Hayes Park

Vibration Assessment

May 2023

NRG

DOCUMENT CONTROL SHEET

Report Reference	**VA/HP/20230209-RK**
Revision	**A**
Issue Purpose	**For Issue**
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Date of Issue	**12.05.2023**

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EXECUTIVE SUMMARY

This report provides a vibration assessment carried out at the planning stage for the proposed development at Hayes Park, Hayes. The vibration assessment has been carried out to determine if vibration isolation is required in order to protect the future residents from ground borne vibration.

Transmission of groundborne vibration to the proposed residential dwellings is likely to result in less than a Low probability of adverse comment when assessed according to the BS 6472 methodology.

No mitigation for groundborne vibration is considered necessary.

INTRODUCTION

This report has been prepared in support of the detailed planning and listed building consent application being submitted by Shall Do Hayes Developments Ltd ('the Applicant') to the London Borough of Hillingdon ('the Council') for the proposed residential conversion of two listed buildings at Hayes Park, Hayes End Road, Hayes, UB4 8FE ('the site').

The description of the proposed development for the detailed planning and listed building consent application is as follows:

"Change of use of the existing buildings to provide new homes (Use Class C3), together with internal and external works to the buildings, landscaping, car and cycle parking, and other associated works."

The proposed development has evolved through an extensive pre-application and wider stakeholder consultation process, which has included collaborative discussions with the Council, Greater London Authority ('GLA'), Historic England ('HE'), and a number of other key stakeholders.

The proposed development will bring two long-term vacant office buildings, which are unique heritage assets, back into active use through their conversion to residential. The proposed development provides the opportunity of a second life for the buildings and presents a long-term sustainable use that will ensure the buildings are protected and celebrated for years to come.

From the outset, the Applicant has taken a carefully informed heritage-led design approach. The objective has been to enhance the listed buildings, their setting, and the contribution they make to the wider surroundings, whist at the same time delivering a range of planning benefits.

A vibration survey has been carried out and a summary of the survey methodology and measured levels are presented in this report.

An assessment of the likely groundborne vibration transfer to the proposed dwellings has been carried out. The survey and assessment have been carried out in accordance with BS 6472.

Local planning policy requirements and national guidance for groundborne vibration due to environmental sources are discussed in the following section.

Site Description

The site is located within the Charville Ward of the London Borough of Hillingdon ('the Council'), who will be the relevant Local Planning Authority for the application.

The site sits within a wider former business park know as 'Hayes Park'. The red line site area which forms the basis of this application is 3.73 hectares and comprises of Hayes Park South, Hayes Park Central, the surrounding grassland area, and the associated car parking and road areas.

The wider Hayes Park business park site (which includes Hayes Park North and the adjacent multi-storey car park - but does not form part of this application) extends to 5.22 hectares. The site is accessed from the east from Park Lane and from the west from Hayes Park Road.

The Hayes Park Central and Hayes Park South buildings are both Grade II* Listed and were designed in the 1960s by American architect Gordon Bunshaft as corporate offices and research laboratories for HJ Heinz UK Limited. The buildings have been occupied by various different occupiers since they were built but are now both vacant. Hayes Park Central has been vacant since September 2020 and Hayes Park South vacant since Summer 2017. Both buildings are three storeys in height and include a basement level used for plant and servicing.

The site is bound to the east and south by the open parkland, which is private land owned by the Church Commissioners. To the west the site is bound by the agricultural land and the buildings of Home Farm. To the north, the site is bound by Hayes Park North and the adjacent multi-storey car park, with open farmland beyond that.

The entirety of the site and the much of the surrounding land is located within the Green Belt. Beyond that, there are large areas of low-density terraced housing. There is a wide selection of parks and leisure facilities in the area, including the Hayes End Recreation Ground, Park Road Green and the Belmore Playing Fields. The nearest town centres are located at Hillingdon Heath Local Centre, 1.6km to the south west, and at Uxbridge Road Hayes Minor Centre, 3.3km to the south east.

The flood risk map for planning identifies that the site is located in Flood Zone 1, and as such has a low probability of flooding.

Assessment Criteria

National Planning Policy Framework

In March 2012 the Department for Communities and Local Government published the National Planning Policy Framework[i] (NPPF); an updated version has been published in July 2021, with little change to the policy framework for acoustics. The document sets out the Planning Policies for England and how these are to be applied.

The National Planning Policy Framework replaces many of the existing Planning Policy documents including Planning Policy Guidance 24: Planning and Noise (PPG24). PPG24 gave guidance on the control of noise to sensitive developments and has been used as the basis of assessment in all Local Authorities in England. The Framework allows local people and their council to produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

It is stated that Planning Policies and decision should ensure new development is appropriate for its location and should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;

The Framework does not discuss vibration in regards to residential development.

The London Plan

The London Plan[ii] contains Policy D14 Noise, which sets out requirements for developments London wide. The wording of D14 is reproduced below:

A. In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:
    1. avoiding significant adverse noise impacts on health and quality of life
    2. reflecting the Agent of Change principle as set out in Policy D13 Agent of Change
    3. mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on development
    4. improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity)
    5. separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening or layout, orientation, uses and materials– in preference to sole reliance on sound insulation
    6. where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles
    7. promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.
B. Boroughs, and others with relevant responsibilities, should identify and nominate new Quiet Areas and protect existing Quiet Areas in line with the procedure in Defra's Noise Action Plan for Agglomerations.

Guidance provided with D14 advocates the use of BS8233: 2014 to provide good internal acoustics.

The Policy D13 Agent of Change is said to concern the impact of noise generating activity and uses, but other nuisances should be consider under the policy.

In the London Plan glossary "noise" is said to include "vibration".

London Borough of Hillingdon

The London Borough of Hillingdon Local Plan: Part 1[iii] contains Policy EM8, which states that:

<u>Noise</u>

The Council will investigate Hillingdon's target areas identified in the Defra Noise Action Plans, promote the maximum possible reduction in noise levels and will minimise the number of people potentially affected.

The Council will seek to identify and protect Quiet Areas in accordance with Government Policy on sustainable development and other Local Plan policies.

The Council will seek to ensure that noise sensitive development and noise generating development are only permitted if noise impacts can be adequately controlled and mitigated.

The policy wording does not discuss vibration, however note 8.120 says that For the purpose of the Hillingdon Local Plan: Part 1- Strategic Policies, noise
(including vibration) means:

"environmental noise" which includes noise from transportation sources;
"neighbour noise" which includes noise from inside and outside peoples homes; and
"neighbourhood noise" which includes noise arising from within the community such as industrial and entertainment premises, trade and business premises, construction sites and noise in the street.

It is therefore considered that "noise" in policy EM8 also includes "vibration".

The London Borough of Hillingdon Supplementary Planning Document contains a section which references "SPD on Noise", which is discussed below.

Development Control for Noise Generating and Noise Sensitive Development[iv]

The "SPD on Noise" sets out the national and regional polices relevant to noise, namely the NPPF, NPSE and London Plan as discussed previously. For vibration it is stated that the LPA [London Borough of Hillingdon] will only normally require a vibration assessment where railways are within 30 metres of a proposed development site. Where a vibration assessment is carried out, the Vibration Dose Value should be not higher than values presented in Table 6 [Table 7] of the document. These are reproduced in Figure 1 below.

07:00 – 23:00	23:00-07:00
16 hour day	8 hour night
< 0.2 ms-1.75	< 0.1 ms-1.75

Figure 1: *SPD on Noise – Vibration Dose Value limits*

The SPD on Noise says that the limits should not be exceeded after mitigation is considered. The document references BS 6472-1: 2008, although it is not stated why the lower value of the range for 'Low probability of adverse comment' has been taken as the limit of acceptability. The assessment methodology of BS 6472: 2008 is discussed in detail in the following section.

The SPD on Noise suggests a limit for re-radiated of LAmax(slow) 35 dB. No reference is made to any guidance, Standards or research papers in establishing suitability for the re-radiated noise limit.

BRITISH STANDARD 6472-1: 2008

The document BS 6472-1:2008[v] contains a methodology for assessing the human response to vibration in terms of the vibration dose value (VDV).

When the vibration is intermittent, such as with road or rail traffic, the Vibration Dose Value may be used to assess the potential for effects. Intermittent vibration is vibration which is perceived in separately identifiable repeated bursts. Its onset can be sudden, or there might be a gradual onset and termination bounding a more sustained event. Bursts may happen several to many times in a day or night period.

For continuous vibration that is not time-varying in magnitude and has a crest factor which is between about three and six, an approximation to the vibration dose value may be determined from the estimated vibration dose value (eVDV). Use of the estimated dose value is not recommended for vibration with time-varying characteristics or shocks.

An assessment of train induced vibration can be undertaken by determining the VDV over a 16-hour day and 8-hour night period (taken to be 0700 to 2300 hours and 2300 to 0700 hours). This takes account of the level of vibration generated by each event, the duration of each event and the total number of events during the day and night periods. In homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception. The Standard provides the criteria shown below in Table 1 for the assessment of vibration effect.

Table 1: *Criteria for assessing adverse comment from vibration levels*

Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings			
Place and time	**Low probability of adverse comment $m.s^{-1.75}$**	**Adverse comment possible $m.s^{-1.75}$**	**Adverse comment probable $m.s^{-1.75}$**
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

The above values can be used for both vertical and horizontal vibration, provided that they are calculated according to the appropriate frequency weightings.

The vibration dose range within 'Low probability of adverse comment' has been adopted as the design target.

Probability of adverse comment to vibration is proportional to the speed, weight, length and number of vehicles passing the assessment location. There is likely to be little variation in these dimensions of laden goods vehicles, in that extremely heavy loads are infrequent and tend to travel slowly.

In cases where it is not possible to measure within buildings, either because of denial of access or for a building yet to be constructed, it will be necessary to estimate the vibration environment to be expected within the building. The presence of a building tends to compress the ground locally by virtue of its weight, which therefore affects the vibration propagation in its vicinity. Calculation of building vibration response is performed by considering the mass, stiffness and damping properties of the structure, and by applying the pre-defined excitation function. Simplified methods exist to calculate the building vibration response under both internal and external excitation and should be applied conservatively.

Noise arising from the vibration of building structures (whether caused by ground-borne vibration, acoustic excitation from external sources, or from internal sources) is sometimes heard within buildings. It is typically characterized by low-frequency noise in the spectral region below about 100 Hz. BS6472 – 1: 2008 does not define acceptable levels for re-radiated noise levels within buildings. London Authority Supplementary Planning documents indicate that 35 dB $L_{Amax,slow}$ should not be exceeded in residential buildings. The design aims for major railway projects in the UK have been set at 40 dB $L_{Amax,slow}$ within residential buildings which is considered a more appropriate design target.

Vibration Level Measurements

Vibration levels were measured on the site on Monday 23rd and Tuesday 24th January 2023. The measurements were made unattended on the existing concrete slab of Central Building. The survey was carried out within the existing building, near the centre of the site. Metrological conditions were calm and dry, with no precipitation during the survey period. Temperatures varied between 1 Celsius and 2 Celsius, with no periods of freezing. A log of metrological measurements form a nearby weather station is shown in Appendix A.

The nearest sources of vibration from transportation are the London Underground Piccadilly Line and London Underground Metropolitan Line both 2.8 km to the north west of the site. The London Underground Central Line is 3.6 km to the north east of the site, London Underground Elizabeth Line 2.7km south of the site. The Great Western Main Line is also 2.7 km south of the site, which runs passenger services from London Paddington to Bristol Tempe Meads and carries freight. All of these transportation infrastructures are thought to be unlikely to significantly affect groundborne vibration conditions at the site due to distance.

There are no known nearby industrial sources of vibration to the site.

The approximate measurement location relative to the surrounding is shown on Figure 2 and a photograph of the triaxial accelerometer is shown in Appendix B. The measurement was made on the ground floor slab, an aerial view has been used to indicate the macro siting only.

Figure 2: *Aerial view of measurement location*

Measurement location 1 was at approximately 1 metre from the surrounding walls on the ground floor concrete slab, within a riser cupboard of the existing Central Building. The vibration level meter was set to measure 1 second values of RMS acceleration, peak acceleration, VDV, and RMS velocity, peak velocity. Spectral measurements of acceleration were made in 1 second averaging periods. Best practice methodology presented in ANC guidelines[vi] were followed for the survey.

The micro siting of measurement location 1 is shown on Figure 3 below. The measurement location is shown marked up with a red circle on the ground floor plan of the existing building, to the left of Figure 3. To the right of Figure 3 the X and Y axis directions are indicted, corresponding to west and south. The Z axis corresponds with vertical.

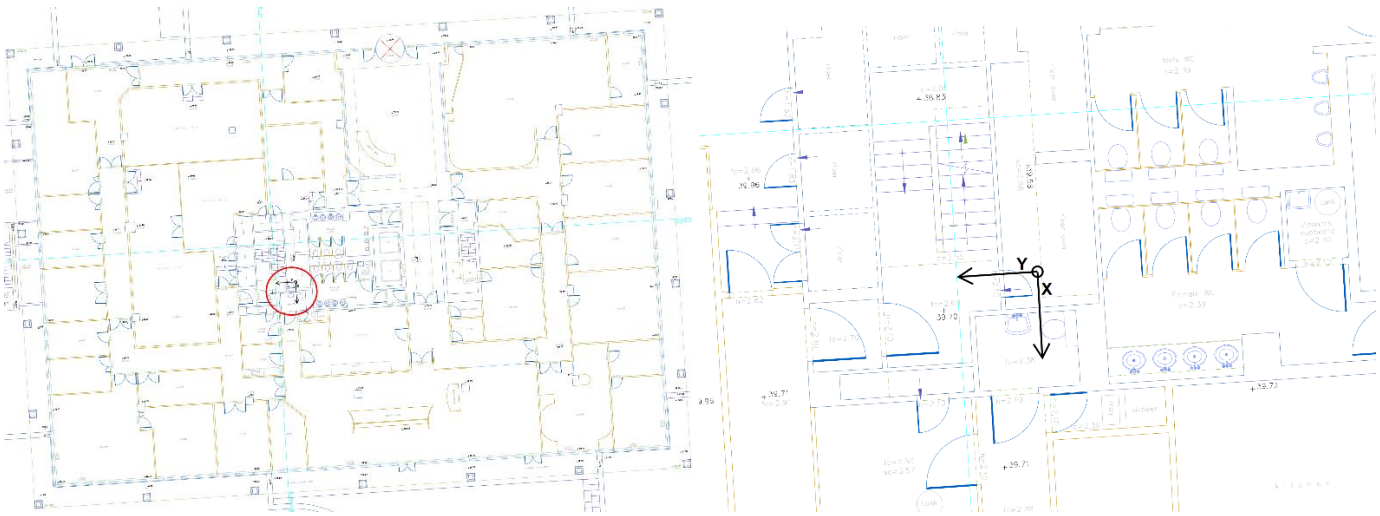

Figure 3: *Measurement location, ground floor of existing Central Building*

Vibration was not perceptible under foot or in the seated position on the concrete slab.

A vibration level meter that conforms to Type 1 (IEC 61260:2001) was used an inventory of all vibration measurement equipment used is given in Table 2 below.

Table 2: *Inventory of Measurement Equipment*

System	Location	Item	Make & model	Serial Number	Last Calibration
1, 2	1, 2,	Anemometer, Barometer, thermometer	Skywatch Xplorer 4	YKF20481-1	
4	1, 2	Vibration Level Meter	Svantek SV106	20917	01/02/2023
4	1	Accelerometer	Svantek SV207B	H1655	01/02/2023

The vibration level meter and accelerometers were due for laboratory calibration, which was carried out after the survey. The laboratory reported no change in sensitivity.

The VDVs measured for the day and night periods is shown in Table 3 below. The time history of weighted acceleration in 1 second periods is shown in Appendix B. The overall values of acceleration shown on the time history graph are weighted with Wd in the X and Y horizontal axis and Wb in the Z vertical axis, in accordance with the weighting definitions in BS6472. Measurements were made on a levelling plate. Measurements made during set up have been omitted.

Table 3: *Summary of measured VDV in X,Y, Z axis*

Period start date time	Duration	measured VDV		
		X $m.s^{-1.75}$	Y $m.s^{-1.75}$	Z $m.s^{-1.75}$
		Ch1	Ch2	Ch3
23/01/2023 11:55:16	10:33:44	0.194	0.194	0.203
23/01/2023 23:00:00	08:00:00	0.181	0.181	0.189
24/09/2020 15:03:08	05:58:57	0.168	0.168	0.176
Day, Cumulated	16:32:41	0.217	0.217	0.227

VIBRATION LEVEL ASSESSMENT

As the vibration levels were measured directly on the concrete slab of the existing building, it is not necessary to predict the effect of transmission from ground to building structure on the vibration level. With the concrete frame construction it is likely that there is attenuation of vibration level at each higher storey of the building, as shown in Table 8-7 of Handbook of Urban Rail Noise and Vibration[vii].

The ground floor measured VDV's are have been used for a worst case assessment using the 'Probability of adverse comment' ranges of BS6472: 2008, shown in Table 4 below. The assessment is for the vertical axis as this showed the higher signal level during each period.

Table 4: *Assessment of VDV levels with* Probability of adverse comment' ranges

Floor level	VDV $m.s^{1.75}$		Probability of adverse comment	
	Day	Night	Day	Night
All floor levels	0.227	0.189	Low	Low

The predicted VDV is considered to demonstrate a 'Low' probability of adverse comment range during the day time and night time. As the assessment shows the highest measured VDV within the buildings to be less than 'Low', no mitigation is considered necessary.

The measured VDV of 0.227 $m.s^{1.75}$ is typical of the ambient background groundborne vibration level at sites that are not affected by significant sources of vibration in London Boroughs. In our opinion, it is unlikely that this level would cause adverse comment or perceptibility for future residents.

Re-Radiated Noise

Noise arising from the vibration of buildings can cause disturbance. It is recommended that structure borne noise due to groundborne vibration is not greater than 40 L_{ASmax} dB in dwellings.

To accurately predict structure borne noise, mathematical modelling such as finite element analysis should be undertaken on a variety of possible foundation and structure configurations. A simplified method has been used, assuming the transfer function from ground to foundation and attenuation per floor. It is predicted that structure

borne noise may be between L_{ASmax} 15 dB and 20 dB (+/- 5 dB) if no specific vibration mitigation is employed in the design.

The predicted vibration induced maxima noise levels for the ground floor are below the condition requirement of 40 L_{ASmax} dB and unlikely to give rise to complaints.

Perception

Compliance with VDV limits does not indicate that vibration will not be perceptible. Exposure to increasing Vibration Dose Value provides a reasonable correlation with likelihood of complaints, however it is stated in BS6472 that vibration perceptibility is closer linked to peak vibration levels. Given that vibration was not perceptible on the ground floor slab, it is unlikely that vibration will be perceptible in any of the residential dwellings.

CONCLUSION

This report has presented the findings of an assessment of likely groundborne vibration levels for the proposed development at Hayes Park, Hayes on behalf of Iceni Projects.

The results of a vibration survey carried out by NRG Consulting on Monday 23rd and Tuesday 24th January 2023 have been used to establish the likely vibration dose value in the proposed residential dwellings. An assessment of the likely groundborne vibration dose value to the proposed dwellings has been carried out. The assessment shows that the VDV in the proposed residential dwellings would result in a 'Low' probability of adverse comment range during the day time and night time at all floor levels.

A further assessment of vibration induced maxima noise levels has shown that reradiated noise is not likely to cause disturbance.

No mitigation is considered necessary to control groundborne vibration.

Compliance with BS 6472: 2008 recommendations should be sufficient to satisfy the requirements of London Borough of Hillingdon Policy EM8 and London Plan Policies D13 and D14 for groundborne vibration.

In our opinion, groundborne vibration should not be a constraint to the granting of planning permission.

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[i] National Planning Policy Framework, Department for Communities and Local Government, July 2021
[ii] The London Plan, Mayor of London, March 2021
[iii] London Brough Hillingdon Local Plan: Part 1: Strategic Policies, November 2012
[iv] Development Control for Noise Generating and Noise Sensitive Development, Supplementary Planning Document, London Boroughs of Hillingdon, Hounslow, and Richmond Upon Thames, July 2014
[v] BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1 Vibration sources other than blasting", BSI, 2008
[vi] Measurement & Assessment of Groundbourne Noise & Vibration, ANC, 2001
[vii] Handbook of Urban Rail Noise and Vibration Control, H.Saurenman J.Nelson G.Wilson, U.S. Department of Transportation, November 1981

Appendix A – Weather history IHAYES8

Weather History for IHAYES8

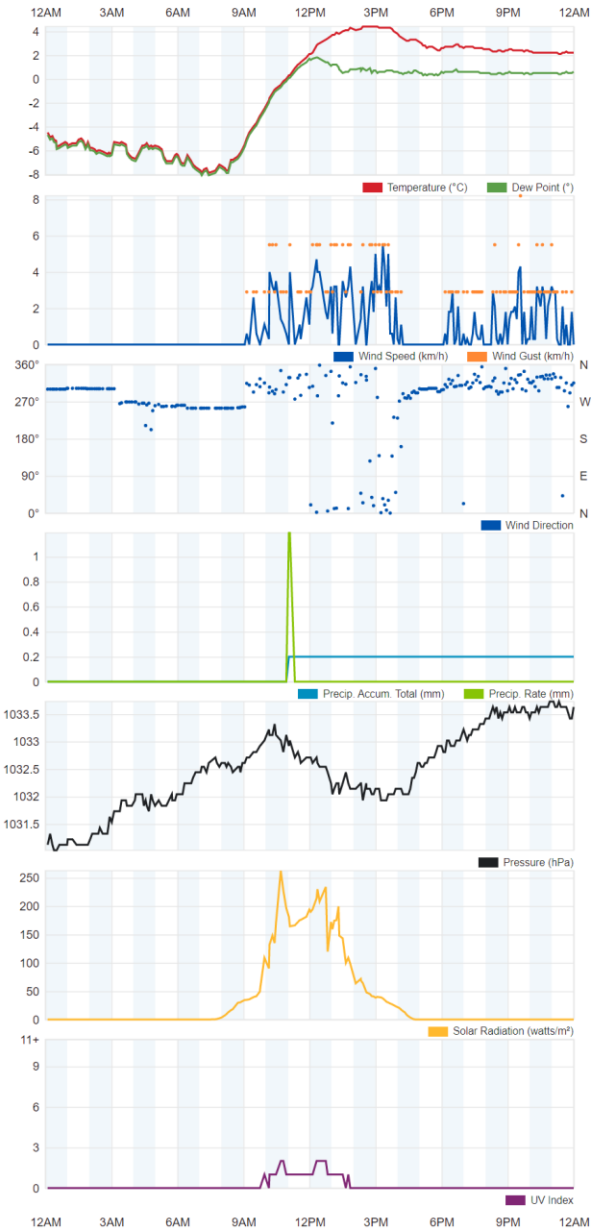
Daily Mode | January | 23 | 2023 | Previous | View | Next

Summary
January 23, 2023

	High	Low	Average
Temperature	4.4 °C	-7.9 °C	2.2 °C
Dew Point	1.8 °C	-8.1 °C	0.1 °C
Humidity	99 %	76 %	86 %
Precipitation	0.20 mm	–	–

	High	Low	Average
Wind Speed	5.5 km/h	0.0 km/h	0.2 km/h
Wind Gust	8.2 km/h	–	0.5 km/h
Wind Direction	–	–	NNW
Pressure	1,033.73 hPa	1,030.82 hPa	

Graph | Table



Weather History for IHAYES8

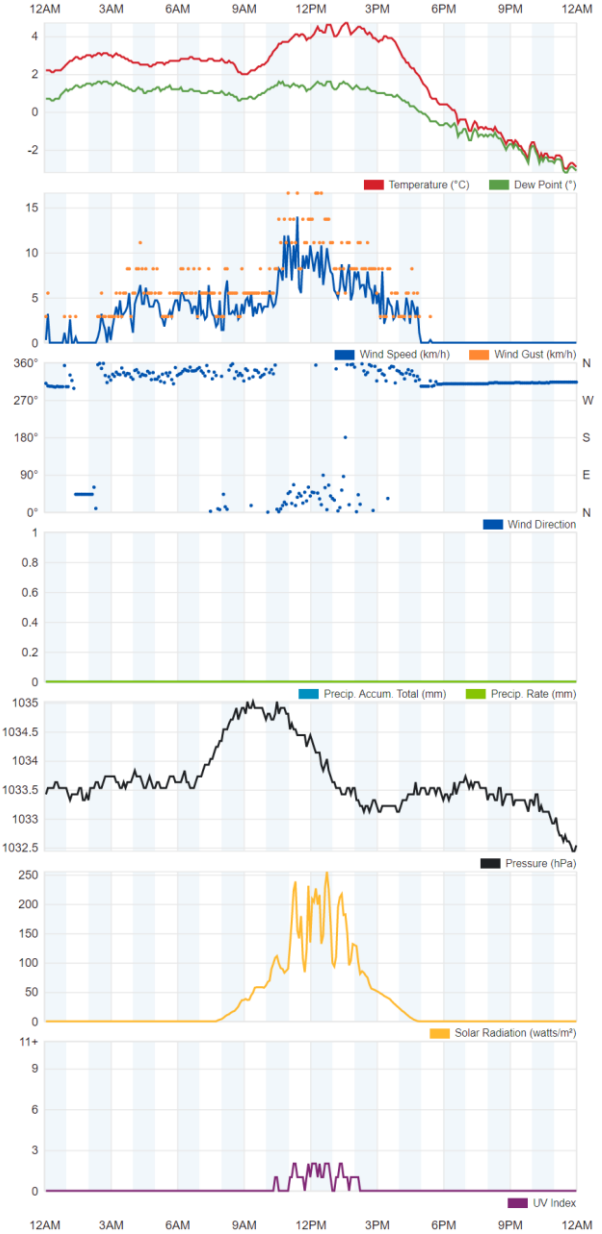
Daily Mode | January | 24 | 2023 | Previous | View | Next

Summary
January 24, 2023

	High	Low	Average
Temperature	4.7 °C	-3.2 °C	1.8 °C
Dew Point	1.6 °C	-3.4 °C	0.2 °C
Humidity	99 %	79 %	90 %
Precipitation	0.00 mm	–	–

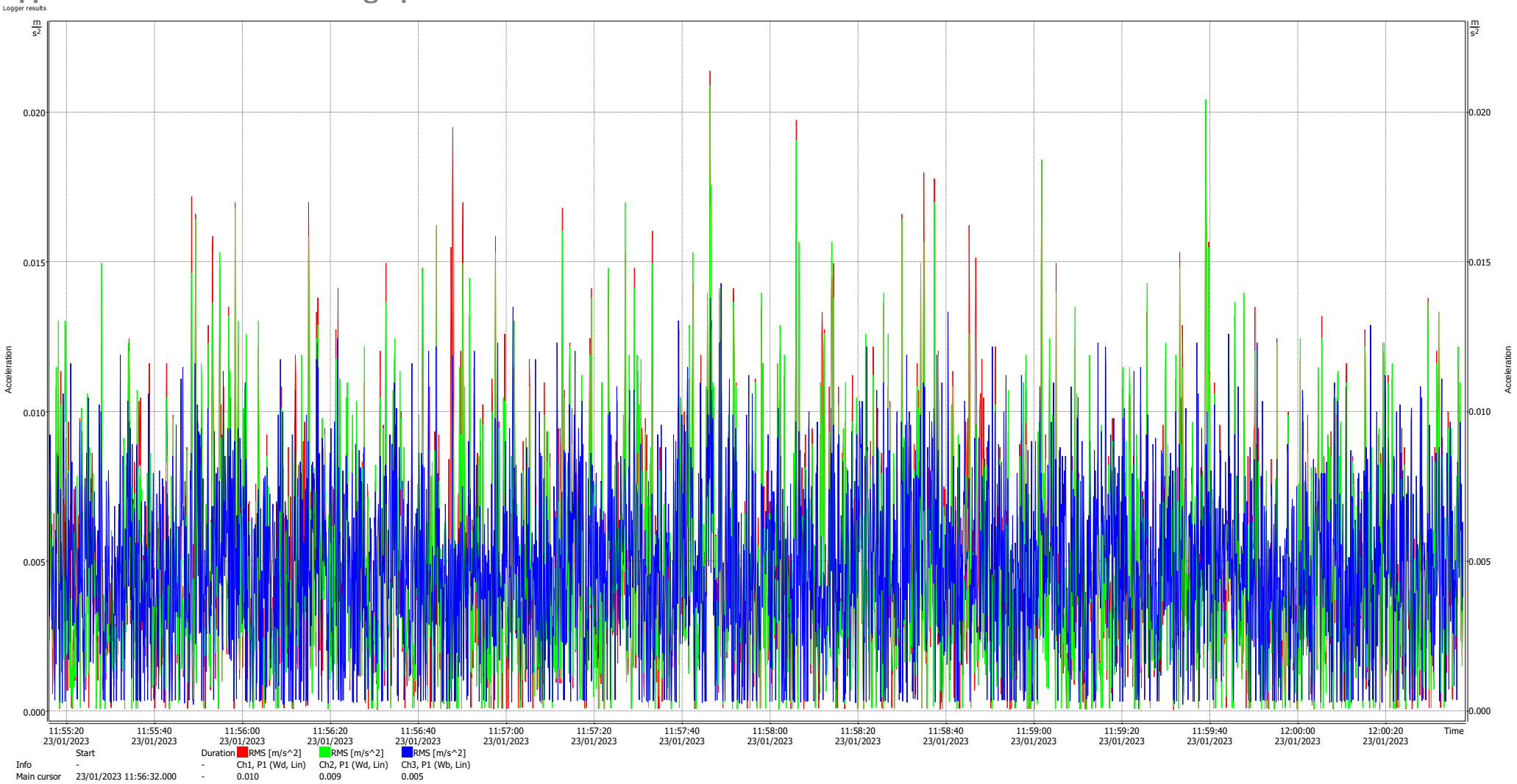
	High	Low	Average
Wind Speed	14.0 km/h	0.0 km/h	1.3 km/h
Wind Gust	16.6 km/h	–	2.1 km/h
Wind Direction	–	–	
Pressure	1,035.02 hPa	1,032.24 hPa	

Graph | Table



Appendix B – Photographs of measurement location

Appendix C – Acceleration level graphs



Ch1 = X Axis , Ch2 = Y-Axis, Ch3 = Z Axis

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