

wardell-armstrong.com

ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING, QUARRYING AND MINERAL ESTATES
WASTE RESOURCE MANAGEMENT



TELEREAL TRILLIUM

Cressington House, St. Marys Road, Liverpool

Noise and Vibration Impact Assessment

February 2015

your earth our world



Wardell Armstrong

2 The Avenue, Leigh, Greater Manchester, WN7 1ES, United Kingdom

Telephone: +44 (0)1942 260101 Facsimile: +44 (0)1942 261754 www.wardell-armstrong.com



JOB NUMBER: LE12752

REPORT NUMBER: 001

TELEREAL TRILLIUM

Cressington House

Noise Impact Assessment

February 2015

PREPARED BY:

PP

E Goldsmith, AMIOA

Environmental Scientist

CHECKED BY:

S C Urquhart, MIOA

Principal Environmental Scientist

APPROVED BY:

M Walton, AMIOA

Technical Director

This report has been prepared by Wardell Armstrong LLP with all reasonable skill, care and diligence, within the terms of the Contract with the Client. The report is confidential to the Client and Wardell Armstrong LLP accept no responsibility of whatever nature to third parties to whom this report may be made known.

No part of this document may be reproduced without the prior written approval of Wardell Armstrong LLP.



Wardell Armstrong is the trading name of Wardell Armstrong LLP, Registered in England No. OC307138.

Registered office: Sir Henry Doulton House, Forge Lane, Etruria, Stoke-on-Trent, ST1 5BD, United Kingdom

UK Offices: Stoke-on-Trent, Birmingham, Cardiff, Carlisle, Edinburgh, Greater Manchester, London, Newcastle upon Tyne, Penryn, Sheffield, Truro, West Bromwich. International Offices: Almaty, Moscow

ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
MINERAL ESTATES AND QUARRYING
WASTE RESOURCE MANAGEMENT

CONTENTS

1	Introduction.....	1
2	Assessment Methodology.....	2
3	Noise and Vibration Survey.....	12
4	Noise Impact Assessment.....	156
5	Vibration Impact Assessment.....	24
6	Noise and Vibration Attenuation Scheme.....	26
7	Conclusions.....	31

APPENDICES

- Appendix A Noise Monitoring Results
- Appendix B Summary of Train Movements

DRAWINGS

- LE12752-001 Noise Monitoring Locations

1 INTRODUCTION

- 1.1.1 By instruction dated 4th December 2015 from Mike Hopkins of Jones Lang LaSalle on behalf of Telereal Trillium, Wardell Armstrong LLP was commissioned to undertake a noise and vibration impact assessment for a proposed residential development at Cressington House, St. Marys Road, Liverpool.
- 1.1.2 The proposed development site is located in Garston, Liverpool, in a predominantly residential area. The site currently comprises existing commercial office buildings which are to be redeveloped in to residential properties.
- 1.1.3 The site is bordered to the north east by St. Mary's Road (A561). To the south east, the site is bordered by existing residential and commercial premises. Approximately 10m to the south, in a deep cut-in, is the Cressington to Liverpool South Parkway railway line with a mixture of residential properties and open space beyond. To the north and west the site is bordered by existing residential properties on Salisbury Road and Victoria Plant Hire. John Lennon Airport is located approximately 3.6km to the south east.
- 1.1.4 The report assesses the results of a noise survey carried out in accordance with current guidance and includes recommendations for noise mitigation as appropriate.

2 ASSESSMENT METHODOLOGY

2.1 Consultation and Scope of Works

2.1.1 The proposed noise assessment methodology was agreed with Dr. Ian Rushforth of Liverpool City Council, prior to the noise survey. The following points were discussed and agreed:

- Attended noise monitoring will be undertaken at three locations; the north eastern, north western and south western parts of the site which are considered to be representative of the proposed residential properties in the vicinity of existing noise sources.
- Noise monitoring will take place between 0400 and 0500 hours in the vicinity of Victoria Plant Hire, which is considered to represent the night time background noise for the rating of industrial noise, should industrial type noise be present.
- Noise monitoring will take place between 0500 and 0700 hours, which is considered to represent the worst case transportation noise during the night time period.
- Noise monitoring will take place between 0700 and 1000 hours which is considered to be representative of worst case transportation noise levels during the daytime period.
- Noise monitoring will take place between 1000 and 1100 hours in the vicinity of Victoria Plant Hire, while no pant items are in operation, which is considered to represent the daytime background noise levels for the rating of industrial noise, should industrial type noise be present.
- Vibration Monitoring will take place between 0400 and 1100 hours in the southern part of the site closest to the Cressington to Liverpool South Parkway rail line.

2.1.2 The scope of the noise assessment is based upon our experience of other similar developments and include consideration of noise at the sensitive areas of the proposed development, i.e. proposed residential areas The assessment specifically identifies the potential impact that existing transportation infrastructure as well as any industrial activities in the vicinity might impose on the proposed development.

2.1.3 The noise and vibration assessment takes into account current guidance, as detailed below:

- National Planning Policy Framework, 2012;
- Noise Policy Statement for England, 2010;
- Planning Practice Guidance - Noise, 2014;
- The World Health Organisation Guidelines for Community Noise 1999 (WHO 1999);
- British Standard 8233: 2014 Guidance on Sound Insulation and noise reduction for buildings (BS8233);
- British Standards 4142: 2014 Method for rating Industrial Noise Affecting Mixed Residential and Industrial Areas; (BS4142: 2014 not published at the time of assessment);
- British Standard 6472 Part 1 - 2008, "Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting (BS6472-1); and
- Department of Transport's technical memorandum Calculation of Rail Noise, 1995 (CRN).

2.1.4 Potential noise and vibration issues that are addressed as part of this assessment are as follows:

- Noise from road traffic on the St. Marys Road and surrounding local road network;
- Industrial type noise originating from 'Victoria Plant Hire' to the north west of the site; and
- Noise and vibration from rail movements along the railway line to the south west of the site between Cressington and Liverpool South Parkway stations.

2.2 Noise and Vibration Survey

2.2.1 As part of this assessment, Wardell Armstrong LLP has carried out an attended noise and vibration survey to assess the current baseline levels at proposed receptor locations. The noise and vibration surveys are discussed in Chapter 3 of this report.

2.3 Guidance

National Planning Policy Framework

2.3.1 In March 2012 the 'National Planning Policy Framework' (NPPF) was introduced as the current planning policy guidance within England. Paragraph 123 of the NPPF states:

'Planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'

2.3.2 With regard to 'adverse impacts' the NPPF refers to the 'Noise Policy Statement for England' (NPSE), which defines three categories, as follows:

'NOEL – No Observed Effect Level

- This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

- This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

- This is the level above which significant adverse effects on health and quality of life occur’.

2.3.3 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided. The second aim refers to the situation where the impact lies somewhere between LOAEL and SOAEL, and it requires that all reasonable steps are taken to mitigate and minimise the adverse effects of noise. However, this does not mean that such adverse effects cannot occur.

2.3.4 The Planning Practice Guidance (PPG) provides further detail about how the effect levels can be recognised. Above the NOEL noise becomes noticeable, however it has no adverse effect as it does not cause any change in behaviour or attitude. Once noise crosses the LOAEL threshold it begins to have an adverse effect and consideration needs to be given to mitigating and minimising those effects, taking account of the economic and social benefits being derived from the activity causing the noise. Increasing noise exposure further might cause the SOAEL threshold to be crossed. If the exposure is above this level the planning process should be used to avoid the effect occurring by use of appropriate mitigation such as by altering the design and layout. Such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused. At the highest extreme the situation should be prevented from occurring regardless of the benefits which might arise. Table 1 summarises the noise exposure hierarchy.

Table 1 National Planning Practice Guidance noise exposure hierarchy			
Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed adverse Effect	No specific measures required

Table 1 National Planning Practice Guidance noise exposure hierarchy (continued)			
Perception	Perception	Perception	Perception
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows for some of the time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

2.3.5 The Noise Policy Statement for England refers to the World Health Organisation (WHO) when discussing noise impacts. The WHO Guidelines for Community Noise 1999 suggest guideline values for internal noise exposure which take into consideration the identified health effects and are set, based on the lowest effect levels for general populations. Guideline values for annoyance which relate to external noise exposure are set at 50 or 55 dB(A), representing day time levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed respectively.

The following guideline values are suggested by WHO:

- 35 dB L_{Aeq} (16 hour) during the day time in noise sensitive rooms
- 30 dB L_{Aeq} (8 hour) during the night time in bedrooms
- 45 dB L_{Amax} (fast) during the night time in bedrooms
- 50 dB L_{Aeq} (16 hour) to protect majority of population from becoming moderately annoyed
- 55 dB L_{Aeq} (16 hour) to protect majority of population from becoming seriously annoyed

2.3.6 British Standard 8233 “Guidance on sound insulation and noise reduction for buildings” 2014 bases its advice on the WHO Guidelines. In addition, for internal noise levels it states;

“Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.”

2.3.7 Furthermore, with regard to external noise, the Standard states;

“For traditional external areas that are used for amenity space such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq, T}$ with an upper guidance value of 55 dB $L_{Aeq, T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited”.

2.3.8 The PPG summarises the approach to be taken when assessing noise. It accepts that noise can override other planning concerns, but states:

“Neither the Noise Policy Statement for England nor the National Planning Policy Framework (which reflects the Noise Policy Statement) expects noise to be considered in isolation, separate from the economic, social and other environmental dimensions of proposed development”.

British Standard 4142:2014 (BS4142), Method for rating and assessing industrial and commercial sound:

2.3.9 BS4142 is used to rate and assess sound of an industrial and/or commercial nature including:

- sound from industrial and manufacturing processes;
- sound from fixed installations which comprise mechanical and electrical plant and equipment;
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

2.3.10 The standard is applicable to the determination of the following levels at outdoor locations:

- rating levels for sources of sound of an industrial and/or commercial nature; and
- ambient, background and residual sound levels, for the purposes of:
 - 1) Investigating complaints;
 - 2) Assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and
 - 3) Assessing sound at proposed new dwellings or premises used for residential purposes.

- 2.3.11 The purpose of the BS4142 assessment procedure is to assess the significance of sound of an industrial and/or commercial nature.
- 2.3.12 BS4142 refers to noise from the industrial source as the 'specific noise' and this is the term used in this report to refer to noise which is predicted to occur due to activities associated with Victoria Plant Hire. The 'specific noise' levels, of the existing industrial premises that have been measured are detailed in Section 3 of this report.
- 2.3.13 BS4142 assesses the significance of impacts by comparing the specific noise level to the background noise level (L_{A90}). Section 3 provides details of the background noise survey undertaken.
- 2.3.14 Certain acoustic features can increase the significance of impacts over that expected from a simple comparison between the specific noise level and the background noise level. In particular BS4142 identifies that the absolute level of sound, the character, and the residual sound and the sensitivity of receptor should all be taken into consideration. BS4142 includes allowances for a rating penalty to be added if it is found that the specific noise source contains a tone, impulse and/or other characteristic, or is expected to be present. The specific noise level along with any applicable correction is referred to as the 'rating level'.
- 2.3.15 The greater the increase between the rating level over the background noise level, the greater the magnitude of the impact. The assessment criteria given by BS4142 are as follows:
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
 - A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.
 - The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
- 2.3.16 Although not stated within BS4142, a difference between the rating level over the background level of -10dB(A) or more is considered to be negligible.

2.3.17 During the daytime, BS4142 requires that noise levels are assessed over 1-hour periods. However, during the night-time, noise levels are required to be assessed over 15-minute periods.

2.3.18 Where the initial estimate of the impact needs to be modified due to context, BS4142 states that all pertinent factors should be taken into consideration, including:

- The absolute level of sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

British Standard 6472 Part 1 - 2008, "Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting (BS6472-1).

2.3.19 Human perception of vibration is extremely sensitive. People can detect and be annoyed by vibration long before there is any risk of structural damage. Cases where damage to a building has been attributed to the effects of vibration alone are extremely rare, even when vibration has been considered to be intolerable by the occupants.

2.3.20 It is not possible to establish exact vibration damage thresholds that may be applied in all situations. The likelihood of vibration induced damage or nuisance will depend upon the nature of the source, the characteristics of the intervening solid and drift geology and the response pattern of the structures around the site. Most of these variables are too complex to quantify accurately and thresholds of damage, or nuisance, are therefore conservative estimates based on a knowledge of engineering.

2.3.21 Where ground vibration is of a relatively continuous nature, there is a greater likelihood of structural damage occurring, compared to transient vibration; for example that caused by transiting vehicles.

2.3.22 With regard to structural response to vibration it is known that actual damage to structures or their finishes due solely to vibration is rare, and that where damage is noted it is often incorrectly ascribed to vibration.

2.3.23 The response of a building to vibration depends upon the type of foundation the building has, the underlying ground conditions, the building construction and the state of repair of the building.

2.3.24 BS6472-1 (2008) provides guidance regarding the significance of VDV values within buildings in terms of human response, as detailed in Table 2.

Table 2: 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 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

*Below these ranges adverse comment is not expected

**Above these ranges adverse comment is very likely

3 NOISE AND VIBRATION SURVEY

3.1.1 On the 20th January 2015, Wardell Armstrong LLP carried out a survey to assess existing noise and vibration levels across the development site.

3.2 Noise

3.2.1 Noise measurements were taken at three monitoring locations; considered to be representative of the proposed sensitive receptors. The monitoring locations are as follows; and are shown on drawing LE12752-001:

- Monitoring Location 1: In the north eastern part of the site adjacent to the north eastern site boundary and St. Marys Road. This location was selected to be representative of proposed dwellings, closest to and with a direct line of sight of St. Marys Road.
- Monitoring Location 2: At the western boundary of the site, in the vicinity of Victoria Plant Hire. This location was selected to be representative of background noise levels at proposed dwellings closest to and with direct line of site of Victoria Plant Hire.
- Monitoring Location 3: Adjacent to the south western boundary closest to the Cressington and Liverpool South Parkway rail line. This location was selected to be representative of proposed dwellings, closest to and with direct line of site of the rail line.

3.2.2 Attended noise monitoring was carried out between 0400 and 1148 hours, on the 20th January 2015.

3.2.3 The noise measurements were made using a Class 1, integrating sound level meter. The sound level meter was mounted vertically on a tripod 1.5m above the ground and more than 3.5 metres from any other reflecting surfaces.

3.2.4 The sound level meter was calibrated to a reference level of 94dB at 1kHz both before, and on completion of, the noise survey. No significant drift in the calibration during the survey was noted.

3.2.5 Weather conditions during the attended survey were as follows:

- Light wind (1-2m/s);
- No precipitation throughout;
- Dry with light frost forming dew from 0730 hours onwards;
- No snow coverage or frozen ground;
- Temperature approximately -1 to +1°C; and
- Overcast.

3.2.6 For the purpose of this assessment daytime hours are taken to be 0700 to 2300 hours and night-time hours to be 2300 to 0700 hours.

3.2.7 The attended noise measurements were taken for a period of 25 minutes to 1 hour during the survey. A-weighted¹ L_{eqs} ² were recorded in accordance with the requirements of BS8233 and WHO guidance. The maximum and minimum sound pressure levels, A-weighted L_{90s} ³ as required by BS4142, and A-weighted L_{10s} ⁴ were also recorded to provide additional information. The measured noise levels are set out in full in Appendix A.

3.2.8 The measured daytime and night time noise levels at Monitoring Location 3 have been adjusted to include scheduled train movements using the methodology contained in the Department of Transport technical memorandum 'Calculation of Railway Noise' 1995 (CRN). The calculation procedure uses a combination of the measured residual noise levels (i.e. noise levels in the absence of trains), the total number of train passes (during the daytime and night-time periods), and a sound exposure level (SEL⁵) of a typical train using the line, to calculate daytime and night time ambient noise levels with all train movements included.

¹ A' Weighting An electronic filter in a sound level meter which mimics the human ear's response to sounds at different frequencies under defined conditions

² L_{eqs} Equivalent continuous noise level; the steady sound pressure which contains an equivalent quantity of sound energy as the time-varying sound pressure levels.

³ L_{90} The noise level which is exceeded for 90% of the measurement period.

⁴ L_{10} The noise level which is exceeded for 10% of the measurement period.

⁵ SEL: The A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted energy as the event.

3.2.9 The Merseyrail Northern Line Train Timetable valid from December 2014 to April 2015 indicates that there are 123 movements of passenger trains along the railway line during the day and 11 movements during the night. During the noise survey, no freight trains were witnessed along the railway line and no existing freight paths are currently listed along this railway line in the Working Timetable. However to be robust the calculations include 10 freight trains during the day and 5 during the night time, to provide a margin of safety for the assessment and ensures the 'worst case scenario' and to account for any potential existing or future freight train movements.

3.2.10 Details of the measurements and calculations carried out to determine the average daytime and night time noise levels are set out in full in Appendix A.

3.2.11 Attended noise monitoring allows observations and detailed notes to be made of the significant noise sources which contribute to each of the measured levels. The observations identified the significant noise sources at the site to be as follows:

Road Traffic: Noise from road traffic along St. Marys Road and the surrounding local road network was audible at all locations throughout the survey. An increase in level of road traffic noise was noted at around 0600 hours.

Industrial Noise: Noise from the operation of plant at Victoria Plant Hire was occasionally audible in the north western area of the site closest to the Victoria Plant Hire Premises.

Rail Movements: Noise from the passage of trains along the rail line between Cressington and Liverpool South Parkway stations was audible at monitoring location 3.

Birdsong: Birdsong was occasionally audible at all locations during the daytime and night-time period.

Other sources: Noise was occasionally audible from overflying aircraft at all locations during the daytime and night-time periods.

3.3 Vibration

- 3.3.1 To establish the levels of ground-borne vibration, generated by the passage of trains, Wardell Armstrong carried out attended measurements on the 20th January 2015.
- 3.3.2 The measurements were taken at monitoring location 3, in the south western part of the site, approximately 10m from the rail line, adjacent to the site boundary, as shown on drawing LE12752/001. This location is considered representative of the nearest proposed residential dwellings to the railway line.
- 3.3.3 Attended monitoring allows observations and detailed notes to be made of the significant sources which contribute to each of the measured levels of vibration.
- 3.3.4 The vibration measurements were taken using a Vibrock V901-2 dual channel vibration recorder version with whole body vibration transducer mounted on a concrete pavement. The vibration level, expressed in terms of the vibration dose value (VDV) and peak particle velocity (PPV), was recorded for hourly periods during the daytime and night-time periods.
- 3.3.5 Vibration monitoring results are detailed in Section 5 of this report in Table 8.

4 NOISE IMPACT ASSESSMENT

4.1 Existing Noise Levels

4.1.1 The measured noise levels at monitoring locations 1 and 3 have been divided into daytime (0700-2300 hours) and night-time (2300-0700 hours) categories to give a single daytime and night-time level for each location. The measured noise levels at monitoring location 1 have also been arithmetically averaged for each time period. The results for each of the monitoring locations are presented in Table 3.

4.1.2 The noise levels at monitoring location 3 have been adjusted to include scheduled train movements using the methodology contained in the Department of Transport technical memorandum 'Calculation of Railway Noise' 1995 (CRN) as described in section 3.2 of this report.

Time	Monitoring Location	Average Measured Noise Level
0700-2300	1	71
2300-0700		68
0700-2300	3	59*
2300-0700		55*

*Noise levels calculated from measured train noise (SEL) and residual noise levels in accordance with CRN.

4.1.3 The maximum noise levels recorded during each night-time period of the survey, at each of the monitoring locations, are summarised in Table 4.

Monitoring Location	Maximum Measured Noise Levels
1	83
3	75

4.2 Assessment of Daytime Noise Levels in Outdoor Living Areas

4.2.1 Table 3 shows that during the daytime, noise levels at the northern part of the development site closest to St. Marys Road are 71dB L_{Aeq} which is above the recommended upper value of 55dB L_{Aeq} , stated in BS8233 and the WHO guidelines, therefore mitigation is required in this area.

4.2.2 Table 3 also shows that during the daytime, noise levels at the southern part of the development site closest to the Cressington to Liverpool South Parkway rail line are 59dB L_{Aeq} which is above the upper WHO guideline value of 55dB L_{Aeq} , therefore mitigation is required in this area.

4.3 Assessment of Daytime Noise Levels in Noise Sensitive Rooms

4.3.1 The daytime noise levels in noise sensitive rooms of the proposed dwellings have been assessed in accordance with the requirements of BS8233. In accordance with BS8233 the acceptable daytime noise level within living rooms and bedrooms is 35 dB L_{Aeq} .

4.3.2 The measured daytime noise levels have been used to determine the noise levels likely at the facades of the properties in the vicinity of the proposed noise sensitive parts of the development.

4.3.3 Monitoring location 1 was situated approximately 7 metres from the St. Marys Road and according to the Sketch Indicative Site Layout (L(02)SK07) provided by Telereal Trillium, the nearest residential façade is approximately 15 metres from the St. Marys Road carriageway.

4.3.4 Before internal noise levels can be calculated, 3dB(A) must be added to the free-field measured levels to allow for the reflection of noise from the proposed housing facades when the buildings are in place.

4.3.5 The internal noise levels for the proposed dwellings have been calculated, using the required glazing schemes to achieve 35dB L_{Aeq} in the noise sensitive rooms.

4.3.6 The calculated noise levels at the façades of the proposed dwellings, together with the level of attenuation required to achieve 35dB L_{Aeq} in the living room and bedroom areas, are summarised in Table 5.

Table 5: Façade Noise Level at Properties in the Vicinity of the Monitoring Locations and Level of Attenuation Required to Achieve the Internal Daytime Noise Limit (Figures in dB(A))		
Properties	Noise Level at the Façade of the Property	Level of Attenuation Needed To Achieve Noise Limit in Living Room Areas
Proposed dwellings in the northern part of the site, nearest to and with direct line of sight of St. Marys Road (Monitoring Location 1).	71*	36
Proposed dwellings in the southern part of the site, nearest to the Cressington to Liverpool South Parkway rail line (Monitoring Location 3).	58*	23

*noise levels have been distance corrected using established procedures in accordance with the sketch indicative layout (L(02)SK07) provided by Telereal Trillium.

- 4.3.7 The facades of the buildings further into the site will be protected by the buildings themselves and/or screened by other buildings and topography. It is considered that the noise levels at these facades, and therefore the level of attenuation the facades would need to provide, to achieve noise limits in accordance with BS8233, will be less than those detailed in Table 5.

4.4 Assessment of Night-time Noise Levels in Bedrooms

- 4.4.1 In accordance with the requirements of BS8233, the acceptable night-time noise levels within bedroom areas is 30 dB L_{Aeq} and individual noise events should not normally exceed 45dB L_{Amax} .
- 4.4.2 The measured night-time noise levels have been used to determine the noise levels likely, at the facades of the properties in the vicinity of the monitoring locations, during the night-time period.
- 4.4.3 Before internal noise levels can be calculated 3dB(A) must be added to the free-field measured levels to allow for the reflection of noise from the proposed housing facades when the buildings are in place.
- 4.4.4 The calculated noise levels at the façades of the dwellings, together with the level of attenuation required to achieve 30dB L_{Aeq} and 45dB L_{Amax} in the bedrooms, are summarised in Table 6.

Table 6: Façade Noise Level at Properties in the Vicinity of the Monitoring Locations and Level of Attenuation Required to Achieve the Internal Night-time Noise Limit (Figures in dB(A))			
Property	Noise Level at the Façade of the Property (L_{Aeq})	Maximum Noise Level at the Façade of the Property (L_{Amax})	Level of Attenuation Needed To Achieve the Noise Limits in Bedrooms
Proposed dwellings in the northern part of the site, nearest to and with direct line of sight of St. Marys Road (Monitoring Location 1).	68*	76	38
Proposed dwellings in the southern part of the site, nearest to the Cressington to Liverpool South Parkway rail line (Monitoring Location 3).	54*	69*	24

*noise levels have been distance corrected using established procedures in accordance with the sketch indicative layout (L(02)SK07) provided by Telereal Trillium.

- 4.4.5 The facades of dwellings facing into the site will be protected by the building itself and/or screened by other buildings. It is considered that the noise levels at these facades and therefore the level of attenuation the facades would need to provide to achieve the 30dB L_{Aeq} and 45dB L_{Amax} in the bedrooms will be less than those detailed in Table 6.

4.5 Industrial Noise Assessment

- 4.5.1 Industrial noise from Victoria Plant Hire was found to be occasionally dominant in the north western part of the site.
- 4.5.2 Therefore an industrial noise assessment has been carried out in accordance with BS4142 to assess the impact of noise from Victoria Plant Hire on proposed sensitive receptors. The main source of noise at Victoria Plant Hire was observed to be JCBs operating in the yard.
- 4.5.3 No noise of an industrial nature was identified prior to 0700 hours i.e during the night time period. Furthermore, after consulting with Victoria Plant Hire it has been confirmed that their opening hours are between 0700 and 1630 hours. It was also noted that during the noise survey on the 20th December 2015 the site opened at 0705 and operations began shortly after.
- 4.5.4 These details are a clear indication that the Victoria Plant Hire premises operates solely during the daytime period and this assumption has been adopted for the purposes of this assessment. Therefore, a night-time BS4142 assessment has not been carried out.

BS4142 assessment of the Victoria Plant Hire premises

Identification of the Specific Noise

- 4.5.5 An assessment of the measured noise level in the vicinity of Victoria Plant Hire, measured between 0730 and 1148 hours has been carried out. It was found that noise from manoeuvring JCBs was occasionally dominant. Only one JCB was observed to be operating at any one time. Noise monitoring equipment was moved to various points along the boundary with Victoria Plant Hire during the survey in order to capture specific noise levels. Using computer software, it has been possible to extract the specific noise level of JCBs from other, ambient noise sources.
- 4.5.6 Due to specific noise measurements being undertaken at a number of different locations, some of which were on an entry road to the existing site, background and residual noise measurements could not be undertaken consecutively or in the exact location of specific noise measurements. Therefore, background noise measurements were undertaken during the quiet daytime period at monitoring location 2 during a period where no noise from Victoria Plant Hire was audible.

- 4.5.7 The highest specific noise level of a JCB was shown to be 65.8dB L_{Aeq} , measured at 3 metres, and this level has been used in the BS4142 assessment.
- 4.5.8 Observations made during the noise monitoring showed that JCBs operated for short periods of time. It seems reasonable to assume that any given JCB typically operates for approximately one third of the total operating time. Therefore 5dB(A) has been subtracted from the specific noise to account for the reduced on-time of JCB operations.

Application of any Acoustic Feature Corrections

- 4.5.9 The specific noise of a JCB operating at Victoria Plant Hire is considered to be intermittent in a manner which is readily distinctive against the residual acoustic environment. Therefore, in accordance with BS4142 a 3dB penalty should be added to the measured noise level for assessment purposes.
- 4.5.10 Furthermore, the specific noise of JCB operations are also considered to be impulsive in nature which is occasionally perceptible against the residual acoustic environment. Subsequently, in accordance with BS4142 a 3dB penalty should be added to the measured noise level for assessment purposes. This brings the total acoustic feature correction to +6dB(A) when assessing the operations at Victoria Plant Hire.

Identification of the Background Noise

- 4.5.11 For the purpose of the assessment the daytime background noise level, of 50dB L_{A90} measured over the periods 1003 to 1042 hours and 1057 to 1128 hours at monitoring location 2, has been used. This is considered typical of the $L_{A90,1hour}$ daytime background noise level in the northern part of the site nearest to the boundary with Victoria Plant Hire.
- 4.5.12 In accordance with BS4142, the noise rating level from Victoria Plant Hire in the vicinity of the closest proposed dwellings in north western part of the site has been compared with the corresponding measured background noise level, as shown in Table 7.

Table 7: BS4142 Assessment of Noise from Victoria Plant Hire at Proposed Dwellings in the North Western Part of the Site– (Figures in dB(A))	
Description	Daytime
Specific Noise i.e. noise level of the operational activities, dB L_{Aeq}	66
On Time Correction, dB	-5
Intermittent Acoustic Feature Correction, dB	+3
Impulsive Acoustic Feature Correction, dB	+3
Rating Level, dB	67
Background Noise Level, dB L_{A90}	50
Excess of rating over background level, dB	+17

4.5.13 The BS4142 assessment indicates that with no mitigation measures, the industrial noise rating level will be +17dB above the existing background noise level. This is likely to be an indication of ‘Significant Adverse Impact’

Assessment Criteria Framework

4.5.14 With regard to ‘adverse impacts’ the NPPF refers to the ‘Noise Policy Statement for England’ (NPSE), which defines three categories of noise impact.

4.5.15 For the purposes of this assessment the Noise Policy Statement for England is used in conjunction with BS4142 to provide a comprehensive characterisation of noise impact while taking in to account the existing noise environment at the proposed development.

4.5.16 The industrial noise impact is classified as follows:

- SOAEL – Significant Observed Adverse Effect Level corresponds to ‘Significant Adverse Impact’ described in BS4142. For this development the SOAEL is defined as a noise impact +10dB above existing background noise level.
- LOAEL – Lowest Observed Adverse Effect Level corresponds to ‘adverse impact’ described in BS4142. For this project the LOAEL is defined as a noise impact +5dB above existing background noise level.
- NOEL – No Observed Effect Level corresponds to a ‘Low Impact’ and for this development is defined as a noise impact at -5dB below the existing background noise level.

- 4.5.17 The result of the BS4142 assessment indicates that with no noise mitigation in place, levels from the Victoria Plant Hire premises are +17dB above the existing background noise level. This shows that the noise impact is above the SOAEL and likely to cause 'significant adverse impact' in the outdoor living areas of the nearest proposed residential dwellings during the daytime.
- 4.5.18 Mitigation measures are therefore required to reduce the noise from the Victoria Plant Hire premises at proposed sensitive receptors.

5 VIBRATION IMPACT ASSESSMENT

5.1 Existing Vibration Levels

5.1.1 The 16 hour daytime and 8 hour night time VDV is calculated automatically by the Vibrock 901-2 seismograph used during this survey.

5.1.2 The vibration levels measured and total vibration dose values at Monitoring Location 3 are summarised in Table 8.

Table 8: Measured Vibration Levels at Vibration Monitoring Location 1 (VDV)			
Time	VDV		
	X	Y	Z
0400-0500	0.023	0.021	0.020
0500-0600	0.023	0.022	0.020
0600-0700	0.023	0.022	0.020
8 Hour VDV (2300-0700)	0.039	0.036	0.034
0700-0800	0.023	0.021	0.020
0800-0900	0.023	0.022	0.020
0900-1000	0.023	0.022	0.021
1000-1100	0.023	0.022	0.020
1100-1107	0.023	0.021	0.020
16 Hour VDV (0700-2300)	0.047	0.044	0.041

5.2 Vibration and Proposed Sensitive Receptors

5.2.1 BS6472-1 (2008) provides guidance regarding the significance of VDV values in terms of human response. The highest 8 hour VDV measured at the site was 0.039 m/s and the highest 16 hour VDV measured was 0.047 m/s. These vibration levels are well below the threshold for low probability of adverse comment in accordance with BS6472-1 (2008), as detailed in Table 2. It should be noted that the VDV within the proposed buildings will depend upon the underlying ground conditions, foundations and final construction details of the building, however due to the low existing vibration levels, significant vibration impacts from train movements along the railway line are not anticipated.

5.2.2 Adverse impacts on residents of the proposed buildings due to vibration from train movements on the Cressington to Liverpool South Parkway rail line are not expected and no vibration mitigation measures will be required.

6 NOISE ATTENUATION SCHEME

6.1 Outdoor Living Areas

- 6.1.1 The measured noise levels, as detailed in Table 3, indicate that existing daytime noise levels in the vicinity of St. Marys Road and the Cressington to Liverpool South Parkway rail line exceed the upper values in BS8233 and WHO guidelines.
- 6.1.2 According to the Sketch Indicative Layout (L(02)Sk07) provided by Telereal Trillium, proposed dwellings in the northern part of the site closest to St. Marys Road have outdoor living areas located on the screened side of dwellings i.e. not located with direct line of sight of St. Marys Road. This should provide sufficient noise mitigation in order to achieve the recommended noise levels within gardens.
- 6.1.3 Mitigation from industrial noise attributed to Victoria Plant Hire is covered in Section 6.5 of this report.
- 6.1.4 To mitigate noise levels in outdoor living spaces closest to the Cressington to Liverpool South Parkway rail line, taking in to account the deep cut-in where the rail line is situated, a 1.5m high close boarded fence with a density of at least 10kg/m² at the south western site boundary between the rail line and proposed dwellings, will provide enough noise attenuation to achieve the recommended noise level within gardens.
- 6.1.5 Mitigation associated with outdoor living spaces will be confirmed during the reserved matters stage.

6.2 Glazing Requirements for Living Rooms and Bedrooms during the Daytime

- 6.2.1 When assessing daytime noise levels in living rooms and bedrooms, the noise attenuation provided by the overall building facade should be considered. To mitigate noise levels, the composition of the building facade can be designed to provide the level of attenuation required. Glazing is generally the building element which attenuates noise the least, so the proportion of glazing in a building facade is an important consideration when assessing overall noise attenuation.
- 6.2.2 In the absence of design details for the building facades, it has been assumed that the glazing to noise sensitive rooms would comprise about 25% of the facade area. To calculate the overall attenuation provided by this percentage of glazing in a brick or block facade, a non-uniform partition calculation can be used.
- 6.2.3 The calculation combines the different degrees of attenuation of the wall element and the window element. A facade element comprising a solid brick or blockwork, will attenuate by 45-50dB (British Standard 8233: "Sound insulation and noise reduction for buildings – Code of practice" 1999) whereas standard double glazing will attenuate road traffic noise by 26-29dB(A) (BRE Digest 379 "Double glazing for heat and sound insulation"). The overall noise attenuation provided by this combination is, therefore, between 32dB(A) and 35dB(A).
- 6.2.4 The noise attenuation requirements for living rooms in properties in different areas of the site are summarised in Table 5. The requirements indicate that slightly enhanced thermal double glazing would ensure that internal noise levels are met with the windows closed at dwellings closest to St. Marys Road.
- 6.2.5 Table 5 also indicates that standard thermal double glazing would ensure that internal noise levels are met with the windows closed at dwellings closest to the Cressington to Liverpool South Park rail line.
- 6.2.6 However, with windows open, the attenuation provided by the façades will be approximately 15dB(A). This would allow the recommended internal noise limit in some living rooms located nearest to, and with a direct line of sight of St. Marys Road and the Cressington to Liverpool South Parkway rail line to be exceeded.
- 6.2.7 On occasions this may be acceptable to the resident, but when quiet conditions are required, the resident should be able to close the windows whilst maintaining adequate ventilation. Some form of acoustic ventilation would therefore need to be installed in some of the living rooms.

- 6.2.8 Alternatively, to meet the required noise levels, sensitive rooms could be located on the screened side of the proposed buildings, away from the main source of noise.
- 6.2.9 Proposed dwellings further into the site will be protected by the buildings themselves and/or screened by other buildings.
- 6.2.10 Glazing requirements can be confirmed, on a plot by plot basis, at the reserved matters stage.

6.3 Glazing Requirements for Bedrooms during the Night Time

- 6.3.1 When assessing night time noise levels in noise sensitive rooms the noise attenuation provided by the overall building facade should be considered in conjunction with both guideline L_{Aeq} and L_{Amax} values.
- 6.3.2 Prediction calculations show that the implementation of enhanced acoustic glazing such as 10/12/6 or equivalent should ensure that recommended guideline internal noise levels are met in bedroom areas across the northern side of the development site, closest to St. Marys Road, with windows closed.
- 6.3.3 The noise attenuation requirements for bedrooms in properties located along the southern site boundary, adjacent to the Cressington to Liverpool South Parkway rail line, standard thermal double glazing would ensure that internal noise levels are met with the windows closed.
- 6.3.4 However, with windows open, the attenuation provided by the façade will be approximately 15dB(A). This may allow the recommended internal noise guideline value to be exceeded in some bedrooms in the northern and southern part of the site.
- 6.3.5 Therefore some form of acoustic ventilation will need to be installed in some noise sensitive rooms nearest to off-site noise sources.
- 6.3.6 The facades of the dwellings further into the site will be protected by the building itself and/or screened by other buildings. It is considered that the noise levels at these facades, will be less than those detailed in Table 6, and it is likely that no specific mitigation will be required.
- 6.3.7 Glazing and ventilation requirements can be confirmed on a plot by plot basis during the reserved matters stage.

6.4 Industrial Noise Attenuation Requirements

- 6.4.1 The noise impact of the Victoria Plant Hire premises on the proposed development is summarised in Table 7. The industrial noise rating level is 17dB above the background noise level within outdoor living areas located closest to the north western edge of the development area, closest to the Victoria Plant Hire premises. Without mitigation this is above the SOAEL and is likely to cause 'significant adverse impact'.
- 6.4.2 To reduce the industrial noise rating level, mitigation measures are required to attenuate noise levels to an acceptable level.
- 6.4.3 The construction of a noise barrier in the form of close boarded fencing at least 2.6 metres high with a density of at least 10kg/m², along the north western site boundary with the Victoria Plant Hire premises, will provide sufficient attenuation of industrial noise, to ensure that noise levels in the central part of outdoor living areas are of an acceptable level.

Table 9: BS4142 Assessment of Noise from Victoria Plant Hire at Proposed Dwellings in the North Western Part of the Site with the Inclusion of Mitigation Measures – (Figures in dB(A))	
Description	Daytime
Specific Noise i.e. noise level of the operational activities, dB L_{Aeq}	66
On Time Correction, dB	-5
Intermittent Acoustic Feature Correction, dB	+3
Impulsive Acoustic Feature Correction, dB	+3
Barrier Correction, dB	-18
Rating Level, dB	49
Background Noise Level, dB L_{A90}	50
Excess of rating over background level, dB	-1

- 6.4.4 The provision of this specific noise barrier is required to ensure that the noise rating level of Victoria Plant Hire is below the existing background noise level in the central part of the outdoor living area at the most exposed dwellings. This barrier will provide an industrial noise impact below the LOAEL criteria described by the NPSE and is classified as 'low impact' in accordance with BS4142. Furthermore this will reduce the noise rating level to below the lower guideline noise level in outdoor living areas of 50dB L_{Aeq}.

7 CONCLUSIONS

- 7.1.1 Wardell Armstrong has carried out a noise and vibration assessment for the proposed residential development located at Cressington House, St. Marys Road, Liverpool.
- 7.1.2 The dominant sources of noise, which will potentially affect the residents of the proposed residential development are road traffic on St. Marys Road and rail noise from the Cressington to Liverpool South Parkway rail line to the south of the site.
- 7.1.3 This report assesses the results of the noise and vibration surveys in accordance with current guidance, the Sketch Indicative Layout (L(02)SK07) provided by Telereal Trillium, and includes recommendations for noise mitigation.
- 7.1.4 The vibration levels are well below the threshold for low probability of adverse comment in accordance with BS6472-1 (2008). It is highly likely that, the vibration impacts from train movements along the Cressington to Liverpool South Parkway rail line will be imperceptible at any location on the site.
- 7.1.5 The results of the noise survey and assessment indicate that to achieve the upper guideline value of $55\text{dB}_{\text{LAeq}}(16\text{ Hour})$ in outdoor living areas, acoustic mitigation would be required for those areas located nearest to, the Cressington to Liverpool South Parkway rail line in the form of 1.5m high close boarded fencing along the south western site boundary.
- 7.1.6 The implementation of the standard thermal insulating glazing should ensure that internal noise levels are met in living rooms and bedroom areas during the daytime across the development with the windows closed.
- 7.1.7 Slightly enhanced acoustic glazing is required to ensure that recommended guideline internal night time noise values are met within bedroom areas across the northern side of the development site, closest to St. Marys Road, with windows closed.
- 7.1.8 Acoustic ventilation would need to be incorporated within bedrooms located nearest to St. Marys Road and the Cressington to Liverpool South Parkway rail line to enable the windows to remain closed whilst allowing necessary ventilation.
- 7.1.9 To protect dwellings closest to the Victoria Plant Hire premises in the north western part of the site from industrial type noise, a 2.6m high close boarded fence is required at the boundary between the development and plant hire premises.
- 7.1.10 The requirement for glazing, acoustic ventilation and mitigation measures can be confirmed, on a plot by plot basis, at the reserved matters stage.

Appendix A
Noise Monitoring Results

Appendix A

Noise Monitoring Results

Monitoring Location 1 – Adjacent to the north eastern site boundary approximately 7m from St. Marys Road						
Time	L_{Aeq} (dB)	L_{A min} (dB)	L_{A max} (dB)	L_{A90} (dB)	L_{A10} (dB)	Comments
20/01/2015 - Night Time						
0505-0529	65.2	42.3	80.2	49.3	68.4	Road traffic noise on St. Marys Road. Low level aircraft noise. Bird noise.
0603-0630	70.0	50.5	82.7	58.1	74.4	Road traffic noise on St. Marys Road. Low level aircraft noise. Bird noise.
20/01/2015 - Daytime						
0702-0728	72.3	57.7	82.7	63.7	75.9	Road traffic noise on St. Marys Road. Occasional distant low level noise from manoeuvring vehicles at Victoria Plant hire. Low level aircraft noise. Bird noise.
0907-0935	70.5	55.1	86.6	63.4	73.4	Road traffic noise on St. Marys Road. Single loud aircraft to east.

Monitoring Location 2 – Adjacent to the north western site boundary and Victoria Plant Hire						
Time	L_{Aeq} (dB)	L_{A min} (dB)	L_{A max} (dB)	L_{A90} (dB)	L_{A10} (dB)	Comments
20/01/2015 - Night Time						
0401-0500	48.8	33.4	65.6	36.0	52.6	Occasional distant road traffic noise from St. Marys Road. Occasional distant train noise to the south. Low level aircraft noise.
20/01/2015 - Daytime						
0730-0735	65.8	62.0	71.5	63.3	67.3	JCB idling, at 3 metres, throughout measurement. Road traffic from St. Marys Road. Low level aircraft noise.
1003-1042	58.2	44.0	78.0	49.9	59.4	Distant road noise from St. Marys Road. Occasional vehicle movements and pedestrian movement on the site. Low level aircraft noise.
1044-1055	66.1	53.9	980.1	58.6	68.9	JCB idling, at 1 metre, throughout the measurement. Road traffic from St. Marys Road. Low level aircraft noise.
1057-1128	57.7	45.9	77.9	51.4	60.1	Distant road noise from St. Marys Road. Occasional vehicle movements and pedestrian movement on the site. Low level aircraft noise.
1129-1148	61.6	52.6	69.9	56.7	64.1	JCB being serviced, at 3 metres, throughout the measurement. Road traffic from St. Marys Road. Low level aircraft noise.

Monitoring Location 3 – Adjacent to the southern site boundary in the vicinity of the Cressington to Liverpool South Parkway rail line.						
Time	L_{Aeq} (dB)	L_{A min} (dB)	L_{A max} (dB)	L_{A90} (dB)	L_{A10} (dB)	Comments
20/01/2015 - Night Time						
0532-0600	52.7	44.0	75.0	46.6	50.5	Distant road traffic to the east. Occasional train movement to the south. Low level aircraft noise. Bird noise.
0633-0700	56.9	48.0	74.4	50.1	57.7	Distant road traffic to the east. Occasional train movement to the south. Low level aircraft noise. Bird noise.
20/01/2015 - Daytime						
0736-0800	56.7	49.9	75.9	51.6	54.9	Distant road traffic to the east. Occasional train movement to the south. Low level aircraft noise. Bird noise.
0939-1000	57.5	45.8	77.0	48.1	55.1	Distant road traffic to the east. Occasional train movement to the south. Occasional airplane noise to the east. Bird noise.

Daytime and Night-time Rail Noise Levels

During the noise survey, rail movements were a dominant source of noise in the southern part of the site (Monitoring Location 3). However, the frequency of train movements varies throughout the day and night, and therefore short period measured levels are not necessarily representative of the entire day or night time periods.

To adjust the measured levels to properly account for train movements throughout the 24 hour period, the following steps are taken: Firstly, remove railway noise from the measured levels (by omitting it from the time history output of the sound level meter) to obtain the 'residual' noise levels. These are set out in Table 1.

Table 1: Summary of Residual Noise Levels Across the Site		
Monitoring Location	Time, h	Residual L_{Aeq} dB
Night-time Measurements		
1	0532-0600	49.1
	0633-0700	54.1
	Night-time Average	51.6
Daytime Measurements		
1	0736-0800	54.4
	0939-1000	53.8
	Daytime Average	54.1

Secondly, the average noise level of all trains using the line must be determined from the measurement data. During the noise survey, train movements at measurement location 3, located 10m from the train line, and the Sound Exposure Levels (SEL) of all trains passing the site were recorded, as summarised in Appendix B.

The third step is to determine the total number of train movements during the daytime and night time. The passenger train movements were counted using the Merseyrail Northern Line Train Times timetable (Hunts Cross or Liverpool – Southport, Lirkby or Ormskirk), valid 14th December 2014 to 4th April 2015. To be robust, the highest number of timetabled daytime and night time movements throughout the week has been used in this assessment.

The total number of train movements passing the site is shown in Table 2:

Table 2: Train Movements Adjacent to the Site	
Time	Number of Train Movements During the Week (Monday-Friday)
0700-2300	Weekday = 123 passenger train movements
2300-0700	Weekday = 11 passenger train movements

For the purpose of this assessment, the highest SEL measured at monitoring location 1, during the daytime and night time has been used in the predictions.

The residual noise levels from measurement location 1 have also been used in the assessment as it is assumed to be representative of levels in the northern part of the site.

The final step is to combine the results of the previous three steps to obtain noise levels which are inclusive of all train movements. Following the prediction methodology set out in CORN (Calculation of Railway Noise, 1995), the daytime and night time noise levels have been determined (including all train movements in Table 2) as shown in Table 3.

Table 3: Calculation of Daytime 16 hour L_{Aeq} and Night-time 8 hour L_{Aeq} at Monitoring Location			
	Passenger/Freight Train noise only (calculated)	Residual noise Taken from Table 1.	Ambient noise including all train movements (calculated)
Monitoring Location			
Daytime $L_{Aeq} = SEL + 10\log(N) - 10\log(T)$ Passenger train SEL = 90.3dB(A) No of Passenger Trains N = 123 Time period T = 16 hours = 57600 seconds	57.2	54.1	59.0
$L_{Aeq} = SEL + 10\log(N) - 10\log(T)$ Assumed freight train SEL = 90.3dB(A) No of Freight Trains, Empty Trains and Depot Movements N = 10 Time period T = 16 hours = 57600 seconds	42.3		
Night-time $L_{Aeq} = SEL + 10\log(N) - 10\log(T)$ Passenger train SEL = 90.3dB(A) No of passenger trains N = 17 Time period T = 8 hours = 28800 seconds	51.6	51.6	54.9
$L_{Aeq} = SEL + 10\log(N) - 10\log(T)$ Assumed freight train SEL = 90.3dB(A) No of Freight Trains, Empty Trains and Depot Movements N = 5 Time period T = 8 hours = 28800 seconds	42.3		

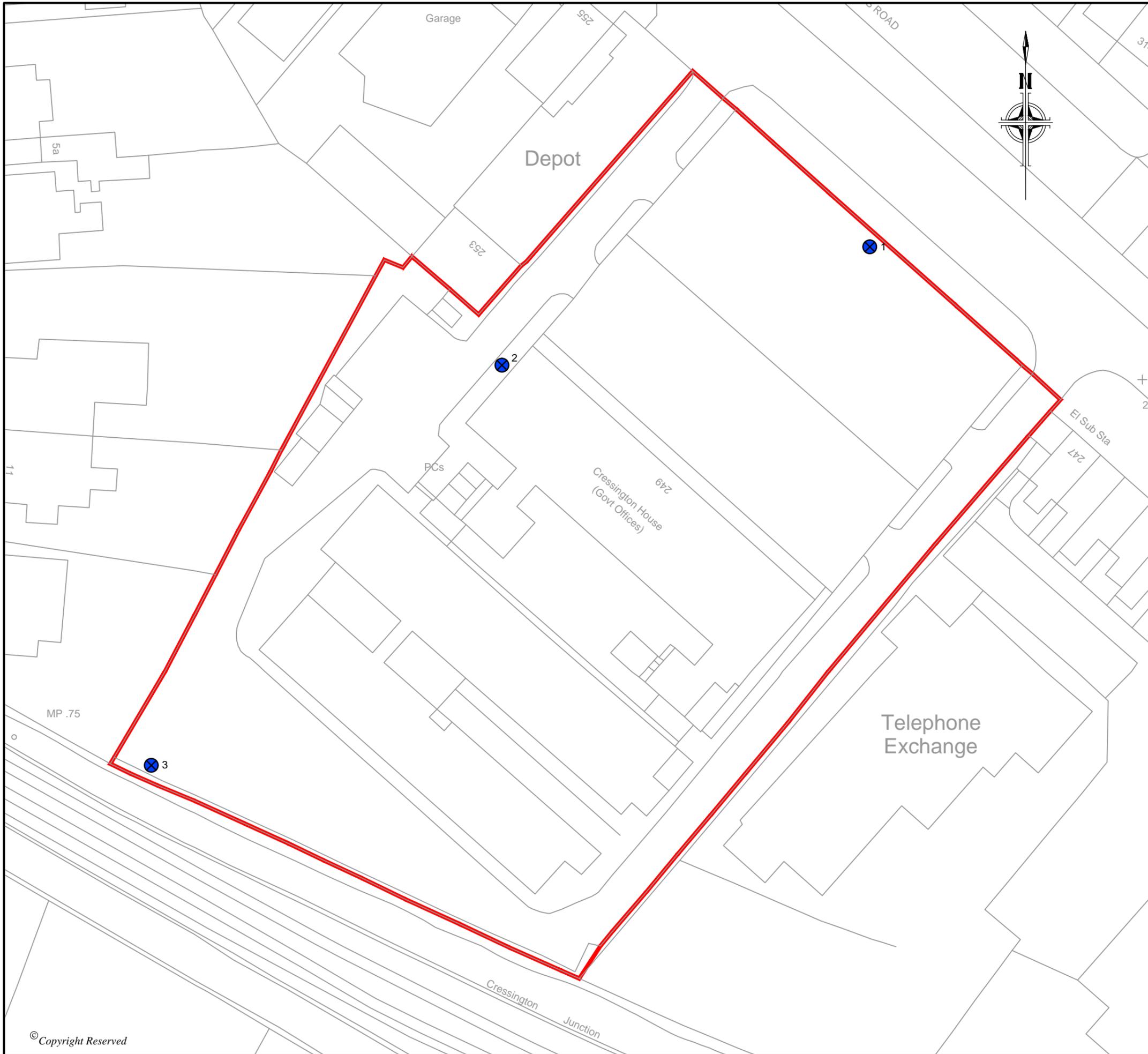
The results of the assessment shows that the daytime and night time noise levels, with all train movements included, predicted in accordance with CORN are higher than the measured average noise levels. Therefore the predicted levels shown in Table 3 will be used in the noise assessment report.

Appendix B
Summary of Train Movements

Appendix B: Summary of Train Movements Measured during the Noise Survey

Measurement Period	Time	Approx. No of Carriages	Type	Direction Travelling	Approx. Speed	Measured SEL
0532-0600	0555	6	Passenger	East	Medium	82.3
0633-0700	0640	3	Passenger	West	Slow	77.3
	0641	4	Passenger	East	Slow	81.8
	0656	6	Passenger	East	Slow	80.4
	0657	6	Passenger	West	Slow	79.0
0736-0800	0741	3	Passenger	West	Slow	82.2
	0756	3	Passenger	West	Slow	80.6
0939-1000	0943	3	Passenger	West	Slow	80.9
	0955	3	Passenger	West	Medium	83.9
	0958	3	Passenger	East	Slow	78.3

Drawing



DO NOT SCALE FROM THIS DRAWING A3

REFERENCE

	SITE BOUNDARY
	NOISE MONITORING LOCATION

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	First Issue	02/02/15	SG	SU	MD

CLIENT
Telereal Trillium

PROJECT
**Cressington House
St Marys Road
Liverpool**

DRAWING TITLE
Noise Monitoring Locations

DRG No. LE12752-001	SCALE 1:500 @ A3	DATE 30/01/15
DRAWN BY JV	CHECKED BY SU	APPROVED BY MD

<input type="checkbox"/> STOKE-ON-TRENT (HEAD OFFICE)	TEL 0845 111 7777	<input type="checkbox"/> CARDIFF	TEL 029 2072 9191
<input type="checkbox"/> NEWCASTLE UPON TYNE	TEL 0191 232 0943	<input checked="" type="checkbox"/> LEIGH	TEL 01942 260101
<input type="checkbox"/> WEST BROMWICH	TEL 0121 580 0909	<input type="checkbox"/> SHEFFIELD	TEL 0114 245 6244
<input type="checkbox"/> LONDON	TEL 020 7287 2872	<input type="checkbox"/> EDINBURGH	TEL 0131 555 3311
		<input type="checkbox"/> TAUNTON	TEL 01823 703100



STOKE-ON-TRENT
Sir Henry Doulton House
Forge Lane
Etruria
Stoke-on-Trent
ST1 5BD
Tel: +44 (0)845 111 7777

CARDIFF
22 Windsor Place
Cardiff
CF10 3BY
Tel: +44 (0)29 2072 9191

EDINBURGH
Suite 2/3, Great Michael House
14 Links Place
Edinburgh
EH6 7EZ
Tel: +44 (0)131 555 3311

GREATER MANCHESTER
2 The Avenue
Leigh
Greater Manchester
WN7 1ES
Tel: +44 (0)1942 260101

LONDON
Sutherland House
5-6 Argyll Street
London
W1F 7TE
Tel: +44 (0)20 7287 2872

NEWCASTLE UPON TYNE
City Quadrant
11 Waterloo Square
Newcastle upon Tyne
NE1 4DP
Tel: +44 (0)191 232 0943

PENRYN
Tremough Innovation Centre
Tremough Campus
Penryn
Cornwall
TR10 9TA
Tel: +44 (0)1872 560738

SHEFFIELD
Unit 5
Newton Business Centre
Newton Chambers Road
Thorncliffe Park
Chapelton
Sheffield
S35 2PH
Tel: +44 (0)114 245 6244

TRURO
Wheal Jane
Baldhu
Truro
Cornwall
TR3 6EH
Tel: +44 (0)1872 560738

WEST BROMWICH
Thynne Court
Thynne Street
West Bromwich
West Midlands
B70 6PH
Tel: +44 (0)121 580 0909

International offices:

ALMATY
29/6 Satpaev Avenue
Rahat Palace Hotel
Office Tower
9th floor
Almaty
Kazakhstan
050040
Tel : +7-727-3341310

MOSCOW
Suite 2, Block 10,
Letnikovskaya St.
Moscow, Russia
115114
Tel: +7(495) 980 07 67

Wardell Armstrong Archaeology:

CUMBRIA
Cocklakes Yard
Carlisle
Cumbria
CA4 0BQ
Tel: +44 (0)1228 564820

your earth our world

