

# Construction Vibration Management Plan

Site: Prestwich MSCP  
Reference: 51-387-R1-1  
Date: September 24





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## EXECUTIVE SUMMARY

|                                                 |                                                                                                                                                                                                                                                                             |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Site Address</b>                             | Fairfax Road, Prestwich M25 1BT                                                                                                                                                                                                                                             |
| <b>National Grid Reference</b>                  | E 381264, N 404269                                                                                                                                                                                                                                                          |
| <b>Proposed Development</b>                     | Construction of multi storey car park                                                                                                                                                                                                                                       |
| <b>Background</b>                               | Planning permission was granted for the proposed development and a condition in relation to construction vibration is required to be discharged, specifically condition 40. As such, this Construction Vibration Management Plan is to be used to discharge this condition. |
| <b>Potential Sources of Noise and Vibration</b> | Potential sources of vibration will exist during construction activities. Worst-case operations/plant are assessed and considered.                                                                                                                                          |
| <b>Assessments Completed</b>                    | E3P have undertaken a BS 5228 assessment for the proposed construction phase of the development in relation to vibration.                                                                                                                                                   |
| <b>Mitigation Recommendations</b>               | The assessment has found that noise and vibration levels are considered acceptable during the Continuous Flight Auger piling. However, Best Practicable Means have been included to minimise potential impacts and recommendations on vibration monitoring given.           |
| <b>Conclusion and Discussion</b>                | This management plan has aimed to minimise the potential impact of construction noise and vibration upon existing receptors and to provide advice on procedures and monitoring to be carried out during this phase of the development.                                      |



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## 1. INTRODUCTION

### 1.1. BACKGROUND

E3P have been commissioned by The Prestwich Regeneration LLP to provide a Construction Noise and Vibration Management Plan (CNVMP) for the permitted multistorey car park at Fairfax Road in Prestwich.

This CNVMP outlines the methods by which the developers will systematically assess, and minimise, the potential impacts of vibration generated by construction activities associated with the construction works for the development.

### 1.2. REPORT OBJECTIVES

The CNVMP is a working document with the specific aim of ensuring that:

- ✳ Determine piling types and expected vibration levels.
- ✳ Vibration impacts are considered as part of routine inspections.
- ✳ Vibration is primarily controlled at source by good operational practices, including physical and management control measures; and
- ✳ all appropriate measures are taken to prevent or, where that is not reasonably practicable, to reduce noise and vibration emissions from construction activities at nearby receptors.

This CNVMP addresses the impact of vibration, and the control measures employed to mitigate the risk. These are supported through monitoring procedures to identify both elevated levels and review complaints should they arise. The complaints management procedure including the management responsibilities are also addressed.

### 1.3. PROPOSED DEVELOPMENT

The developer intends to construct a multistorey car park at an existing ground level car park site. Planning permission was granted and Condition 40 is required to be discharged in relation to the construction phase of the development:

*Notwithstanding the submitted Environmental Statement, prior to any piling work taking place within any relevant phase or sub-phase of the development, the following shall occur in consecutive order for that phase or sub-phase:*

- *An assessment shall be undertaken to determine the levels of ground borne vibration associated with the piling works within the development which shall identify all affected receptors and detail how impacts can be mitigated and/or reduced.*
- 1. *A scheme based upon the findings in part (1) shall be submitted to and approved in writing by the Local Planning Authority outlining the type of piling, its location, noise/vibration levels and details of mitigation measures to ensure that the impact of the piling works on the receptors identified in (1) are mitigated/reduced.*
- 2. *The development shall be carried out in strict accordance with the approved scheme for that phase.*

*Reason: To ensure impacts on amenity from are acceptable and to accord with the requirements of Policy EN1/2(b) of the Bury Unitary Development Framework, and the National Planning Policy Framework.*



## 2. ASSESSMENT METHODOLOGY

### 2.1. BS 5228: NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES - PART 2: VIBRATION: 2009+A1 2014 (BS 5228-2)

This standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background to vibration control is described and guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

Guidance criteria are suggested for the assessment of the significance of vibration effects, such criteria are provided in terms of Peak Particle Velocities (PPV) and are concerned with both human and structural responses to vibration. Those applicable to human perception and disturbance are presented within Table 1.

**Table 1 PPV Criteria – Human Exposure**

| Vibration level | Effect                                                                                                                                                                                          |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.14 mm/s       | Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration. |
| 0.3 mm/s        | Vibration might be just perceptible in residential environments                                                                                                                                 |
| 1.0 mm/s        | It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.                   |
| 10 mm/s         | Vibration is likely to be intolerable for any more than a very brief exposure to this level.                                                                                                    |

The Standard goes on to present guidance criteria applicable to the vibration response limits of buildings in terms of the component PPV, these are presented within Table 2.

**Table 2 PPV Criteria – Buildings**

| Type of building                                                                     | Peak component particle velocity in frequency range of predominant pulse |                                                           |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------|
|                                                                                      | 4 Hz to 15 Hz                                                            | 15 Hz and above                                           |
| Reinforced or framed structures<br>Industrial and heavy commercial buildings         | 50 mm/s at 4 Hz and above                                                | 50 mm/s at 4 Hz and above                                 |
| Unreinforced or light framed structures<br>Residential or light commercial buildings | 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz                           | 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above |

Note 1: Values referred to are at base of the building

Note 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

It should be noted that the values presented within Table 2 are applicable to cosmetic damage only. It is stated within BS 5228-2 that minor damage is possible at vibration magnitudes which are greater than twice those given in the Table. The guide values for building damage are an order of magnitude higher than for human disturbance.



### 3. SOURCES OF VIBRATION

Sources of vibration generated at the site are limited to the following activities:

- ✿ Piling (CFA piling).
- ✿ Construction.
- ✿ Delivery of material; and
- ✿ On-site vehicle movements.

As not all of the sources of vibration mentioned above are continuous, the sources will vary throughout the day.

Continuous flight auger (CFA) piles are a type of foundation that involves drilling and concreting in one operation to create a pile. They are a common method for installing foundations in a variety of ground conditions and are especially suited to areas where low noise and vibration are important. CFA piles are virtually vibration-free and produce low noise emissions, making them ideal for use near buildings and homes.

The operating periods when vibration from on-site activities has the potential to occur during Site working, and delivery times which are assumed to be limited to the following:

- ✿ Monday to Friday – 08:00-18:00.
- ✿ Saturdays – 08:30-14:00; and
- ✿ Sundays and Bank Holidays – No work to be carried out without the prior written approval of the Local Planning Authority.

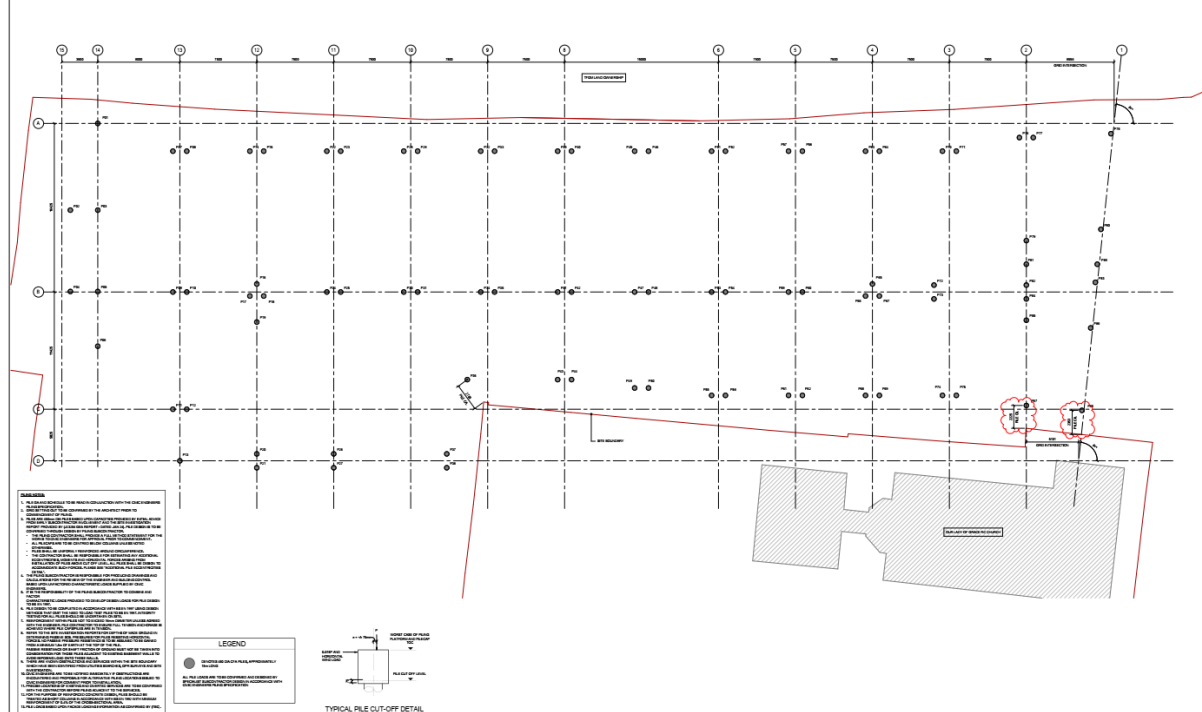
Sensitive receptors will include residents living close to and surrounding the Site, specifically, those along Highfield Road, Highfield Place and Our Lady of Grace RC Church to the south of the site.



## 4. CONSTRUCTION NOISE AND VIBRATION PREDICTIONS

All predictions are based on the below Piling GA drawing provided by the client.

**Figure 1 Piling GA**



### 4.1. CONSTRUCTION NOISE ASSESSMENT

It is inevitable with any major development that there will be some disturbance caused to those nearby during the clearance and construction phases of the Site. However, disruption due to construction is only temporary, limited to the Site and is of medium-term duration. Indeed, the impact will be localised to the nearest receptor/s to a phase and, as such, a medium-term consideration is considered appropriate.

The predictions have followed the methodology contained within BS 5228-1 and are in terms of the  $L_{Aeq,T}$  over the core working day, which is assumed to be 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 on Saturdays. Any minor deviation from these times has little to no impact on the outcome of these assessments.

It is noted in the condition that requirements for piling only are required. As such, only the proposed CFA piling is assessed.

Table 3 sets out the typical plant type, number and assumed utilisation (percentage 'on-time') used in the prediction of noise levels during the key construction activities.

**Table 3 Construction plant details**

| PLANT TYPE                             | SOUND PRESSURE LEVEL AT 10 m, $L_{Aeq,T}$ (dB) | NUMBER OF PLANT ITEMS | ASSUMED % ON TIME |
|----------------------------------------|------------------------------------------------|-----------------------|-------------------|
| CFA Piling – 450 mm dia and 15 m depth | 77                                             | 1                     | 90                |



For the purpose of these predictions, it was assumed that the intervening ground between the construction noise sources and the receivers will be acoustically hard such that there will be no additional attenuation of sound due to ground absorption thus informing a worst-case assessment.

Noise predictions have been undertaken for the closest receptors in the immediate vicinity of the Site. No further calculations are undertaken as assessments and any mitigation measures are considered worst-case.

Table 4 sets out the average predicted unmitigated piling noise. For the purposes of this assessment and absolute criterion of 75 dB is applied to receptors, in accordance with the threshold value for urban areas. Noise levels in exceedance of these values are highlighted in bold.

To inform the assessment, an average position in the centre of the built form of the development is used to predict expected noise levels at each respective receptor. Any works that take place closer to the receptor, at certain pile locations, for instance, will be for a short period and an average, central position, is considered robust for the duration of the works.

**Table 4 Predicted average unmitigated demolition and construction noise levels**

| Receptor                    | Average distance (m) | Average piling noise levels, $L_{Aeq,10hrs}$ (dB) |
|-----------------------------|----------------------|---------------------------------------------------|
| Highfield Road              | 36                   | 65.4                                              |
| Highfield Place             | 26                   | 68.2                                              |
| Our Lady of Grace RC Church | 18                   | 71.7                                              |
| Poppythorn Lane             | 43                   | 63.9                                              |

A review of Table 4 identifies that the calculated unmitigated piling noise level at all receptors falls below 75 dB as an average consideration across a short-term period. As such, mitigation measures are required.

It should be noted that these predictions are worst case and that it is unlikely that operations are to be conducted on the sections of the Site closest to each of the identified receptors for significant periods of time. For most of the construction phase it is expected that activities will be conducted at greater distances from the receptors.

## 4.2. CONSTRUCTION VIBRATION ASSESSMENT

E3P has confirmed that Continuous Flight Auger (CFA) piles will be used which would not result in significant vibration levels. Indeed, CFA piles are a recommended alternative where elevated levels of vibration are expected during piling activities.

As such, assessment of the potential vibration is based on historic data given in BS 5228 for rotary bored piling with diameter of 450 mm. It is important to note that CFA piles are noted to be virtually vibration free and so any assessment here is considered worst case and based on best available data.

**Table 5 Typical Vibration Levels**

| Operation          | Distance (m) | PPV (mm/s) |
|--------------------|--------------|------------|
| CFA Piling example | 10           | 1.0        |
|                    | 14           | 0.8        |
|                    | 26           | 0.02       |



It should be noted that the data presented within the above table is general in nature and is not specific to the Site, however the vibration levels and associated distances can be used to determine the typical distances at which specific impacts are likely to be registered.

The closest point of the site to the closest sensitive receptor (to the north west) is noted to be approximately 10 m to the closest pile or between 5 and 10 m for the church. This would result in a level of approximately 1.0 mm/s at the receptor with levels of less than 3 mms likely between 5 and 10 m from the receptor.

Therefore, given that the criteria for cosmetic damage for unreinforced lightweight structures is 15 mm/s and that the works would be brief close to the receptor, it is expected that levels of vibration from on-site operations are highly unlikely to cause any potential cosmetic damage to the existing receptors even when considering the highest likely vibration levels. Furthermore, the expected vibration levels would be no more than 3 mm/s for very short periods and ongoing levels are likely to be less than 1 mm/s consistently.

BS 5228 provides the following advice for the worst-case levels:

*It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.*

For the vast majority of periods, the following would be applicable:

*Vibration might be just perceptible in residential environments.*

The closest receptor is not residential in nature but is considered as sensitive. Therefore, it is recommended that prior warning is given. However, the impact of vibration at the receptors is considered low.

### **4.3. CONDITION DISCHARGE INFORMATION**

E3P have provided the required information in order to discharge condition 40 of the planning permission. For clarity, the following is provided and summarised:

*Notwithstanding the submitted Environmental Statement, prior to any piling work taking place within any relevant phase or sub-phase of the development, the following shall occur in consecutive order for that phase or sub-phase:*

- *An assessment shall be undertaken to determine the levels of ground borne vibration associated with the piling works within the development which shall identify all affected receptors and detail how impacts can be mitigated and/or reduced.*

This assessment is shown in Sections 4.1 and 4.2. Here, likely levels of vibration are given, Section 4.2, with identification of receptors throughout. As noted in the assessments, no mitigation is required. However, BPM are provided in Section 5.0.

1. *A scheme based upon the findings in part (1) shall be submitted to and approved in writing by the Local Planning Authority outlining the type of piling, its location, noise/vibration levels and details of mitigation measures to ensure that the impact of the piling works on the receptors identified in (1) are mitigated/reduced.*

As noted above, BPM is provided along with a management plan including for monitoring is given in the report.



2. *The development shall be carried out in strict accordance with the approved scheme for that phase.*

*Reason: To ensure impacts on amenity from are acceptable and to accord with the requirements of Policy EN1/2(b) of the Bury Unitary Development Framework, and the National Planning Policy Framework.*

Accordingly, sufficient information has been provided in order to satisfy the condition.



## **5. NOISE AND VIBRATION CONTROL MEASURES**

### **5.1. GENERAL**

The below details physical and management measures which should be included in on-site practices and procedures to control noise at the nearby receptors especially when working in close proximity to existing work spaces. These measures are in the form of best practicable means (BPM) with noise generating activities being limited to core working hours to minimise nuisance.

Within the constraints of efficient site working and the requirements of the relevant British Standards, the following noise control measures should be implemented, wherever practicable and considered necessary, during the construction period:

- ✳ General induction training for site operatives and specific training for staff having responsibility for particular aspects of controlling noise from the site.
- ✳ Use of most environmentally acceptable and quietly operating plant and equipment appropriate to the works with emission levels limited to relevant EC Directive/UK Statutory Instrument levels and levels quoted in BS 5228.
- ✳ The use of particularly noisy plant should be limited to normal daytime periods, avoiding anti-social hours such as early in the morning.
- ✳ Plant maintenance operations should be undertaken away from the nearest noise-sensitive properties at all times and wherever practicable.
- ✳ Plant not in operation should be shut down, i.e. not left idling.
- ✳ Drivers should ensure that lorry tailgates are shut and locked before leaving tipping or drop off areas.
- ✳ Use of electric generators opposed to diesel powered, wherever possible.
- ✳ Care will be taken when erecting or striking scaffolds to avoid impact noise from banging steel. All operatives undertaking such activities will be instructed on the importance of handling the scaffolds to reduce noise to a minimum.
- ✳ Deliveries will be programmed to arrive during daytime hours only. Care will be taken when unloading vehicles to minimise noise. Delivery vehicles would be routed so as to minimise disturbance to local residents. Delivery vehicles will be prohibited from waiting on the highway or within the site with their engines running.

### **5.2. SITE MANAGEMENT RESPONSIBILITY**

The Technically Competent Manager (TCM) (or designated responsible person) will have responsibility for ensuring that nuisances and hazards arising from the facility due to noise and vibration are minimised. Regular meetings should, where possible, be instigated to discuss current and planned site operations that have the potential to generate noise and vibration emissions.

### **5.3. MANAGEMENT CONTROL MEASURES**

A comprehensive range of management control measures should be implemented at the site including:



- 🔸 All plant and equipment should be regularly maintained to ensure that no item will produce excessive noise and/or vibration.
- 🔸 Traffic movements on Site should be kept within the core working hours to avoid disturbance for receptors along the local road network.
- 🔸 A speed limit of 10mph should be in place at the site access and within the site to limit the level of noise and vibration, especially from heavy goods vehicles; and
- 🔸 Site staff should be made aware that they are working in the immediate vicinity of residential receptors and avoid all unnecessary noise and vibration due to misuse of tools and equipment, and unnecessary shouting and radios. To further enhance this, staff should be trained to operate the equipment and plant without causing excess noise and vibration including measures such as not dropping waste from a height.

If at any time it is necessary to undertake temporary actions that are likely to cause elevated levels of noise and/or vibration, the TCM (or designated responsible person) should liaise with the Environmental Health Officer (EHO) at the Local Planning Authority and the closest affected dwellings to inform them of the works to take place and the duration the works will last.

The above measures can typically reduce noise levels by approximately 5-10 dB. As such, noise levels can be reduced to below levels acceptable in rural areas and therefore the impact is not considered significant, and the construction noise levels are considered the lowest practicable.





## **7. NOISE AND VIBRATION CONTINGENCY MEASURES**

### **7.1. INTRODUCTION**

Elevated levels of noise and vibration may be identified either by receipt of a complaint from a third party suggesting that there is excessive noise and/or vibration or by detection of a result of the environmental monitoring.

This Section details the contingency measures in place to identify the source of elevated noise and/or vibration levels, bring levels back under control and minimise their impact.

### **7.2. NOISE AND VIBRATION COMPLAINT INVESTIGATION**

A site diary, plus forms to record complaints, should be completed by the TCM (or designated responsible person) and input into the IMS, or similar.

All complaints from third parties should be forwarded to the TCM (or designated responsible person).

The TCM (or designated responsible person) should ensure that:

- ✚ The complaint is investigated to identify the cause, if necessary, this may involve direct communication with the complainant.
- ✚ In the event of elevated levels of noise and/or vibration being detected, the presence of 'abnormal' onsite activity is assessed and if necessary preventative action is taken that will prevent a reoccurrence of the same problem. These actions must be documented.
- ✚ The Complainant should be contacted and given information on the investigations conducted and actions taken as appropriate.
- ✚ Complaints involving a location with Local Authority Contracts will be reported in line with specific Contract requirements and timescales. Local procedures may need to be in place to ensure these are adhered to.
- ✚ If the investigation indicates that the complaint has not been justified this should be clearly recorded on the report. All complaints must be logged.

### **7.3. ELEVATED NOISE AND/OR VIBRATION LEVELS**

Any elevated levels of noise and/or vibration identified on site and/or by the complaints procedure identified above will be mitigated as follows:



- ✿ The TCM (or designated responsible person) will investigate the source of the noise and/or vibration and carry out a range of checks at the identified source of the elevated levels if it is found to be originating from within the site. As part of these checks, the TCM (or designated responsible person) will consider the need for further monitoring.
- ✿ Any noise and vibration monitoring will be completed in accordance with BS 5228:2008+A1:2014 Parts 1 and 2. Monitoring locations will be agreed with the EHO prior to undertaking monitoring.
- ✿ The results of any noise and/or vibration monitoring will determine whether the site is causing an unacceptable impact at the receptor in question.
- ✿ The TCM (or designated responsible person) will then ensure the plant is being operated to the manufacturer's specification, to the requirements set out in Section 3 of this management plan and ensure that any improvements required to minimise the noise and/or vibration levels are made.

To further mitigate the elevated levels, the following actions shall also be considered.

- ✿ The replacement of equipment identified as generating excess noise and/or vibration.
- ✿ Once the improvements identified by the TCM (or designated responsible person) have been completed, the manager will commission a further set of monitoring to ensure that the improvements have met the required standard. If the levels are still not being met then the manager will repeat the request for improvements and subsequent monitoring until the limits are met.

If operational failings are identified, the retraining of employees should take place to ensure that all employees operate to the required standards. If the failings are identified as part of the operating techniques, then the problem will be raised as part of the review of control measures detailed in Section 5.

The TCM (or designated responsible person) will ensure a close liaison with the LPA throughout all stages of the process following an identified elevated noise and/or vibration level.

## **7.4. REPORTING MEASURES**

In the event of elevated levels of noise and/or vibration being identified, the event should be reported into an appropriate management system by a member of operational staff. Upon notification of an Environmental Incident, the TCM (or designated responsible person) should complete an incident reporting form. The completed form should then be distributed throughout the company for review at operational, management and health and safety meetings.

The system should record any actions taken to rectify the issue, ensure that any necessary actions or review are recorded onto the system and ensure that the person reporting the incident is notified.

The TCM (or designated responsible person) will investigate the performance failure event within 2 hours and, if necessary, will report the event to the LPA. Once the issue has been resolved, the corrective action taken will be entered onto the system and the issue should be closed.



## **8. EMERGENCY PLANS**

### **8.1. GENERAL**

This Section considers the potential for accidents (or incidents) which would result in the loss of control of noise emissions and could have an unacceptable short-term impact at the closest receptors.

The measures in place to mitigate any emergency situations will generally be the same as the contingency measures identified in Section 5.

If the situation is considered to be an emergency by the site manager (or designated responsible person) then the mitigation measures will be immediately implemented, and the manager will consider limiting the hours of operation or immediately suspending the site operations creating the unacceptable levels of noise. These measures will be considered on a case by case basis.

### **8.2. BREAKDOWN OF EQUIPMENT AND PLANT**

Elevated levels of noise may escape from the site due to the breakdown of any plant items or equipment. Machines not operating to the manufacturer's specification may create unacceptable levels of noise and the failure of control equipment such as damage to acoustic cladding or acoustic barriers may allow unacceptable levels of noise to escape from the site.

In the event of equipment breakdown, the mitigation measures to be undertaken are the same as the contingency mitigation measures detailed in Section 5.

**END OF REPORT**

# APPENDIX I

# LIMITATIONS



## **GENERAL**

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P "Terms of Business" or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.
3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.
4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

## **NOISE AND VIBRATION IMPACT ASSESSMENTS**

5. Where a noise or vibration survey is required to inform an assessment, E3P will endeavour to ensure that all noise and vibration measurements taken are robust, representative and reliable in order to inform an accurate assessment.
6. Where mitigation measures are specified in this report, it should be noted that these measures are relative to a specific sound or vibration source, both in terms of the measured sound pressure and vibration level and the character of the sound source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, E3P cannot be held responsible for any subsequent variations in the proposed mitigation performance.
7. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects' responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.
8. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.
9. E3P does not warrant work/data undertaken/provided by others.

# **APPENDIX II**

## **GLOSSARY**



## NOISE

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source. The most widely used weighting mechanism that best corresponds to the response of the human ear is the "A"-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or LAeq, LA90 etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective but, as a general guide, a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions. An indication of the range of sound levels commonly found in the environment is given in the following table.

**Table 6**      **Typical Sound Pressure Levels**

| SOUND PRESSURE LEVEL | LOCATION/EXAMPLE           |
|----------------------|----------------------------|
| 0                    | Threshold of hearing       |
| 20-30                | Quiet bedroom at night     |
| 30-40                | Living room during the day |
| 40-50                | Typical office             |
| 50-60                | Inside a car               |
| 60-70                | Typical high street        |
| 70-90                | Inside a factory           |
| 100-110              | Burglar alarm at 1 m away  |
| 110-130              | Jet aircraft on take off   |
| 140                  | Threshold of pain          |



## ACOUSTIC TERMINOLOGY

**Table 7 Terminology**

| DESCRIPTOR              | EXPLANATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>dB (decibel)</b>     | The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2E-05 Pa).                                                                                                                                                                                                                                                                                                        |
| <b>dB(A)</b>            | A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. "A" weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.                                                                                                                                                                                                                                                                   |
| <b>LAeq, T</b>          | LAeq is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.                                                                                                                                                                                                                                                                                                   |
| <b>LAmx</b>             | LAmx is the maximum A-weighted sound pressure level recorded over the period stated. LAmx is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the "fast" sound level meter response.                                                                                                                               |
| <b>L10 and L90</b>      | If a non-steady noise is to be described, it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L10 is the level exceeded for 10% of the time and as such can be regarded as the "average maximum level". Similarly, L90 is the "average minimum level" and is often used to describe the background noise. It is common practice to use the L10 index to describe traffic noise. |
| <b>Free-field Level</b> | A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally, as measured outside and away from buildings.                                                                                                                                                                                                                                                                                  |
| <b>Fast</b>             | A time weighting used in the root-mean-square section of a sound level meter with a 125-millisecond time constant.                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Slow</b>             | A time weighting used in the root-mean-square section of a sound level meter with a 1000-millisecond time constant.                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>dB (decibel)</b>     | The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2E-05 Pa).                                                                                                                                                                                                                                                                                                        |
| <b>dB(A)</b>            | A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. "A" weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.                                                                                                                                                                                                                                                                   |