



## Proposal for Verification Testing for Mineral Processing Facility

**Site name:** Hemerdon Mine Mineral Processing Facility

**Site address:** Hemerdon Mine, Plympton, Devon PL7 5BS

**Operator name:** Drakelands Restoration Limited

**Application reference:** EPR/AP3203ML/A001

## Table of Contents

Table of Contents.....	2
1. Introduction .....	3
2. Monitoring Personnel .....	5
3. Monitoring Standards .....	5
4. Monitoring Equipment.....	6
5. Monitoring Locations .....	7
6. Monitoring Plan .....	9
7. Reporting of Data.....	11

## 1. Introduction

### Overview

This Verification Plan has been developed in response to the following question posed within the Schedule 5 Notice requiring further information served by the Environment Agency (EA) on 5 October 2023 with respect to the environmental permit application for the operation of the Minerals Processing Facility (MPF) at Hemerdon Mine (permit application reference: EPR/AP3203ML/A001).

*Submit a written plan, stating how you would test the low frequency noise emitting screens, and control measures, once they have been installed in order to demonstrate emissions do not exceed sound pressure levels specified in the Application e.g., those set out at Table 6-1 of the Low Frequency Noise Impact Assessment and Table 3-1 of the Noise Management Plan. The plan must include details of:*

- *the experience or qualifications of those carrying out the testing;*
- *the monitoring standards being worked to;*
- *the approach to testing of near field and far field;*
- *how directionality of emissions will be considered;*
- *monitoring of background levels and any identifying in-combination effects;*
- *the effectiveness of the abatement on all screens;*
- *how the impact of wind conditions shall be considered;*
- *the timescales required for monitoring and reporting;*
- *how beating effects would be captured; and,*
- *how this information will be reported to the Environment Agency.*

*We would require verification testing of the screens and control measures stated in the Noise Impact Assessment (dated August 2023). The plan would be to verify the emissions of low frequency noise, and confirm they are aligned with the assumptions and results in the Noise Impact Assessment.*

This Verification Plan has been written to detail the monitoring that will be carried out during the commissioning and ramp up of the MPF. There are a multitude of tests that will be carried out to ensure that the equipment upon installation is operating correctly. The scope of this document is specifically the monitoring that will be carried out in relation to Low Frequency Noise (LFN) to assess compliance with predictions that were made prior to operations commencing.

The verification testing methodology report is therefore intricately linked with the Noise Management Plan (NMP)<sup>1</sup> and Noise Impact Assessment (NIA)<sup>2</sup> reports and should be read and considered in conjunction with those reports.

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<sup>1</sup> Hemerdon Mine Low Frequency Noise Impact Assessment, WSP, August 2023 & Schedule 5 Response (October 2023)

<sup>2</sup> Hemerdon Mine Noise Management Plan for Minerals Processing Facility, WSP, October 2023 (V6)

## Objectives

The objectives of the verification testing are:

- To measure and quantify the sound pressure levels experienced at identified far field receptor locations in the vicinity of Hemerdon mine, recorded during operation of the MPF screens. The sound pressure levels are to be measured and quantified in terms of the absolute sound pressure levels, the temporal variation of sound pressure levels (for example due to beating effects or time of day) and the frequency content of the sound pressure levels.
- To compare the measured sound pressure levels during operation of the MPF screens with the background levels in the absence of operations at the MPF. Note that the background levels may include an element of low frequency noise arising from other sources that are not associated with Hemerdon mine. This might include low frequency noise from other industrial, commercial or minerals processing sites.
- To quantify the contribution of the operating MPF screens at Hemerdon to the low frequency noise climate at the identified receptor locations, via comparison of the measured sound pressure levels during operation of the MPF screens with the measured background levels.
- To compare the measured far field sound pressure levels in combination with the environmental conditions at the time of monitoring with those predicted through noise modelling.
- To determine the effectiveness of the low frequency noise control measures applied to the screens at Hemerdon mine. The effectiveness of the control measures is to be quantified in terms of the reduction in sound pressure levels compared to the unmitigated situation (using the best available data for the unmitigated situation), namely the sound pressure levels provided in Table 6-1 of the NIA.
- To obtain information on the character of low frequency sound experienced at the identified receptor locations; e.g. any observed beating effects (including the magnitude and periodicity of any beating effects).
- To obtain information relating to other factors that may affect the levels and perception of low frequency sound at the identified receptor locations; e.g. the effects of meteorological conditions such as wind speed and direction.

The results of the above will be used to inform updates of the Noise Management Plan, as described in Section 1.3 of the NMP.

## Monitoring Strategy

It is proposed to carry out verification testing in two phases:

- The first phase is to carry out verification testing on all screens individually with plywood prior to ore commissioning and full operations, this has been termed 'Construction Verification'. This will allow any adjustments to be made to the screens and the LFN mitigation techniques to ensure alignment with the NIA.
- Only once all screens have been verified through the Construction Verification process will ore commissioning commence. During ore commissioning and subsequent full operations screens will be monitored in combination with mineral material, termed below as 'Ore Commissioning

Verification'. It is anticipated that this phase will last at least 6 months from the time that the first ore is processed until the entire MPF is fully operational.

Ongoing monitoring for LFN will be determined in consultation with the EA and in accordance with permit requirements.

The proposed monitoring is detailed in Section 5 Monitoring Plan.

## **2. Monitoring Personnel**

The person(s) conducting the verification tests will be required to demonstrate that they have the necessary qualifications and experience to undertake the testing. This will be demonstrated by either:

- The person being a corporate member of the Institute of Acoustics (MIOA, FIOA or HonFIOA); or
- The person having the same level of academic qualifications and length of experience as would be required to achieve corporate membership of the Institute of Acoustics.

Note that the general requirements for entry to corporate membership of the IOA are that the person:

- Holds an acceptable educational qualification such as a degree in acoustics, the IOA Diploma in Acoustics or some other degree level qualification where the course included a significant element or module in acoustics; and
- Has had experience for at least three years of responsible work which demands a knowledge of acoustics or its application. The minimum period of professional experience must all have been undertaken after completion of the appropriate qualification in acoustics.

## **3. Monitoring Standards**

The verification testing will, *where applicable*, take into account the guidance contained within the following technical standards and guidance documents:

- BS 4142: 2014+A1:2019: Methods for rating and assessing industrial and commercial sound (2019)
- Association of Noise Consultants BS 4142: 2014+A1:2019: Technical Note (2020)
- EA: Method Implementation Document (MID) for BS 4142 (2023)
- NANR45 Procedure for the assessment of low frequency noise disturbance, University of Salford (2005)
- Other standards and guidance referenced in the above documents, such as those relating to measurement instrumentation.

It is noted that BS 4142 is not directly applicable to the measurement and assessment of low frequency noise and this is discussed in more detail in Section 2.2 of the NIA. However, some of the guidance within BS 4142 and the associated guidance documents, such as that relating to measurement instrumentation and dealing with meteorological effects, is relevant to the situation at Hemerdon.

## **4. Monitoring Equipment**

### ***Construction Verification***

During the construction verification phase, far field sound pressure levels for each screen running individually will be measured at accessible locations detailed in Section 5 far field monitoring locations.

For each location, the sound pressure levels would be captured for a period of 10 minutes at a frequency of at least 100 Hz. This is to provide sufficient frequency resolution to separate the output from the screen under test from any other equipment that might be emitting low frequency noise. An estimate of the screen contribution will be made by determining the sound energy in a 0.5 Hz band centred on the screen running frequency, and subtracting the sound energy in the adjacent 0.5 Hz band above. Spectrograms from each measurement would be calculated so that any time dependence in the measurements can be assessed.

Meteorological records from the Hemerdon mine weather station would be recorded at the times of testing to assess the effect of wind on the recordings.

The equipment used will be a laptop computer running the M+P Analyzer software with the sound pressure signal acquired using a National Instruments 9234 cDAQ module. The microphone will be a Class 1 device with a frequency range down to 4 Hz. This will be calibrated to National Standards before the verification exercise and field calibrated before each set of measurements.

### ***Ore Commissioning Verification***

Eatec Dynamics has developed remote monitors that can be configured to continuously monitor LFN. They can be set up to simultaneously record and process low frequency air pressure down to 5 Hz, audible sound up to 26 kHz, vibration at any meaningful frequency as well as other environmental parameters such as wind speed and direction, temperature, humidity, etc.

For LFN, the time history of air pressure is recorded and processed into summary information for each set period (usually one hour). These data are sent by mobile broadband to nominated recipients. All time history data can also be transmitted if required, or the information can be held locally and selectively transmitted on request.

The time histories will show the extent of beating which has been specifically identified by the EA.

With air pressure records of one hour duration, very fine resolution spectra can be calculated. The standard processing tools developed by Eatec Dynamics will generate this information as Fast Fourier Transforms (FFTs) or spectrograms. These tools could be extended to extract from an FFT the precise contribution of each individual screen at the MPF to determine the relative contribution and total output from the site. This would allow any changes with time to be tracked.

## 5. Monitoring Locations

### *Near field*

Near field monitoring is not proposed due to the uncertainty of this data and the fact that any detected noise levels in the near field are going to be influenced by reflections due to the proximity and variability of structures in the MPF area. Therefore, verification testing will be based purely on data gathered at far field monitoring locations.

### *Far field Monitoring Locations*

The far field measurement locations will be selected from the nearest noise sensitive receptors, as detailed in the NIA and NMP, and identified in Table 1 below.

**Table 1 - Nearest Noise Sensitive Receptors and Potential Measurement Locations**

Receptor Reference	Land Use	Compass Direction from the Site	Approximate Distance to Closest Site Boundary (m)	Approximate Distance to the Existing Processing Plant (m)
A: Birchland Farm	Residential	South-east	300	1,100
B: Galva House	Residential	South-west	480	950
C: Newnham House	Residential	South-west	1,000	1,475
D: Boringdon Hall	Hotel and spa	South-west	760	3,000
E: Mumford Cottage	Residential	North-east	820	2,000
F: Portworthy Farmhouse	Residential	North-west	200	1,900
G: Windwhistle Farm	Residential and hotel	South-west	950	1,400
H: Dartmoor Zoo	Zoo	South-east	320	1,250
I: Wotter	Residential	North-west	1,640	3,245
J: Broadoaks Cottages	Residential	North	990	2,390
K: East of Lee Moor*	Public land	North-east	1,520	2,900
L: Lutton	Residential	East	2,120	2,930
M: Cornwood Inn	Pub and restaurant	East	3,050	3,820
N: Gorah Cottages	Residential	East	1,150	1,950
O: Yondertown	Residential	East	1,680	2,490
P: Road Junction^	Public land	South-west	1,530	2,070
Q: Colebrook**	Public land	South-west	1,150	2,480
R: Elfordleigh Hotel	Hotel	West	1,070	2,340

\*Representative of residential receptors in Lee Moor  
^Representative of residential receptors in the area of Highglen Drive  
\*\* Representative of residential receptors in the north of Plympton in the area of Elford Crescent

The noise-sensitive receptors listed above can, for the purpose of describing them, be grouped into the following:

- Receptors to the east and south-east of the processing area, including Cornwood Inn (Receptor M), Lutton (Receptor L), Yondertown (Receptor O), Gorah Cottages (Receptor N) and Dartmoor Zoo (Receptor H) and Birchland Farm (Receptor A).
- Receptors to the south-west and west of the processing area, including Galva House (Receptor B), Windwhistle Farm (Receptor G), road junction (Receptor P), Colebrook (Receptor Q), Boringdon Hall (Receptor D), Elfordleigh Hotel (Receptor R) and Newnham House (Receptor C)
- Receptors to the north-west, north and north-east of the processing area, including Mumford Cottage (receptor E), Portworthy Farmhouse (Receptor F), Wotter (Receptor I), Broadoak Cottages (Receptor J) and East of Lee Moor (Receptor K).

The receptors to the east and south-east are generally visually screened from the mine by intervening topography. With the exception of Dartmoor Zoo, they are rural residential areas.

The receptors to the south and south-west are, with the exception of the road junction, a mix of residential and commercial properties. The mine is at a higher elevation than these receptors. All, except Colebrook are in a rural location.

The receptors to the north-west, north and north-east are generally at a higher elevation than the mine, some with intervening topography which visually screens the mine. With the exception of East of Lee Moor, they are all residential and in a rural setting.

Whilst the intervening topography between the site and some of the receptors visually screens the site, there are considered to be no structures or topography in the areas which is capable of screening LFN from the mine at the receptors.

As the noise sensitive receptors and potential monitoring locations can be grouped into various community areas located at different compass directions from the site, with each identified community area being subject to similar intervening topography affecting sound propagation, validation measurements need not be undertaken at each and every receptor location identified in Table 1 above. Instead, in some situations, measurements undertaken at a specific receptor location can be considered to be representative of the noise climate at other locations within the immediate vicinity.

The choice of measurement locations will, of course, depend on the cooperation of residents and land owners to allow installation of automated measurement equipment or allow attended measurements to be undertaken on private property.



## 6. Monitoring Plan

### *Construction Verification*

1. During the general construction works, each screen will be placed, aligned and enclosure installed along with associated chute work and discharge points.
2. Discharge points will be installed to suit the operating conditions, inclusive of the installation of conveyor belting and skirting.
3. Deck vents and associated screen panels will be installed along with a plywood covering that will represent the level of material coverage that will be present on the screen in operations.
4. Screens will be tested individually, as available, utilising a temporary power supply and associated services.
5. The screen will be operated at its design condition, in the presence of the Vendors Representative.
6. Standard mechanical and electrical inspections will be completed and further work carried out as necessary until the screen is approved as healthy.
7. The screen will be operated and LFN readings will be taken at a number of roving far field locations distributed in different directions from the MPF including a downwind location over an appropriate period. All data including wind direction will be recorded.
8. The data gathered will be analysed and compared to the predicted model results with a single screen running.
9. If far field measurements exceed expected levels (these being derived considering modelled noise levels for the screen, environmental conditions and background noise levels, amongst other things), then adjustments to the screen and / or mitigation measures will be carried out. This may include but is not limited to:
  - Inspecting enclosure for correct rigidity whilst running, if rigidity for a particular side(s) is low apply additional stiffening.
  - Inspecting and adjusting skirting.
  - Inspecting and adjusting chute work.
10. Retesting will be carried out and the associated results tabulated.
11. Adjustment work will only be deemed as complete once the far field measurements are below or align with predicted model results.
12. The temporary power supply and services will be disconnected, the plywood removed and the area returned to general construction activities.
13. Design modifications and / or adjustments will be formalised and incorporated into the screen/enclosure documentation including design drawings and operational parameters and manuals.
14. The completed Construction Verification report for each screen will be submitted to the EA for sign off.
15. The Noise Management Plan will be amended as required.

The LFN model will be updated with empirical data from each single screen test, as completed and further adjustments made to screens and / or mitigation measures until such time as the overall LFN outputs remains within the original model run predictions.

### ***Ore Commissioning Verification***

1. All screens and enclosures will be set to the construction certified conditions determined as per Construction Verification process.
2. Continuous noise monitoring will commence at far field locations and throughput rates and environmental conditions will be monitored and recorded.
3. General commissioning with ore will commence (up to 6 months from start to finish). All screens will be operated simultaneously.
4. If far field measurements exceed expected levels (these being derived considering modelled noise levels for the screen, environmental conditions and background noise levels, amongst other things), then the dominant source(s) of LFN will be identified and any minor adjustments to the screen and / or mitigation measures will be carried out, as operationally feasible and required. This work will be carried out in consultation with the Environment Agency.
5. The Noise Management Plan will be amended as required.

### ***Assessment of directionality***

As detailed in the NIA, directionality in the far field is dominated by wind speed and wind direction and, for the purpose of verification testing, the assessment of directionality is limited to these effects. Further information is provided in the Wind conditions section below.

### ***Wind conditions***

There is a permanent and operational meteorological station within the mineral processing area of the mine (grid co-ordinates SX 56773 58841) which measures and records wind speed and wind direction, amongst other things. The data from the meteorological station which corresponds to the noise measurement periods will be analysed to determine the conditions during any noise monitoring.

In addition, the remote far field monitors which will be used during ore commissioning, ramp up and ongoing operations provide real time wind data.

### ***Background effects***

Background effects will be accounted for by:

- Carrying out background LFN monitoring in the far field immediately prior to any verification testing; or
- By using noise levels at adjacent narrow bands obtained during the measurement of the screen.

The chosen methodology and justification will be detailed in the reporting to the EA.

### ***In-combination effects***

In-combination effects will be determined via the Ore Commissioning Verification testing during which all screens will be operating.

### ***Beating effects***

The time histories of the remote monitors will show the extent of beating. Time history graphs will be included in the verification report submitted to the EA.

## **7. Reporting of Data**

A Construction Verification report will be submitted to the EA within 2 weeks of completion of each screen test with plywood.

During the Ore Commissioning Verification phase and during ramp up of the process, the continuous monitoring results will be submitted to the EA on a monthly basis within 5 working days of the end of the month. Any other monitoring data will be provided upon request at any reasonable time.

In both cases a spreadsheet of measured data including meteorological data and a full analysis of the results will also be provided to the EA.

Ongoing reporting of data will be carried out in accordance with the permit requirements.