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Cc: Andrew Guyton <ANGUY@orsted.co.uk>; Stuart Livesey <STLIV@orsted.co.uk>
Subject: Hornsea Project Three (UK) Ltd response to Deadline 6 (Part 7)

Dear Kay, K-J

Please find attached the 7th instalment of documents.

Best regards,
Dr Dominika Chalder PIEMA
Environment and Consent Manager

[redacted]

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Hornsea Project Three
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Appendix 23 to Deadline 6 submission - Construction Traffic Noise and Vibration Assessment at The Old Railway Gatehouse

Date: 8 February 2019

Hornsea 3
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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2019.

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Acronyms

Acronym	Description
BS	British Standard
CRTN	Calculation of Road Traffic Noise
dB(A)	Decibels A-weighted
DMRB	Design Manual for Roads and Bridges
HDVs	Heavy Duty Vehicles
HGVs	Heavy Goods Vehicles
NIR	Noise Insulation Regulations
NSRs	Noise Sensitive Receptors
PPV	Peak Particle Velocity
SEL	Sound Exposure Level
VDV	Vibration Dose Values

1. Introduction

1.1 This document set outs the methodology and results of the assessment of traffic noise and vibration from vehicles travelling to and from the main construction compound during the construction of the Hornsea Project Three offshore wind farm (planning application reference EN010080) (hereafter referred to as Hornsea Three). The location of the main construction compound is the former Oulton Airfield as shown on Figure 8.1 Volume 3, Chapter 8: Noise and Vibration of the Environmental Statement (APP-080) and Figure 1.1 of this report.

1.2 Construction traffic to and from the main construction compound will make use of the existing road network, with all construction traffic accessing and egressing the compound from the B1149 and The Street. Along the section between the B1149 and the proposed access to the main construction compound, The Street provides access to a number of field parcels, Docking Farm, Heydon Road and one residential property (The Old Railway Gatehouse) (located at grid reference 614812 326538).

1.3 The outline access strategy to the main construction compound for Hornsea Three is set out in Appendix 32 of the Applicant's Deadline 4 submission (REP4-053. Option 1: Passing Places) as well as the Outline CTMP submitted at Deadline 6 and has been identified as acceptable in principle by Norfolk County Council (NCC) (as set out in the Statement of Common Ground between both parties submitted at Deadline 4, REP4-019). The access strategy will create a number of vehicle passing places along The Street to facilitate the movement of two-way traffic associated with the temporary construction works. The give way point of one of the proposed passing places is located 42 m south of The Old Railway Gatehouse and approximately 24 m south of the edge of the garden.

1.4 The residential property is located immediately fronting The Street, and immediately adjacent to an existing pronounced road hump associated with the dismantled railway which runs beneath The Street. Given its proximity to The Street and the road hump, there is the potential for noise and vibration impacts associated with the Hornsea Three construction traffic to adversely affect The Old Railway Gatehouse. As such, this document sets out the assessment of the effects on The Old Railway Gatehouse as the primary noise sensitive receptor (NSR) and the need for any mitigation.

1.5 The assessment has been informed by baseline surveys (see Section 3), construction traffic forecasts for this section of The Street (also Section 3) and the outline access strategy as set out in Appendix 32 of the Applicant's Deadline 4 submission (REP4-053) as well as the Outline CTMP submitted at Deadline 6. The location of the main construction compound relative to the Old Railway Gatehouse and the locations of the baseline surveys are shown on Figure 1.1 below**Error! Reference source not found.**. The key parameters that have been used to inform the assessment are discussed in paragraph 4.22.

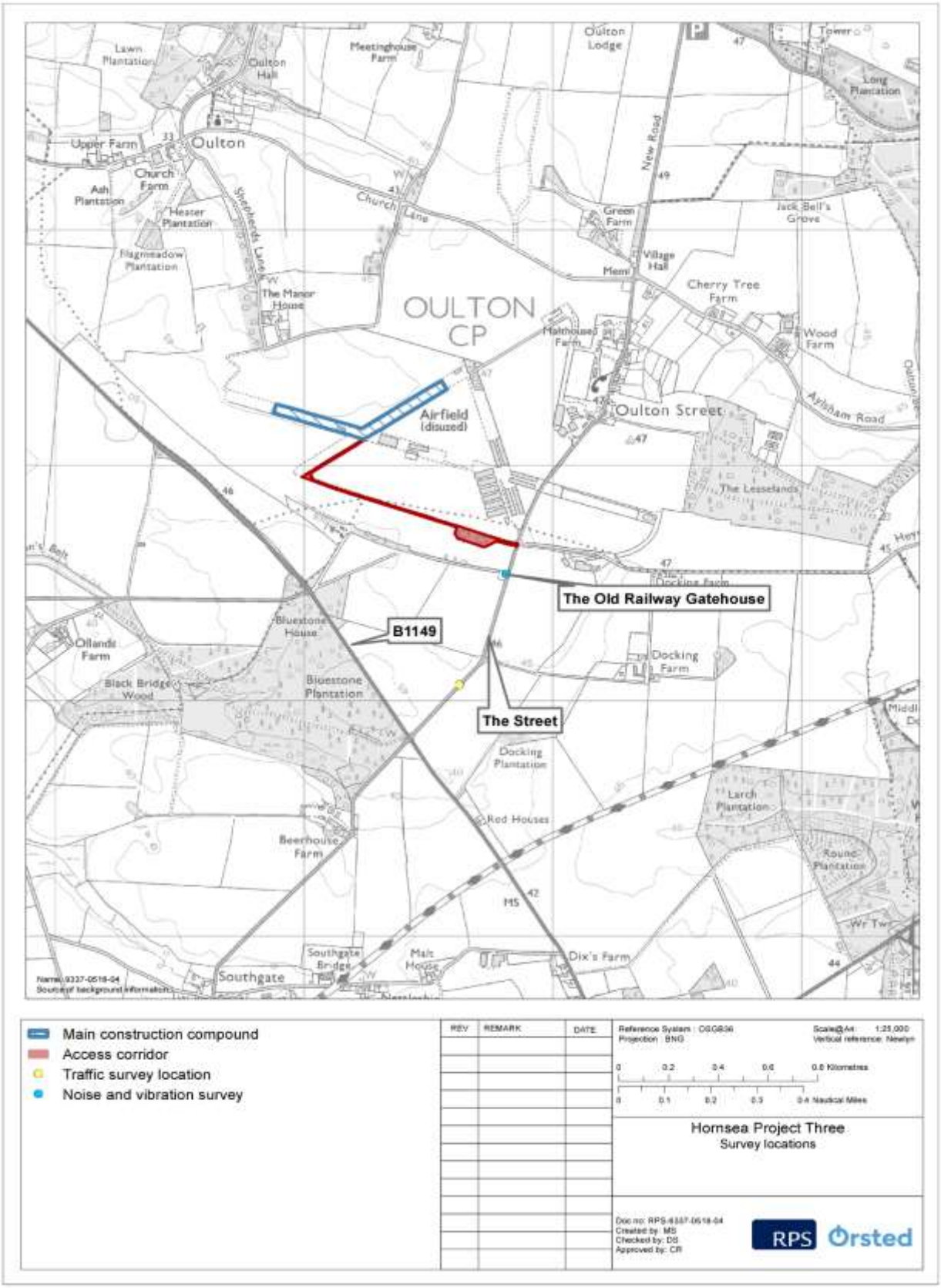

Figure 1.1: Baseline Survey Locations

2. Consultation

2.1 As part of ongoing engagement with interested parties and stakeholders, the Applicant has engaged with the residents of The Old Railway Gatehouse following the submission of the DCO application. A summary of this consultation is provided below:

- 14/10/18: Phone Call to gain approval for noise and vibration survey and methodology at The Old Railway Gatehouse;
- 15/10/18: Create Consulting Engineers Limited met with residents on site when setting up survey equipment at property;
- 18/10/2018: Email informing the residents of additional traffic surveys being undertaken along The Street and offering a follow up meeting during week commencing 12/11/2018;
- 10/12/2018: Meeting with the residents to provide an update on the outline access strategy and baseline noise and vibration surveys; and
- 23/01/2019: Meeting with the residents to provide an update on the outline access strategy and findings of the noise and vibration assessment, including the proposed mitigation to the existing road hump.

2.2 The Applicant has also continued to engage with a number of other interested parties post-submission of the application regarding the main construction compound, including Norfolk County Council, Broadland District Council and Oulton Parish Council. Details of the consultation undertaken up to December are set out in Appendix 1 of the Applicant's submission at Deadline 3 (REP3-010) with additional meetings and correspondence undertaken in early 2019.

3. Methodology

Noise Criteria

3.1 The methodology used to assess construction traffic noise and vibration impacts at The Old Railway Gatehouse is the same as that set out in section 1.3 of Volume 6, Annex 8.2: Construction Noise Model Output of the Environmental Statement (APP-168) and is summarised below.

3.2 The noise changes identified in Table 3.1 have been used to assess the magnitude of noise impacts associated with construction traffic on The Street resulting from the use of the main construction compound for the construction of Hornsea Three. These are based on the guidance in Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7 'Noise and Vibration' for the Classification of Magnitude of Noise Impacts (Highways Agency, 2011). These DMRB criteria best reflect the temporary (i.e. non-permanent, albeit relatively long-term) nature of the construction noise impacts; the short-term response to a temporary change best matches the DMRB long-term response to a permanent change.

Table 3.1: Classification of magnitude of temporary noise impacts within DMRB.

Magnitude of Impact	Noise Change, $L_{Aeq,T}$ / $L_{A10,18h}$
No change	0
Negligible	0.1– 2.9
Minor	3 – 4.9
Moderate	5 – 9.9
Major	10+

3.3 Road traffic on the public highway has been modelled using a noise change procedure based on the methodology in the 'Calculation of Road Traffic Noise' (CRTN) (Department for Transport, 1988). This considers the increase in noise from individual road links, based on the change in flow, speed and Heavy Goods Vehicle (HGV) composition. Within the assessment, HGVs and heavy duty vehicles (HDVs) are regarded as having comparable noise emissions.

3.4 BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration' provides useful guidance and information and recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. It includes sections on: community relations; vibration and persons on site; neighbourhood nuisance; project supervision; control of vibration and measurement.

3.5 BS 5228-2 provides the following advice on community relations and is considered to be good practice for both noise and vibration control:

*"**4 Community relations***

Good relations with people living and working in the vicinity of site operations are of paramount importance. Early establishment and maintenance of these relations throughout the carrying out of site operations will go some way towards allaying people's fears.

It is suggested that good relations can be developed by keeping people informed of progress and by treating complaints fairly and expeditiously. The person, company or organization carrying out work on site should appoint a responsible person to liaise with the public. The formation of liaison committees with members of the public can be considered for longer term projects when relatively large numbers of people are involved."

*"**6.3 e) Attitude to the site operator**. It is well established that people's attitudes to vibration can be influenced by their attitudes to the source or activity itself. Vibration from a site will tend to be accepted more readily by local residents, if they consider that the contractor is taking all possible measures to avoid unnecessary vibration. The attitude to the contractor can also be improved through good community liaison and information distribution and the provision of a helpline to respond to queries or complaints. The acceptability of the project itself can also be a factor in determining community reaction."*

3.6 Section 2 of this report summarises the ongoing consultation between The Old Railway Gatehouse residents and the Applicant following the submission of DCO application.

3.7 Communication with the residents will continue prior to and during the construction stage in accordance with the Communication Plan Framework (Appendix A of the Outline Code of Construction Practice (updated and submitted at Deadline 6)), which includes the appointment of a Community Liaison Officer and the implementation of a complaints procedure and a 24-hour help line). As the Communication Plan Framework forms part of the Outline CoCP, (which will form the basis of detailed CoCP(s)), it will be agreed with the relevant planning authority prior to commencement of works.

Vibration Criteria

3.8 In Volume 3, Chapter 8: Noise and Vibration of the Environmental Statement (APP-080) construction vibration was assessed using the methodology within BS5228-2, which specifically relates to vibration from construction activities. As vibration at The Old Railway Gatehouse is generated by vehicle movements (both Hornsea Three traffic and other construction and non-construction HGVs) and will occur over an extended period (i.e. up to 30 months during the active use of the main construction compound), it is considered appropriate to use BS6472 for assessment of human effects of vibration in this report.

3.9 BS6472-1:2008 'Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1' provides guidance on how to assess the vibration in buildings, between the frequency range of 0.5 Hz to 80 Hz, and how these levels are perceived by the average human.

3.10 In terms of vibration levels, the following table shows the criteria in terms of vibration dose values (VDV). These values represent the best judgement currently available and may be used for both vertical and horizontal vibration, provided that they are correctly weighted. This table has been obtained from the standard BS 6472-1:2008.

Table 3.2: Vibration dose value ranges which might result in probability of adverse comment within residential buildings.

Place and period	Low Probability of Adverse Comment $m/s^{1.75}$	Adverse Comment Possible $m/s^{1.75}$	Adverse Comment Probable $m/s^{1.75}$
Residential buildings 16h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

3.11 The vibration magnitude assessment criteria given in Table 3.2 has been based on human response to vibration, as opposed to building damage, as these are the more stringent (lower) criteria.

3.12 Table B.1 of BS 5228-2:2009+A1:2014 also provides guidance on effects of vibration levels, in terms of human perception and disturbance. These are given in Table 3.3 and are the same as those used in Table 8.14 of Volume 3, Chapter 8: Noise and Vibration of the Environmental Statement (APP-080).

Table 3.3: Guidance on effects of vibration levels.

Vibration Level (PPV)	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 mm/s	It is likely that vibration of this level in residential environments will cause complaints 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.

3.13 Also, within BS5228-2, are details on how buildings react to vibration structurally. These have been included within Table 3.4. The peak particle velocity (PPV) values given are as assessed at the base of the building.

Table 3.4: Transient vibration guide values for cosmetic damage

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

3.14 BS5228-2 states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 3.4, and major damage to a building structure can occur at values greater than four times the tabulated values.

4. Surveys

Baseline Noise and Vibration Survey

4.1 In order to establish the existing acoustic environment at The Old Railway Gatehouse, baseline noise and vibration surveys were conducted between the 15 and 21 October 2018. During the baseline surveys, no sources of commercial noise (i.e. fixed plant) or vibration were observed in the immediate vicinity of The Old Railway Gatehouse. The existing acoustic environment was dominated by road traffic noise from The Street with the general noise levels remaining low given the rural setting.

Noise survey

4.2 Sound measurements were taken continuously between 15 and 21 October using a semi-permanent noise monitor installation located at a representative distance from the front façade of the property at an approximate distance of 2 m from the edge of the carriageway (see Figure 4.1).

4.3 The semi-permanent sound monitoring equipment comprised a single Norsonic 140 real time sound level analyser with a Norsonic 1217 outdoor microphone system. Once fully assembled, the unit was calibrated with a Norsonic 1251 acoustic calibrator, to a level of 113.8 dB at 1 kHz and checked for sensitivity both before and after the measurements. No variations greater than 0.1 dB were noted.

4.4 The microphone was positioned on an extended boom approximately 2.5 m above ground level in line with the monitoring procedure detailed within Calculation of Road Traffic Noise 1998 (CRTN). The equipment was setup to record the sound levels every second in terms of $L_{Aeq,T}$, $L_{Amax,F}$ and $L_{feq,T}$ (from 6.3 Hz to 20 kHz). The Norsonic software NorReview was used to post process and calculate the SEL, $L_{Aeq,T}$ and $L_{A10,T}$ values.

Figure 4.1: Location of sound monitoring equipment at The Old Railway Gatehouse on the façade closest to The Street

Vibration survey

4.5 Vibration measurements were taken using a single Vibrock set up at the base of the front of the property in line with the sound level meter (see Figure 4.2). The Vibrock unit was set to run continuously between 15 and 21 October, measuring Vibration Dose Values (VDV) and Peak Particle Velocity (PPV).

4.6 The Vibrock used in the survey was a Vibrock V901. The unit was set up with the two transducers mounted and levelled on a heavy paving slab, weighted down with sand bags. The x-axis was approximately parallel to the direction of The Street.

Figure 4.2: Vibration monitoring equipment installed at The Old Railway Gatehouse on the closest façade to The Street

Weather conditions

4.7 During the installation of the survey equipment, the weather was noted to be damp and overcast (50% cloud coverage), 11°C and with wind speeds below 5 m/s. For the remainder of the survey, the weather was reviewed from a local weather station (see Figure 4.3). The weather remained dry and suitable for monitoring for the remainder of the monitoring duration.

Figure 4.3: Weather monitoring equipment installed at The Old Railway Gatehouse

Baseline sound measurement results

4.8 Table 4.1 presents the baseline sound levels at The Old Railway Gatehouse, expressed as overall single figure values in dB(A) which have been rounded to the nearest whole integer. Levels are reported for: the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) which is a measure of the ambient or average noise level; the 10th percentile level ($L_{A10,T}$), which is the noise level exceeded for 10% of the time and is a measure often used to describe road traffic noise; and the night-time maximum noise level ($L_{AF(Max),T}$).

4.9 Note, the highest night time $L_{AF(Max)}$ value was actually measured as 92.2 dB(A), but in accordance with the WHO Guidelines for Community Noise and BS8233:2014, the 10th highest peak values have been used for each of the individual night time periods.

Table 4.1: Measured sound levels for all day and night times

Date	Duration	Ambient Noise Level dB $L_{Aeq,T}$	Level exceeded 10% of the time dB $L_{A10,T}$	10th Highest Maximum dB $L_{AF(Max),T}$
Day time				
Mon 15 October 2018	10h 50 min	58	53	N/A
Tue 16 October 2018	16h	60	55	N/A
Wed 17 October 2018	16h	59	54	N/A
Thurs 18 October 2018	16h	60	54	N/A
Fri 19 October 2018	16h	59	54	N/A
Sat 20 October 2018	16h	57	53	N/A
Sun 21 October 2018	16h	57	53	N/A
Night time				
Mon 15 October 2018	8h	52	32	78
Tue 16 October 2018	8h	51	36	77
Wed 17 October 2018	8h	52	37	80
Thurs 18 October 2018	8h	51	37	78
Fri 19 October 2018	8h	48	36	76
Sat 20 October 2018	8h	47	37	72

4.10 The linear averages of the whole individual day activities have been tabulated into a single line for day and night times, with the highest of the nightly $L_{AF(max),T}$ readings used.

Table 4.2: Ambient and maximum sound levels dB (re 20 µPa)

	Ambient Noise Level dB $L_{Aeq,T}$	Level exceeded 10% of the time dB $L_{A10,T}$	Maximum Daily 10th Highest Maximum $L_{AF(max),T}$
Day time (07:00 – 23:00)	59 dB	54 dB	N/A
Night time (23:00 – 07:00)	50 dB	36 dB	80 dB

4.11 The existing levels of sound were as expected for the rural setting, i.e. relatively low ambient sound levels during the day and levels reducing further during the night. Peak noise levels associated with car and HGV movements passing the measurement location elevate the ambient $L_{Aeq,T}$ metric and set the maximum noise levels recorded.

HGV noise measurements

4.12 Traffic noise levels from The Street were measured through the use of audio recordings and the use of the NorReview software. Multiple sound events associated with HGV passing by the noise monitor were measured, along with the corresponding audio recordings during the monitoring duration.

4.13 This resulted in several measurements of the Sound Exposure Level (SEL) of each HGV movement. The SEL is the sum of the sound energy produced by the HGV movement (the specific noise) condensed into a period of one second.

A series of SEL measurements were obtained for various HGV passes between the 15 and 21 October using the sound measuring equipment described in paragraph 4.3 and these are listed in Table 4.3. These dates, times and sound levels were taken as an identifiable sample of corroborated HGV passes as identified from audio recording through the NorReview files. As such, there were many other HGV movements over the course of the week and the list in

4.14 Table 4.3 provides a representative sample of these events.

The SEL was calculated through the use of the NorReview software, highlighting the initial increase of sound level and stopping when the event was no longer discernible. The arithmetic averages of the various HGV movements have been indicated in

4.15 Table 4.3.

Table 4.3: Average SEL, $L_{Aeq,T}$ and $L_{AF(Max)}$ values for HGV movements dB (re 20 µPa)

Date	Time	Duration (seconds)	Sound Exposure Level dB SEL	Specific Noise dB $L_{Aeq,T}$	Maximum dB $L_{AF(Max),T}$
Tue 16 October 2018	12:43	40s	89	73	85
Tue 16 October 2018	12:50	54s	82	65	76
Tue 16 October 2018	13:37	43s	91	75	87
Thurs 18 October 2018	13:50	22s	102	89	99
Thurs 18 October 2018	20:34	70s	90	71	86
Sat 20 October 2018	12:35	19s	93	81	92
Sat 20 October 2018	13:09	12s	81	70	79
Sat 20 October 2018	13:10	16s	78	66	72
Sat 20 October 2018	13:12	22s	79	66	78
Sat 20 October 2018	13:24	19s	76	64	73
Sat 20 October 2018	13:47	18s	76	63	72
Sat 20 October 2018	14:00	20s	84	71	81
Average		**59s**	**93**	**79**	**90**

4.16 It was noted that the baseline sound level is already affected by passing HGVs and other vehicles associated with agricultural activities. Between the hours of 07:00h and 19:00h on the 18 October, there were 129 instances where the sound level increased over 70 dB $L_{Aeq,T}$ due to vehicle movements and 18 instances where the sound level increased over 79 dB $L_{Aeq,T}$. This date was selected as it falls in the middle of the potato harvest when HGV movements would be high. However, feedback from the residents of The Old Railway Gatehouse was that they considered the number of HGV movements to have been depressed during the survey period compared to the normal number of HGV movements at this time of year. The poor weather had delayed the potato harvest and the residents of The Old Railway Gatehouse stated that the typical number of HGV movements at this time of year was much higher. For the purpose of the noise level change assessment, the use of lower baseline traffic flows (whether perceived or actual) would result in a maximum design scenario assessment. In respect to the absolute noise level assessment and vibration assessment, it is considered that the use of lower baseline traffic flows, as suggested by stakeholders, would not change the outcomes or conclusions of the assessment as presented.

Vibration measurement results

The results from the measured VDV and PPV between the 15 and 21 October 2018 are shown in Table 4.4 and

4.17 Table 4.5.

Table 4.4: VDV and PPV daytime levels measured at the base of The Old Railway Gatehouse

Date	Daytime Vibration Levels				
	16 Hour VDV			16 Hour PPV	
	X	Y	Z	Max	Time
Mon 15 October 2018	0.564	1.050	0.556	2.00 mm/s	12:26:22
Tue 16 October 2018	0.017	0.027	0.048	2.00 mm/s	12:42:40
Wed 17 October 2018	0.016	0.022	0.038	1.63 mm/s	07:23:00
Thurs 18 October 2018	0.017	0.021	0.032	0.400 mm/s	08:15:00
Fri 19 October 2018	0.018	0.021	0.033	0.475 mm/s	09:56:00
Sat 20 October 2018	0.017	0.025	0.031	0.275 mm/s	07:10:30
Sun 21 October 2018	0.02	0.026	0.031	0.175 mm/s	12:16:40

Table 4.5: VDV and PPV night-time levels measured at the base of The Old Railway Gatehouse

Date	Night-time Vibration Levels				
	8 Hour VDV			8 Hour PPV	
	X	Y	Z	Max	Time
Mon 15 October 2018	0.014	0.018	0.025	0.275 mm/s	06:21:10
Tue 16 October 2018	0.013	0.019	0.037	1.50 mm/s	06:36:30
Wed 17 October 2018	0.016	0.018	0.030	0.300 mm/s	06:52:00
Thurs 18 October 2018	0.017	0.018	0.031	0.325 mm/s	06:52:10
Fri 19 October 2018	0.017	0.018	0.031	1.75 mm/s	23:14:50
Sat 20 October 2018	0.016	0.018	0.029	0.150 mm/s	23:04:10
Sun 21 October 2018	0.016	0.018	0.028	0.225 mm/s	06:31:00

4.18 The VDV levels are within the required levels as stipulated by BS 6472-1:2008 suggesting that, as measured, the current level of vibration at The Old Railway Gatehouse is less than 'Low Probability of Adverse Comment' for both day time and night time, but may be at a level which is noticeable.

4.19 The PPV levels, with a maximum level of 2 mm/s, are within the banding which would suggest that vibration at these levels may cause complaints but can be tolerated if prior warning and explanation has been given to residents, as detailed within Table 3.3 of this report. These levels are also well below the 10 mm/s which constitutes the threshold of intolerable vibration for any more than a very brief exposure. In the absence of any passing vehicles, baseline vibration levels are negligible.

Traffic Forecast Surveys

4.20 Traffic surveys were undertaken on links around the main construction compound using Automatic Traffic Counters (ATC) in June 2018 and are reported in Appendix B: Main Construction Compound Access Strategy of Appendix 1 of the Applicant's submission to Deadline 3 (REP3-010).

4.21 In summary, an ATC was located along link ID 208 – The Street (as shown in Figure 1.1). The survey recorded total traffic volumes and vehicle classifications over a consecutive 14-day (two-week) period via pneumatic tubes installed across the carriageway.

Traffic calculations

4.22 The temporary impact (i.e. non-permanent, albeit relatively long-term) of additional vehicle movements on the existing road network associated with construction works may affect NSRs along the section of The Street between the B1113 and the entrance of the Oulton airfield, which in this case is limited to The Old Railway Gatehouse. A high proportion of these additional vehicles will be HGVs and HDVs (see paragraph 4.23 below). Noise arising from these vehicle movements can be predicted using established methodologies, using key parameters including: traffic flows, traffic speed, and the type and weight of vehicles. These parameters are set out in the VISSIM Modelling undertaken to inform consultation with Oulton Parish Council regarding the main construction compound access strategy (see Appendix 8 of the Applicant's submission to Deadline 5 (REP5-016)). The duration of use of the main construction compound has also been taken into account in the assessment. As set out in the Main Construction Compound Briefing Note (Appendix 1 of the Applicant's submission to Deadline 3 (REP3-010)) the active use of the main construction compound will be limited to up to 30 months excluding mobilisation and demobilisation. This could be across a single construction phase or two construction phases within an eight year construction window.

4.23 Predicted traffic flows with and without Hornsea Three construction traffic were generated as part of a traffic capacity assessment for The Street. The traffic capacity assessment assumes that the more intensive use of the main construction compound is until approximately 2028 (see paragraph 5.48 of the Main Construction Compound Access Strategy (Annex B of Appendix 1 of the Deadline 3 submission (REP3-010)). Whilst the Hornsea Three construction traffic flows travelling to and from the main construction compound will not increase during the construction period, baseline traffic flows are expected to increase and therefore, 2028 represents the maximum design scenario in baseline traffic flow growth.

4.24 The traffic modelled data is shown in Table 4.6. Based on the traffic forecasts for Hornsea Three (as set out in Volume 6, Annex 7.1: Transport Assessment of the Environmental Statement (APP-159)), it is predicted that the main construction compound will generate a peak 18-hour weekday traffic flow of 118 HGV/HDV and 130 staff movements (non-HGV). This equates to 59 HGVs (two-way movements) accessing the main construction compound each day.

Table 4.6: Construction traffic noise data – 18hr AAWT forecast 2028

Link Name	18hr AAWT 2028 without Hornsea Three				18hr AAWT 2028 with construction of Hornsea Three			
	Total vehicles	HGV	%HGV	Speed (kph)	Total vehicles	HGV	%HGV	Speed (kph)
The Street, Oulton	775	110	14%	69	1023	228	22%	69

4.25 Based on these traffic flows, noise change calculations were undertaken in accordance with the protocol of CRTN (DoT, 1988). Calculations allow for changes in flow, HGV/HDV composition and speed, and the without-construction traffic and with-construction traffic scenarios for the year 2028. Following consultation with NCC, consideration has also been given to the potential for a reduction in speed limit along this section of The Street to 30 mph for the duration of the active use of the main construction compound.

HGVs and staff movements associated with the Hornsea Three construction works will not be travelling to the main construction compound at night and will be limited to the working hours as set out in the Outline CoCP (as submitted at Deadline 6). As such, night-time traffic movements along The Street would be limited to abnormal indivisible loads (AIL) movements. As noted within the Outline CTMP (updated and submitted at Deadline 6) the Applicant will have to agree timings and routings of AIL with the relevant highways authority. Furthermore, the Applicant has included commitments within the Outline CTMP (Appendix 3 submitted at Deadline 6) which commit to the notification of Oulton Parish Council (and the residents of the Old Railway Gatehouse) of any known night-time AIL movements to minimise the disturbance. As such no significant noise and vibration effects on the Old Railway Gatehouse during night-time are expected and therefore such effects have been scoped out of this assessment.

Limitations

4.26 For the traffic noise model, predicted noise levels consider noise only from road links for which traffic data have been provided. The prediction does not include noise from any other sources, such as wind/environmental noise, agricultural activity or industry. However, noise from these other sources would only serve to mask any effects associated with the construction traffic using the main construction compound, and so calculations are considered an assessment of maximum impact.

4.27 Assessment by both prediction and measurement of noise levels has been relied upon for this assessment. In general, measurement is appropriate for assessing effects at an individual or small number of locations, with prediction being preferable for wider assessment, as noise measurements are only representative of the location at which the measurement was undertaken and cannot be easily extrapolated to other locations.

4.28 Whilst the prediction method is preferred, if an assessment were to be made on the basis of measured noise from actual traffic flows, "*Section III – The measurement method*" of CRTN (DoT, 1988) sets out the measurement procedures that would be followed. Measurements would only be warranted where clear aims or assessment methodology required it. Flows provided for the road links around Oulton are generally low, and all flows for all scenarios are below the minimum flow for which CRTN (DoT, 1988) is appropriate. CRTN says in paragraph 30:

"*Calculations of noise level for traffic flows below 50 veh/h or 1000 veh/18-hour day are unreliable and measurements* [of noise levels with and without construction traffic] *should be taken when evaluating such cases.*"

4.29 It is considered that the low flow limitation of CRTN (DoT, 1988) is less applicable to calculations of noise change in the L_{Aeq} metric, given the calculation methodology of L_{Aeq} is based on an energy/ flow sound-event calculation, without the necessary adjustment for the time element associated with the L_{A10} prediction for which CRTN is designed. Its use is therefore, appropriate in assessment against the noise change criteria; however, the prediction of absolute noise levels should be treated with more caution. The noise measurements undertaken of passing HGV movements allows for a better prediction of the effects of construction traffic, however direct measurement of construction traffic specific to the scheme can only be undertaken once that construction traffic is present. Consequently, it can be used in validation but not prediction.

4.30 CRTN (DoT, 1988) also requires that for receptors less than 4 m from the carriageway edge, calculation is based on a separation distance of 4 m. It is implied within CRTN that this may introduce uncertainty (in that for a calculation as required by the Noise Insulation Regulations, the calculation should not be relied upon if the results are within 3 dB of the relevant criteria). This is of particular relevance to The Old Railway Gatehouse receptor, which is estimated to be approximately 1.5 m (horizontal distance) from the carriageway edge of The Street. It is considered that the assessment of noise change, however, is robust at this distance (with uncertainties in the model assumptions cancelling out between the without and with scenarios) and it is only the prediction of absolute noise levels that should be treated with more caution.

4.31 Given the relatively low volume of construction traffic generated, where the construction traffic joins more heavily trafficked existing roads, such as the B1149, the percentage change in flow, and consequentially the noise change for NSRs potentially affected would be expected to be less than +3 dB, i.e. of negligible significance.

5. Construction Traffic Noise

Assessment of Noise Change

5.1 Noise change calculations have been undertaken for The Street, Oulton, for the length to which the traffic flows apply. The calculations consider total 18-hour average flows, percentage HGV/HDV and representative speed, using the formula from CRTN (DoT, 1988). The noise changes forecast in Table 5.1 represent the expected noise change at The Old Railway Gatehouse based solely on the provided traffic flows and do not consider any of the designed-in noise and vibration mitigation proposed by the Applicant as set in paragraph 7.1. This is considered to represent a maximum design scenario.

5.2 Where any non-negligible noise change is predicted, the absolute noise level for the receptors assessed is also calculated, following the methodology within CRTN (DoT, 1988).

Table 5.1: Construction traffic noise impact calculation - 18hr AAWT forecast

Link Identity	Base Flow, 2028 18hr AAWT	Additional Future Flow, 2028 from construction of Hornsea Three	dB noise change	Impact magnitude
The Street, Oulton	775	248	2.3	Negligible

5.3 From the results presented in Table 5.1, The Old Railway Gatehouse, which fronts The Street, is predicted to experience a **negligible adverse** impact due to the change in noise associated with Hornsea Three construction vehicles.

5.4 It is recognised, however, that an increase in average daily HGV/HDV pass-bys from 110 per day to 228 per day will increase the frequency of maximum noise events at The Old Railway Gatehouse.

5.5 From the prediction methodology within CRTN (DoT, 1988), allowing a -3 dB conversion from $L_{A10,18hr}$ prediction to $L_{Aeq,16hr}$, the noise level incident at The Old Railway Gatehouse where façades front The Street will experience a predicted daytime noise level of 66.3 dB $L_{Aeq,16hr}$ in 2028 with existing and Hornsea Three construction traffic. This is an increase of 2.3 dB from the level of 64.0 dB $L_{Aeq,16hr}$ predicted for 2028 without Hornsea Three construction traffic.

5.6 Façades of The Old Railway Gatehouse further from The Street will experience a lesser magnitude of road traffic noise, but the same relative increase due to the additional movements associated with construction vehicles (both HGV and staff).

5.7 For context of this noise magnitude, the noise levels required for sound insulation to be provided under The Noise Insulation Regulations 1975 as amended 1998 are 68 dB $L_{A10,18hr}$, (and subject to other requirements). In the absence of mitigation (see section 7) the predicted noise level identified in paragraph 5.5 (66.3 dB $L_{Aeq,16hr}$) with the Hornsea Three construction traffic equates to 69.3 dB $L_{A10,18hr}$; and therefore, exceeds the NIR threshold at which insulation would be provided for permanent traffic change. There is no equivalent set threshold for temporary traffic noise change, but this threshold has been applied to represent a maximum design scenario.

5.8 In terms of potential disturbance to the residents at The Old Railway Gatehouse, the DMRB Volume 11 Section 3 Part 7 HD 213/11, Annex 6 'Assessing Traffic Noise and Vibration Nuisance' has been considered. Following the approach in the guidance, change in noise exposure from around 67 dB $L_{A10,18hr}$ to 69 dB $L_{A10,18hr}$ may result in an increase in the "*percentage of people bothered very much or quite a lot by traffic noise*" from 26% to 32% for residents of The Old Railway Gatehouse. It is noted however, that statistical predications cannot accurately predict the response of individuals and that "*individuals vary considerably in their sensitivity to noise*". The wording "*percentage of people bothered very much or quite a lot by traffic noise"* comes directly from DMRB Annex 6. In the context of this assessment, the percentages relate to what might be the expected response of a statistically significant number of residents under these circumstances, and so are not necessarily applicable to the small number of residents at The Old Railway Gatehouse.

5.9 Where The Street crosses the dismantled railway immediately adjacent to The Old Railway Gatehouse, the carriageway contains a 'hump' or ridge (where the road has been built over the railway line). As noted in paragraph 3.1, the above assessment is based on traffic change only. Although the effects of the existing hump may elevate the absolute noise levels above those estimated in paragraph 5.5, any relative noise change would be less prone to increase.

5.10 Although the assessment, as presented in paragraph 5.3 concludes that the effects due to the change in noise would be negligible adverse, the Applicant has proposed mitigation to further minimise noise and vibration impacts on The Old Railway Gatehouse as set out in paragraph 7.1, which includes the regrading of the existing road hump, and imposition of a temporary 30 mph speed limit along this section of The Street. Taking this into consideration, the proposed reduction to 30 mph (48 kph) would result in a reduction in approximately 1.3 dB in overall traffic noise. This would reduce the noise increase from 2.3 dB to 1.0 dB. The regrading of the road hump would also reduce the noise levels associated with HGV movements along this section of The Street, leading to a further reduction in the noise change predicted at The Old Railway Gatehouse. On this basis no significant effects are expected on the The Old Railway Gatehouse in respect to change in noise levels.

Assessment of noise levels

5.11 From the noise survey and representative SEL level calculated for an HGV pass-by of The Old Railway Gatehouse, a prediction of the expected noise level at the residential façade closest to The Street has been undertaken.

5.12 The peak 18-hour weekday traffic for Hornsea Three (as set out in paragraph 4.23 above), would be an estimated 118 HGV movements (59 HGVs in and out of the main construction compound) along The Street.

The predicted impact of the HGV movements has been derived through the use of the data in

5.13 Table 4.3, based on the quantity of activity events over the required assessment period using the following equation;

$$L_{Aeq,T} = SEL + 10log_{10}(^{1}/_{T}) + 10log_{10}(N)$$

5.14 Where:

- SEL is the equivalent L_{Aeq} over a one second period for the noise event;
- T is the reference time period in seconds and
- N is the number of movements in the time period, T.

5.15 This would result in the sound levels from the HGV movements being increased from the measured 59 dB $L_{Aeq,16h}$ up to 67 dB $L_{Aeq,16h}$. This would be a difference of approximately 8 dB (taking into account rounding). This would be classed as a moderate increase in sound levels in line with the assessment criteria given in Table 3.1.

5.16 As the calculation has been prepared using the peak movements only, it has been assumed that for the majority of the time, the traffic movements would be approximately 50% lower. Therefore, an estimated sound level would be in the region of 64 dB $L_{Aeq,16h}$. This would be a difference of approximately 6 dB, and still be classed as being a moderate noise increase.

5.17 To represent a maximum design scenario, the calculation assumes that the existing road hump remains in place (i.e. the measures outlined in paragraph 7.1 have not been taken into account). On this basis, the discrepancy between the 6 – 8 dB increase in noise levels predicted here and the approximately 3 dB increase predicted in Table 5.1 primarily arises due to the influence of the existing road hump adjacent to The Old Railway Gatehouse.

5.18 However, as noted in paragraph 7.1, the Applicant has committed to regrade the existing road hump and to impose a temporary speed limit, in order to reduce or remove the influence of the road hump on HGV noise, which would reduce the noise level change to be a minor noise increase. The minor noise increase can be considered a minor adverse effect, and thus not significant in EIA terms.

5.19 During consultation, The Old Railway Gatehouse residents identified a concern regarding the potential for noise impacts associated with vehicles stopping, accelerating and/or changing gear when pulling away from the passing place close to The Old Railway Gatehouse travelling north along The Street.

5.20 There is no established method for calculating or assessing noise from accelerating traffic. Guidance used to assess the impacts of construction noise (i.e. DMRB Volume 11 Section 3 Part 7 HD 213/11, Annex 5 paragraph A5.23) says "*Speed variations at junctions should generally be ignored in assessing noise nuisance as there is a trade-off between the effects of reducing speed and the additional engine noise generated by deceleration and acceleration.*"

5.21 However, it is acknowledged that where HGVs have stopped at a passing place, their noise in moving away may be greater than for a constant-speed vehicle passing. Whilst the noise increase would be minor, below the maximum design scenario threshold for sound insulation under the NIR (see paragraph 5.7), there is a potential for disturbance to the residents within the Old Railway Gatehouse (see paragraph 5.8). On this basis the Applicant has identified measures which could be implemented to further minimise impacts. This would be offered as optional mitigation, to be taken forward should residents wish, however it is not essential to mitigate the effects.

Assessment of predicted vibration levels

5.22 The highest related VDV for a traffic movement was measured at 07:20h on the morning of the 17 October 2018 with the following characteristics:

Table 5.2: Measured maximum design scenario for HGV movement

X-axis	Y-axis	Z-axis	Weighted RMS
0.006m·s$^{-1.75}$	0.01m·s$^{-1.75}$	0.033m·s$^{-1.75}$	0.035m·s$^{-1.75}$

5.23 Using a similar approach to that used predicting the noise levels, the additional effect of the HGV movements can be calculated. The scaling factor for the VDV is equal to the number of events (in this instance, 118 HGVs) raised to the power of 0.25. Consequently, the weighted r.m.s. acceleration of 0.035 m·s$^{-1.75}$ multiplied by 118$^{\wedge 0.25}$ gives an overall VDV level of 0.11 m·s$^{-1.75}$, which in accordance with Table 1 of BS 6472-1, (Table 3.2 within this report), approaches a level indicating 'Low Probability of Adverse Comment'.

5.24 It must be noted that the VDV has been calculated on the highest measured individual vibration dose value. Where the weight of the HGVs is significantly greater when compared with the agricultural trailers measured during the survey (as will be the case for some of the Hornsea Three HGV traffic), the effect of the vibration would likely be increased above that predicted in paragraph 5.23. For general vibration (i.e. assuming that discontinuities such as the existing road hump are removed), a doubling in vehicle weight for all passing HGVs gives doubling in the vibration acceleration levels, whilst a doubling of vehicle speed gives a change of a factor of 3.3. For the purpose of assessing potential effects of Hornsea Three HGV vehicle movements, a doubling in the VDV would not change the outcomes of the assessment with levels predicted falling within the "Low Probability of Adverse Comment".

5.25 The PPV levels (peak levels) are unlikely to increase purely due to an increased number of vehicles, unless as before, the weight of the HGVs varies; the increase in number of peaks does not relate to the magnitude of each peak.

5.26 In summary, with the implementation of the designed-in mitigation measures as set out in paragraph 7.1 (i.e. the regrading of the existing road hump and the temporary speed limit of 30 mph), the VDV and PPV levels arising from the movement of Hornsea Three construction traffic would result in vibration levels within the "Low Probability of Adverse Comments".

6. Cumulative Impacts

6.1 There is the potential for cumulative traffic noise impacts to occur as a result of construction traffic from Hornsea Three as well as Norfolk Vanguard (planning application reference EN010079) (and onshore works associated with Norfolk Boreas) using The Street to access its compound.

6.2 As reported Appendix 25 to the Applicant's Deadline 6 submission, the Norfolk Vanguard Application states the following in respect to the use of The Street:

"Traffic for the Norfolk Vanguard site has been identified as 96 HGV's per day as per as Paragraph 5.9 of Main Construction Access Strategy issued in September 2018"

6.3 The cumulative traffic flows have been added to the base and development traffic reported in Table 6.1 to give predicted traffic flows for cumulative scenarios for the purpose of informing the noise and vibration assessment, covering: 2028 Base + Hornsea Three + Norfolk Vanguard Traffic.

Table 6.1: Cumulative traffic noise data - 18hr AAWT forecast 2028

Link Description	Hornsea Three (Daily Traffic)		Norfolk Vanguard (Daily Traffic)	
	Total vehicles	HGV	Total vehicles	HGV
The Street, Oulton	248	118	178	96

6.4 The additional noise changes resulting from these cumulative scenarios, as calculated using the CRTN methodology, are reported in Table 6.2 and Table 6.3. The noise change for the 2028 + Hornsea Three traffic assumes that the designed-in mitigation as set out in paragraph 7.1 has not been implemented. This presents the maximum design scenario and reduces the level of uncertainties in the cumulative traffic noise changes.

Table 6.2: Cumulative traffic noise change, from 2028 Base flow

	Noise change from 2028 Base to:	
	2028 Base + Hornsea Three traffic	2028 Base + Hornsea Three + Norfolk Vanguard
Change in $L_{Aeq,18hr}$	2.3 dB	3.5 dB

Table 6.3: Cumulative traffic noise change, from 2028 Base plus Hornsea Three Construction traffic flow

	Noise change from 2028 Base + Hornsea Three Traffic to:
	2028 Base + Hornsea Three + Norfolk Vanguard
Change in $L_{Aeq,18hr}$	1.2 dB

6.5 In summary, the cumulative schemes considered, together could add up to a further 1.2 dB noise increase above that arising from the Hornsea Three construction traffic alone. This would occur if peak traffic associated with Hornsea Three coincides with peak traffic for Norfolk Vanguard.

6.6 As the maximum design scenario, it would bring the total increase from the 2028 base level to the Hornsea Three and cumulative traffic to a + 3.5 dB noise increase. That would equate to a minor adverse noise increase for the circumstance that all peak traffic coincide.

6.7 A consideration of the cumulative effects on noise levels following the calculations in paragraph 5.15 has also been undertaken, based on the SEL contributed by each anticipated HGV pass-by.

6.8 This would result in the sound levels from the HGV movements being increased from the measured 59 dB $L_{Aeq,16h}$ up to a maximum of 69 dB $L_{Aeq,16h}$ (for the scenario "2028 Base + Hornsea Three Traffic Norfolk Vanguard Traffic"). This would be a difference of approximately 10.6 dB. This would be classed as a major increase in sound levels without the proposed mitigation.

6.9 However, as noted in paragraph 7.1, the Applicant has committed to regrade the existing road hump and to impose a temporary speed limit, which is expected to reduce the noise level change to a minor noise increase which is not significant in EIA terms.

7. Mitigation

Designed-in Mitigation

7.1 The results of the noise assessment indicate that existing noise levels are influenced by the presence of the existing road hump adjacent to The Old Railway Gatehouse. The road hump delineates the former railway line which is an undesignated heritage asset and thus cannot be removed. The Applicant has therefore committed to regrade the road surrounding the hump, building up the vertical alignment of The Street either side of the road hump. This would in essence reduce the severity of the road hump and thus, reduce noise and vibration impacts associated with HGV movements and ultimately reduce the noise level change. The Applicant has also committed to implementing a temporary speed limit along this section of The Street. The works to regrade the existing road hump and the temporary speed limit are secured through the access strategy for the main construction compound set out in the Outline CTMP (Appendix 3 submitted at Deadline 6).

7.2 As concluded in the above assessments, with the designed-in mitigation considered, no significant noise and vibration effects are anticipated at the Old Railway Gatehouse.

7.3 Furthermore, the Communication Plan Framework in the Outline CoCP (REP4-023) sets out a complaints procedure, which will be in place during the construction phase to provide a mechanism for the identification of unreasonable noise emissions such that these can be investigated and if appropriate, mitigation implemented.

Optional Mitigation

7.4 Although the assessment has not identified a need for optional mitigation (beyond the design-in measures discussed in paragraphs 7.1 and 7.2), the Applicant notes the potential for there to be an increase in disturbance experienced by the residents of the Old Railway Gatehouse as a result of the additional traffic movements and the change in the flow of the traffic (i.e. vehicles accelerating from the passing place). As such, the Applicant has identified measures to further minimise impacts comprising the installation of double glazing along the façade closest to The Street, or the provision of a wall along the garden. This would be offered as optional mitigation, to be taken forward should residents wish, however it is not essential to mitigate the effects.

8. Summary and Conclusions

8.1 An increase of 248 construction vehicles is predicted as passing The Old Railway Gatehouse, comprising 118 HGVs/HDVs and 130 staff movements. This is predicted to lead to an increase of 2.3 dB at The Old Railway Gatehouse (without mitigation), this would equate to a negligible adverse impact.

8.2 However, the assessment, based on measured noise levels at The Old Railway Gatehouse, has indicated that the noise increase compared to baseline may be of the order of 6 dB to 8 dB at this property. This would be considered a moderate noise increase (without mitigation).

8.3 However, the Applicant has committed to minimise potential noise and vibration effects through the implementation of a temporary speed limit along this section of The Street (to 30 mph) and regrading of the existing road hump. With the implementation of this mitigation, the noise level change would reduce from moderate (as reported in paragraph 8.2) to be a minor noise increase. The minor noise increase can be considered a minor adverse effect, and thus not significant in EIA terms.

8.4 Traffic forecasts have also been provided to allow the assessment of construction traffic from Hornsea Three and the cumulative effect of Hornsea Three in combination with Norfolk Vanguard. This has identified the potential for a cumulative traffic noise increase of 3.5 dB (assuming both projects are delivered concurrently) which would be considered to be a minor increase in overall noise levels.

8.5 A consideration of the cumulative effects on noise levels following the calculations in paragraph 5.15 has also been undertaken, based on the SEL contributed by each anticipated HGV pass-by. This would result in the sound levels from the HGV movements being increased from the measured 59 dB $L_{Aeq,16h}$ up to a maximum of 69 dB $L_{Aeq,16h}$ (for the scenario "2028 Base + Hornsea Three Traffic Norfolk Vanguard Traffic"). This would be a difference of approximately 10.6 dB. This would be classed as a major increase in sound levels without the proposed mitigation. However, as noted in paragraph 7.1, the Applicant has committed to regrade the existing road hump and to impose a temporary speed limit, which is expected to reduce the noise level change to a minor noise increase which is not significant in EIA terms.

8.6 Although the assessment has not identified a need for optional mitigation (beyond the designed-in measures identified), the Applicant notes the potential for there to be an increase in disturbance experienced by the residents of the Old Railway Gatehouse as a result of the additional traffic movements and the change in the flow of the traffic (i.e. vehicles accelerating from the passing place). As such, the Applicant has identified measures to further minimise impacts comprising the installation of double glazing along the façade closest to The Street, or the provision of a wall along the garden. This would be offered as optional mitigation, to be taken forward should residents wish, however it is not essential to mitigate the effects.

9. References

British Standards Institute (2014) British Standard 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'. Milton Keynes, BSI.

British Standards Institute (2014) British Standard 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'. Milton Keynes, BSI.

British Standards Institute (2008) British Standard 6472-1:2008 'Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting.' Milton Keynes, BSI.

Department of Transport (1988) Calculation of Road Traffic Noise (CRTN). London, HMSO.

Highways Agency (2011) Design Manual for Roads and Bridges (DMRB). London, The Stationary Office.

The Noise Insulation Regulations 1975. (1975) SI 1763. London, HSMO.

The Noise Insulation (Amendment) Regulations 1988. (1988) SI 2000. London, HMSO.

Nelson, P.M. (1987) The Transportation Noise Reference Book, Butterworth & Co.

RPS (2016) Vibration and Noise Level Monitoring Regarding Application Ref: TA/2012/902 for the Periodic Review of a Mineral Site Planning Permission Land at Oxted Quarry, Chalkpit Lane, Oxted, Surrey RH8 0QW. JAE7869_036-REPT-01-R0. RPS