
**Appendix A14.1
Baseline Vibration
Monitoring for DART+
West EIAR**

APPENDIX A14.1 – BASELINE VIBRATION MONITORING REPORT FOR DART+ WEST EIAR

Executive Summary

Vibration monitoring has been conducted at 47 locations along the alignment of the DART+ West Project consisting of 37 long-term unattended surveys and 10 short-term attended surveys. The Proposed Project is split into six zones, A to F.

Within Zones A, B and C, the surrounding environment is urban. The vibration monitoring locations are adjacent to the railway line. At the vast majority of locations, the vibration meter was placed in the rear garden of the properties between 5 m and 20 m from the train line. The PPV results indicate a low vibration environment. The existing baseline VDV_{day} and VDV_{night} values are below a value where a low probability of adverse comment would be expected within a building as defined within BS 6472-1 (2008).

Within Zones D, E and F, the surrounding environment is suburban. The vibration monitoring locations in these zones are also adjacent to the railway line and, similar to Zones A, B and C, at the majority of locations, the vibration meter was placed in the rear garden of the properties between 5 m and 20 m from the train line, however, in these zones, some meters were at a further distance from the train line, depending on the nearest secure location. The PPV results indicate a low vibration environment. The existing baseline VDV_{day} and VDV_{night} values are below a value where a low probability of adverse comment would be expected within a building as defined within BS 6472-1 (2008).

Introduction

This report includes the relevant survey details and results associated with baseline vibration monitoring undertaken as part of the DART+ West project. The surveys have been undertaken to inform the noise and vibration chapter of the DART+ West EIAR.

Vibration monitoring has been undertaken at 47 locations across the study area, including 37 long-term unattended surveys and 10 short-term attended surveys. The survey methodology and results are included within this report.

Survey Methodology

Study Area

The Proposed Project covers an extensive linear study area between the Dublin Docklands and Clonsilla. At Clonsilla, the route splits in two and the study area proceeds linearly to Maynooth and M3 Parkway. The study area for the EIAR is split into six distinct zones, as described in Table 1.

Table 1 Geographical Split of Assessment Zones

Reference	Description
Zone A	Connolly to Glasnevin Junction (GSR) approximately 2,530 m in length.
Zone B	Spencer Dock to Glasnevin Junction (MGWR) approximately 3,020 m in length.
Zone C	Glasnevin Junction to Clonsilla Station approximately 10,320 m in length.
Zone D	Clonsilla to M3 Parkway approximately 7,500 m in length.
Zone E	Clonsilla Station to Maynooth Station approximately 12,620 m in length.
Zone F	Maynooth Station to Depot approximately 5,000 m in length.

Survey Locations

Baseline vibration surveys have been conducted at locations representative of the nearest vibration sensitive areas which have the potential to be impacted by construction works and/or those likely to be impacted during the operational phase of the Proposed Project. Baseline vibration measurements were made over both long-term and short-term periods to inform the assessment.

- Long-term surveys (typically one day in duration) were made at a total of 37 locations.
- Short-term surveys (attended day-time measurements), made at a total of 10 locations along the length of the proposed Project were used to supplement the long-term surveys.

Each location is discussed in the relevant geographic area, Zone A to Zone F, in the following sections.

Zone A

A total of 4 long-term unattended monitoring locations and 2 attended monitoring locations were surveyed within Zone A. The location reference and a description of the survey positions are included in Table 2.

Table 2 Noise Monitoring Locations Zone A

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N02	Shamrock Terrace, North Strand, Dublin 3
N04	Newcomen Ave, North Strand, Dublin 3
N08	Ardilaun Square, Ballybough, Dublin 13
N10	Drumcondra Park, Drumcondra, Dublin 3
Attended Noise Survey Locations	
N03	Ossory Road, Dublin 3
N12	Whitworth Road, Dublin 3

Zone B

Five (5 no.) long-term unattended monitoring locations and 2 attended monitoring locations were surveyed within Zone B, as described in Table 3.

Table 3 Noise Monitoring Locations Zone B

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N01	Canon Lillis Avenue, Seville, Place Dublin 1
N07	Clonliffe Avenue, Ballybough, Dublin 3
N09	Fitzroy Avenue, Drumcondra, Dublin 3
N11	St Patrick's Road, Drumcondra, Dublin 9
N13	Lindsay Road, Glasnevin, Dublin 7
Attended Noise Survey Locations	
N05	Bessborough Avenue, Dublin 3
N06	Spring Gardens Street, Dublin 3

Zone C

A total of 10 long-term unattended monitoring locations and 1 attended survey location were surveyed within Zone C. The location reference and a description of the survey positions are included in Table 4.

Table 4 Noise Monitoring Locations Zone C

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N15	Dalcassian downs, Glasnevin, Dublin 9
N18	Claremont Court, Glasnevin, Dublin 11
N19	Ratoath Estate, Cabra, Dublin 7.
N20	Ashington Gardens, Navan Road, Dublin 7.
N21	Glendhu Road, Navan Road, Dublin 7.
N22	Martin Savage Park, Navan Road, Ashtown, Dublin 15
N24	Castleknock Meadows, Laurel Lodge, Dublin 15

Location	Description of Survey Location
N25	Cherry Drive, Carpenterstown, Dublin 15
N26	Riverwood Square, Carpenterstown, Dublin 15
N28	Larch Grove, Clonsilla, Co. Dublin
Attended Noise Survey Locations	
N23	Castleknock Park, Castleknock, Dublin 15

Zone D

A total of 5 long-term unattended monitoring locations and 1 attended survey location were surveyed within Zone D. The location reference and a description of the survey positions are included in Table 5.

Table 5 Noise Monitoring Locations Zone D

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N46	Barnhill, Clonsilla, Co Dublin
N48	Edenmore House, Loughsallagh, Dunboyne, Co. Meath
N49	Elton Grove, Millfarm, Dunboyne, County Meath
N50	Silver Birches Crescent, Millfarm, Dunboyne, Co. Meath
N51	Bennetstown, Dunboyne, County Meath
Attended Noise Survey Locations	
N47	Stirling Road, Hilltown, Co. Meath

Zone E

A total of 9 long-term unattended monitoring locations and 4 attended survey locations were surveyed within Zone E. The location reference and a description of the survey positions are included in Table 6.

Table 6 Noise Monitoring Locations Zone E

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N29	Barberstown House, Clonsilla, Dublin 15
N30	Station House, Clonee Road, Allenswood, Lucan
N31	Glendale Meadows, Leixlip, County Kildare
N33	River Forest, Leixlip, County Kildare
N34	Riverforest, Captains Hill, Leixlip, County Kildare
N35	River Forest View, Leixlip, Cco. Kildare
N37	Glen Easton Way, Leixlip, County Kildare
N39	Donoughmore House, Pyke Bridge, Maynooth, County Kildare
N41	Silken Vale, Maynooth, County Kildare
Attended Noise Survey Locations	
N32	Glendale Meadows, Leixlip, County Kildare
N36	Louisa Bridge, Leixlip, County Kildare

Location	Description of Survey Location
N38	Blakestown, Leixlip, County Kildare
N40	Parklands Grove, Maynooth, Co. Kildare

Zone F

A total of 4 long-term unattended monitoring locations were surveyed within Zone F. The location reference and a description of the survey positions are included in Table 7. No attended monitoring locations were surveyed within this zone.

Table 7 Noise Monitoring Locations Zone F

Location	Description of Survey Location
Unattended (Long-term) Noise Survey Locations	
N42	Woodlands, Maynooth, County Kildare
N43	Braganstown, Kilcock, Co. Kildare
N44	Connaught Street, Kilcock, Co. Kildare
N45	Brayton Park, Kilcock, Co. Kildare

Survey Periods

Unattended noise surveys were undertaken between September 2020 and March 2021. The specific survey dates for each location are included in the survey results tables in Section 3.0.

Attended noise surveys were undertaken in April 2021. The specific survey dates and times for each location are included in the survey results tables in Section 3.0.

Survey Equipment and Personnel

The survey was undertaken using Rion VM-56 vibration meters with PV-83D tri-axial accelerometer.

Calibration certificates of monitoring equipment are included within Appendix A.

The surveys were conducted by AWN Consulting.

Survey Procedure

Vibration measurements were conducted in general accordance with the guidance contained in British Standard BS 7385. Part 1: *Guide for measurement of vibrations and evaluation of their effects on buildings* (1990).

Vibration was measured in the three orthogonal axes.

The equipment was set to log for 30 second intervals on a continual basis at all locations.

Survey Parameters

The following vibration parameters are discussed within this report.

PPV Peak Particle Velocity (PPV) is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s). It is defined as follows within BS 7385: (1990) as:

“the maximum instantaneous velocity of a particle at a point during a given time interval”

VDV Vibration Dose Value (VDV) is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows within British Standard BS 6472: (2008) *Guide to evaluation of human exposure to vibration in buildings (2008): Part 1 - Vibration sources other than blasting*, as:

“The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s^2 and the time period over which the VDV is measured is in seconds. This yields VDV in $m/s^{1.75}$ ”

The frequency weightings used in the BS 6472 (2008) document is W_b weighting for vertical axis and W_d for the horizontal axes.

Reference Guidance

BS 6472: (2008) Guide to evaluation of human exposure to vibration in buildings (2008): Part 1 - Vibration

The measured baseline VDV are discussed with reference to BS 6472 (2008) Part 1.

BS 6472 uses the Vibration Dose Value (VDV) which is measured or forecast over the day or night-time periods in terms of $m/s^{1.75}$. The VDV parameter takes into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

The following table, as set out in the standard, details the values of VDV where various comments from occupiers are possible. The standard notes that the values are applicable for both vertical and horizontal vibration with the appropriate weighting applied.

Table 8 VDV ($m/s^{1.75}$) above which various degree of adverse comment may be expected in residential buildings

Building Type	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential building – Day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential building – Night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

BS 5228-2: 2009 + A1 2014: Code of practice for noise and vibration control on construction and open sites – Vibration

There are no current standards which provide guidance on typical ranges of human response to vibration in terms of PPV for continuous or intermittent vibration sources.

BS5228 (2009 + A1 2014) Part 2, provides a useful guide relating to the assessment of human response to vibration in terms of the PPV. Whilst the guide values are used to compare typical human response to construction works, they tend to relate closely to general levels of vibration perception from other general sources. Table 9 below summarises the range of vibration values and the associated potential effects on humans.

Table 9 Guidance on effects of human response to PPV magnitudes

Vibration Level, PPV	Effect
0.140 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies. At lower frequencies people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1 mm/s	It is likely that a vibration level of this magnitude in residential environments will cause complaint.

Survey Results

At the vast majority of locations, the accelerometer was positioned within the rear garden of properties at distances between 5 m and 20 m from the train line. At some of the more rural locations, the accelerometer was positioned further from the train line, depending on the nearest secure location.

On review of the data recorded during the surveys, there are a number of significant outlier vibration values that are associated with the accelerometer being knocked, doors slamming or other events not related to the train line. These outliers have been carefully removed from the data as they do not represent the baseline vibration environment.

The following sections present the results of the attended and unattended vibration surveys in terms of PPV and VDV in the X, Y (horizontal) and Z (vertical) directions.

Zone A

Unattended Surveys

The unattended noise survey results relating to Zone A are summarised in Table 10.

Table 10 Unattended vibration monitoring results in Zone A

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N02	13/01/2021	0.0042	0.0042	0.0450	0.0017	0.0018	0.0220	0.02	0.02	0.02	0.86	0.88	0.82	0.04	0.04	0.04
N04	13/10/2020	0.0008	0.0008	0.0032	0.0006	0.0006	0.0016	0.01	0.01	0.01	1.13	1.17	1.11	0.04	0.04	0.04
N08	15/12/2020	0.0034	0.0045	0.0048	0.0020	0.0021	0.0048	0.02	0.02	0.02	1.00	0.99	1.00	0.04	0.04	0.04
N10	25/11/2020	0.0023	0.0022	0.0030	0.0012	0.0012	0.0016	0.02	0.02	0.02	1.35	1.40	1.31	0.03	0.03	0.03

Attended Surveys

The attended noise survey results relating to Zone A are summarised in Table 11.

Table 11 Attended vibration monitoring results in Zone A

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N03	22/04/2021	09:21	0.0082	0.0085	0.0160	0.03	0.03	0.03	0.90	0.93	0.84	0.07	0.07	0.09
		11:18	0.0010	0.0012	0.0300	0.04	0.05	0.03	0.21	0.18	0.62	0.06	0.08	0.07
		12:45	0.0009	0.0012	0.0066	0.04	0.05	0.03	0.09	0.11	0.22	0.06	0.08	0.05
N12	22/04/2021	10:40	0.0006	0.0006	0.0026	0.03	0.03	0.03	0.13	0.05	0.47	0.04	0.04	0.03
		12:20	0.0006	0.0007	0.0026	0.03	0.03	0.02	0.80	0.09	0.76	0.04	0.05	0.03
		13:50	0.0007	0.0009	0.0048	0.03	0.04	0.03	0.09	0.09	0.31	0.04	0.06	0.03

Zone B

Unattended Surveys

The unattended noise survey results relating to Zone B are summarised in Table 12.

Table 12 Unattended vibration monitoring results in Zone B

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N01	16/12/2020	0.0008	0.0007	0.0030	0.0005	0.0005	0.0015	0.01	0.01	0.01	0.13	0.11	0.16	0.01	0.01	0.01
N07	15/12/2020	0.0022	0.0023	0.0240	0.0014	0.0014	0.0150	0.01	0.01	0.01	0.24	0.14	0.26	0.01	0.01	0.01
N09	13/01/2021	0.0025	0.0022	0.0260	0.0015	0.0012	0.0140	0.01	0.01	0.01	0.27	0.27	0.30	0.01	0.01	0.01
N11	12/10/2020	0.0043	0.0030	0.0330	0.0021	0.0019	0.0210	0.01	0.01	0.01	0.61	0.44	0.37	0.02	0.02	0.01
N13	02/12/2020	0.0180	0.0190	0.0340	0.0012	0.0012	0.0026	0.02	0.02	0.02	1.21	1.27	1.18	0.03	0.03	0.03

Attended Surveys

The attended noise survey results relating to Zone B are summarised in Table 13.

Table 13 Attended vibration monitoring results in Zone B

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N05	22/04/2021	09:44	0.0022	0.0028	0.0370	0.03	0.03	0.03	0.36	0.30	0.51	0.04	0.04	0.04
		11:37	0.0022	0.0021	0.0290	0.03	0.03	0.02	0.32	0.23	0.46	0.04	0.05	0.03
		13:06	0.0033	0.0024	0.0300	0.04	0.04	0.03	0.52	0.85	0.41	0.07	0.07	0.06
N06	22/04/2021	10:07	0.0011	0.0012	0.0160	0.03	0.03	0.03	0.17	0.19	0.32	0.03	0.04	0.04
		11:57	0.0012	0.0008	0.0110	0.03	0.03	0.02	0.21	0.28	0.20	0.04	0.04	0.04
		13:25	0.0007	0.0007	0.0039	0.03	0.03	0.03	0.61	0.70	0.31	0.04	0.05	0.04

Zone C

Unattended Surveys

The unattended noise survey results relating to Zone C are summarised in Table 14.

Table 14 Unattended vibration monitoring results in Zone C

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N15	25/11/2020	0.0035	0.0031	0.0310	0.0018	0.0016	0.0170	0.01	0.01	0.01	0.21	0.20	0.26	0.01	0.01	0.01
N18	23/11/2020	0.0054	0.0028	0.0340	0.0033	0.0018	0.0220	0.02	0.02	0.02	0.41	0.26	0.43	0.03	0.03	0.03
N19	17/12/2020	0.0150	0.0150	0.0260	0.0014	0.0014	0.0036	0.02	0.02	0.02	1.11	1.13	1.08	0.03	0.03	0.03
N20	29/09/2020	0.0019	0.0023	0.0190	0.0012	0.0015	0.0120	0.01	0.01	0.01	0.15	0.21	0.21	0.01	0.01	0.01
N21	26/11/2020	0.0140	0.0150	0.0530	0.0027	0.0022	0.0340	0.01	0.01	0.01	0.38	0.27	0.66	0.01	0.01	0.01
N22	18/01/2021	0.0180	0.0180	0.0360	0.0046	0.0047	0.0200	0.02	0.02	0.02	1.17	1.19	1.13	0.05	0.05	0.05
N24	25/01/2021	0.0019	0.0021	0.0530	0.0013	0.0013	0.0300	0.02	0.02	0.02	0.17	0.16	0.53	0.03	0.03	0.03
N25	01/12/2020	0.0009	0.0014	0.0087	0.0006	0.0013	0.0038	0.01	0.01	0.01	0.18	0.17	0.22	0.01	0.01	0.01
N26	30/03/2021	0.0018	0.0018	0.0094	0.0012	0.0012	0.0022	0.02	0.02	0.02	0.07	0.07	0.06	0.03	0.03	0.03
N28	19/10/2020	0.0016	0.0016	0.0280	0.0013	0.0007	0.0040	0.01	0.01	0.01	0.26	0.35	1.07	0.01	0.01	0.01

Attended Surveys

The attended noise survey results relating to Zone C are summarised in Table 15.

Table 15 Attended vibration monitoring results in Zone C

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N23	28/04/2021	11:29	0.0006	0.0007	0.0031	0.03	0.03	0.02	0.07	0.10	0.31	0.04	0.04	0.03

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
		12:33	0.0012	0.0006	0.0053	0.02	0.02	0.02	0.39	0.09	0.60	0.04	0.04	0.03
		13:31	0.0006	0.0007	0.0022	0.03	0.03	0.03	0.24	0.25	0.08	0.03	0.04	0.03

Zone D

Unattended Surveys

The unattended noise survey results relating to Zone D are summarised in Table 16.

Table 16 Unattended vibration monitoring results in Zone D

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N46	26/11/2020	0.0017	0.0017	0.0036	0.0012	0.0012	0.0015	0.02	0.02	0.02	0.14	0.10	0.10	0.03	0.03	0.03
N48	01/12/2020	0.0180	0.0180	0.0330	0.0016	0.0017	0.0120	0.02	0.02	0.03	1.08	1.08	1.01	0.03	0.04	0.04
N49	30/11/2020	0.0026	0.0029	0.0220	0.0027	0.0039	0.0190	0.01	0.01	0.01	0.82	0.66	0.75	0.01	0.01	0.01
N50	07/01/2021	0.0009	0.0010	0.0150	0.0014	0.0014	0.0110	0.01	0.01	0.01	0.28	0.27	0.32	0.01	0.01	0.01
N51	30/11/2020	0.0160	0.0160	0.0290	0.0012	0.0013	0.0020	0.02	0.02	0.02	1.19	1.23	1.16	0.03	0.03	0.03

Attended Surveys

The attended noise survey results relating to Zone D are summarised in Table 17.

Table 17 Attended vibration monitoring results in Zone D

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N47	28/04/2021	12:03	0.0007	0.0007	0.0051	0.03	0.03	0.02	0.09	0.10	0.11	0.04	0.05	0.04

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
		13:01	0.0007	0.0014	0.0040	0.03	0.03	0.02	0.59	0.58	0.13	0.04	0.04	0.04
		14:02	0.0006	0.0007	0.0051	0.03	0.03	0.03	0.11	0.09	0.12	0.04	0.04	0.04

Zone E

Unattended Surveys

The unattended noise survey results relating to Zone E are summarised in Table 18.

Table 18 Unattended vibration monitoring results in Zone E

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N29	19/01/2021	0.0140	0.0140	0.0240	0.0150	0.0160	0.0290	0.02	0.02	0.02	1.11	1.14	1.07	0.03	0.03	0.03
N30	07/12/2020	0.0037	0.0059	0.0300	0.0020	0.0032	0.0160	0.01	0.01	0.01	0.27	0.49	0.40	0.01	0.01	0.01
N31	15/09/2020	0.0079	0.0038	0.0370	0.0027	0.0025	0.0210	0.01	0.01	0.01	1.01	0.26	0.31	0.02	0.01	0.01
N33	17/09/2020	0.0050	0.0073	0.0083	0.0007	0.0006	0.0047	0.01	0.01	0.01	0.88	1.37	0.41	0.02	0.01	0.01
N34	06/10/2020	0.0043	0.0047	0.0230	0.0021	0.0028	0.0110	0.01	0.01	0.01	0.62	0.61	0.57	0.01	0.01	0.01
N35	07/12/2020	0.0170	0.0170	0.0310	0.0012	0.0013	0.0050	0.02	0.02	0.02	1.05	1.09	1.01	0.03	0.03	0.03
N37	16/09/2020	0.0027	0.0074	0.0340	0.0016	0.0036	0.0180	0.01	0.01	0.01	0.30	0.66	0.68	0.02	0.01	0.01
N39	05/10/2020	0.0015	0.0029	0.0280	0.0007	0.0006	0.0130	0.01	0.01	0.01	0.46	0.98	0.74	0.01	0.01	0.01
N41	10/12/2020	0.0010	0.0007	0.0053	0.0012	0.0005	0.0039	0.01	0.01	0.01	0.57	0.11	0.20	0.01	0.01	0.01

Attended Surveys

The attended noise survey results relating to Zone E are summarised in Table 19.

Table 19 Attended vibration monitoring results in Zone E

Location	Date	Start Time	Daytime VDV, 16hr			Minimum PPV			Maximum PPV			Median PPV		
			X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N32	21/04/2021	10:29	0.0008	0.0007	0.0110	0.03	0.03	0.03	0.22	0.10	0.31	0.06	0.05	0.06
		12:14	0.0017	0.0068	0.0110	0.03	0.03	0.03	0.84	0.31	0.58	0.05	0.07	0.06
		13:52	0.0006	0.0007	0.0061	0.03	0.03	0.03	0.05	0.08	0.22	0.04	0.05	0.06
N36	21/04/2021	11:00	0.0006	0.0006	0.0056	0.02	0.03	0.03	0.13	0.11	0.29	0.03	0.04	0.03
		12:39	0.0008	0.0009	0.0057	0.03	0.03	0.02	0.16	0.16	0.18	0.04	0.04	0.03
		14:22	0.0007	0.0007	0.0040	0.03	0.03	0.03	0.08	0.08	0.24	0.04	0.05	0.04
N38	21/04/2021	11:24	0.0006	0.0007	0.0045	0.03	0.03	0.02	0.29	0.12	0.12	0.03	0.04	0.03
		13:04	0.0008	0.0008	0.0052	0.03	0.03	0.02	0.19	0.21	0.17	0.04	0.05	0.03
		14:49	0.0007	0.0008	0.0055	0.03	0.03	0.03	0.15	0.20	0.15	0.04	0.05	0.04
N40	21/04/2021	11:49	0.0005	0.0006	0.0015	0.03	0.03	0.03	0.08	0.17	0.05	0.03	0.04	0.03
		13:28	0.0006	0.0006	0.0009	0.03	0.03	0.02	0.06	0.85	0.26	0.03	0.04	0.03
		15:12	0.0006	0.0006	0.0012	0.03	0.03	0.03	0.05	0.35	0.17	0.04	0.04	0.03

Zone F

Unattended Surveys

The unattended noise survey results relating to Zone F are summarised in Table 20.

Table 20 Unattended vibration monitoring results in Zone F

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N42	12/01/2021	0.0008	0.0006	0.0082	0.0005	0.0005	0.0004	0.01	0.01	0.01	0.12	0.08	0.14	0.01	0.01	0.01
N43	09/12/2020	0.0015	0.0024	0.0023	0.0012	0.0012	0.0017	0.02	0.02	0.02	0.20	0.44	0.14	0.03	0.03	0.03
N44	09/12/2020	0.0006	0.0006	0.0025	0.0005	0.0005	0.0009	0.01	0.01	0.01	0.04	0.05	0.05	0.01	0.01	0.01

Location	Date	Daytime VDV, 16hr			Night-time VDV, 8hr			Minimum PPV			Maximum PPV			Median PPV		
		X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
N45	10/12/2020	0.0055	0.0056	0.0230	0.0058	0.0060	0.0230	0.02	0.02	0.02	0.40	0.39	0.38	0.05	0.05	0.05

Summary and Conclusions

Baseline vibration monitoring has been undertaken at 47 monitoring locations as part of the baseline study for the noise and vibration chapter of the DART+ West EIAR.

Monitoring consisted of 37 long-term unattended surveys and 10 short-term attended surveys adjacent to existing rail lines.

The baseline vibration environment at all locations is low. Vibration levels associated with passing rail was detectable above the baseline environment at all locations. However, the overall range of vibration levels measured at all locations was low and would not give rise to levels of vibration typically perceptible to building occupants.

The existing baseline VDV_{day} and VDV_{night} values are below a threshold defined in BS 6472-1 (2008) such that a *low probability of adverse comment* would be expected within a building.

APPENDIX A. Calibration Certificate for Monitoring Equipment RION VM-56 – Serial Number 680043



CERTIFICATE OF CALIBRATION

Date of Issue: 01 November 2019

Certificate Number: TCRT19/1825

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

Telephone 01908 642646 Fax 01908 642814

E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustic Noise and Vibration Ltd trading as ANV Measurement Systems

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Approved Signatory

K. Mistry



Client	AWN Consulting Limited The Tecpro Building, IDA Business & Technology Park, Clonshaugh Dublin 17 Ireland
Purchase Order No.	DOD/19/Cal03
Instrument	Rion VM-56 Tri-Axial Vibration Meter
Serial No.	00680043
Accelerometer Type	VM-56
Accelerometer Serial No.	80047
Program	2.0
Client Asset No.	N/A
Procedure ID.	VM-56 Issue 1
Job Number	TRAC19/11477
Date of Calibration	01 Nov 2019
Previous Cert. number	N/A
Date of Previous Cert.	N/A
Rig Number	6
Kit Number	24
Calibration Status	Passed Calibration

This calibration is traceable to National Standards. ANV Measurement Systems sources used to perform calibrations are calibrated at the National Physical Laboratory or by UKAS laboratories accredited for the purpose.

The performance of the system (the meter, accelerometer) was found to be within the manufacturer's specification.

Comment

This certificate reports recorded values for the instrument 'As Received'.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT19/1825

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Environment

The ambient environmental conditions at the time of the calibration were:

Temperature: 22.9 ± 1°C, Humidity: 40 ± 5%RH, Atmospheric pressure 98.2 ± 1 kPa

Test results

Each accelerometer axis was mounted co-axially with a Rion LS-10C servo accelerometer, and tests conducted for the dynamic range, PPV linearity and frequency response of the complete system. Additional electrical tests were carried out on the amplitude linearity of the instrument.

PPV linearity response for the complete system at 16 Hz

With PV-83CW serial No. 80047

Weightings for all channels turned OFF

Target Vel. mm/s	Actual Vel. mm/s	Indicated (X) mm/s	Error (X) %	Indicated (Y) mm/s	Error (Y) %	Indicated (Z) mm/s	Error (Z) %
0.50	0.51	0.57	11.56	0.55	7.65	0.54	5.69
1.00	1.02	1.09	6.67	1.08	5.69	1.06	3.73
2.50	2.55	2.67	4.51	2.66	4.12	2.60	1.77
5.00	5.11	5.31	3.93	5.30	3.73	5.18	1.38
10.00	10.13	10.59	4.50	10.43	2.92	10.35	2.13
20.00	20.27	21.24	4.80	21.03	3.76	20.61	1.69

Permitted tolerance ± 10% ± 1 LSD (Least Significant Digit).

Linearity errors in dB measured electrically at 40 Hz

Weightings for all channels turned OFF

Level changes in dB; reading error in dB given for each axis. "m/s²" is actual reading in m/s².

1 m/s² Range

Level dB	Error (X) dB	m/s ² (X)	Error (Y) dB	m/s ² (Y)	Error (Z) dB	m/s ² (Z)
0	REF	0.98154	REF	0.98129	REF	0.98130
-20	-0.01	0.09805	-0.01	0.09802	-0.01	0.09803
-40	-0.02	0.00979	-0.02	0.00979	-0.02	0.00979
-60	-0.10	0.00097	-0.10	0.00097	-0.10	0.00097
-66	-0.03	0.00049	-0.21	0.00048	-0.03	0.00049
-72	-0.23	0.00024	-0.23	0.00024	-0.23	0.00024

Permitted tolerance ±1.0 dB.

10 m/s² Range

Level dB	Error (X) dB	m/s ² (X)	Error (Y) dB	m/s ² (Y)	Error (Z) dB	m/s ² (Z)
20	-0.03	9.79122	-0.03	9.75526	-0.03	9.73534
0	REF	0.98208	REF	0.97857	REF	0.97679
-20	-0.01	0.09808	-0.01	0.09775	-0.01	0.09758
-30	-0.01	0.03102	-0.03	0.03085	-0.06	0.03067
-40	0.04	0.00987	-0.02	0.00976	0.02	0.00979
-52	-0.31	0.00238	0.69	0.00266	-0.01	0.00245

Permitted tolerance ±1.0 dB.

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Frequency Responses For Complete System

Measured on the 1 m/s² range with weightings as indicated in the table and PV-83CW serial No. 80047

Frequency Hz	Applied Acc. m/s ²	X (Wd) rms m/s ²	Error X %	VDV (X) m/s ^{1.75}	Error X %
3.981	0.285	0.15654	5.4	0.30765	5.3
5.012	0.355	0.15445	5.2	0.30359	5.1
6.310	0.355	0.12187	5.1	0.23974	5.0
7.943	0.355	0.09586	4.5	0.18849	4.4
10.00	0.355	0.07622	4.9	0.14987	4.8
12.59	0.355	0.06052	5.3	0.11912	5.3
15.85	0.355	0.04836	6.2	0.09515	6.2
19.95	0.550	0.06014	7.3	0.11834	7.3

Frequency Hz	Applied Acc. m/s ²	Y (Wd) rms m/s ²	Error Y %	VDV (Y) m/s ^{1.75}	Error Y %
3.981	0.285	0.15640	5.3	0.30743	5.2
5.012	0.355	0.15372	4.7	0.30199	4.5
6.310	0.355	0.12149	4.7	0.23878	4.6
7.943	0.355	0.09627	5.0	0.18928	4.9
10.00	0.355	0.07622	4.9	0.14987	4.8
12.59	0.355	0.06054	5.3	0.11907	5.3
15.85	0.355	0.04850	6.5	0.09539	6.5
19.95	0.550	0.06064	8.2	0.11932	8.2

Frequency Hz	Applied Acc. m/s ²	Z (Wb) rms m/s ²	Error Z %	VDV (Z) m/s ^{1.75}	Error Z %
3.981	0.285	0.26307	3.0	0.52192	3.8
5.012	0.355	0.37779	2.4	0.74853	3.1
6.310	0.355	0.38731	2.1	0.76723	2.7
7.943	0.355	0.37632	2.0	0.74338	2.4
10.00	0.355	0.35641	1.6	0.70262	1.7
12.59	0.355	0.32928	1.2	0.64883	1.3
15.85	0.355	0.29668	1.3	0.58400	1.3
19.95	0.550	0.39872	0.8	0.78497	0.8
25.12	0.550	0.33640	3.3	0.66184	3.3
31.62	0.550	0.27597	2.9	0.54310	2.9
39.81	0.550	0.21843	1.0	0.42982	1.0
50.12	0.550	0.17703	3.4	0.34836	3.3
63.10	0.550	0.13695	3.8	0.28950	3.8
79.43	0.550	0.10077	4.1	0.19832	4.1

Tolerance required @ 4 Hz to 63 Hz +12%/-11% ; @ 80 Hz +26%/-21%

All results meet the manufacturer's specification.

END OF CALIBRATION

CALIBRATED BY :- A. Lloyd