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NETWORK RAIL

BORDERS RAILWAY

OPERATIONAL NOISE AND VIBRATION

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Registered Office
Park House
39 Bo'ness Road
Grangemouth
Stirlingshire
FK3 8AN

Tel: +44 (0)1324 878822

Fax: +44 (0)1324 878823

Email: info@ikmconsulting.co.uk

Registered in Scotland: SC179251

www.ikmconsulting.co.uk

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Prepared By:	Dawn Findlay	Date:	24 May 2016	Initials:	<i>DF</i>
Checked By:	Caroline Low	Date:	24 May 2016	Initials:	<i>CL</i>
Authorised By:	Liz Copland	Date:	24 May 2016	Initials:	<i>LC</i>

1. NON-TECHNICAL SUMMARY

IKM Consulting Ltd (IKM) was commissioned by Network Rail to undertake noise and vibration monitoring of the operational Borders Railway to demonstrate compliance with the Waverley Railway Noise and Vibration Policy (ERM 2008) or the Waverley Railway Policy. The purpose of the policy document is to set out Network Rail's commitments for mitigating noise and vibration effects during the operation of the Borders Railway. As laid out in the policy document, Network Rail are required to instruct monitoring of the operational effects of the railway, at six monthly intervals, for the first three years after the railway opened to passengers, and annually thereafter. The policy document is legally enforceable through Section 46 of the Waverley Railway (Scotland) Act 2006.

IKM began this monitoring in February 2016 and the full dataset will be collected by 2021.

IKM met with Network Rail and environmental health officers (EHOs) from the relevant Local Authorities (Midlothian Council and Scottish Borders Council) to agree a suitable monitoring method, and to identify suitable locations to carry out noise and vibration monitoring. During the meeting it was agreed that noise monitoring during a day-time and night-time period would be undertaken at 22 locations along the route and three of those locations would also have vibration monitoring undertaken.

Noise and vibration monitoring was undertaken between Thursday 18th February and Saturday 5th March 2016. An additional day of monitoring was undertaken on Wednesday 16th March 2016. All monitoring conformed with the technical memorandum *Calculation of Railway Noise (CRN)* (The Department of Transport, 1995) and the British Standard BS 6472 (2008) Evaluation of Human Exposure to Vibration in Buildings (BS 6472:2008).

During the day-time period (06:00-00:00) and the night-time period (00:00 – 06:00) noise levels did not exceed the Unacceptable Impact Levels of 66dB and 61dB, respectively. The night-time maximum noise level L_{Amax} (stipulated as exceeding 82dB) was breached at only one location and this location will be monitored during the next round of noise monitoring.

Vibration monitoring was undertaken at three properties, as requested by Network Rail and the EHO's. On all occasions the vibration dose values (VDV) levels were found to be lower than the threshold specified in the policy document.

All findings have been relayed to Network Rail.

2. INTRODUCTION

2.1 Brief

IKM Consulting Ltd (IKM) was commissioned by Network Rail to undertake noise and vibration monitoring of the operational Borders Railway to demonstrate compliance with the Waverley Railway Noise and Vibration Policy (ERM, 2008). The purpose of the policy document is to set out Network Rail's commitments for mitigating noise and vibration effects during the operation of the Borders Railway. As laid out in the policy document, Network Rail are required to instruct monitoring of the operational effects of the railway, at six monthly intervals for the first three years after the railway opened to passengers and annually thereafter. The policy document is legally enforceable through Section 46 of the Waverley Railway (Scotland) Act 2006.

Noise Thresholds

As part of the policy document, the requirements for noise mitigation relate to a set of noise thresholds:

Unacceptable Impact Levels:	Day - L_{Aeq} , (06:00 – 00:00 hours) 66dB
	Night - L_{Aeq} , (00:00 – 06:00 hours) 61dB
	Night - L_{Amax} , greater than 82dB

Vibration Thresholds

Regarding train vibration, the following vibration dose value (VDV) levels are given in the policy document, for the level at which, or below, the probability of adverse comment is considered to be low:

Day (07:00 – 23:00 hours) – $0.4\text{m/s}^{1.75}$

Night (23:00 – 07:00) – $0.13\text{m/s}^{1.75}$

Any measured noise or vibration levels will be compared to the two sets of thresholds.

IKM began this monitoring in February 2016 and the full dataset will be collected by 2021.

2.2 Scope of Works

As part of the project, IKM undertook the following scope of work:

- A review of all previous noise related reports for the project (as listed in the reference section of this report)
- Identify locations along the route where noise and vibration monitoring was required, to target the following:
 - Noise sensitive receptors identified in the Environmental Statement;
 - Noise barrier locations;
 - Noise or vibration related complaints received; and
 - Known noise and vibration 'hot spots'.
- Consult with Network Rail and environmental health officers (EHOs) from the Local Authorities –Midlothian Council and Scottish Borders Council – to agree the scope of noise and vibration monitoring and proposed locations.
- Carry out noise and vibration monitoring surveys, where required.
- Produce a written report detailing all results from the noise monitoring, including a non-technical summary for ease of use by Network Rail, in identifying any areas requiring potential mitigation.

Please note that all references to trains in this document relate to passenger train services only. No consideration is given to any other nature of rail traffic.

2.3 Disclaimer

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Any noise and vibration survey provides data as observed during a specified monitoring period only. The acoustic environment for the site is interpreted as a whole on the basis of a limited number of survey results; it was therefore not possible to preclude the existence of on-site conditions that were not encountered during the noise survey. This report has been compiled in accordance with appropriate British Standards.

3. BACKGROUND

3.1 Agreement of Scope

On the 9th February 2016, IKM met with Network Rail and the Environmental Health Officers (EHO's) from the relevant Local Authorities (Midlothian Council/Scottish Borders Council) to agree the scope for the monitoring and to discuss and agree suitable monitoring locations.

During this meeting, it was agreed that noise monitoring would be undertaken at 22 locations along the route, whilst vibration monitoring would be carried out at three of those locations. The monitoring locations took account of the noise barrier locations, sensitive receptors identified in the Environmental Statement and noise and vibration 'hot spots' where complaints associated with the operation of the railway had been lodged with the local authority and/or Network Rail.

The EHO's requested that IKM capture the following data during their monitoring regime:

- Two train passes travelling in each direction (northwards: from Tweedbank towards Edinburgh and southwards: from Edinburgh towards Tweedbank) during the day-time reference period of 07:00 – 23:00. A total of four train passes were required during the day-time period for each monitoring location i.e. two northbound and two southbound.
- Two train passes travelling in each direction during the night-time reference period of 23:00 – 07:00. A total of four train passes were required during the night-time period for each monitoring location.
- Note the different combination of carriage numbers (i.e. two carriages and four carriages), to allow a comparison to be undertaken in the noise levels produced.
- At monitoring locations close to a station, target different scenarios, i.e. trains pulling into/away from the station and trains idling in the station, to allow a comparison to be undertaken.

3.2 Programme and Notification Letters

Following the meeting with Network Rail and the EHO's, IKM developed a detailed noise and vibration monitoring programme intended to capture all the data sets and scenarios discussed above, with the aid of the ScotRail passenger timetable for the route. The monitoring programme was sent to Network Rail who then used this information to produce notification letters for the 22 residents located at the required monitoring locations.

3.3 Monitoring Locations

Table 1 below details the locations that featured on the monitoring programme. The table indicates whether vibration monitoring was required, if the monitoring was required because a noise barrier was present, or if the monitoring was required due to a previous complaint.

Table 1: Monitoring Locations Featured in February – March 2016 Monitoring Programme

Monitoring Location (ML)	Address	Noise Barrier or Complainant	Vibration Monitoring Required?
1	Harelaw, Dalkeith, Midlothian, EH22 1SB	Noise barrier	NO
2	Avenue Road, Dalkeith, Midlothian, EH22 3BP	Noise barrier	NO
3	Bonnyrigg Rd, Dalkeith, Midlothian EH22 3HA	Noise barrier	NO
4	Westfield Bank, Dalkeith, Midlothian EH22 3DN	Complaint	YES
4a	Westfield Bank, Dalkeith, Midlothian EH22 3DN	Complaint	YES
5	Westfield Drive, Dalkeith, Midlothian EH22 3NS	Complaint	NO
6	Hardengreen Lane, Dalkeith, Midlothian, EH22 3NA	Complaint	NO
6a	Dalhousie Mains, Dalkeith, Midlothian EH22 3LZ	Noise barrier	NO
7	Victoria Gardens, Newtongrange,	Noise barrier	NO

Monitoring Location (ML)	Address	Noise Barrier or Complainant	Vibration Monitoring Required?
	Dalkeith, Midlothian EH22 4NL		
8	Station Rd, Newtongrange, Dalkeith, Midlothian EH22 4NB	Noise barrier	NO
9	Dean Park, Newtongrange, Dalkeith, Midlothian, EH22 4LX	Noise barrier	NO
10	Jenks Loan, Newtongrange, Dalkeith, Midlothian EH22 4DD	Noise barrier	NO
11	Fushie Bridge, Gorebridge, EH23 4QG	Noise barrier	NO
12	Tynehead, Pathhead EH37 5XS	Complaint during construction	NO
13	Heriot, Scottish Borders EH38 5YR	Complaint	NO
14	Still Haugh, Fountainhall, Galashiels, Scottish Borders TD1 2SL	Noise barrier	NO
15	Stow Primary School, Station Yard, Stow, Galashiels, TD1 2SQ	Noise barrier	NO
16	Woodlea, Wood St, Galashiels, Scottish Borders TD1 1QW	Complaint	NO
17	Plumtree Place, Galashiels, Scottish Borders TD1 1PZ	Noise barrier	NO
18	High Buckholmside, Galashiels, Scottish Borders TD1 2HW	Complaint	YES
19	Glenfield Rd E, Galashiels, Scottish Borders TD1 2UE	Complaint	NO
20	Tweedbank Ave, Tweedbank, Galashiels, Scottish Borders TD1 3SP	Complaint	NO

4. METHODOLOGY

4.1 General

Noise and vibration monitoring was undertaken between Thursday 18th February and Saturday 5th March 2016. An additional day of monitoring was undertaken on Wednesday 16th March 2016, following an initial review of the data, when it was discovered that a small number of train passes had been missed on-site and one data file was corrupt when downloaded from the noise meter.

4.2 Meteorological Conditions

All noise monitoring was undertaken during favourable weather conditions and conformed to the requirements detailed in Section 41 Physical Conditions for Measurement detailed within Calculation of Railway Noise (1995). Scheduled monitoring was cancelled where meteorological conditions were poor or did not meet the requirements of Section 41. All scientists carried a pocket weather meter, and were able to record temperature and average/maximum wind speeds during the monitoring period.

4.3 Noise Monitoring

A Brüel & Kjaer 2250 analysing digital sound level meter (SLM) was used to record noise levels. The B&K 2250 is a Class 1 sound meter. The SLM is independently calibrated at a UKAS accredited laboratory at least once every two years. Calibration certificates for the SLM microphone, pre-amplifier and calibrator were kept with the equipment on-site and are attached as Appendix A. The sound meter was calibrated on-site at the start and end of each monitoring shift, to ensure that there was no drift in the sensitivity of the instrument. A fitted omni-directional microphone and windshield was attached to the meter for all noise monitoring. The microphone was orientated towards the railway. The microphone was mounted on a freestanding tripod, which was extendable from 1.2m - 4.5m above ground level, representative of the height of a first floor bedroom.

Noise levels were recorded in one hour sampling periods, which was divided into one minute increments to enable further dissemination of the data for each train pass wherever possible. Broadband and frequency noise data was recorded concurrently. Noise monitoring was undertaken using a slow weighted time response.

IKM aimed to obtain between 45 minutes and one hour of data at each monitoring location, with the intention of recording the passage of two trains in both directions at each monitoring location during the day and night reference time-periods.

On the majority of occasions, the noise meter was be set up to record façade readings, located between the (railway- facing) façade of the sensitive property and the railway. The noise meter was located approximately 1m from this façade. On some occasions a façade reading was not possible (due to access or obstructions) and a free-field reading was undertaken (i.e. located at least 3.5m from all other reflective surfaces, other than the ground.)

The following noise parameters were recorded at each location:

- L_{Aeq} The equivalent continuous A-weighted sound pressure level.
- L_{AF10} , L_{AF50} and L_{AF90} The noise level exceeded for 10%, 50% or 90% of the sampling period of the measured time, respectively. L_{AF90} is commonly understood to represent the background noise level.
- L_{Amax} and L_{Amin} The maximum/minimum noise level measured during the sampling period.

All readings were given in decibels (dB) based on the A-weighted network, using slow time response weighted (S).

IKM used three sound level meters during the monitoring programme and all measurements complied with the measurement method detailed in Calculation of Railway Noise (1995).

4.4 Vibration Monitoring

A Vibrock V901-2 triaxial vibration seismograph was used to record ground-borne vibration. Two transducers were set up on a firm, horizontal, surface situated as close to the building's foundations as possible, for example on a back door step. The transducers were set up to measure vibration dose value (VDV). The arrows on the transducers were orientated in the direction of the noise source (i.e. the railway). The transducers were firmly coupled to the surface by weighting with sandbags. Calibration certificates for this equipment were kept on-site and are included as Appendix A.

During the monitoring programme, IKM used one vibration seismograph.

The seismograph was set up to measure vibration dose value (VDV) in $\text{mms}^{-1.75}$.

The vibration meter was set up to record continuously for between 45 minutes and one hour periods at each monitoring location.

At three monitoring locations vibration monitoring was carried out within a property. IKM employed the same methodology as detailed above, but instead of setting the seismograph up at a location close to the building's foundation, the meter was set up at a location where the resident reported the highest vibration levels had occurred (this was typically beside a couch in a living room or beside a bed in the bedroom).

All vibration monitoring complied with the British Standard *BS: 6472 (2008)*.

4.5 Limitations in the Noise Data Set

There are a few areas where there were limitations in the dataset:

- One northbound night-time train pass is missing for ML7 – Victoria Gardens. The noise meter was later found to have recorded a very low L_{Aeq} , L_{Amax} and L_{Amin} values, which showed that the noise meter was not functioning correctly, on this occasion.
- On a few occasions, the site staff were required to set up meters in different positions at the same monitoring location due to access restrictions. Where this has occurred, we have highlighted this in the dataset (Appendix B).

- IKM was unable to assess Unacceptable Impact Levels for 21 train passes across the route due to a difference in the time reference period (between those stated in Calculation of Railway Noise (1995) and the Unacceptable Impact Thresholds). During the next monitoring round train passes should be targeted within the time reference period for Unacceptable Impact Levels (00:00-06:00), if possible;
- IKM has not undertaken any statistical analysis of the noise levels recorded when different numbers of carriages passed the monitoring locations. IKM did make an attempt to capture different train lengths, and the data collated has been logarithmically averaged to ensure that carriage numbers greater than two have been taken into account.

5. RAIL TRAFFIC CALCULATIONS

5.1 Rail Traffic Calculations

Appendix B shows a calculation which allows comparison to the Unacceptable Impact levels given in the policy document. The Unacceptable Impact Levels are defined as the levels at which, if, after consideration of measures at source, any of the relevant unacceptable levels are exceeded, then noise insulation will be offered, provided the corresponding ambient noise level is routinely exceeded by at least 1dB.

As the Unacceptable Impact Level's time reference periods are slightly different from the time reference period given within Calculation of Railway Noise (1995) (i.e. $L_{Aeq, 18hr}$ (06:00 – 00:00) and $L_{Aeq, 6hr}$ (00:00 – 06:00)), the train passes had to be collated into the new time reference periods and a similar calculation process was undertaken, as detailed below:

- Referring to a published rail timetable, for the Borders Railway, to determine the total number of trains passing each monitoring location during an 18 hour day (06:00 – 00:00), and an 6 hour night (00:00 - 06:00);
- Determining the $L_{Aeq, 18hr}$ (day-time) and $L_{Aeq, 6hr}$ (night-time) parameters for both northbound and southbound trains using the formula:

$$L_{Aeq,T} = SEL + 10 \log n - 10 \log T$$

where

n = number of trains passing in time period, T

T = reference time period, in seconds.

Once this data had been calculated, IKM compared the new values to the Unacceptable Impact Levels detailed in the Policy document and entered a "YES" or "NO" to show whether the day or night thresholds had been breached. IKM also examined the noise data to see if the measured L_{Amax} noise levels breached the NIGHT L_{Amax} Unacceptable Impact Level.

5.2 Limitations for Unacceptable Noise Impact Levels

The calculations for the time reference periods for the Unacceptable Impact Levels were limited by the fact that for a number of monitoring locations IKM had not gathered any data during the night-time reference period of 00:00 – 06:00. Moreover, where IKM recorded train passes during the night-time period of 00:00 -06:00, on most occasions, IKM recorded one train pass in one or both directions, which was below the level requested by the EHOs. These limitations arose in part due to the combination of the following:

- The timescale available over which to conduct the monitoring programme with the deadline of 6th March 2016; and
- The very few train passes that occur within the 00:00 – 06:00 time period requiring multiple revisits to obtain the required dataset for each monitoring location.

Furthermore, when referring to Calculation of Railway Noise (1995), trains between 23:00 and 00:00 are considered to be night-time trains, whereas when calculating Unacceptable Impact Thresholds, trains during this one hour period are considered as day-time trains. This increased the data set for day-time trains, but correspondingly reduced the night-time data for Unacceptable Impact Thresholds.

6. FINDINGS AND DISCUSSIONS

6.1 Noise

To accompany Appendix B, the spreadsheet containing all of the noise data and calculations, IKM created a summary table, which forms the first workbook of the spreadsheet and summarises our findings. An extract of the summary table is included as part of Table 3 below.

Table 3: Extracted Noise Information from Summary Table in Appendix B

Monitoring Location (ML)	Location	DAY Unacceptable Impact Level Breach (L _{Aeq})		NIGHT Unacceptable Impact Level Breach (L _{Aeq})		NIGHT Unacceptable Impact Level Breach (L _{Amax})
		Northbound	Southbound	Northbound	Southbound	
1	Harelaw	NO	NO	NTC	NTC	NO
2	Avenue Road	NO	NO	NO	NO	YES - Northbound
3	Bonnyrigg	NO	NO	NO	NO	NO
4	Westfield Bank	NO	NO	NO	NTC	NO
4a	Westfield Bank	NO	NO	NO	NTC	NO
5	Westfield Drive	NO	NO	NO	NTC	NO
6	Hardengreen Lane	NO	NO	NO	NO	NO
6a	Dalhousie Mains	NO	NO	NO	NTC	NO
7	Victoria Gardens	NO	NO	NTC	NTC	NO
8	Station Road	NO	NO	NO	NO	NO
9	Dean Park	NO	NO	NO	NTC	NO
10	Jenks Loan	NO	NO	NO	NO	NO

Monitoring Location (ML)	Location	DAY Unacceptable Impact Level Breach (L _{Aeq})		NIGHT Unacceptable Impact Level Breach (L _{Aeq})		NIGHT Unacceptable Impact Level Breach (L _{Amax})
		Northbound	Southbound	Northbound	Southbound	
11	Fushiebridge	NO	NO	NTC	NTC	NO
12	Tynehead Farm	NO	NO	NTC	NO	NO
13	Stagebank	NO	NO	NTC	NO	NO
14	Fountainhall Village	NO	NO	NO	NTC	NO
15	Stow Primary School	NO	NO	NTC	NO	NO
16	Woodlea	NO	NO	NTC	NTC	NO
17	Plumtree Place	NO	NO	NTC	NO	NO
18	High Buckholmside	NO	NO	NO	NTC	NO
19	Glenfield Road East	NO	NO	NTC	NTC	NO
20	Tweedbank Avenue	NO	NO	NO	NTC	NO

Key:

Unacceptable Impact Levels

NTC – No train captured within relevant time reference period in required direction.

6.1.1 Unacceptable Impact Levels – Breaches

During the day-time period (06:00 – 00:00), there were no breaches of the Unacceptable Impact Levels (66dB).

During the night-time period (00:00 – 06:00), the calculated noise levels, did not exceed the Unacceptable Impact Level (61dB) at any location. However, there was one exceedance of the night-time L_{Amax} Unacceptable Impact Level of greater than 82dB. This occurred at ML2 – Avenue Road during a northbound train pass.

The policy states that “if, after consideration of measures at source, any of the relevant unacceptable levels is exceeded then noise insulation will be offered, providing the corresponding ambient noise level is routinely exceeded by at least 1dB”.

6.2 Vibration

Vibration monitoring was undertaken at three properties, as requested by Network Rail and the EHO’s. On all occasions the VDV levels were lower than the level at which the probability of adverse comment is considered to be low. The events recorded on-site are included as Appendix C and are summarised in the Table 4 below.

Table 4: Borders Railway Operation - Vibration Results

Event Number	Date	Monitoring Time	Location	VDV m/s^{-1.75}	Breach of Threshold	PPV (mm/s) where monitored
9	22/02/2016	DAY	ML4a Westfield Bank - External	0.051	NO	0.325
10	22/02/2016	DAY	ML4 Westfield Bank - External	0.048	NO	NTC
11	23/02/2016	NIGHT	ML4a Westfield Bank - External	0.037	NO	NTC
12	24/02/2016	NIGHT	ML4a Westfield Bank - Internal bedroom	0.037	NO	NA
13	25/02/2016	NIGHT	ML18 High Buckholmside -External	0.043	NO	0.325
14	25/02/2016	DAY	ML18 High Buckholmside -Internal Living Room	0.043	NO	0.325
15	26/02/2016	DAY	ML4 Westfield Bank Internal Living Room	0.039	NO	NA

Although the VDV values, collated at each receptor, did not at any time exceed the low probability for adverse comment levels, IKM would still consider there to be potential for adverse comment regarding vibration levels generated by operation of the Borders Railway. This is due to the fact that humans are sensitive to vibration levels that occur below the various threshold levels stipulated in the guidance document.

In addition, although PPV threshold levels are not mentioned in the policy document, the levels recorded on-site, in addition to the VDV levels, are considered to be low, and unlikely to lead to concern.

7. CONCLUSIONS

7.1 Noise Conclusions

Noise monitoring was undertaken at the 22 monitoring locations between Thursday 18th February and Saturday 5th March 2016. An additional day of monitoring was undertaken on Wednesday 16th March 2016. IKM carried out noise monitoring in line with the document *Calculation of Railway Noise 1995*, and addressed Network Rail's and the EHO's requirements for the monitoring discussed on 9th February 2016.

There were no breaches in the day-time and night-time Unacceptable Impact Level thresholds and there was only one breach in the night-time L_{Amax} Unacceptable Impact Threshold level of greater than 82dB.

8. REFERENCES

Atkins 2015. Baseline Noise Survey and Station Operational Noise Assessment.

Atkins 2012. Detailed Assessment of Noise Barrier Requirements.

British Standards 2008. BS: 6472 Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration sources other than blasting

Department of Transport (1995). Calculation of Railway Noise.

ERM 2008. Summary of Noise Barrier Locations and Dimensions along the Railway Corridor.

ERM 2008. Waverley Railway Noise and Vibration Policy – Waverley Railway Project (ERM 0069389_027)

Electronic ScotRail Timetable (Edinburgh - Newcraighall - Tweedbank) Valid 20th March - 7th August 2016 (https://www.scotrail.co.uk/sites/default/files/assets/download_ct/edinburgh_-_tweedbank.pdf) accessed February 2016

Scottish Government 2006. Waverley Railway (Scotland) Act 2006 (asp 13)

APPENDICES

Appendix A
Calibration Certificates

Appendix B
Monitoring Data and Noise Calculations

Appendix C
Vibration Events