625	65	
Excavation	Tracked excavator 30t	C2.16	103	100	103	2	100	0.25	0.0125	73	73
Pipe laying	Tracked excavator 30t	C2.16	103	100	103	2	90	0.25	0.01125	73	73
Backfill	Tracked excavator 30t	C2.16	103	100	103	2	100	0.25	0.0125	73	73
Compaction	Vibratory roller	C5.20	103	100	103	2	100	0.25	0.0125	73	73
Re-instatement	Tracked excavator 30t	C2.16	103	100	103	1	70	0.125	0.00875	72	77
	Tractor	C4.75	107	100	107	1	70	0.125	0.00875	76	

Table 5.2: Calculation of Average Daily Activity Noise Levels (Typical Urban Open Cut Sections)

Activity	Equipment										Activity L_{Aeq} at 10m, dB
	Project Plant Description	BS 5228 Ref. for Closest Available Substitute Plant	L_{WA}, dB	% On-time	Corrected L_{WA}, dB	No. Passages per Day	Progress (m / day)	No. Passages per Hour	Speed (km/h)	Adjusted L_{Aeq} at 10m, dB	
Trial holes	Saw	C4.73	112	10	102	1	18	0.125	0.00225	76	81
	Breaker	C1.6	111	25	105	1	18	0.125	0.00225	79	
Main laying	Saw	C4.73	112	25	106	1	18	0.125	0.00225	80	84
	Hydraulic breaker	C5.1	116	10	106	1	18	0.125	0.00225	80	
	Tracked excavator	C5.11	101	100	101	1	18	0.125	0.00225	75	
	Dumper (removal)	C4.3	104	100	104	8	18	1	5	54	
	Dumper (bedding)	C4.3	104	100	104	8	18	1	5	54	
	Pipe delivery lorry	C2.34	108	100	108	1	18	0.125	5	49	
Pipe welding	Welder	C3.31	101	50	98	1	18	0.125	0.00225	72	74
	Welding generator	C3.33	85	100	85	1	18	0.125	0.00225	59	
	Angle grinder	C4.93	108	5	95	1	18	0.125	0.00225	69	
Backfill	Dumper	C4.3	104	100	104	12	18	1.5	5	56	85
	Trench rammer	-	108	100	108	2	18	0.25	0.00225	85	
Re-instatement	Saw	C4.73	112	10	102	1	18	0.125	0.00225	76	86
	Whacker plate	C5.29	110	50	107	1	18	0.125	0.00225	81	
	Vibratory roller	C5.22	109	50	106	1	18	0.125	0.00225	80	
	Delivery lorry	C2.34	108	25	102	2	18	0.25	0.00225	79	

Table 5.3: Calculation of Average Daily Activity Noise Levels (Typical Construction Compounds, Logistics Hubs and Trenchless Locations)

Activity	Equipment							Activity L_{Aeq} at 10m, dB
	Project Plant Description	BS 5228 Ref. for Closest Available Substitute Plant	L_{WA}, dB	% On-time	Corrected L_{WA}, dB	No. Plant Items	Adjusted L_{Aeq} at 10m, dB	
Construction compound / Logistics Hub installation	Tracked excavator 25t	C2.19	105	100	105	1	77	80
	Delivery lorry for geotextile material	C2.34	108	10	98	1	70	
	Rolling and compaction	C5.22	109	25	103	1	75	
Construction compound / Logistics Hub usage	Generator for site cabins	C4.78	94	100	94	1	66	78
	Lorry for delivery of materials	C2.34	108	10	98	1	70	
	Dumper for movement of materials	C4.3	104	50	101	1	73	
	Excavator for movement of materials	C2.19	105	50	102	1	74	
Piling at trenchless crossing locations	Vibratory piling rig	C3.8	116	40	112	1	84	84
HDD / auger boring	Generator for site cabins	C4.78	94	100	94	1	66	84
	Excavation of pit	C2.16	103	50	100	1	72	
	Excavator for assisting on pullback	C2.19	105	50	102	1	74	
	Dumper for movement of materials	C4.3	104	10	94	1	66	
	Drilling equipment	C3.15	110	100	110	1	82	
	Generator for drill	C4.96	105	100	105	1	77	

Table 5.4: Calculation of Average Daily Activity Noise Levels (Typical Out-of-Hours Working)

Activity	Equipment							Activity L_{Aeq} at 10m, dB
	Project Plant Description	BS 5228 Ref. for Closest Available Substitute Plant	L_{WA}, dB	% On-time	Corrected L_{WA}, dB	No. Plant Items	Adjusted L_{Aeq} at 10m, dB	
Out of hours deliveries	Generator for site cabins	C4.78	94	100	94	1	66	77
	Lorry for delivery of materials	C2.34	108	25	102	1	74	
	Dumper for movement of materials	C4.3	104	40	100	1	72	
HDD / auger boring	Generator for site cabins & lighting	C4.78	94	100	94	1	66	84
	Excavator for assisting on pullback	C2.19	105	50	102	1	74	
	Dumper for movement of materials	C4.3	104	10	94	1	66	
	Drilling equipment	C3.15	110	100	110	1	82	
	Generator for drill	C4.96	105	100	105	1	77	
Hydrostatic pressure testing	Pump	C11.1	109	100	109	1	81	81
	Generator for pump	C4.78	94	100	94	1	66	

Table 5.5: Estimated Number of Days that Activities Could Cause Noise at Closest Receptors

Location	Activity	Estimated Number of Days
Rural	Fencing	2
	Topsoil strip	2
	Haul road preparation	10
	Pipe stringing	3
	Pipe welding	3
	Excavation	3
	Pipe laying	1
	Backfill	2
	Compaction	2
	Reinstatement	3
Urban	Each activity (see Table 5.3)	3
Construction compound / logistics hub	Set up	3
Construction compound / logistics hub	Installation use	20
Trenchless crossing drive sites	Horizontal directional drilling / auger bore	20

5.1.6 The Computer Aided Noise Abatement (CadnaA) noise modelling software published by DataKustik GmbH, was used to undertake all installation noise calculations. The software was configured to use the noise prediction methodology set out in BS 5228-1:2009+A1:2014 (BSI, 2014a).

5.1.7 The CadnaA software allows a noise propagation model to be constructed using spatial data obtained from Ordnance Survey (OS).

5.1.8 The noise modelling process takes the information listed below into account.

- Noise emission data – the activity L_{Aeq} results presented in Table 5.1 to Table 5.4.
- Receptor locations and classifications have been taken from the OS AddressBase Plus dataset.
- Distance between noise source and receptor based on the development plans and OS Mastermap data.
- Small building features (i.e. those with areas less than $20m^2$) that relate to small outbuildings and other structures have been removed from the dataset to ensure that screening is only provided by large structures in the model.
- Ground attenuation – acoustically absorptive ground (such as grassland or other ground surfaces suitable for growing vegetation) provides more attenuation than acoustically hard ground (such as concrete, water and paving). For propagation across rural areas, absorptive ground (corresponding to a ground absorption coefficient of 1) has been used for all calculations presented in this assessment. For propagation in urban areas, hard ground (corresponding to a ground absorption coefficient of 0) has been used.
- Where works are taking place in a trench, the acoustic screening provided by trench walls is not taken into account.

- No ground height contours have been incorporated into the model, which means that attenuation due to ground screening has not been accounted for in the model.

5.1.9 Based on the principles described in Annex E.2 and E.3.3 of BS 5228-1:2009+A1:2014 (BSI, 2014a), the values presented in Table 5.6 have been adopted as assessment thresholds. The calculated receptor noise levels have been compared to these thresholds to derive the magnitude of change.

5.1.10 For daytime installation noise, the highest monthly average noise level over the works has been used to derive the magnitude of change. For night-time noise, the magnitude of change is based on the noisiest night during the works.

5.1.11 The activities that would occur outside normal working hours (e.g. pipe pulling at trenchless sites) could occur during both evening and night periods. The greatest potential for impact out of hours would occur during the night. The assessment has therefore considered the impacts during the night to provide a precautionary assessment approach. Where out of hours works occur only during the evening, impacts would be lower than identified, as assessment thresholds are typically lower for evening periods than night periods.

Table 5.6: Adopted Assessment Thresholds for Noise Impacts During Installation

Receptor Type	Period	Relevant Free Field External Noise Level $L_{Aeq,T}$, dB	Source
Residential receptors in rural and suburban locations	Day	70	BS 5228-1:2009+A1:2014 Annex E.2 / AL72 (BSI, 2014a)
Residential receptors in urban areas	Day	75	BS 5228-1:2009+A1:2014 Annex E.2 / AL72 (BSI, 2014a)
Educational, religious, health and other noise sensitive community facilities	Day	65	Lower daytime threshold from example method presented in BS 5228-1:2009+A1:2014 Annex E.3.3 (BSI, 2014a).
Industrial/commercial/retail	Day	75	BS 5228-1:2009+A1:2014 Annex E.2 / AL72 (BSI, 2014a)
Residential receptors	Night	45	World Health Organization's Guidelines for Community Noise (Berglund et al., 1999)

5.1.12 In order to determine the significance of effects using the procedure outlined in Chapter 6 Overview of Assessment Process, the magnitudes of change presented in Table 5.7 have been selected using professional judgement. All human receptors are considered to have medium sensitivity.

Table 5.7: Magnitude of Change

Magnitude of Change	Criteria
Large	Exceedance of relevant threshold by 5dB or greater
Medium	Exceedance of relevant threshold by less than 5dB
Small	Compliance with relevant threshold by less than 5dB
Negligible	Compliance with relevant threshold by 5dB or greater

5.1.13 The thresholds in Table 5.6 are considered to represent the onset of significant effects.

5.1.14 Using the CadnaA noise model and the input data described above, the numbers of sensitive receptors that could experience significant effects were calculated for the following assessment periods:

- Day;
- Night; and
- Day or Night.

5.1.15 The number of receptors within the 'Day or Night' category is not always the sum of the number of receptors within the 'Day' and 'Night' categories, as some properties that experience noise effects during the day could also experience effects during the night. It should be noted that whether a receptor is at risk is of daytime or night time effects is location dependent (with potential night time works only identified in certain areas).

5.1.16 The predicted effects during installation have also been described in terms of Government policy. The Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) are defined in the Noise Policy Statement for England (NPSE) (Defra, 2010) and the Planning Practice Guidance for Noise (PPG-Noise) (Ministry of Housing, Communities & Local Government, 2014). The LOAEL is defined in the NPSE as "*the level of noise exposure above which adverse effects on health and quality of life can be detected*." PPG-Noise defines the LOAEL as the level above which 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*."

5.1.17 A daytime outdoor level of 50dB $L_{Aeq,16h}$ has been adopted as the LOAEL at all human receptors. This is the level that relates to the onset of 'moderate annoyance', according to the World Health Organization Guidelines for Community Noise (Berglund et al., 1999).

5.1.18 For night periods a LOAEL of 40dB $L_{Aeq,8h}$ has been adopted, based on the recommendations for the avoidance of sleep disturbance in the Night Noise Guidelines for Europe (World Health Organization, 2009). It is not considered that there would be any noticeable change in quality of life at levels below these values, given the temporary nature and expected overall duration of the works.

5.1.19 The SOAEL is defined in the NPSE as "*the level above which significant adverse effects on health and quality of life occur*." PPG-Noise defines the SOAEL as the level above which 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*." As exceedance of the SOAEL relates to material change in behaviour and/or attitude, it is considered to represent a degree of effect beyond the onset of a

significant adverse effect identified under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

5.1.20 For day periods, an exceedance of 75dB $L_{Aeq,16h}$ for a cumulative total of 30 days or more has been adopted as the SOAEL (i.e. when the threshold is exceeded for 30 days or more over the duration of works). Note that this is not directly comparable to the threshold values presented in Table 5.6, which relate to a calculated average monthly noise level.

5.1.21 For night periods, the Night Noise Guidelines for Europe (World Health Organisation, 2009) introduced an interim target of 55dB $L_{Aeq,8h}$ as an annual average. An exceedance of this threshold for a cumulative total of 30 nights or longer has been adopted as the SOAEL.

5.1.22 The adopted LOAEL and SOAEL values for residential receptors are summarised in Table 5.8.

Table 5.8: Adopted LOAEL and SOAEL Values for Noise Impacts During Installation

Period	Adopted LOAEL	Adopted SOAEL
Day	50dB $L_{Aeq,16h}$	Exceedance of 75dB $L_{Aeq,16h}$ for a cumulative total of 30 days
Night	40dB $L_{Aeq,16h}$	Exceedance of 55dB $L_{Aeq,8h}$ for a cumulative total of 30 nights

5.1.23 The adopted SOAEL values are commensurate with those that have previously been adopted for the assessment of construction noise in approved applications for development consent (e.g. the A14 Cambridge to Huntingdon Improvement Scheme).

5.1.24 It should be recognised that there is no evidence that occupants of buildings near short term construction works experience significant health effects. The concepts of LOAEL and SOAEL have been applied to the assessment of noise during installation on a precautionary basis.

Vibration from Site Equipment During Installation

5.1.25 Prediction of free-field vibration levels arising from the use of piling rigs and vibratory plant and equipment (such as horizontal drilling rigs or rotary ground compaction plant) during the works has been undertaken using the calculation methodologies set out in BS 5228-2:2009+A1:2014 (BSI, 2014b). The horizontal distances from equipment at which significant effects are possible have been calculated. The predicted vibration levels are presented in terms of the peak particle velocity (mm/s), which is commonly abbreviated to PPV.

5.1.26 Other items of surface plant are not recognised as sources of high levels of environmental vibration. They would be expected to generate vibration levels well below those at which cosmetic building damage is predicted to occur, or where it is likely that vibration in residential environments would result in complaints. Therefore, a quantitative assessment of vibration from other items of surface plant has not been undertaken.

5.1.27 The assessment thresholds are based on relevant guidance within BS 5228-2:2009+A1:2014 (BSI, 2014b) for human response. These are based on thresholds in BS 7385-2:1993 (BSI, 1993) and BS 6472-1:2008 (BSI, 2008).

5.1.28 The adopted threshold for medium magnitude of change for continuous vibration within buildings is a PPV of 1.0mm/s. The effect at this level is described in BS 5228-2:2009+A1:2014 (BSI, 2014b) as follows: '*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'*.

5.1.29 When determining the significance, the likely duration of effect has also been considered using professional judgement.

5.2 Noise and Vibration from Construction Vehicles on Public Highways

5.2.1 Guidance set out in 'Calculation of Road Traffic Noise' (Department for Transport and the Welsh Office, 1988) and the Design Manual for Roads and Bridges (Highways Agency, 2011) has been used to formulate a proportionate assessment method to consider the potential noise and vibration effects due to traffic on public highways during installation.

5.2.2 The adopted assessment thresholds, which are presented in Table 5.9, are based on those in the 'Classification of Magnitude of Noise Impacts in the Long Term' presented in the Design Manual for Roads and Bridges (Highways Agency, 2011). These are seen as the most appropriate given the temporary nature of the noise impacts.

Table 5.9: Adopted Thresholds for Noise from Traffic on Public Highways During Installation (Highways Agency, 2011)

Change in Traffic Noise Level, dB $L_{A10,18hr}$	Magnitude of Change	Significance of Effect
0.1 – 2.9dB	Negligible	Negligible, not significant
3.0 – 4.9dB	Small	Minor, not significant
5.0 – 9.9dB	Medium	Moderate, significant
>= 10 dB	Large	Major, significant

5.2.3 Data from Appendix 13.1 Traffic and Transport Technical Note have been reviewed to establish the change in traffic noise levels during installation.

5.3 Noise and Vibration from Operation of the Pipeline

5.3.1 A source sound power level for the replacement pumping equipment at Alton Pumping Station has been derived using the empirical formula for estimating the sound power of pumps provided in 'Engineering Noise Control – Theory and Practice' by Bies and Hansen (2009). This formula is based on research undertaken by the United States Army in the 1970s and is considered to represent an appropriately precautionary methodology.

5.3.2 The noise levels due to pumping activity at the nearest residential property have been calculated using the propagation algorithms contained in ISO9613-2 (ISO, 1996). These calculated levels have been compared to average daytime and night-time traffic noise levels which have been taken from strategic noise mapping of the A31 undertaken by Defra in 2012 to satisfy the requirements of the Environmental Noise Directive.

5.3.3 Additionally, predicted operational levels have been compared to the LOAEL for night-time noise effects of 40dB $L_{Aeq,8h,}$ based on recommendations from the World Health Organization (2009).

5.3.4 Where predicted operational levels are below both the ambient noise levels and the LOAEL, operational noise is deemed to be minor, and not significant. Where predicted operational levels are greater than 10dB below both the ambient noise levels and the LOAEL, operational noise is deemed to be negligible on the basis that such a level would not have the potential to cause an increase in the ambient noise level.

5.3.5 Vibration due to the operation of Alton pumping station has been considered qualitatively.

6 Potential Effects

6.1 Noise and Vibration from Pipeline Installation Activity

6.1.1 Based on the estimated activity noise levels, Table 6.1 presents the approximate number of receptors expected to experience effects. The calculations have been based on various conservative factors, including the following:

- Calculated monthly average noise levels are based on precautionary estimates of the duration of each activity.
- Where works are taking place in a trench, the acoustic screening provided by trench walls has not been taken into account.
- Calculated monthly average noise levels are based on all installation activity that would occur near any particular receptor being completed within one month. In practice, the works would be spread out over a longer duration, and therefore the assessed monthly average is a precautionary estimate.
- Calculated monthly average noise levels are based on the situation prior to noise-reducing measures.

Table 6.1: Potential Noise Effects on Receptors (Without Noise-reducing Measures)

Receptor Group	Period	Magnitude of Change	Potential Significance of Effect	Approximate Number of Receptors (rounded to nearest 5 receptors)	
				Residential	Other Community Receptors
Urban	Day	Large	Major, significant	290	65
		Medium	Moderate, significant	260	40

Receptor Group	Period	Magnitude of Change	Potential Significance of Effect	Approximate Number of Receptors (rounded to nearest 5 receptors)	
				Residential	Other Community Receptors
		Small	Minor, not significant	725	80
Urban	Night	Large	Major, significant	130	5
		Medium	Moderate, significant	320	5
		Small	Minor, not significant	615	5
Rural	Day	Large	Major, significant	35	<5
		Medium	Moderate, significant	95	<5
		Small	Minor, not significant	290	10
Rural	Night	Large	Major, significant	<5	0
		Medium	Moderate, significant	10	0
		Small	Minor, not significant	30	<5

6.1.2 To illustrate how noise-reducing measures, including those to be agreed in the Noise and Vibration Management Plan, could potentially reduce the number of significant effects, some sensitivity tests have been undertaken based on the assumption that noise-reducing measures could result in a 5dB(A) or a 10dB(A) reduction in noise levels. As an example for information, BS 5228-1:2009 +A1:2014 (BSI, 2014a) states that, as a working approximation, an attenuation of 5dB(A) can be achieved if the top of the plant is just visible to the receiver over the noise barrier, and of 10dB(A) when the noise screen completely hides the sources from the receiver.

6.1.3 For the purpose of this assessment, reductions of 5dB(A) and 10dB(A) are respectively described as ‘moderate’ and ‘good’ standards of noise reduction.

6.1.4 Tables 6.2 and 6.3 present an estimate of the number of receptors likely to experience effects with ‘moderate’ and ‘good’ standards of noise reduction.

Table 6.2: Estimated Number of Properties Experiencing Noise Effects During Installation (Assuming Noise-reducing Measures Achieve a ‘Moderate’ Reduction of 5dB)

Receptor Group	Period	Magnitude of Change	Significance of Effect	Approximate Number of Receptors Expected to Experience Effect (rounded to nearest 5 receptors)	
				Residential	Other Community Receptors
Urban	Day	Large	Major, significant	<5	20
		Medium	Moderate, significant	285	65
		Small	Minor, not significant	260	105
Urban	Night	Large	Major, significant	45	<5
		Medium	Moderate, significant	90	5
		Small	Minor, not significant	320	10

Receptor Group	Period	Magnitude of Change	Significance of Effect	Approximate Number of Receptors Expected to Experience Effect (rounded to nearest 5 receptors)	
				Residential	Other Community Receptors
Rural	Day	Large	Major, significant	10	<5
		Medium	Moderate, significant	30	<5
		Small	Minor, not significant	95	<5
Rural	Night	Large	Major, significant	0	0
		Medium	Moderate, significant	<5	0
		Small	Minor, not significant	10	0

6.1.5 Provided the noise-reducing measures including those to be agreed in the Noise and Vibration Management Plan achieve a 'moderate' degree of noise reduction, fewer than 370 urban residential properties, 40 rural residential properties, 65 urban community facilities and 5 rural community facilities have the potential to experience temporary and short term significant effects. These overall values are lower than the sum of corresponding day and night values in Table 6.2, as some properties that experience significant effects during the day could also experience effects during the night.

Table 6.3: Estimated Number of Properties Experiencing Noise Effects During Installation (Assuming Noise-reducing Measures Achieve a 'Good' Reduction of 10dB)

Receptor Group	Period	Magnitude of Change	Significance of Effect	Approximate Number of Receptors Expected to Experience Effect (rounded to nearest 5 receptors)	
				Residential	Other Community Receptors
Urban	Day	Large	Major, significant	<5	<5
		Medium	Moderate, significant	<5	20
		Small	Minor, not significant	285	65
Urban	Night	Large	Major, significant	10	0
		Medium	Moderate, significant	35	<5
		Small	Minor, not significant	90	5
Rural	Day	Large	Major, significant	<5	<5
		Medium	Moderate, significant	<5	<5
		Small	Minor, not significant	30	<5
Rural	Night	Large	Major, significant	0	0
		Medium	Moderate, significant	0	0
		Small	Minor, not significant	<5	0

6.1.6 If a 'good' degree of noise reduction is achieved, fewer than 45 urban residential properties, 10 rural residential properties, 20 urban community facilities and 5 rural

community facilities have the potential to experience significant short term effects. These receptors are those located closest to the potential works.

6.1.7 Tables 6.4 and 6.5 provide further details on the locations of the receptors that have the potential to experience significant (i.e. major or moderate) effects.

Table 6.4: Estimated Number of Properties Experiencing Noise Effects During Installation (By Postcode Area)

Region	Town/Area	Post Code	No noise reducing measures		Assuming 'Moderate' noise reduction of 5dB		Assuming 'Good' noise reduction of 10dB	
			Residential	Other Community Receptors	Residential	Other Community Receptors	Residential	Other Community Receptors
Waverley	Crondall, Ewshot	GU10	5	0	0	0	0	0
Rushmoor	Farnborough, Cove	GU14	275	20	145	5	20	0
Surrey Heath	Frimley, Frimley Green	GU16	100	5	25	5	0	0
Surrey Heath	Lightwater	GU18	75	0	25	0	0	0
Hart	Church Crookham, Crookham Village	GU52	40	5	10	0	5	0
Runnymede	Addlestone, New Haw	KT15	45	5	20	5	0	0
Runnymede	Chertsey, Lyne	KT16	105	5	5	0	0	0
Winchester	New Alresford, Old Alresford, Cheriton, Tichborne	SO24	5	0	0	0	0	0
Spelthorne	Ashford	TW15	345	60	170	45	25	15
Spelthorne	Shepperton	TW17	5	0	0	0	0	0
Spelthorne	Staines, Egham Hythe	TW18	15	5	5	0	5	0

Table 6.5: Estimated Number of Properties Experiencing Noise Effects During Installation (By Road)

Note: only results for roads where the rounded number of significant effects is ≥10 are presented

Region	Town/Area	Post Code	Road	No noise reducing measures		Assuming 'Moderate' noise reduction of 5dB		Assuming 'Good' noise reduction of 10dB	
				Residential	Other Community Receptors	Residential	Other Community Receptors	Residential	Other Community Receptors
Rushmoor	Farnborough, Cove	GU14	Ship Lane	45	5	25	0	0	0
			Ringwood Road	25	0	25	0	0	0
			Bridge Road	10	0	0	0	0	0
			Cove Road	40	0	30	0	15	0
			Highfield Close	15	0	10	0	0	0
			Highfield Path	10	0	0	0	0	0
			Nash Close	35	0	25	0	0	0
			Newton Road	10	0	0	0	0	0
			Prospect Road	15	0	0	0	0	0
			Stake Lane	10	0	10	0	0	0
			Union Street	10	0	5	0	0	0
			West Heath Road	15	0	10	0	5	0
Surrey Heath	Frimley, Frimley Green	GU16	Henley Drive	25	0	0	0	0	0
			Penshurst Rise	15	0	5	0	0	0
			Bowling Green Court	15	0	0	0	0	0
Surrey Heath	Lightwater	GU18	Blackthorn Drive	10	0	5	0	0	0
			Burdock Close	20	0	10	0	0	0
			Heronscourt	15	0	5	0	0	0
Runnymede	Chertsey, Lyne	KT16	Guildford Road	85	0	0	0	0	0
Spelthorne	Ashford	TW15	Edward Way	15	0	10	0	0	0
			Woodthorpe Road	175	30	110	20	5	0
			Fern Walk	20	0	0	0	0	0
			Brookside Avenue	15	0	0	0	0	0

Region	Town/Area	Post Code	Road	No noise reducing measures		Assuming 'Moderate' noise reduction of 5dB		Assuming 'Good' noise reduction of 10dB	
				Residential	Other Community Receptors	Residential	Other Community Receptors	Residential	Other Community Receptors
			Celia Crescent	15	0	0	0	0	0
			Kingston Road	15	5	5	0	0	0
			Ruggles Brise Road	15	0	0	0	0	0
			Ferndale Road	15	0	15	0	0	0
			London Road	20	0	15	0	15	0
			Marlborough Road	15	0	0	0	0	0
			Station Road	10	0	10	0	0	0

6.1.8 Tables 6.1 to 6.5 provide a precautionary and conservative indication of potential noise effects (as set out in paragraph 6.1.1). It is expected that, in practice, the numbers of properties potentially experiencing effects would be lower than the numbers quoted in these tables. In addition, any effects would be experienced for a short period of time as explained below.

6.1.9 Along open cut sections of the route, noise effects at nearby receptors would be short term in nature, with receptors experiencing quiet periods between successive installation activities.

6.1.10 The duration of effects for receptors near trenchless crossing worksites, construction compounds and logistics hubs would be greater than for open cut sections. However, at all receptors, effects are described as short term.

Assessment of Noise during Pipeline Installation using National Policy Descriptors

6.1.11 This section considers the predicted effects during installation in terms of Government policy, using descriptors from the NPSE (Defra, 2010). The adopted values for the LOAEL and SOAEL are discussed in detail within Section 5.

6.1.12 For day periods, an exceedance of 75dB $L_{Aeq,16h}$ for a cumulative total of 30 days or more has been adopted as the SOAEL. For night periods, an exceedance of 55dB $L_{Aeq,8h}$ for a cumulative total of 30 nights or more has been adopted as the SOAEL.

6.1.13 The first aim of the NPSE states that noise exceeding the SOAEL "*should be avoided while also taking into account the guiding principles of sustainable development*". The potential for noise levels at receptors to exceed the SOAEL has therefore been considered, taking into account the likely durations that works would occur in close proximity to receptors.

6.1.14 When considering works that would take place along open cut sections of the route in both urban and rural locations, the combined durations of the successive works would not have the potential to exceed 75dB $L_{Aeq,16h}$ for 30 days. Therefore, the SOAEL would not be exceeded for receptors along open cut sections of the route.

6.1.15 Receptors near trenchless crossing worksites could experience noise over a longer duration. Within the overall works at trenchless crossing sites, the piling, excavation and drilling works have the potential to temporarily exceed the adopted daytime SOAEL noise level at the closest receptors. Noise levels during other trenchless crossing works, such as pipe pulling and reinstatement, would not be expected to exceed the adopted daytime SOAEL noise level. Based on the anticipated timescales, the combined duration of the piling, excavation and drilling works would not exceed 30 days, and therefore the daytime SOAEL would not be exceeded for receptors near trenchless crossing worksites.

6.1.16 At certain trenchless crossing worksites there is the potential for aspects of the works associated with pipe pulling to occur during the night. Although these works have the potential to exceed 55dB $L_{Aeq,8h}$ at the closest receptors, they would only occur for a duration of a few nights at most. There is not considered to be potential for the works to exceed this level for a period of 30 nights and therefore the night time SOAEL would not be exceeded for receptors near trenchless crossing

worksites. Similarly, pipeline hydrostatic testing, which would also involve the operation of pumping equipment during the night, would be a one-off event that occurred during one night only, and would not cause the SOAEL to be exceeded.

6.1.17 Due to the relatively close proximity of a number of trenchless crossing worksites in the vicinity of West Heath Road, Farnborough, receptors in this location have the greatest potential to experience significant effects during installation. Trenchless crossings are proposed for the crossing of the mainline railway and a nearby water course. Approximately 200 metres away, an additional trenchless crossing is proposed at Stake Lane. The combined potential of these worksites to cause the SOAEL to be exceeded at nearby receptors has been considered. It has been found that, although there is the potential for 75dB $L_{Aeq,16h}$ to be temporarily exceeded at the closest receptors to each trenchless crossing worksite, the exceedance is not expected to occur for a combined period greater than 30 days (or nights) at any receptor. Therefore the SOAEL would not be exceeded for any local receptor.

6.1.18 In summary, the SOAEL is not expected to be exceeded at any receptor during installation.

6.1.19 The second aim of the NPSE refers to the situation where the impact lies between LOAEL and SOAEL, which applies to approximately 90% of the receptors in the study area. It requires that '*all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development*'. The project adheres to this policy requirement through the commitments to good practice measures set out in the REAC.

Vibration from Site Equipment During Installation

Ground Compaction Works Along Open Cut Sections

6.1.20 BS 5228-2:2009+A1:2014 (BSI, 2014b) provides empirical vibration prediction methods for the prediction of vibration levels associated with soil compaction. Results are presented in terms of the 95% confidence level (i.e. where the probability of peak particle velocity levels being lower than this value is 95%), as well as the 67% and 50% confidence levels. This probabilistic approach reflects uncertainties in the physical factors that influence the transmission of ground vibration, such as soil type and density.

6.1.21 Table 6.6 illustrates the expected levels of ground vibration at different distances from intensive ground compaction works (i.e. using vibratory compaction plant with a large amplitude of drum vibration, and dual rollers). Compaction would occur along the pipeline trench, and not across the entire width of the installation corridor. Therefore, the distances in Table 6.6 would relate to the distance between a particular receptor and the pipeline trench. It should be borne in mind that the trench could be located anywhere within the limits of deviation, as described in Chapter 3 Project Description.

Table 6.6: Predicted Levels of Vibration During Ground Compaction Works

Distance from Ground Compaction Works (m)	Peak Particle Velocity due to Ground Compaction Works (mm/s)		
	95% Confidence Level	67% Confidence Level	50% Confidence Level
20	9.3	4.8	2.5
40	3.4	1.8	0.9
60	1.9	1.0	0.5
90	1.0	0.5	0.3

Vibratory Piling Works at Trenchless Crossings

6.1.22 At certain trenchless crossings, sheet piling could be used to support shaft walls.

6.1.23 BS 5228-2:2009+A1:2014 (BSI, 2014b) provides empirical vibration prediction methods for piling. These methods have been used to undertake preliminary predictions of construction vibration at a range of representative distances. The range of estimated vibration levels associated with vibratory piling works at these distances is presented in Table 6.7.

Table 6.7: Predicted Levels of Vibration During Vibratory Piling Works

Distance from Ground Compaction Works (m)	Peak Particle Velocity due to Vibratory Piling Works (mm/s)		
	95% Confidence Level	67% Confidence Level	50% Confidence Level
20	5.4	2.6	1.2
40	2.2	1.0	0.5
60	1.3	0.6	0.3
90	0.8	0.4	0.2

Rotary Works at Trenchless Crossings

6.1.24 During certain installation activities at trenchless crossings (e.g. auger bore and HDD), there is the potential for vibration effects at nearby receptors. These activities are considered likely to generate similar levels of vibration to rotary bored piling due to the similar mechanisms involved.

6.1.25 Empirical data presented in Table D.6 of BS 5228-2:2009+A1:2014 (BSI, 2014b) suggests that vibration from rotary bored piling activities would fall to below 1.0mm/s at a distance of approximately 10m to 15m.

6.1.26 Certain non-rotary works at trenchless crossings (e.g. pipe pulling) could require working outside core working hours. However, it is considered that these activities do not have the potential to give rise to noticeable vibration levels at local receptors.

Summary

6.1.27 A comparison of the predicted vibration levels with the 1.0mm/s threshold presented in Section 4 indicates that vibration during installation activities has the potential to be readily perceptible indoors at receptors in certain circumstances.

6.1.28 Vibration would only be experienced for a short duration (i.e. measured in minutes and hours, rather than days), whilst the works occur at the closest position to a particular receptor. In addition, works with the potential to cause high levels of vibration (e.g. vibratory piling, ground compaction and rotary drilling) are only expected to take place during normal working hours.

6.1.29 As set out in the requirements of the Noise & Vibration Management Plan, receptors that could experience peak particle velocities above 1.0 mm/s, would be provided with prior warning and explanation (G100).

6.1.30 Taking these factors into account, it is considered that any residual vibration effects due to installation activities would be minor.

6.1.31 In all cases, the predicted vibration levels associated with ground compaction would fall well below the vibration levels defined in BS 7385-2:1993 (BSI, 1993) which could give rise to cosmetic damage to buildings.

6.2 Noise and Vibration from Construction Vehicles on Public Highway

6.2.1 The greatest potential for adverse noise effects due to site traffic during installation would be along rural roads with low baseline traffic flows, where the highest percentage increase in traffic flows are expected to occur. Based on the results of the Transport Assessment (**application document 7.4**), New Road Windlesham is considered to have the greatest potential increase in noise due to a combination of low baseline flows and high numbers of site vehicle movements.

6.2.2 As detailed in the Transport Assessment, the existing Annual Average Weekday Traffic flow along New Road Windlesham is 6,799 vehicles. The peak number of additional vehicle movements on this link during installation (including those associated with deliveries, plant and worker site access) is 34 heavy vehicles and 189 light vehicles.

6.2.3 These increases are expected to give rise to an increase in noise along New Road Windlesham of approximately 0.2 dB during the installation period, which is not considered significant.

6.2.4 Increases in noise along all other routes used by site traffic are expected to be less than this, and therefore no significant adverse noise effects associated with traffic movements are expected along public highways for any section of the project.

6.2.5 Although there is the potential for occasional materials deliveries out of hours, these would not be regular, and would not represent a significant increase in noise in rural or urban areas.

6.3 Noise and Vibration from Operation of the Pipeline

6.3.1 As discussed earlier, the only activity with potential to give rise to noise and vibration effects during operations is the replacement of pumping equipment at Alton Pumping Station.

6.3.2 The facility, which is located to the east of Holybourne, is enclosed by the A31, which passes immediately to the north of the site, and the Alton line of the South Western

main line railway, which passes immediately to the south. The nearest residential property (Hawbridge Farm) is located approximately 350m to the south of the facility, across the South Western main line railway.

6.3.3 Although local background ($L_{A90,T}$) noise levels have not been measured, the area is covered by strategic noise mapping of the A31 undertaken by Defra in 2012 to satisfy the requirements of the Environmental Noise Directive. These results (Extrium, 2018) indicate that existing weighted 24-hour traffic noise levels are approximately 55dB L_{den} at Hawbridge Farm, while night-time traffic noise levels at Hawbridge Farm are estimated to be in the range 45–50dB L_{night}.

6.3.4 The electrical rating of the proposed replacement pump is expected to be up to 600kW. An empirical formula for estimating the sound power of pumps, provided in 'Engineering Noise Control – Theory and Practice' by Bies and Hansen (2009), has been used to derive a sound power level for the proposed replacement pump of 98dB(A). Using the propagation calculation methodology provided in ISO9613-2 (ISO, 1996), a sound pressure level of 29dB $L_{Aeq,T}$ has been calculated at Hawbridge Farm, at a distance of approximately 350m from Alton Pumping Station. This noise level is more than 10dB below the existing night time traffic noise level of 45–50dB $L_{night,}$ the guideline level for the avoidance of sleep disturbance of 45dB $L_{Aeq,T}$ recommended by the World Health Organization (Berglund et al., 1999) and the adopted night time LOAEL of 40dB $L_{Aeq,8h}$. It is therefore concluded that the operation of the proposed replacement pump would give rise to negligible noise effects.

6.3.5 The replacement pump comprises rotating equipment, which has the potential to be significant vibration sources if not rotationally balanced. However, the design would require all proposed rotating equipment to be rotationally balanced, and therefore any vibration transmitted into the surrounding ground would be negligible and orders of magnitude lower than would be expected to give rise to nuisance or damage at local properties. Therefore, no further assessment of operational vibration is provided.

6.3.6 The assessment indicates that the operation of the proposed additional pump at Alton Pumping Station would not give rise to adverse noise or vibration effects.

7 Mitigation and Residual Effects

7.1 Noise and Vibration from Pipeline Installation Activity

Noise

7.1.1 BS 5228-1:2009+A1:2014 (BSI, 2014a) identifies that where '*widespread community disturbance or interference with activities or sleep*' is likely to occur and if construction activities are likely to continue for a '*significant period of time*', provisions for temporary rehousing can be made. Example thresholds for qualification are provided, where construction noise exceeds thresholds '*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*'

7.1.2 The progressive nature of the installation works along open cut sections of route, whereby successive activities would progress along the route with durations of respite between activities, would mean that noise level and duration criteria would not be met at receptors along the route. Similarly, the criteria are not expected to be exceeded at receptors near trenchless crossings locations, construction compounds or logistics hubs.

7.1.3 BS 5228-1:2009+A1:2014 (BSI, 2014a) also provides separate example thresholds that can be used to determine eligibility for noise insulation. However, the installation of noise insulation to affected properties is not considered to be proportionate to the scale and duration of the expected effects, and is therefore not proposed for this project.

7.1.4 The contractor(s) shall be required to produce a Noise and Vibration Management Plan and to submit this as part of the Construction Environment Management Plan (CEMP), for the approval the relevant planning authority. The Noise and Vibration Management Plan will set out detailed measures to reduce noise and vibration during installation.

7.1.5 No mitigation is proposed above the good practice measures outlined in the REAC.

Vibration

7.1.6 No significant construction vibration effects have been identified, and therefore no mitigation is proposed above the good practice measures outlined in the REAC.

7.2 Noise and Vibration from Construction Vehicles on Public Highway

7.2.1 No significant effects related to construction vehicles on the public highway have been identified, and therefore no mitigation is proposed above the good practice measures outlined in the REAC.

7.3 Noise and Vibration from Operation of the Pipeline

7.3.1 No significant effects during the operation of the pipeline have been identified, and therefore no mitigation is proposed.

8 Summary

8.1.1 No significant effects have been identified for the following activities:

- noise and vibration due to traffic on the public highway during installation;
- vibration from compaction, piling and drilling activity during installation; and
- noise and vibration due to operations.

8.1.2 A number of receptors may still experience adverse noise impacts during installation, even with the application of good practice measures. However, these will be temporary and short-term, and within the normal working hours unless by exception (refer to Good Practice Commitment G5 in Table 4.1). An estimate of the overall number of receptors expected to experience significant short term noise, based on cautious precautionary calculations, is presented in Table 8.1. As

previously explained, the number of receptors within the 'Day or Night' category in Table 8.1 is not always the sum of corresponding day and night values, as some properties predicted to experience noise effects during the day could also experience effects during the night.

Table 8.1: Matters of Significance for Noise and Vibration Effects

Group	Period	No noise reducing measures		'Moderate' noise reduction of 5dB		'Good' noise reduction of 10dB	
		Residential	Other Community Receptors	Residential	Other Community Receptors	Residential	Other Community Receptors
Urban	Day	550	105	290	85	<5	20
	Night	450	10	135	10	45	<5
	Day or Night	880	105	370	65	45	20
Rural	Day	130	<5	40	<5	10	<5
	Night	10	0	<5	0	0	0
	Day or Night	135	<5	40	<5	10	<5

8.1.3 The receptors with the potential to experience significant effects represent approximately 1% of the receptors in the study area. In relation to the overall scale of the installation activities, the number of receptors with the potential to experience significant short term effects is considered small.

8.1.4 As a result of the precautionary approach to` assessment, it is expected that, in practice, the numbers of receptors potentially experiencing short term significant effects would be lower than in Table 8.1.

8.1.5 The aims of government noise policy are considered to be met by the proposals, and receptors would not be expected to experience significant effects on health and quality of life.

8.1.6 The commitment to agreeing a Noise and Vibration Management Plan with the relevant planning authority would ensure that appropriate noise and vibration mitigation would be implemented during the works.

8.1.7 The overall significance of various types of environmental impact on People and Communities is considered in Chapter 13 People and Communities.

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