
Subject Preston New Road - Noise Management Plan

Date 4 January 2017

Job No/Ref 230382-03/D021a

Preston New Road – Noise Management Plan

Summary

This document presents a noise management plan for the Preston New Road shale gas exploration site in response to planning condition 26. It establishes the framework within which noise from the site will be controlled. Control will be by the following measures:

- project design,
- planning,
- Best Practicable Means,
- setting noise limits,
- noise monitoring, and
- community liaison.

Details of these approaches are provided within this plan.

Noise modelling are given in Appendix B (for drilling), Appendix C (for fracturing), Appendix D (for site access construction works) and Appendix E (for flaring).

This noise management plan also incorporates the noise monitoring methodology, required by planning condition 28.

1 Introduction

This document presents a noise management plan (NMP) for shale gas exploration works at a site on the A583 Preston New Road, Lancashire. The Plan is required in order to satisfy condition 26 of the planning permission granted on 6 October 2016 for works referred to in this report as the Preston New Road Exploration Works (PNR EW) (planning permission granted on appeal – ref no: APP/Q2371/W/15/3134386; Application Ref: LCC/2014/0096).

The following responds to the requirement of planning condition 26 which states:

Prior to the commencement of development of the access and site and interconnections to the gas and water grid, a noise management plan shall be submitted to the County Planning Authority for approval in writing. The plan shall provide:

- a. Data from the relevant manufacturers' noise tests for each item of noise-emitting plant to be used on site to establish whether noise emissions are likely to be compliant with conditions 29 and 30;

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- b. If not likely to be compliant, details of what mitigation would be introduced and timescales for implementation;
- c. Details of instantaneous mitigation methods for each item of noise emitting equipment and any longer term mitigation;
- d. Procedures for addressing any complaints received.

The approved noise management plan shall be implemented in full throughout the operational life of the site including decommissioning and restoration.

The Plan also includes the noise monitoring methodology, responding to planning condition 28, which states:

Prior to the commencement of development, details of a noise monitoring methodology shall be submitted to the County Planning Authority for approval in writing.

This methodology shall include:

- a. permanent monitoring at a single location throughout all phases of the development, commencing from the construction of the access road and the site;
- b. temporary monitoring at any other location as reasonably requested by the County Planning Authority;
- c. details of the equipment to be used (which shall be of a type that can transmit live monitoring of noise data direct to the County Planning Authority and can record audio);
- d. the locations at which the permanent equipment is to be installed; and
- e. details of how and on what the equipment is to be attached, including the height and details of any structure to be used.

The approved monitoring methodology and equipment shall be employed and the monitoring data shall be made available to the County Planning Authority to view live on line at all times, provided this condition shall not be breached in the event of a temporary disruption in the live feed in which case reasonable endeavours shall be used to resume the live feed without compromising the integrity of the data record.

The results of the monitoring shall include L_{A901hr} , L_{Aeq1hr} , $L_{Aeq100ms}$ and $L_{Amax,1hr}$ noise levels, the prevailing weather conditions on any hourly basis, details of equipment and its calibration used for measurements and comments on other sources of noise which affect the noise climate and including audio recording to identify noise sources where noise limits are exceeded. Audio recording shall be triggered to commence at a level below the noise limit to be agreed in advance with the County Planning Authority.

If the results indicate that the noise levels from the site exceed those set out in conditions 29 and 30, remedial action shall be implemented within 48 hours.

This NMP establishes the framework within which noise from the site will be controlled. Control will be by the following measures:

- project design,
- planning,

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- Best Practicable Means,
- setting noise limits,
- noise monitoring, and
- community liaison.

2 Management of noise impacts

The requirement to use Best Practicable Means to mitigate the effects of noise and vibration is set out in section 72 of the Control of Pollution Act 1974 and section 79 of the Environmental Protection Act 1990. Best Practicable Means incorporates two essential elements:

- Practicable – this is defined as reasonably practicable having regard, among other things, to local conditions and circumstances; the current state of technical knowledge; and to financial implications; and
- Means – these are the means to be employed, including design, installation, maintenance, manner and periods of operation of plant and machinery; and the design, construction and maintenance of buildings and structures.

2.1 Working hours

Allowable activities will need to comply with the working hours set out in condition 19 and the noise limits defined in condition 29 and set out below. These conditions are included at Appendix A of this plan.

2.2 Plant repair and maintenance

All planned repairs and maintenance of plant shall be undertaken during normal working hours. By exception repair and maintenance may need to be carried out outside normal working hours. Activities outside normal working hours that could give rise to disturbance will be kept to a practicable minimum. Such maintenance activities shall only be undertaken within the site compound and behind the site hoarding.

2.3 Noise Control

The contractor will, in so far as is reasonably practicable, control and limit noise levels so that residential properties and other sensitive receptors are protected from excessive noise from the site. Best Practicable Means shall be employed at all times and for all stages of set up, use and decommissioning of the site.

Details of the site activities and steps to minimise noise are set out in this NMP. Any changes to the noise monitoring methodology set out in this plan, working practices or equipment to be used that affect the off site noise level will be discussed with Lancashire County Council (LCC). Noise prediction, evaluation and assessment of noise will, by necessity, be a continuous activity throughout all stages of set up, use and decommissioning of the site.

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Measures to be considered in implementing Best Practicable Means will be consistent with condition 31 and the recommendations of BS5228-1:2014 and will, where reasonably practicable, include the following as appropriate:

- careful selection of plant, construction methods and programming. For types of plant where it is applicable, only plant conforming to SI 2001/1701 (UK implementation of EC directive 2000/14/EC on noise emission from plant for use outdoors) will be used if placed on the market or put into service since January 2002. Plant placed on the market or put into service prior to that date shall conform to SI 1985/1968 (as amended) or to SI 1988/361 (as amended) as appropriate to the type of plant;
- equipment to be sited as far from sensitive receptors or as close to any acoustic screen located between the activity and the receptor as reasonably practicable;
- the use, by preference, of non-audible warning systems and where audible warnings are necessary for reversing, vehicles operations will be planned to minimise reversing;
- the use of white noise reversing alarms for all site based vehicles;
- provision of lined and sealed acoustic covers for equipment which will be in place while equipment is running;
- regular maintenance of all equipment;
- adequate lubrication to prevent screeching and squealing;
- operation of equipment in the mode of operation that minimises noise;
- shutting down equipment when not in use;
- avoiding waiting or queuing on the public highway with engines running;
- handling all materials in a manner which minimises noise;
- fitting of and maintenance of silencers to all plant, machinery and vehicles;
- design and use of site hoarding and screens, where practicable and necessary, to provide acoustic screening at the earliest opportunity;
- erection of operational noise barriers as early as practicable in the construction process to provide additional protection against construction noise;
- choice of routes and programming for the transport of equipment, materials and personnel;
- shouting and raised voices kept to a minimum. Use of tannoys and outdoors radios prohibited except for safety and urgent communication;
- operation of a 24-hour helpline for the general public once works commence, with all calls logged, together with the responses given and the callers' concerns actioned in an appropriate manner; and
- site induction includes instruction on measures to minimise noise.

3 Noise levels

Noise levels have been calculated using SoundPlan software and source levels based on measured noise levels for individual plant items, where practicable, or in accordance with the methods set out in BS5228-1:2014 to provide relevant plant data.

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Where noise measurements during the works give rise to more accurate information on levels and propagation characteristics, the information will be reviewed and used in addition to, or instead of, the information used in the initial calculations.

The following noise predictions assume that the site will be fully enclosed by a solid 4m high site hoarding.

3.1 Drilling noise predictions

Full details of the calculation of drilling noise levels are given in Appendix B, including the main items of plant and the noise level attributed to the plant. The principal factors defining off-site noise are:

- a. Drilling rig;
- b. Shale shakers;
- c. Mud pumps;
- d. Generators; and
- e. 4m high solid site hoarding enclosing the site on all sides.

The site layout is shown below. Off-site noise levels will be recalculated if any significant changes to this layout are made. Significant changes include different positioning or orientation of the main noise-producing plant items; use of different plant items or different numbers of plant items; and different locations of plant in relation to noise screens, including office/storage containers that provide a screening effect.

The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits



Figure 1. Site layout during drilling

Without further mitigation, the noise levels at the closest dwelling to the site (Staining Wood Cottages – SWC) are calculated to exceed the night time noise limit. The mitigation described below will therefore be provided.

3.1.1 Drilling noise mitigation

In addition to the 4m hoarding around the site, the following mitigation will be installed during initial set up of the site and before drilling starts:

- Sound absorption in enclosures to shale shakers, and ventilation provision for operating with doors closed, according to Best Practicable Means of working;
- Sound absorption in enclosures to generators, including louvres;
- Enclosures to mud pumps;
- Rubber bushings to reduce pipework vibration; and
- Barrier enclosing the rig: minimum of 7m, maximum of 10m high.

3.1.2 Additional drilling noise mitigation

As a precaution, to respond quickly if higher noise levels arise, or to address any tonality or impulsivity that exceeds the criteria given in condition 30 (see Appendix A), the following mitigation measures will be available and implemented within 48 hours of the need being identified:

- Additional attenuators and silencers to generators;
- Enclosure for the top drive; and
- Immediate reduction in drilling rate outside normal daytime working hours.

3.2 Hydraulic fracturing pumping noise predictions

Full details of the calculation of noise levels during hydraulic fracturing pumping operations are given in Appendix C. The principal factors are:

- a. Pump type;
- b. Number of pumps; and
- c. 4m high solid site hoarding enclosing the site on all sides.

The site layout is shown below. Off-site noise levels will be recalculated if any significant changes to this layout are made. Significant changes include different positioning or orientation of the main noise-producing plant items; use of different plant items or different numbers of plant items; and different locations of plant in relation to noise screens, including office/storage containers that provide a screening effect.

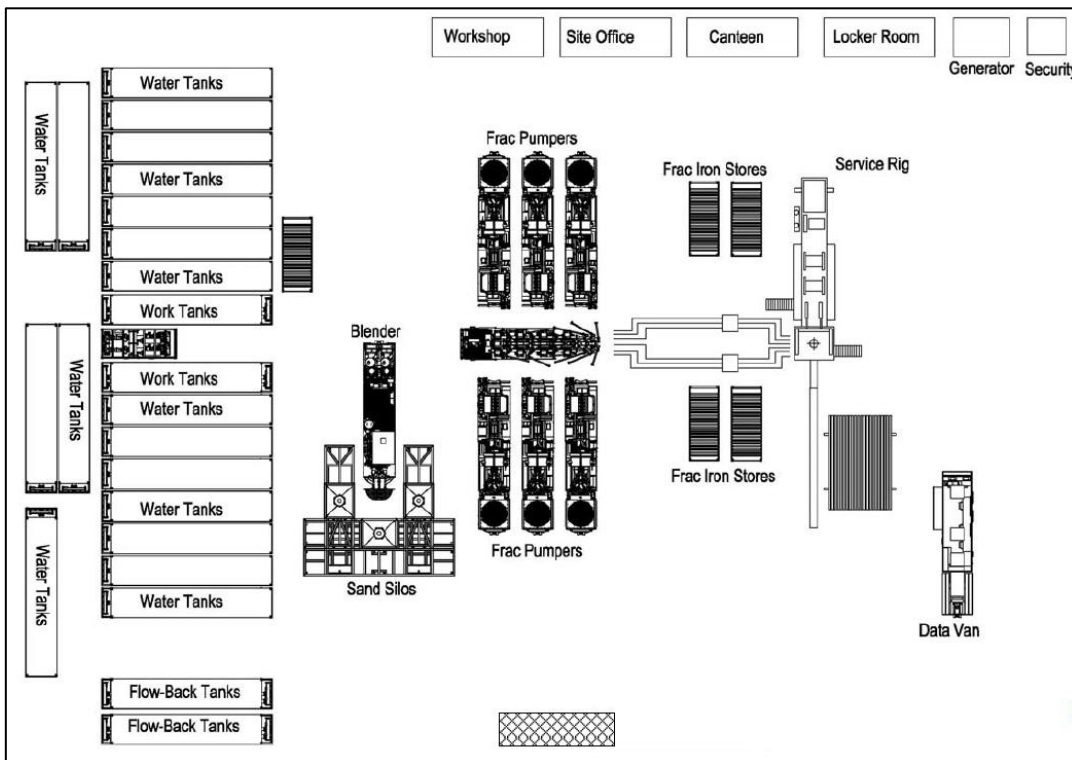


Figure 2. Site layout during fracturing

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The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits.

3.2.1 Hydraulic fracturing noise mitigation

The following mitigation will be installed during initial set up of the hydraulic fracturing equipment site and before starting the fracturing:

- Pumps will be enclosed by a 5m high solid barrier, positioned 2m from the pumps.

3.2.2 Additional hydraulic fracturing noise mitigation

As a precaution, to respond quickly if higher noise levels arise, or to address any tonality or impulsivity that exceeds the criteria given in condition 30 (see Appendix A), the following mitigation measures will be implemented within 48 hours of the need being identified:

- Additional attenuators and silencers to generators

3.3 Construction of site access

Construction of the site access road will be a short duration activity and will require temporary use of plant closer to SWC than will be required once the site is operational, particularly for the connection with the A583 Preston New Road.

Noise impacts will be minimised through the use of Best Practicable Means of working. Noise levels based on the assumed equipment and processes set out in Appendix D indicate that the daytime noise criterion will not be exceeded at SWC.

The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits

4 Noise monitoring

Condition 29 requires that: "Noise from the site under free-field conditions at 1.2 to 1.5 metres height above the surrounding ground level at any boundary of any residential property, shall not exceed $55\text{dB}_{\text{L}_{\text{Aeq},1\text{hr}}}$ between 0800 and 2100 and shall not exceed $39\text{dB}_{\text{L}_{\text{Aeq},1\text{hr}}}$ or $57\text{dB}_{\text{L}_{\text{Amax}}}$ between 2100 and 0800."

Condition 28 requires that the LCC approves details of a "noise monitoring methodology", which must include the matters set out in (a) to (e) of condition 28 (see Appendix A). The approved monitoring methodology and equipment must be employed and the monitoring data made available to LCC live online.

The nearest residential property to the site is Staining Wood Cottage (SWC). The purpose of condition 29 is not to monitor the total noise near the boundary of SWC (which already in fact exceeds the thresholds in Condition 29 due to existing baseline traffic noise etc), but to monitor whether noise from the exploration site (noise emitted from the site is abbreviated as "NFS" in the

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following discussion) exceeds the levels set out in Condition 29. This section 4 explains how Cuadrilla proposes to isolate and monitor the NFS in the presence of the existing noise.

In summary, it is proposed that this is achieved by establishing a permanent monitoring site at a location which is representative of the level of NFS that would be experienced at the boundary of SWC were there no other baseline noise at SWC. Cuadrilla currently expects to position this monitoring site approximately in the location shown as "Location 2" in Figure 3. Location 2 appears appropriate because it is away from traffic on Preston New Road, so is expected to have a lower baseline noise level, and is closer to the site, so the NFS would be higher than at SWC. Measurement at Location 2 therefore facilitates the exercise of isolating NFS. However, Location 2 cannot be fixed until: (i) baseline levels at Location 2 are confirmed as suitable and have been fully defined and (ii) the finalised drilling rig layout and equipment have been defined to enable noise predictions to be made.

Monitoring is also proposed close to SWC, at "Location 1" as shown on Figure 3. Monitoring at this location is proposed in order to contextualise the NFS against existing baseline noise.

A three dimensional noise model will be created based on the drilling rig layout and equipment and the site topography that will enable the difference in NFS at Location 2 and Location 1 to be calculated. An adjustment can then be made to the Location 2 measurements during the works that enables the NFS at SWC to be determined and the contribution from the baseline noise to be excluded. Raw monitoring data from Locations 1 and 2 will be fed through to LCC live online. However, the level of NFS against which compliance with Condition 29 is to be measured, and the triggers in 4.2.1 of this plan applied, will be based not on raw noise monitoring data from Locations 1 or 2, but on the data from Location 2 adjusted by the noise model to represent the NFS which would be heard at SWC if background noise were excluded.

The noise monitoring equipment will record noise levels continuously throughout the preparation, use and decommissioning of the site. Additionally, baseline noise levels will be recorded at SWC for one month before any site preparation activity commences. The fixed loggers at Locations 1 and 2 will be supported by additional short term measurements at other locations if reasonably requested by LCC. Weather conditions will be logged continuously for the duration of the noise logging.

To assist Cuadrilla in understanding the possible cause of any noise complaints, a third logger will be installed within the exploration site boundary. This data will not be publicly available and will not be routinely provided to LCC.

4.1 Measurement locations

As explained above, two permanent noise monitors will be used throughout the works:

- Location 1 to measure and record the actual noise levels at SWC, the closest residential property; and
- Location 2 will be a proxy for SWC, to be used to trigger alerts (described in 4.2.1), with a reduced risk of interference with triggers by road traffic noise from the A583 Preston New Road.

Location 1 will be on the north side of the A583 so that a secure and accessible location can be provided that does not require access arrangements to be made with property owners and to minimise any risk of tampering.

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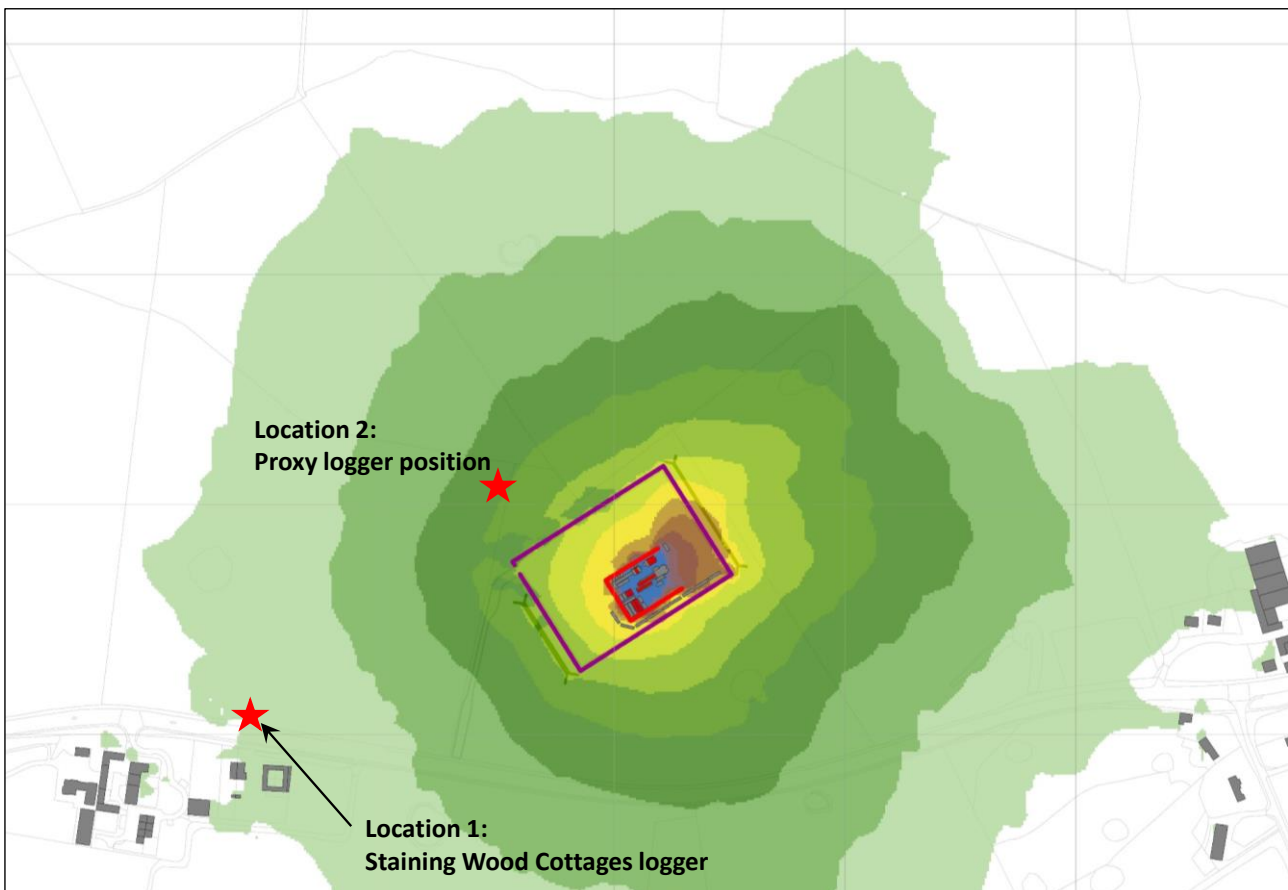
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Location 2 will be established at a location to be representative of $39\text{dB}L_{\text{Aeq},1\text{hr}}$ freefield at the boundary of SWC, plus an adjustment to allow measurement of site noise in the presence of the baseline levels. This will be achieved by creating a three dimensional noise model of the drilling rig, site layout and topography, and comparing the noise level at SWC with that at Location 2.

Location 2 will be selected based on:

- Areas where changes in noise levels due to changes in on-site plant noise levels will be similar to the changes experienced at SWC, i.e. Locations 1 and 2 are exposed similarly to changes in noise from the main noise sources;
- Areas where the modelled noise contours are widely spaced to minimise any impact of error due to distance from the site;
- A location where the noise modelling indicates that the drilling noise is predicted to exceed the baseline noise level;
- Minimal intrusion of traffic noise from Preston New Road; and
- Safe and secure location that will remain free from risk of tampering or disturbance throughout the duration of the works, including damage or disturbance by livestock.

As noted above, the exact position of Location 2 has yet to be confirmed. However, the likely position of Location 2 and the confirmed position of Location 1 are shown in Figure 3. Figure 4 shows the noise monitoring station arrangement.



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Figure 3: Permanent monitoring locations

A third monitor, Location 3, will be used only to assist Cuadrilla in understanding the source of any exceedence of off-site noise and the data will not be available on line. Location 3 will be within the site boundary at a location that will not interfere with any works and that is affected as little as possible by on-site vehicle movements or other variable or mobile noise sources. Location 3 may not be fixed throughout the period of the works and may need to be changed for the various phases including site set up, drilling, fracturing and grid connections.

Temporary monitoring will be undertaken at other locations as reasonably requested by LCC in the event of comments being received by residents.

A weather station will be located at Location 2 which records rainfall and wind direction



Preston New Road - Indicative Noise Monitoring Stations

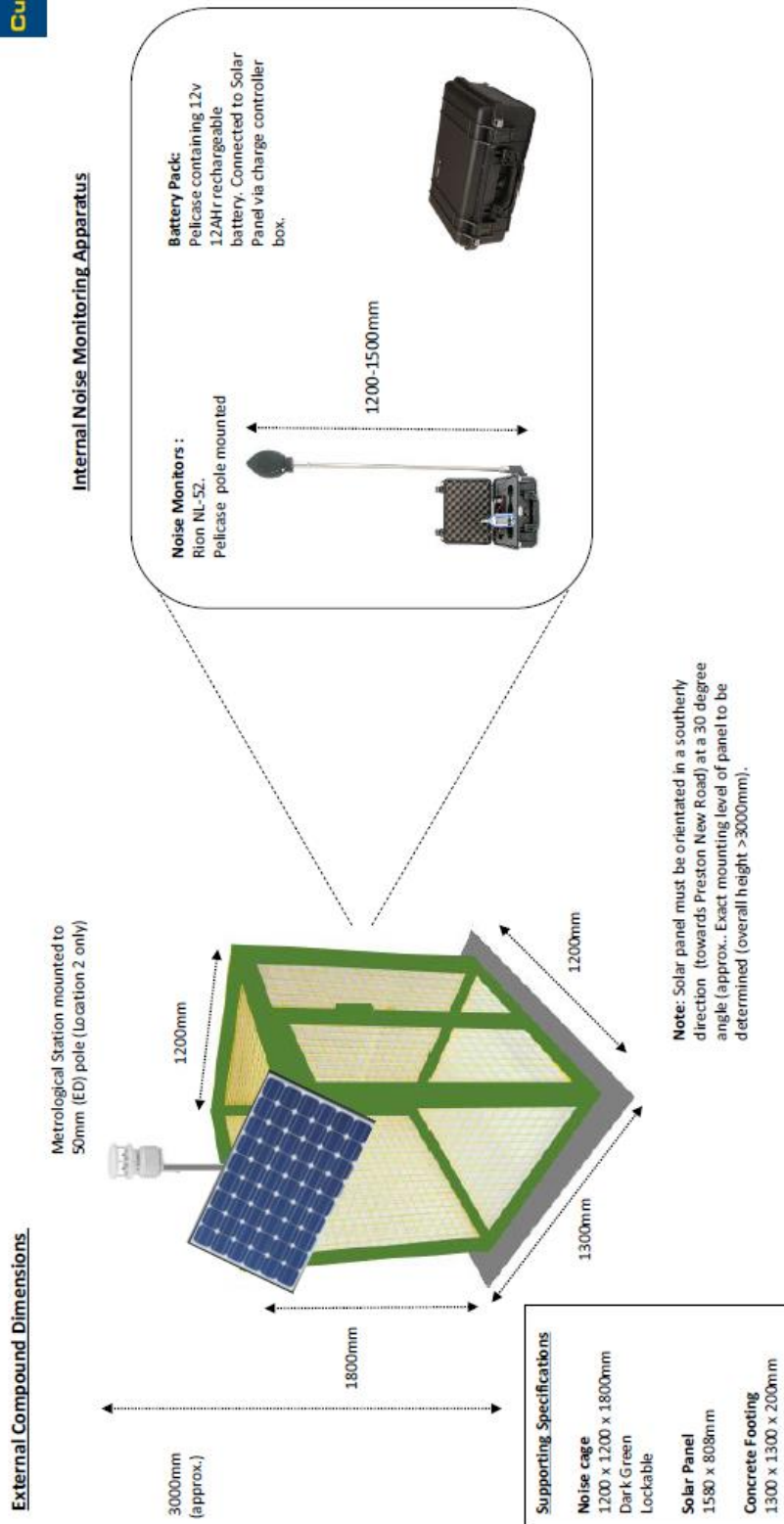


Figure 4: Schematic of the fixed acoustically transparent noise monitoring stations

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4.2 Equipment

Logging sound level meters shall comply with BS EN 60804¹ (if manufactured prior to 2003) or BS EN 61672, Part 1² (if manufactured after 2003).

Periodic calibration of sound level meters meeting the requirements of BS EN 60804 is to be carried out in accordance with BS 7580: 1997: Parts 1 and 2 as appropriate. Meters meeting the requirements of BS EN 61672-1 shall be periodically calibrated in accordance with BS 7580: 1997 until such date as it is superseded by BS EN 61672: Part 3, when the latter standard shall be used. Sound level calibrators shall be calibrated in accordance with BS EN 60942: 2003. Sound level meter kits shall undergo calibration as specified in this paragraph every 12 months.

Additionally, a calibration check will be undertaken at least once every two weeks and a calibration tone will also be recorded to provide a further check on the equipment.

All sound level meters shall have a valid calibration certificate issued by a United Kingdom Accreditation Service (UKAS) accredited calibration laboratory or equivalent European accreditation body.

4.2.1 Permanent monitoring

The installed monitoring system is the Rion LivEnviro (see Figure 4) http://www.noise-and-vibration.co.uk/app_id13/app/livenviro

Microphones will be mounted on a secure mast at a location approximately 1.5m above the local ground level at a location at least 3.5m (consistent with BS7445-2:1991) from any sound-reflecting surface (other than the ground). The equipment will log noise level indices (set out below). At Location 2, subject to the ambient noise level being sufficiently low to avoid false triggering, audio samples will be recorded in the event that the noise limit is reached. Audio recording will be triggered using a 5 minute Leq set equal to the hourly limit to ensure adequate recording of data. If the ambient noise level exceeds the criterion, so that triggering is impracticable, then audio recordings will be taken for one minute in every 10 minutes to provide samples for review. Sample audio data will also be recorded at Location 1.

Trigger noise levels will be set so that they correspond to the following site noise levels that would exist at SWC in the absence of the baseline (traffic etc) noise. As explained earlier, this will be calculated using the Location 2 data, adjusted in accordance with the noise model.

Between 21.00 and 08.00hr:

- 37dB_{L_{Aeq,1hr}} to send a warning (amber) SMS text message to Cuadrilla's site manager that the noise limits are being approached.
- 38dB_{L_{Aeq,1hr}} to trigger audio recording.
- 39dB_{L_{Aeq,1hr}} to send an exceedance (red) SMS text message to Cuadrilla's site manager so that action can be taken immediately.

Between 08.00 and 21.00hr:

¹ British Standard Institution (2001); BS EN 60804:2001. Specification for Integrating averaging sound level meters

² British Standard Institution (2013); BS EN 61672-1:2013. Electroacoustics. Sound level meters. Specifications

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- 53dB $L_{Aeq,1hr}$ to send a warning (amber) SMS text message to Cuadrilla's site manager that the noise limits are being approached.
- 54dB $L_{Aeq,1hr}$ to trigger audio recording.
- 55dB $L_{Aeq,1hr}$ to send an exceedence (red) SMS text message to Cuadrilla's site manager so that action can be taken immediately.

Remote communication with both noise loggers is required and the measured data will be available to LCC and to Cuadrilla at all times, to view in real time and for later review.

4.2.2 Temporary monitoring

As may be reasonably requested by LCC from time to time, it will be necessary to measure sound levels at other locations. These are likely to be at the boundary of properties closest to the exploration site and for periods of up to 24 hours. Any such measurements would not necessarily demonstrate that the site noise has caused an exceedence of the conditioned noise limits, since the measurements would also include contribution from existing (baseline) noise sources.

Measurements will be made with the microphone mounted on a tripod and positioned 1.5m above local ground level and at least 3.5m from any sound reflecting surface (other than the ground).

The date, time, location, weather conditions and subjective comments on the main audible sources of noise will be recorded for each period of temporary monitoring.

No live communication or download of data from these temporary measurements will be available. Data will be reported to LCC as soon as practicable after completion of the measurements. Initial data will be provided within 24 hours of completion of the monitoring and confirmed results of each period of temporary monitoring will be provided in a written report within one working week of completing each period of measurement.

During construction of the site access, in the event of complaint regarding noise, there may be a requirement to check noise levels at SWC and report the results to LCC.

4.3 Measurement parameters

The results of the monitoring will include, as a minimum, $L_{A90,1hr}$, $L_{Aeq,1hr}$, $L_{Aeq,100ms}$, $L_{Amax,F}$ and unweighted 1/3 octave band $L_{eq,1hr}$ noise levels covering the range at least 20Hz to 10kHz. Data will be sampled at 100ms. The presentation of the data from Location 2 will include the correction required to be applied to the Location 2 data in order to calculate the site (only) noise level at SWC.

The presence of acoustic character in the site noise will be assessed as required by condition 30. The sound level meter positioned at Location 1 provides full audio recording functionality. If complaints arise in relation to tones or impulsivity, an initial review of the audio will be undertaken. If such character is apparent then a detailed analysis will be undertaken. The audio recording of the calibration signal (to confirm the validity of the data) and the resulting signal under investigation will be analysed using 01dB Metravib dBFa software to determine the relevant tone or impulsive noise with regard to the respective Nordic methods.

Due to the high ambient noise levels in relation to the assessment criteria, and the amount of data that would need to be stored to provide full audio recording, the equipment will record samples periodically (e.g. 1 minute in each 10 minute period) for subsequent analysis should issues of tonal

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or impulsive sound arise. For each new phase of the works, full audio recording would be undertaken for the first week of operations, with periodic samples taken thereafter.

The prevailing weather conditions (wind speed and direction and temperature) will be logged hourly and will be available to LCC to view on line with the noise data.

4.4 Baseline monitoring

Monitoring at the SWC fixed location will commence at least 1 month before any site activity (including establishing the site access, site preparation and set up) commences so that a robust baseline is established.

The baseline measurements will record as a minimum the $L_{A90,1hr}$, $L_{Aeq,1hr}$, $L_{Aeq,100ms}$ and $L_{Amax,F}$ noise levels.

4.5 Measurement duration

Measurements will be made continuously, 24 hours a day, from one month before site preparation works commence until the completion of the site restoration.

LCC will be advised within 24 hours of Cuadrilla becoming aware of any failure of any of the noise monitoring system.

4.6 Reporting

Cuadrilla will inform LCC within 24 hours of the occurrence of any exceedence of the noise limit ('red' alerts). Cuadrilla will inform LCC of the cause of the alert and implement any remedial action that is necessary within 48 hours of the occurrence of the event.

Cuadrilla will submit weekly records showing the raw sound levels recorded at Location 1 and Location 2 and the 'corrected' data from Location 2. The data will be presented graphically and submitted within one week of the end of each weekly monitoring period. The Location 1 levels that are due only to the site noise will also be reported.

4.7 Records

Data will be available to LCC on line sourced from the Rion LivEnviro system to inspect throughout the duration of use of the exploration site, until completion of the restoration works.

5 Community liaison

Effective liaison with the local community is essential both to reduce the impact of noisy activities and to ensure that those affected by unavoidable noise are given adequate notice and an explanation of why such activities are necessary.

Community liaison in respect of noise will be consistent with that for other aspects of the works and will follow Cuadrilla's Community Liaison Group Terms of Reference and Cuadrilla's Operational Complaints Procedure.

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Appendix A: Planning Conditions

Hours of Working

Condition 19

The following hours of working shall apply to the development:

Activity	Permitted hours of work
Site construction and restoration, including: <ul style="list-style-type: none">• Delivery or removal of materials,• Construction of the site access and compound• Installation of the interconnections to the national gas and water grids• Works associated with the delivery and removal of plant and equipment associated with all drilling and extended flow testing of gas monitoring works during the exploration and appraisal phases of the site	07.30 to 18.30 hours Mondays to Fridays (except Public Holidays) 08.30 to 12.00 hours on Saturdays (except Public Holidays) Not permitted Sundays or Public Holidays.
<ul style="list-style-type: none">• Drilling boreholes and operational management of drilling and extended flow testing• Well operations• Flowback and testing operations (including those involving pumping equipment) but excluding hydraulic fracturing pumping operations• Carrying out essential repairs to plant and equipment used on site	24 hours / 7 days a week
<ul style="list-style-type: none">• Pumping associated with hydraulic fracturing operations	08.00 to 18.00 Monday to Fridays 09.00 to 13.00 hours on Saturdays Not permitted Sundays or Public Holidays.

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Control of Noise

Condition 26

Prior to the commencement of development of the access and site and interconnections to the gas and water grid, a noise management plan shall be submitted to the County Planning Authority for approval in writing. The plan shall provide:

- a. Data from the relevant manufacturers' noise tests for each item of noise-emitting plant to be used on site to establish whether noise emissions are likely to be compliant with conditions 29 and 30;
- b. If not likely to be compliant, details of what mitigation would be introduced and timescales for implementation;
- c. Details of instantaneous mitigation methods for each item of noise emitting equipment and any longer term mitigation;
- d. Procedures for addressing any complaints received.

The approved noise management plan shall be implemented in full throughout the operational life of the site including decommissioning and restoration.

Condition 28

Prior to the commencement of development, details of a noise monitoring methodology shall be submitted to the County Planning Authority for approval in writing.

Prior to the commencement of development, details of a noise monitoring methodology shall be submitted to the County Planning Authority for approval in writing.

This methodology shall include:

- a. permanent monitoring at a single location throughout all phases of the development, commencing from the construction of the access road and the site;
- b. temporary monitoring at any other location as reasonably requested by the County Planning Authority;
- c. details of the equipment to be used (which shall be of a type that can transmit live monitoring of noise data direct to the County Planning Authority and can record audio);
- d. the locations at which the permanent equipment is to be installed; and
- e. details of how and on what the equipment is to be attached, including the height and details of any structure to be used.

The approved monitoring methodology and equipment shall be employed and the monitoring data shall be made available to the County Planning Authority to view live on line at all times, provided this condition shall not be breached in the event of a temporary disruption in the live feed in which case reasonable endeavours shall be used to resume the live feed without compromising the integrity of the data record.

The results of the monitoring shall include L_{A901hr} , L_{Aeq1hr} , $L_{Aeq100ms}$ and $L_{Amax,1hr}$ noise levels, the prevailing weather conditions on any hourly basis, details of equipment and its calibration used for measurements and comments on other sources of noise which affect the noise climate and including audio recording to identify noise sources where noise limits are exceeded. Audio recording shall be

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triggered to commence at a level below the noise limit to be agreed in advance with the County Planning Authority.

If the results indicate that the noise levels from the site exceed those set out in conditions 29 and 30, remedial action shall be implemented within 48 hours.

Condition 29

Noise from the site under free-field conditions at 1.2 to 1.5 metres height above the surrounding ground level at any boundary of any residential property, shall not exceed 55dB $L_{Aeq,1hr}$ between 0800 and 2100 and shall not exceed 39dB $L_{Aeq,1hr}$ or 57dB L_{Amax} between 2100 and 0800.

Condition 30

Steady-state noise from the site above a level of 30dBA under free field conditions at 1.2 to 1.5 metres height above the surrounding ground level at any boundary of any residential property shall be free from prominent tones and impulses. A prominent tone or impulse shall be:

- a. A distinguishable, discrete, continuous note (whine, hiss, screech, hum etc) with ΔL_{ta} of 4 or more as defined in Joint Nordic Method 2 set out in ISO 1996 -2.
- b. Distinct impulse noise (bangs, clicks, clatters or thumps) with P (Predicted Prominence) of 6 or more as defined in Nordtest Method NT ACOU 112.

Condition 31

All plant, equipment and machinery used in connection with the operation and maintenance of the site shall be maintained in accordance with the manufacturer's specification at all times throughout the development.

Appendix B: Drilling noise modelling

The following have been used in the calculation of off-site noise levels during drilling.

Source noise levels

The following provides the plant noise levels derived from data provided for the VDD370 rig and the distributed noise source model approach described in the Regulation 22 information.

Noise source	Number	Frequency (Hz)								Overall dB(A)
		31.5	63	125	250	500	1k	2k	4k	
Centrifuge	1	95	92	89	83	80	78	76	75	84
Generator	3	106	103	108	96	92	90	84	78	96
HPU	1	97	96	98	101	94	88	87	84	96
Mud pump	3	99	101	101	104	98	94	91	90	101
Pumps and hopper	1	90	92	92	95	89	85	82	81	92
Shale shaker	3	105	102	99	93	90	88	86	85	94
Top drive	1	96	95	92	95	93	90	85	78	95

Table B1 Plant noise – octave band sound power levels (dB). Calculations assume all equipment operates continuously (ie 100% on-time)

Propagation and attenuation of sound

Noise modelling and the propagation of sound from the site used SoundPlan³ software, which is a well-established, industry-standard, 3D noise modelling package that implements ISO 9613-2:1996⁴ and has the following features:

- Distance attenuation
- Ground absorption
- Assumes down wind conditions
- Source directivity
- Atmospheric attenuation
- Diffraction

A 3D model was created that includes not only the sound sources, but also the topography, ground cover and buildings.

Table B1 to **Table B4** present the parameters used in the SoundPlan model. Figure B1 illustrates the drill rig and noise barrier arrangement.

³ See <http://www.soundplan.eu/english>

⁴ ISO 9613-2: 1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation

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Ground absorption	Applicable to:	Used in the model for:
G = 0	100% hard ground such as asphalt, water or industrial sites	Roads, water bodies
G = 1	100% soft ground such as fields, forests or grass	All other areas

Table B1 Ground absorption parameters

Parameter	Value
Reflection order	1
Max search radius (m)	5000
Max reflection distance from receiver (m)	200
Max reflection distance from source (m)	50
Allowed tolerance (dB)	0.001

Table B2 SoundPlan calculation parameters

Parameter	Two Storey	Single Storey
Height of building (m)	8.00	3.50
Height of first receiver above ground floor (m)	1.50	1.50
Height of floors (m)	2.80	2.80
Number of floors	2	1
Number of basement floors	0	0

Table B3 SoundPlan buildings properties

Parameter	Value
Air pressure	1013.3 mbar
Rel. Humidity	70.0%
Temperature	10.0°C
Meteorological Correction.	Zero (worst case assumption)

Table B4 SoundPlan atmospheric properties (SoundPlan default values)

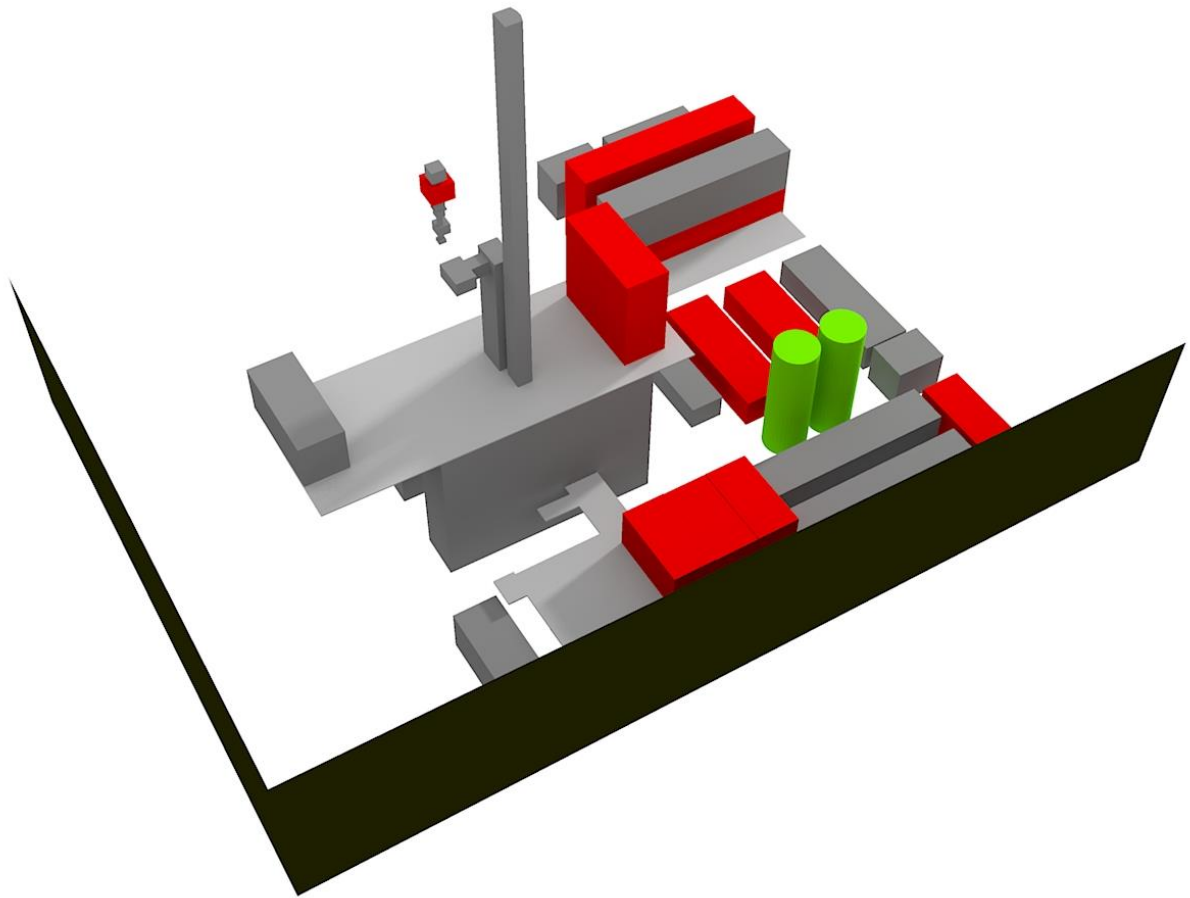


Figure B1 Drilling rig model showing principal noise sources (red) and additional noise barrier (black)

The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits

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Appendix C: Hydraulic fracturing modelling

The following have been used in the calculation of off-site noise levels during fracturing.

Source noise levels

The following provides the fracturing plant noise levels. Each fracturing pump has been modelled as comprising the three elements tabulated and levels adjusted to be equivalent to the sound power levels measured at the Preese Hall site.

Noise source	Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Fan		115	116	113	112	110	104	98	114
Pump		88	94	102	105	103	100	94	107
Engine		103	112	111	112	111	112	106	116

Table C1 Plant noise – octave band and overall sound power levels (dB)

Propagation and attenuation of sound

Modelling are the same as those applied for drilling noise predictions given in Appendix B.

The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits

Appendix D: Site access and grid interconnection construction noise modelling

The following plant details have been used in the calculation of off-site noise levels during construction of the access road.

Source noise levels

Plant	% on-time	Sound power level	Source of noise data
Tracked excavator	25	105	BS5228 Table C 2-2
Dump truck (tipping fill)	25	107	BS5228 Table C 2-30
Dumper	100	104	BS5228 Table C 4-4
Tracked excavator	100	106	BS5228 Table C 2-3
Dump truck (empty)	100	115	BS5228 Table C 2-31
Dozer	15	109	BS5228 Table C 2-12
Vibratory roller	15	102	BS5228 Table C 2-39
Wheeled mobile crane	50	98	BS5228 Table C 3-30
Lorry with lifting boom	15	105	BS5228 Table C 4-53
Lorry	75	108	BS5228 Table C 2-34

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Diesel generator	100	89	BS5228 Table C 4-76
Wheel wash*	10	91	BS5228 Table C 3-13

Table D1 Plant noise

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Tracked excavator	75	84	78	74	70	68	64	61
Dump truck (tipping fill)	85	74	78	73	73	74	67	63
Dumper	82	76	75	74	68	68	64	55
Tracked excavator	75	84	78	74	70	68	64	61
Dump truck (empty)	86	79	79	79	79	84	69	60
Dozer	85	74	76	73	72	78	62	59
Vibratory roller	88	83	69	68	67	65	62	59
Wheeled mobile crane	80	72	71	67	65	62	57	49
Lorry with lifting boom	81	78	76	74	72	69	64	56
Lorry	73	78	78	78	74	73	68	66
Diesel generator	80	74	57	54	53	48	45	37
Wheel wash*	75	75	62	58	55	54	48	40

Table D2 Plant noise– octave band sound pressure levels at 10m (dB)

* Water jet pump from BS used as no wheel wash data available. In the unlikely event the dry wheel wash is proving a source of noise greater than expected then a mitigation measure of manual scrubbing of tyres by operatives will be utilised when a vehicle is parked on the dry wheel wash.

The totals will be compliant with the overall noise limits and have been modelled within the Environment Statement and subsequent Regulation 22 information to demonstrate compliance with the proposed noise limits

Propagation and attenuation of sound

Modelling are the same as those applied for drilling noise predictions given in Appendix B.

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Appendix E: Flare noise modelling

The following information has been used to assess off-site noise during flaring. Noise from the flares was reported within the Environment Statement (Arup, 2014) to be low (less than 20dBL_{Aeq}) at all dwellings.

