Phase 5 A629 Kirklees

Construction Noise & Vibration Assessment

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Comments

Comments

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1. Introduction

The Phase 5 A629 Halifax Road project comprises a package of improvements for the A629 between Halifax and Huddersfield. The aim of Phase 5 is to ease congestion, reduce journey times and create capacity on the corridor between Ainley Top roundabout and Huddersfield ring road thereby accommodating future housing and employment growth for Kirklees and the wider region.

The road improvements will be undertaken in four areas as follows:

Area A: Blacker Road / New North Road / Edgerton Road / Edgerton Grove Road junction (Blacker Road junction) – Widening will be carried out along New North Road, Edgerton Road and Blacker Road to provide more traffic lanes approaching the junction.

Area B: Halifax Road / Birkby Road / East Street junction (Cavalry Arms junction) – Birkby Road will be re-aligned to remove the wide stagger.

Area C: Between Cavalry Arms junction and Birchencliffe Hill Road (Prince Royd) – Proposed to remove parking from both sides of the road to improve traffic flow and enable footways to be used safely.

Area D: Yew Tree Road to Ainley Top roundabout (Ainley Top) – Lengthening the approach lands to the roundabout from Yew Tree Road. A new signal controlled left slip to bypass the roundabout for traffic travelling to the M62. Dedicated northbound cycle lane (Yew Tree Road to roundabout).

The potential noise and vibration impacts arising from the construction of the proposed improvement works are assessed within this report.

Appendix A presents a glossary of acoustic terminology used in this report.

2. Assessment Methodology & Impact Criteria

2.1 Assessment Methodology

2.1.1 Road Infrastructure Construction Noise

The road infrastructure construction works which are considered to be the noisiest are:

- breaking road surface;
- earth works;
- road planing;
- spreading chipping/fill;
- rolling and compaction; and
- paving.

Predicted construction noise levels are based on the likely plant and equipment to be used during road infrastructure works as detailed within BS 5228-1: 2009+A1:2014[1].

The 'ABC Method' provided in BS 5228 has been used to assess the potential impact. This method defines category threshold values which are determined by the time of day and existing prevailing ambient noise levels. The noise generated from road infrastructure works is then compared with the derived BS 5228 'threshold value'. If the noise level exceeds the 'threshold value', a significant impact is deemed to occur.

Noise threshold levels have been established for the relevant existing SRs based upon the prevailing baseline noise levels.

Calculated noise levels from road infrastructure works represents a worst-case scenario over a one-hour period with plant operating at the closest point to the nearest SR. In practice, noise levels would tend to be lower owing to greater separation distances, screening effects and periods of plant inactivity.

2.1.2 Road Infrastructure Construction Vibration

There are two aspects of vibration that require consideration:

- potential vibration effects on people or equipment within buildings; and
- potential vibration effects on buildings.

There are currently no British Standards that provide a methodology for predicting levels of vibration from demolition and construction activities other than BS 5228-2:2009+A1:2014[2], which relates to percussive, or vibratory, rolling and piling only. As stated in BS 5228, and as generally accepted, the threshold of vibration perception for humans in residential environments is typically in the PPV range 0.15 to 0.3 mm/s at frequencies between 8 Hertz (Hz) and 80Hz with complaints likely at 1 mm/s. Based on historical field measurements undertaken by Waterman and having regard to information contained within BS 5228, **Table 1** details the distance at which certain activities may give rise to 'just perceptible' levels of vibration from road construction works.

[1] British Standard (BS) 5228-1:2009 +A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites, Part One: Noise. BSI, Great Britain.
[2] British Standard (BS) 5228-2:2009 +A1:2014: Code of Practice for Noise and Vibration Control on Construction and Open Sites, Part One: Vibration. BSI, Great Britain.

Table 1: Distance at which Vibration May Just be Perceptible

Construction Activity	Distance from Activity when Vibration may Just be Perceptible (metres)[1]
Heavy vehicles	5 – 10
Excavation	10 – 15
Vibratory Roller	15 – 20

Note: [1]Distances for perceptibility are only indicative and dependent upon a number of factors, such as the radial distance between source and receiver, ground conditions, and underlying geology.

2.2 Impact Criteria

Road Infrastructure Construction Noise and Vibration

The criteria in **Table 2** were adopted to assess the magnitude of impact from construction works.

Table 2: Magnitude of Impact Road Infrastructure Works

Magnitude Impact	Construction Noise Level dB $L_{Aeq,T}$	Level of Vibration (Human Disturbance)	Definition
Negligible	≤PNL	<0.3mm/s	The effect is not of concern
Minor	≤TNL but > PNL	≥0.3mm/s to <1mm/s	The effect is undesirable but of limited concern.
Moderate	≤TNL+5dB	≥1mm/s to <10mm/s	Likely to give rise to complaints, but normally can be tolerated if warning and explanation has been given to residents. The effect gives rise to some concern but is likely to be tolerable depending on scale and duration.
Major	>TNL+5dB	≥10mm/s	Vibration likely to be intolerable. Also above 10mm/s potential for cosmetic damage (damage) to building increases.

Note: PNL – Prevailing Noise Level; TNL – threshold noise level

Where a moderate or major magnitude of impact is predicted then this is considered to constitute a significant effect where the following applies:

1) 10 or more day in any 15 consecutive days;
2) A total number of days exceeding 40 in any 6 consecutive months.

2.3 Mitigation

Due to the close proximity of the road improvement works to residential dwellings, when works are undertaken at the shortest distance to dwellings, the assumption is that mitigation measures would be implemented to reduce noise emissions. This should afford 10dB[3] reduction in noise emissions and would include measures such as:

- Use of mobile screening around works, such as Heras or comparable acoustic blankets on temporary barriers;
- Use of modern, quiet and well-maintained machinery such as electric powered plant;

[3] Table B1 BS5228-1:2009+A1:2014.

- Vehicles and mechanical plant used for the works would be fitted with exhaust silencers, which would be maintained in good and efficient working order and operated in such a manner as to minimise noise emissions in accordance with the relevant EU / UK noise limits applicable to that equipment or no noisier than would be expected based the noise levels quoted in BS5228. Plant should be properly maintained and operated in accordance with manufacturers' recommendations. Electrically powered plant would be preferred, where practicable, to mechanically powered alternatives;
- Changing, where possible, methods and processes to keep noise levels low;
- Positioning plant as far away from residential property as physically possible;
- Works would be limited to the daytime hours and would be subject to agreement with Kirklees Council and hours worked on noisy operations would be limited; and
- Liaison with the occupants of adjacent properties most likely to be affected by noise or vibration from road improvement works, should also take place. The occupants should be informed of the nature of the works, proposed hours of work and anticipated duration prior to the commencement of activities.

It is on this basis that the assessment has been undertaken.

3. Baseline Conditions

3.1 Sensitive Receptors

The residential dwellings proximate the Phase 5 improvement works Areas have the potential to experience noise and vibration effects due to the construction works.

The sensitive receptors (SRs) which have the potential to experience the greatest noise and vibration impacts from the construction works are presented in **Table 3**.

Table 3: Sensitive Receptors

SR Ref	Phase 5 Area	Type of Receptor	Address / Name	Approximate Shortest Distance to Construction Works
SR A	Area A	Residential	3 Edgerton Road	5m
SR B	Area A	Residential	131 Blacker Road	6 -10 m
SR C	Area A	Residential	18a/18b Edgerton Green	5-10m
SR D	Area B	Residential	The Gate 81A Halifax Road	5m
SR E	Area B	Residential	402 Birkby Road	8-10m
SR F	Area C	Residential	99a Halifax Road	5m
SR G	Area C	Residential	103 Halifax Road	5m
SR H	Area D	Residential	121 Yew Tree Road	5m
SR I	Area D	Residential	107-113 Yew Tree Road	35m

3.2 Environmental Noise Levels

A number of baseline surveys have been undertaken to establish prevailing noise levels within each of the four areas A to D. Waterman conducted two concurrent measurements at the Blacker Road / Edgerton Grove junction (Area A) and East Street / Birkby Road junction (Area B) on Thursday 24th October 2019, as detailed within Technical Note WIE14496-100-TN-1.1.1 dated November 2019. Waterman also conducted noise measurements proximate to Halifax Road and Area C on 12th and 13th November 2018. AECOM conducted baseline noise measurement within rear garden of 123 Yew Tree Road (Area D) in 2017 as detailed in '*A629 Monitoring and Evaluation – Baseline' report*. **Table 4** presents a summary of the measured baseline noise levels.

Table 4: Measured Daytime Environmental Noise Levels

Area	Location	Description	dB $L_{Aeq,T}$	dB $L_{A10,T}$
A	Edgerton Grove Road	3m from road edge. 3-hour measurement	72	73
A	Blacker Road	3m from road edge. 3-hour measurement	70	73
B	East Street	5m from road edge. 3-hour measurement	69	71
B	Birkby Road	3m from road edge. 3-hour measurement	70	73
C	Halifax Road	2m from road edge. 90-minute measurement	73	75
D	Yew Tree Road	9m from road edge. Long-term (16/7/2017-21/7/2017)	66	68

4. Construction Assessment

4.1 Noise

4.1.1 Construction Threshold Levels

Table 5 presents the construction threshold levels at representative residential properties proximate to the construction works for each of the four areas. These have been derived having regard to the measured environmental noise levels presented as **Table 3**, with an adjustment for distance to the residential property where required.

Table 5: Construction Threshold Level

SR Ref	Phase 5 Area	Address / Name	Prevailing Daytime Noise Level dB $L_{Aeq,T}$	Construction Threshold Noise Level dB $L_{Aeq,T}$
SR A	Area A	3 Edgerton Road	68	75
SR B	Area A	131 Blacker Road	68	75
SR C	Area A	18a/18b Edgerton Green	66	70
SR D	Area B	The Gate 81A Halifax Road	68	75
SR E	Area B	402 Birkby Road	62	65
SR F	Area C	99a Halifax Road	68	75
SR G	Area C	103 Halifax Road	65	70
SR H	Area D	121 Yew Tree Road	65	70
SR I	Area D	107-113 Yew Tree Road	63	70

4.1.2 Construction Noise Impact (with 10dB mitigation)

Table 6 presents the predicted construction noise levels at the selected SRs together with the assigned level of impact, based on prevailing noise level and derived construction threshold level. Noise source details for construction activities together with the calculation algorithm are presented within **Appendix B**.

Table 6: Construction Noise Levels & Impact When Works At Shortest Distance (& At 10m)

SR	Description	Activity and Construction Noise Level				
		Breaking	Planing	Earthworks	Spreading / Chipping / Rolling / Compaction	Paving
SR A	3 Edgerton Road	81 Major (75 – Minor)	80 Major (74 – Minor)	78 Moderate (72 – Minor)	76 Moderate (70 – Minor)	77 Moderate (71 – Minor)
SR B	131 Blacker Road	79 Moderate (75 - Minor)	78 Moderate (74 - Minor)	76 Moderate (72 - Minor)	74 Moderate (70 - Minor)	75 Moderate (71 - Minor)

SR	Description	Activity and Construction Noise Level				
		Breaking	Planing	Earthworks	Spreading / Chipping / Rolling Compaction	Paving
SR C	18a/18b Edgerton Green	81 Major (75 - Moderate)	80 Major (74 - Moderate)	78 Major (72 - Moderate)	76 Major (70 - Moderate)	77 Major (71 - Moderate)
SR D	The Gate 81A Halifax Road	81 Major (75 - Minor)	80 Major (74 - Minor)	78 Moderate (72 - Minor)	76 Moderate (70 - Minor)	77 Moderate (71 - Minor)
SR E	402 Birkby Road	77 Major (75 - Major)	76 Major (74 - Major)	74 Major (72 - Major)	72 Major (70 - Major)	73 Major (71 - Major)
SR F	99a Halifax Road	81 Major (75 - Minor)	80 Major (74 - Minor)	78 Moderate (72 - Minor)	76 Moderate (70 - Minor)	77 Moderate (71 - Minor)
SR G	103 Halifax Road	81 Major (75 - Minor)	80 Major (74 - Minor)	78 Major (72 - Minor)	76 Major (70 - Minor)	77 Major (71 - Minor)
SR H	121 Yew Tree Road	81 Major (75 - Minor)	80 Major (74 - Minor)	78 Major (72 - Minor)	76 Major (70 - Minor)	77 Major (71 - Minor)
SR I	107-113 Yew Tree Road	64 Minor (n/a >10m)	63 Negligible (n/a >10m)	61 Negligible (n/a >10m)	59 Negligible (n/a >10m)	60 Negligible (n/a >10m)

During construction of the road improvement works, an increase in the prevailing noise level is predicted, which is to be expected when introducing construction plant within relatively close proximity to residential receptors. The magnitude of the noise impact when works are undertaken at the shortest distance are predominantly moderate to major but reducing to minor when works are undertaken at 10 metres, with the exception of 402 Birkby Road.

The prevailing noise levels at 402 Birkby Road are lower due to it being set-back from Birkby Road and therefore more distant from the noise source. As a result of this, the construction threshold noise level (TNL) is lower compared to that of the other SRs. Taking account of the absolute predicted noise level at 402 Birkby Road however, the overall impact is **not** considered to be significant. This is also considered to be applicable to the other SRs providing works at the shortest distance are not undertaken for 10 or more days in any 15 consecutive days or a total number of days exceeding 40 in any 6 consecutive months.

4.1.3 Construction Vibration Impact

Based on the relatively short distance from works to sensitive receptor, it is likely that at times just perceptible vibration may be discernible. The main potential cause of vibration is likely to arise from surface break-out and vibratory roller. **Table 7** presents typical vibration levels from a jackhammer and vibratory roller at a distance of 5 metres and 10 metres together with the magnitude impact. These have been derived from Table 7-4 of FTA report 0123[4]. It should be borne in mind that vibration PPV levels are indicative and will vary depending on type of plant (make/model) and ground conditions.

[4] Volope JA. (September 2018) FTA report 0123. Transit Noise & Vibration Impact Assessment Manual.

Table 7: Typical PPV From Construction Plant

Plant	Distance (m)	PPV (mm/s)[1]	Magnitude Impact
Jackhammer	5	0.07	Negligible
	10	0.02	Negligible
Vibratory Roller	5	0.14	Negligible
	10	0.40	Minor

Note: PPV indicative and dependent on plant type and ground conditions.

This assessment indicates that although road improvement works will give rise to vibration, the magnitude is predicted to be predominantly negligible to minor adverse. However, given the variability in vibration with plant type and ground conditions, where vibration generating works are undertaken within 10 metres of properties it is recommended that vibration monitoring is undertaken at a representative location of the properties to ensure agreed vibration targets are not exceeded.

5. Conclusion

During construction of the road improvement works an increase in both prevailing noise and vibration levels is predicted.

The magnitude of the noise impact when works are undertaken at the shortest distance are predominantly moderate to major adverse, reducing to minor when works are undertaken at 10 metres or more away from the noise Sensitive Receptors, with the exception of 402 Birkby Road.

Taking account of the absolute predicted noise level at 402 Birkby Road however, the overall impact is **not** considered to be significant. This is also considered to be applicable to the other SRs providing works at the shortest distance from the properties are not undertaken for 10 or more days in any 15 consecutive days or a total number of days exceeding 40 in any 6 consecutive months.

The magnitude of vibration impact is predicted to range from negligible to minor adverse. However due to the variability with plant type and ground conditions, given the proximity of the works to residential receptors, vibration monitoring at a representative location to the residential receptors is recommended during vibration generating activities to ensure target criteria are not exceeded.

APPENDICES

A. Glossary of Acoustic Terminology

Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Broadband	Containing the full range of frequencies.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound that is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;

Four engine jet aircraft at 100m	120 dB
Riveting of steel plate at 10m	105 dB
Pneumatic drill at 10m	90 dB
Circular wood saw at 10m	80 dB
Heavy road traffic at 10m	5 dB
Telephone bell at 10m	65 dB
Male speech, average at 10m	50 dB
Whisper at 10m	25 dB
Threshold of hearing, 1000 Hz	0 dB

dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3dB).
L_{Amax} noise level	This is the maximum noise level recorded over the measurement period.
L_{Amin} noise level	This is the lowest level during the measurement period.
$L_{Aeq,T}$ noise level	This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'.

	It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise.
L_{A90} noise level	This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.
L_{A10} noise level	This is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise
PPV (mm/s)	Peak Particle Velocity (PPV), greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis then the resultant PPV (peak particle velocity) is the vector sum i.e. the square root of the summed squares of the maximum velocities, regardless of when in the time history those occur.

B. Construction Noise Calculations

Construction Noise Assessment

The significance criteria for the construction noise assessment are based on 'The ABC Method' from BS 5228-1:2009+A1:2014. An extract describing this method is provided below.

Example Method 1 – The ABC Method

Table E.1 shows an example of the threshold of potential significant effect at dwellings when the total site noise level rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the site noise level. If the site noise level exceeds the appropriate category value, then a significance effect is deemed to occur.

Table E.1 **Example threshold of significant effect at dwellings**

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A[A)]	Category B[B)]	Category C[C)]
Night-time (23.00-07.00)	45	50	55
Evenings and weekends[D)]	55	60	65
Daytime (07.00-19.00) and Saturdays (07.00-13.00)	65	70	75

NOTE1 A **potential significant effect is indicated** if the site L_{AeqT} noise level, exceeds the threshold level for the Category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total L_{Aeq} noise level for the period increases by more than 3 dB due to site noise.

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays.

(Source: BS 5228-1:2009+A1:2014, Page119)

Generic calculations were undertaken using the data and procedures set out in BS 5228:2009+A1:2014 for the noisiest construction phases, to derive indicative noise levels at selected SRs. The highest noise levels tend to be associated with plant used for road breaking, earthmoving and vibratory compaction. The calculations assume that plant would be operating at the closest point to the SR, such as the construction Site boundary. The noisiest construction phases and associated noise levels are as follows with no mitigation:

- Road Breaking 85 dB(A) at 10m
- Earthworks 84 dB(A) at 10m
- Planing 82 dB(A) at 10m
- Spreading Chipping / Rolling & Compaction 80 dB(A) at 10m
- Pavement 81 dB(A) at 10m

Table B1 presents a breakdown of the construction noise levels at a distance of 10 metres used in the assessment of construction noise.

Table B1: Breakdown of Road Improvement Works Noise Levels at 10 Metres (no mitigation)

Road Breaking	BS5228:2014	LAeq @10m	Distance (m)	Kh	(t/T)*100	Partial Exposure	Barrier Attenuation	Noise Level @ NSR LAeq,1h (dB)	Overall LAeq,1h (dB)
Road breaker hand-held pneumatic	Table C5 ref 4	86	10	0	0.75	-1	0	84.8	**85**
Wheeled excavator (removing broken road)	Table C5 ref 11	73	10	0	0.25	-6	0	67.0	
Earthworks									
Tracked Excavator (14t)	Table C2 ref 7	70	10	0	1	0	0	70.0	**84**
Wheeled Backhoe Loader (8t)	Table C2 ref 8	68	10	0	1	0	0	68.0	
Hydraulic Vibratory Compactor (Tracked Excavator)	Table C2 ref 42	78	10	0	1	0	0	78.0	
Dozer (11t)	Table C2 ref 13	78	10	0	1	0	0	78.0	
Lorry (4-axle wagon)	Table C2 ref 34	80	10	0	1	0	0	80.0	
Planing									
Road planer	Table C5 ref 7	82	10	0	1	0	0	82.0	**82**
Rolling and Compaction									
Vibratory roller	Table C5 ref 21	80	10	0	1	0	0	80.0	**80**
Paving									
Spreading chip/fill (dozer)	Table C5 ref 13	82	10	0	0.25	-6	0	76.0	**81**
Asphalt paver and tipper lorry	Table C5 ref 33	75	10	0	0.25	-6	0	69.0	
Vibrator compactor (asphalt)	Table C5 ref 29	82	10	0	0.5	-3	0	79.0	

Distance adjustment

L_{Aeq} at distance r = L_{Aeq} at 10m – 20 log (r/10)

UK and Ireland Office Locations