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# Application by Suffolk County Council for an Order Granting Development Consent for the Lake Lothing Third Crossing (Lowestoft)

## Development Consent Order 201(…)

## Planning Inspectorate Reference TR010023

**Acoustic Supporting Evidence on behalf of Northumbrian Water Limited**

On behalf of **Northumbrian Water Limited**

Project Ref: 42498/3002 | Date: January 2019

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## Document Control Sheet

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**Project Ref:** **42498/3002**

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| **For and on behalf of Peter Brett Associates LLP** | | | | |

| Revision | Date | Description | Prepared | Reviewed | Approved |
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This report has been prepared by Peter Brett Associates LLP ('PBA') on behalf of its client to whom this report is addressed ('Client') in connection with the project described in this report and takes into account the Client's particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

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# 1 Introduction

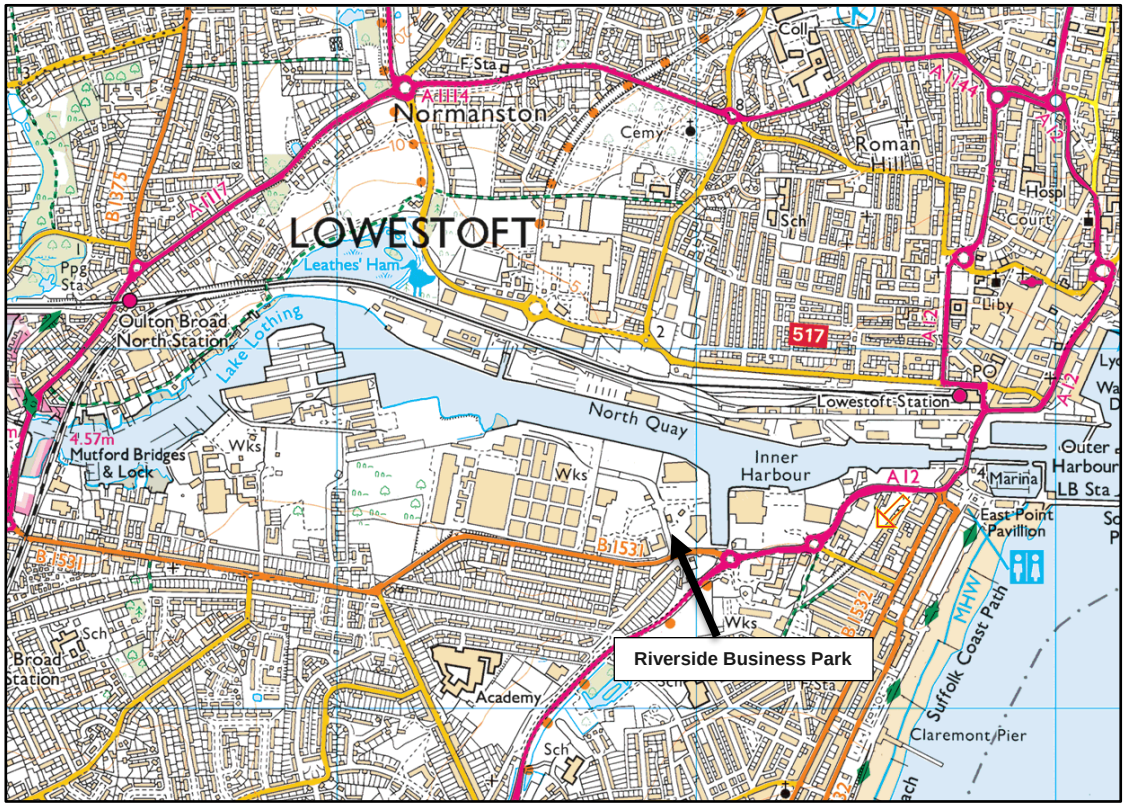
## 1.1 Introduction and Background

1.1.1 This report has been prepared by Peter Brett Associates ("PBA", now part of Stantec) on behalf of Northumbrian Water Limited ("NWL") who trade locally as Essex & Suffolk Water. It follows a review of the application by Suffolk County Council ("SCC") for an Order granting Development Consent for the proposed new bridge crossing over Lake Lothing, Lowestoft (Planning Inspectorate Reference TR010023) (Lake Lothing Third Crossing, the "Scheme").

1.1.2 In view of the nature of the Scheme, which is considered to be "nationally significant", the Scheme proposals are the subject to a Development Consent Order (DCO) application to provide the necessary Planning and Compulsory Acquisition powers to construct and maintain the Scheme.

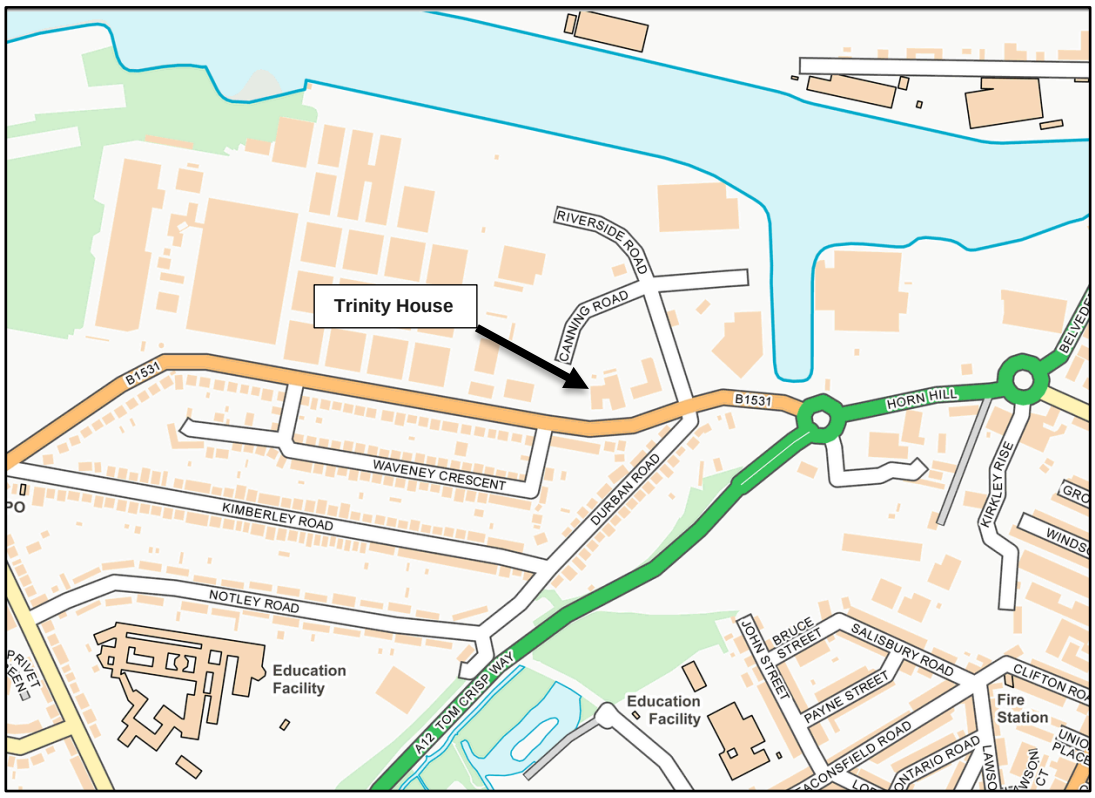
1.1.3 Essex & Suffolk Water has a call centre, Trinity House, located south of Lake Lothing on land adjacent to the proposed bridge approach road (Riverside Business Park). The location of Riverside Business Park is shown on **Figure 1**. NWL is the freehold owner of Trinity House (and the associated land) (registered under Title number SK347381). The location of Trinity House is shown on **Figure 2**.

Figure 1 – Wider Location Plan




1.1.4 Existing access to the Riverside Business Park, including Trinity House, is via Riverside Road and Canning Road, as shown on Figure 2. Riverside Road is within the footprint of the proposed bridge's elevated approach and therefore access will no longer be possible via Riverside Road and a replacement access will be required.

Figure 2 – Road network around Riverside Business Park




1.1.5 NWL has always been supportive of the principles of the Scheme, which will relieve traffic congestion and assist the development and regeneration of Lowestoft. However, it is essential to NWL that a series of issues are clarified and resolved in relation to NWL's land interests and operational activities at Trinity House both during construction and operation.

## 1.2 Purpose of this Report

1.2.1 PBA have been commissioned by NWL to advise on the possible noise and vibration effects of the Scheme on the operation of Trinity House.

1.2.2 This report has been produced to identify the likely impact of the proposed development on the operations at Trinity House.

1.2.3 A noise level survey has been carried out by PBA to ascertain the existing external and internal noise levels around Trinity House. The details of the survey are contained in **Appendix B**.

1.2.4 PBA have carefully reviewed the DCO application documents. The review scope was as follows:

- Review of the potential noise and vibration impacts of the works during construction on Trinity House;
- Review of the potential noise and vibration operational impacts on the immediate area around Trinity House; and
- Review of any other material that is considered relevant to Trinity House operational activities.

## 1.3 Structure of this Report

1.3.1 The structure of this report is as follows:

- a summary of NWL's operations at the Trinity House Call Centre in terms of acoustics;
- a summary of the Scheme proposals as they pertain to noise and vibration;
- the identified issues with the Scheme that might affect Trinity House, separated under construction phase, general highway design arrangements, operational phase, and on-street car parking; and
- summary and conclusions.

## 1.4 Acoustic Terminology

1.4.1 A glossary of acoustic terminology used within this report is contained within **Appendix A**.

# 2 NWL Trinity House Call Centre

## 2.1 Introduction

2.1.1 This section provides a summary of the existing operations at Trinity House as they pertain to acoustics.

2.1.2 This provides a context for the review of the DCO application documents, and how the Scheme might affect the important operations at Trinity House.

## 2.2 Call Centre Operations

### Operating Times and Employee Numbers

2.2.1 Trinity House is a strategic operational site comprising a purpose-built call centre (for both the Northumbrian and Essex and Suffolk operating regions of NWL).

2.2.2 The call centre operates between 7:30am and 8:00pm Monday to Friday, and 8:00am to 5:00pm Saturdays. Currently there are over 240 employees based at the call centre working in shift systems in a building with capacity for up to 263 employees. This comprises a mixture of full and part-time as well as temporary personnel.

2.2.3 In addition to the existing capacity, NWL have confirmed to us that their longer term plans include constructing a new wing to the building which will further increase the number of staff employed at the Call Centre.

## 2.3 Internal Acoustic Environment

### The Importance of an Appropriate Acoustic Environment

2.3.1 Trinity House was specifically designed as a call centre. Call centres are spaces which require an appropriate acoustic environment in order to function optimally. Workers within a call centre generally require an environment which has a sufficiently high background sound level to mask intruding speech but not so high as to result in communication issues, whether between workers or via the use of headsets. A combination of appropriate external building fabric (to control noise ingress), specification of building services (to control internal noise levels) and absorption (to control reverberation) is required to ensure the space is acoustically fit for purpose. Shortfalls in any of the above areas can lead to an unacceptable acoustic environment which can have consequences on a wide number of non-acoustic and acoustic factors including:

- Staff health and wellbeing;
- Efficiency of service; and
- Quality of service.

### Internal Ambient Noise Level Criteria

2.3.2 There is no specific guidance with respect to the acoustic environment within a call centre. However, BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’ details criteria associated with office spaces. Additional guidance is included in the British Council of Offices Guide to Specifications Chapter 8: Acoustics. In both cases the criteria relate to unoccupied office spaces and therefore do not include contributions from office workers.

2.3.3 We have undertaken a review of a number guidance documents with respect to office developments. **Table 2.1** summarises the typical internal ambient noise levels:

Table 2.1: Summary of Internal Noise Level Criteria

| Reference Document | Office Area Type | |
|---|---|---|
| | Small/Cellular | Large/Open-Plan |
| BCO 2009 | NR35 $L_{eq}$ | Open Plan NR40 $L_{eq}$ |
| BS8233: 2014 | 35-40 dBA $L_{eq,T}$ (NR30-45 $L_{eq}$) | 45-50 dBA $L_{eq,T}$ (NR40-45 $L_{eq}$) |

NB: NR ≈ dBA – 6

2.3.4 In addition, with reference to BCO guidance, $L_{Amax(fast)}$ noise ingress levels should not normally exceed 55 dBA in open plan/speculative offices or 50 dBA in cellular offices.

2.3.5 Based on the above criteria, and taking into account the requirement for an improved acoustic environment over and above the usual requirements for an office it would be typical to specify an internal ambient noise level criteria (related to anonymous traffic noise) of 35-40 dB $L_{Aeq,T}$. with $L_{Amax(fast)}$ noise ingress levels controlled so as to not exceed 50 dBA.

## Internal Ambient Noise Levels (Trinity House)

2.3.6 PBA have undertaken a detailed sound survey within Trinity House. Full details of the sound survey are detailed in **Appendix B**. **Table 2.2** details the results of the internal ambient noise level survey.

Table 2.2: Summary of Internal Ambient Noise Levels

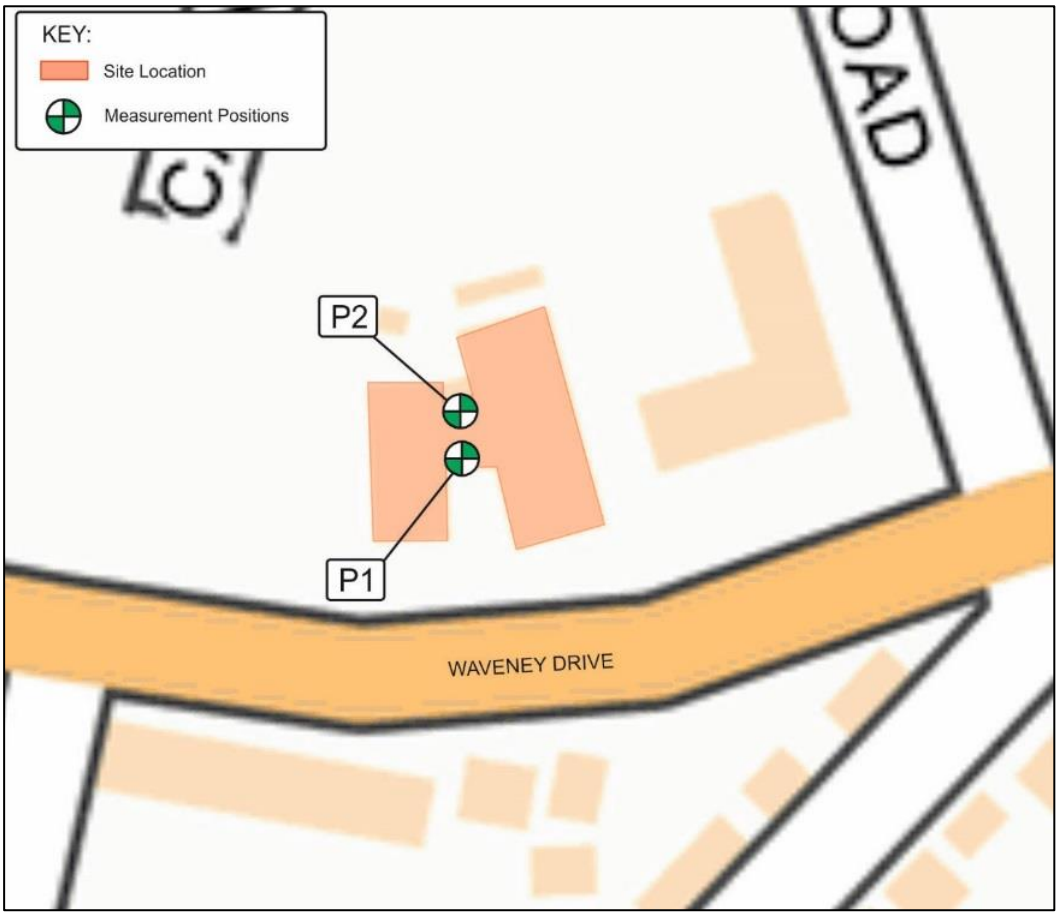
| Description | Representative Internal Reverberant Sound Pressure Level (dB $L_{Aeq,T}$) |
|---|---|
| General Call Centre Activity | 51 |
| Call Centre with No Activity | 33 |

2.3.7 It should be noted that the noise level measurements within the call centre when there was no activity were undertaken in the evening when no staff were present. Analysis of the measured external noise levels suggest that internal noise levels during the typical working day are around 1-2 dB higher than those measured internally during the evening. Actual internal ambient noise levels are therefore likely to be in the region of 35 dB $L_{Aeq,T}$ during a typical working day, in-line with criteria typically proposed for a call centre.

## External Ambient Noise Levels (Trinity House)

2.3.8 PBA have undertaken a detailed external sound survey at Trinity House. Full details of the sound survey are detailed in **Appendix B**. Measurements were undertaken at two locations at the site, selected to be representative of the front-facing and rear-facing façade of Trinity House. The locations of the measurement positions are indicated in **Figure 3**.

Figure 3 - Unmanned Environmental Sound Survey Locations (Image Contains Ordnance Survey © Crown Copyright and Database Right 2018)




2.3.9 **Table 2.3** details the results of the external ambient noise level survey.

Table 2.3: Summary of External Ambient Noise Levels

| Location | Representative External Free-Field Sound Pressure Level (dB $L_{Aeq,T}$) |
|---|---|
| P1 Waveney Road Façade | 61 |
| P2 Rear Façades | 57 |

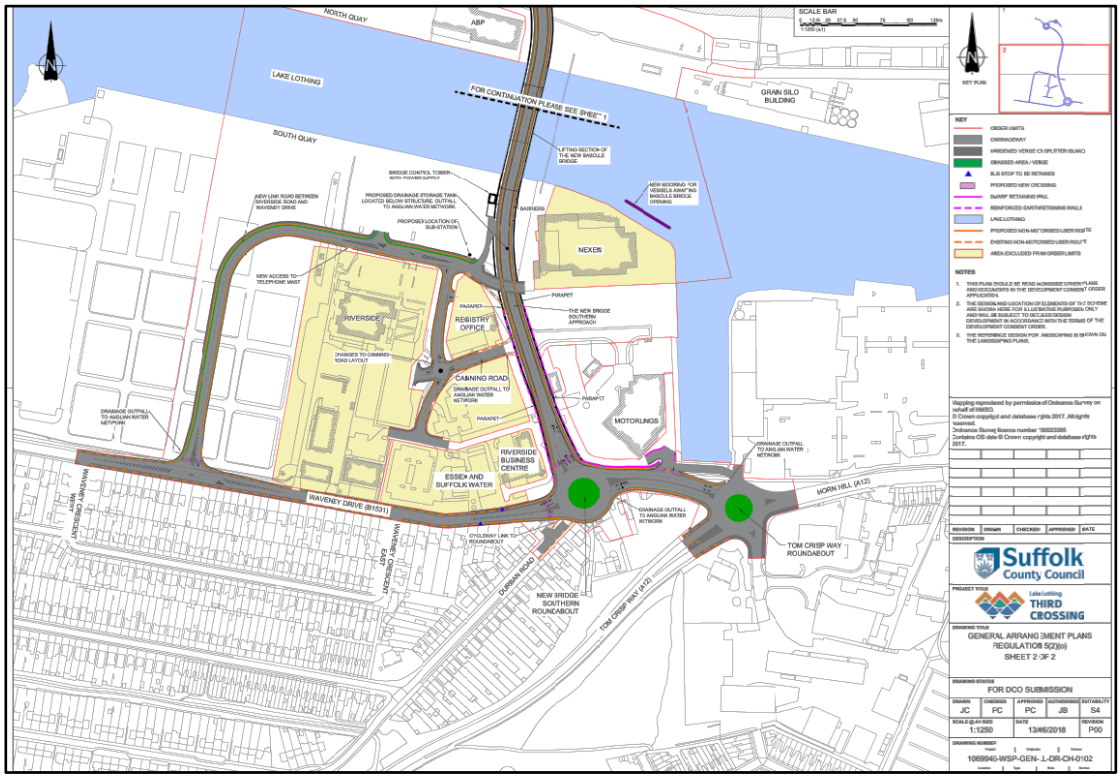
# 3 Scheme Proposals

3.1.1 The proposed Scheme involves the construction, operation and maintenance of a new third highway crossing (bascule bridge – an opening bridge with a counterweight that balances the span as it opens) linking the areas to the north and south of Lake Lothing in Lowestoft.

3.1.2 The objectives of the Scheme are to, inter alia, reduce congestion and delay on the existing bridges over Lake Lothing, improve accessibility, reduce community severance, reduce collisions, encourage more sustainable forms of travel, open up opportunities for regeneration and development, and provide the capacity needed to accommodate planned growth.

3.1.3 The illustrative General Arrangement Plan (Sheet 2 of 2) of the proposed highway layout on the southern side is reproduced below in **Figure 4** for ease of reference.

Figure 4 – General Arrangement Plan (Sheet 2 of 2)



# 4 Review of DCO Application Documents

## 4.1 Introduction

4.1.1 PBA have carefully reviewed the DCO application documents and identified issues where investigation is required. The following section details the findings of our review and identifies the issues pertinent to both the assessment of the impact of the scheme as a whole and the effect on the Trinity House in particular in both construction and operational phases.

## 4.2 Scoping Report

4.2.1 It was recognised in the noise and vibration section of the Scoping Report that significant noise and vibration effects were likely to occur during the construction phase of the Scheme (para 4.7.1).

4.2.2 The Scoping Report identifies potentially sensitive receptors on the basis of whether they are classed as 'Dwellings' or 'Other Receptors' (para 4.7.11), but does not identify the location of the receptors, nor does it identify the type of receptors falling within the 'Other Receptors'. It is therefore not clear from the Scoping Report whether Trinity House has been treated as a noise sensitive receptor however paragraph 4.7.10 states that *"Sensitive receptors as defined in HD213/11 include dwellings, hospitals, schools, community facilities and designated areas"*.

4.2.3 DMRB HD213/11 provides methodology to assess operational noise but refers to other documents including BS 5228 for construction noise. It is important to note that DMRB HD213/11 does not identify what constitutes a noise or vibration sensitive receptor, nor does it include an exhaustive list of examples of receptors. Responsibility is placed on the applicant to identify sensitive receptors likely to be affected by a scheme.

4.2.4 It should also be noted that the classification of magnitude of noise or vibration impacts contained within DMRB HD213/11 are not specifically applicable to a single type of sensitive receptor (e.g. residential). The guidance can therefore also be drawn upon in assessing impacts at non-residential receptors.

4.2.5 It is therefore the case that as at the stage of Scoping, it is not clear whether SCC has treated Trinity House as a sensitive receptor.

## 4.3 Environmental Statement

4.3.1 Paragraph 13.1.7 of the ES highlighted the general approach adopted for the noise and vibration assessment which included:

- Identification of noise & vibration sensitive receptors in the vicinity of those locations where noise or vibration, or a change in noise or vibration, is likely to be generated as part of the scheme;
- Calculation of the levels of noise or vibration, or the change in noise or vibration levels, that will be experienced at those identified noise sensitive receptors, evaluating the significance of these calculated levels;
- Identification and assessment of potential mitigation measures where potentially significant noise or vibration effects are predicted to occur and more generally to improve or enhance the noise and vibration climate wherever possible.

4.3.2 It is considered that the ES does not fulfil the above as it does not consider the potential impact on Trinity House, which is a sensitive receptor, and fails to include key information as detailed below.

### Identification of Noise Sensitive Receptors

4.3.3 Based on the DCO application documents, it is not clear whether Trinity House has been treated as a sensitive receptor.

4.3.4 Note 41 of the ES states that *"offices have not been included within the operational noise or vibration assessment as they are not considered a sensitive receptor in the DMRB HD213/11."* In the absence of additional information it must be assumed that Trinity House has been treated as an 'office' and has therefore not been identified as a sensitive receptor or assessed in the ES.

4.3.5 As explained in paragraph 4.2.3 and 4.2.4 of this report, DMRB HD213/11 does not identify what constitutes a noise or vibration sensitive receptor, nor does it include an exhaustive list of examples of receptors. It is left to the professional judgment of the assessor to identify those receptors which should be treated as sensitive. In this instance, it is our firm view that given the sensitivity of Trinity House to noise it should be treated as a noise sensitive receptor.

4.3.6 Table 13-12 of the ES and the accompanying note (43) does identify Trinity House as a noise sensitive receptor in respect of the construction of the scheme. No explanation is given as to why Trinity House is sensitive with respect to construction works, but not operational impacts. This does not appear to be logical.

4.3.7 The effect of the Applicant's approach is that no assessment has been undertaken of the potential operational noise and vibration effects of the scheme on Trinity House.

### Operational and Construction Traffic Data and Noise Model Parameters

*Traffic Data*

4.3.8 The assessment of the likely noise and vibration impact associated with a proposed road scheme is based primarily on AAWT 18-hour traffic data (for both operational and construction assessments). It is important that appropriate traffic data is used to screen areas where potential impacts have been identified and to assess impacts on sensitive receptors.

4.3.9 Whilst references to traffic data are included within Chapter 13 of the ES (e.g. paragraphs 13.3.46, 13.3.49 – 13.3.51) the actual AAWT 18-hour traffic data is not presented in the ES. As such it is not possible to verify the findings of the ES with respect to the predicted operational and construction traffic impacts.

*Presentation of Results*

4.3.10 The results of the operational noise assessment are provided as a count of the number of *'dwellings'* and *'other sensitive receptors'* exceeding certain identified criteria. Without interrogating the noise maps it is not possible to identify the level of impact at a given receptor. For reports of this nature it would be expected that the impact at each receptor would be identified in a table or similar format.

### Assessment of Operational Noise Associated with the Bridge

4.3.11 Moveable steel bridges have the potential to be a source of noise and vibration, both during operation of the bridge (i.e. raising and lowering) and from traffic passing over the bridge (Noise nuisance caused by movable bridges, C.C. Tollenaar and D.F. de Graaf, Euronoise 2015). The ES contains no assessment of the potential noise and vibration impact associated with the operation of the bridge.

### Construction Effects

4.3.12 Paragraph 13.5.18 of the ES states that the predicted worst case noise levels at Trinity House associated with construction works are likely to be '*around the LOAEL*'. In this instance that corresponds to a noise level of around 70 dB $L_{Aeq,T}$.

4.3.13 It is not clear how noise levels associated with construction are considered to be '*around the LOAEL*' as the predicted level at Reference C is 77 dB $L_{Aeq,T}$, 7 dB above the LOAEL threshold identified in Table 13-13.

4.3.14 This suggests that construction impacts at Trinity House have not been correctly calculated or interpreted.

4.3.15 Based on the information provided it is not possible to verify the calculations and assessment of impact detailed within the ES due to lack of information on plant locations.

# 5 Assessment of the Potential Impact on Trinity House

## 5.1 Introduction

5.1.1 Section 4 highlights the areas of concern in the documentation submitted to support the DCO.

5.1.2 We have undertaken a preliminary assessment of the potential impact of the operation of the proposed development on the existing and future operations at Trinity House based on the information available in the ES and on further surveys undertaken by PBA.

5.1.3 The results of the preliminary assessment are detailed as follows.

## 5.2 Operational Effects

5.2.1 As the ES does not identify Trinity House as a noise sensitive receptor with respect to operational effects no assessment has been undertaken of operational noise impacts on Trinity House in the ES. However, analysis of the noise maps (Figures 13.3 and 13.4) suggest the changes in noise levels at Trinity House as a result of the scheme. Notwithstanding the lack of verifiable traffic data, **Table 4.1** below details the calculated change in noise level (with reference to the Figures included in the ES) and the associated impact with reference to criteria detailed within the ES.

Table 4.1: Operational Impact at Trinity House

| Description | Change in Noise Level ($L_{A10,18hour}$) | |
|---|---|---|
| | Waveney Road Façade | Rear Facade |
| Short Term 2022 DM vs 2022 DS | +1.0 dB to +2.9 dB<br>Minor Impact | +5 dB<br>Major Impact |
| Long Term 2022 DM vs 2037 DS | +3.0 dB to +4.9 dB<br>Minor Impact | +5 dB to +9.9 dB<br>Moderate Impact |

5.2.2 Baseline environmental measurements have been undertaken as part of the ES. Position C (reference Figure 13.1) is considered to be the most representative of Trinity House.

5.2.3 The results of the baseline monitoring detailed in Appendix 13A of the ES suggest that noise levels in the vicinity of Trinity House are around 62 dB $L_{Aeq,T}$ during the daytime period (07:00 – 19:00). The measurement locations within the ES were not taken adjacent to Trinity House and therefore it is not possible to make a direct comparison with sound levels measured by PBA at Trinity House. However, based on the closest measured locations it is considered that the sound levels are slightly higher than those detailed in Section 4 of the PBA's Environmental Sound Survey Report in Appendix B. The additional surveys undertaken by PBA support those undertaken by the applicant with the results broadly in line with each other.

5.2.4 The measured and calculated ambient internal noise levels based on the information detailed in the ES and additional measurements undertaken by PBA are detailed in **Table 4.2**.

Table 4.2: Internal Ambient Noise Levels at Trinity House

| Description | Internal Ambient Noise Levels ($L_{Aeq,12hour}$) | |
|---|---|---|
| | Waveney Road Façade | Rear Facade |
| Measured Sound Levels | 35 dB | 35 dB |
| Calculated Short Term 2022 DM vs 2022 DS | 36 dB to 38 dB | 40 dB |
| Calculated Long Term 2022 DM vs 2037 DS | 38 dB to 40 dB | 40 dB to 45 dB |

5.2.5 The results of the assessment suggest that internal noise levels following completion of the scheme are likely to exceed industry standard guidance levels (including BCO guidance and BS 8233 as detailed in section 2.3.5 of this report) within Trinity House. Given the sensitivity of the building to noise this may result in issues with speech intelligibility, particularly if call centre operatives raise their voices to compensate, resulting in increased activity noise levels. This may have consequential effects, such as a requirement for improved communication equipment to address this issue or additional mitigation in the form of uprated glazing/cladding.

5.2.6 Based on the above assessment it is considered that the potential noise impact on the call centre has not been appropriately assessed and information has not been presented in a transparent manner to allow it to be interrogated by third parties. To remedy the deficiencies in the ES, the applicant should update the assessment to include full details of traffic data and a full assessment of the potential operational noise impacts on Trinity House.

# 6 Response to Suffolk County Council's Comments

## 6.1 EN35

### NWL Representation

6.1.1 What mitigation measures have been recommended to protect Trinity House and how these will be secured (particularly given the lack of detail in the Interim Code of Construction Practice);

### Applicant Response

6.1.2 The Interim CoCP sets out the range of measures that will be included in the full CoCP to control and limit unacceptable noise and vibration. Chapter 6 of the interim CoCP sets out the full range of measures required, including communication measures, monitoring, and practical steps to be taken. The Applicant is liaising with NWL to understand what measures it considers are necessary, given its existing internal noise environment.

6.1.3 The Applicant notes the process by which the CoCP will be finalised has been agreed with WDC/SCC, and further that the Applicant has agreed with SCC/WDC to seek consent under S61 of the Control of Pollution Act at the relevant time.

### PBA Response

6.1.4 Mitigation measures have not yet been proposed to protect Trinity House due to the lack of available construction information and there are concerns with respect to the adequacy of the assessment detailed in the ES. Early and effective liaison between the Application and NWL will be essential to ensure that operations at Trinity House are adequately protected from noise and vibration associated with the Scheme.

6.1.5 PBA have carried out sound level measurements around Trinity House that quantify the existing noise climate. Appropriate noise levels should be set and secured through the CoCP. It would be prudent for NWL or their representatives to have prior involvement in the development of any related Section 61 consent, which will allow for the safeguarding NWL's interests in the context of Trinity House.

## 6.2 EN36

### NWL Representation

6.2.1 Assumptions made in relation to operational road traffic noise (for flows < 1000 veh/18-hour).

### Applicant Response

6.2.2 CRTN criteria screens out road links where flow is modelled to be less than 1,000 vehicles in an 18-hour period. This is due to calculations based upon this level of flow being unreliable. The traffic model has excluded Riverside Road from the assessment in the do minimum scenario due to low flow but has included the Scheme. Noise levels at NWL in the model will therefore be influenced mainly by Waveney Drive in the do minimum scenario and excluding Riverside Road to provide a worst-case assessment.

### PBA Response

6.2.3 There is no CRTN criteria that screens out road links where flows are modelled to be less than 1,000 vehicles in an 18-hour period. Granted, as part of the assumptions when implementing the noise assessment, one of the assumptions could be to disregard flows less than 1000 vehicles/18hour, but CRTN does not say that this should or should not be done.

6.2.4 Notwithstanding the above, the lack of available traffic data means that it is difficult to verify that if flows less than 1000 vehicles/18 hour have been considered in the 'Do Minimum' scenario (i.e. without development), they haven't automatically been disregarded in the 'Do Something' scenario (i.e. with development) (if greater than 1000 vehicles/18 hour). This could lead to an underestimation of the DS scenario sound levels.

6.2.5 The AAWT 18-hour traffic data on which the assessments detailed in the ES are based should be made available.

## 6.3 EN37

### NWL Representation

6.3.1 Reasons for variations in assessment data (such as duration of short term measurements, lack of consistent data collection at all points).

### Applicant Response

6.3.2 Different data collection periods have been used to account for locations of attended and unattended monitoring. The noise monitoring that was undertaken was agreed with SCC and WDC in advance of it being undertaken (see Paragraph 13.4.2 of the ES (document reference 6.1 / PINS document reference APP136) and the Applicant considers it to be fit for purpose and representative of the noise sensitive receptors closest to the Scheme.

### PBA Response

6.3.3 In comparing the noise levels measured at position C as described in Table 13-12 of the ES with those measured in a similar position by PBA, there appears to be a good correlation between the data sets and so have no further concerns with respect to this point.

## 6.4 EN38

### WDC and SCC Representation

6.4.1 The Local Authorities should continue working with the applicant and contractors on the development of the Interim/Final Code of Construction Practice into a completed document. In particular, the Council concurs with the points raised by SRL Technical Services Limited in their communication dated 5th September 2018, including:

- The need for additional baseline noise monitoring
- The requirement for prediction and assessment of noise from the construction phase, including careful comparison of predicted noise against existing ambient noise levels;
- Consideration and assessment of construction activities against eligibility thresholds for noise insulation in accordance with BS5228; and
- Identification and assessment of any other sources of noise that will be associated with the operational phase, including alarms.

6.4.2 The details of the Code of Construction Practice (such as existing ambient noise levels; Threshold Noise limits; working hours; assessment of air quality impacts from construction HGVs; etc) cannot be agreed until definitive details of the project are known and the final Code of Construction Practice is in development. We do not rule out the possibility that Control of Pollution Act 1974 s61 applications (prior consent for work on construction sites) would be required for any of the works.

6.4.3 This approach avoids prematurely committing the scheme to detailed controls based on the current level of available detail.

**Applicant Response**

6.4.4 The extent of baseline monitoring for the purposes of the ES was previously agreed with the local authorities.

6.4.5 The need for additional baseline noise monitoring is not considered to be necessary to inform the assessment of significance that is presented in the ES, particularly given the range of mitigation measures presented in the Interim CoCP. The control of noise pollution through Section 61 of the Control of Pollution Act 1974 will also allow WDC to approve the hours of works and provide the Council with a further element of control.

6.4.6 A separate assessment of construction noise based upon SCC and WDC request to use BS5228 is being undertaken and will be discussed with those parties with the aim of reaching agreement on this matter. The parties are however agreed consent would be sought under s61 of the Control of Pollution Act 1974, and thus noise and vibration mitigation measures can be finalised at this stage of the process when final details of construction methodologies are known.

6.4.7 It has been agreed with WDC and SCC, as outlined in the SoCG, that the Code of Construction Practice is an appropriate tool to control the construction phase of the Scheme and that final details of any monitoring and mitigation measures that are agreed to be necessary will be incorporated into the final Code of Construction Practice, as is provided for in the text of Chapter 6 of the Interim CoCP.

6.4.8 An assessment of the likely noise arising from any traffic signals on the Scheme Bascule Bridge is presently ongoing, although it is not considered likely to result in a significant effect.

6.4.9 This matter has been agreed with SCC/WDC in the SoCG.

**PBA Response**

6.4.10 It is agreed that the Code of Construction Practice is an appropriate tool to control noise and vibration associated with the construction phase of the scheme and that a Section 61 application should be made. As the surveys undertaken by PBA are broadly in line with the results of the surveys undertaken by the applicant at Position C further baseline surveys are not considered necessary (with respect to the potential impact on Trinity House).

6.4.11 It is agreed that construction calculations should be undertaken to assess the impact at receptors including Trinity House. The assessment should have regard to threshold criteria outlined in BS 5228-1:2009+A1:2014.

6.4.12 It is essential that NWL and the potential effects on Trinity House are adequately considered in this process, and that appropriate mitigation and the means by which it will be secured are identified.

6.4.13 As discussed previously an assessment of operational noise associated with the moveable steel bridges, both during operation of the bridge (i.e. raising and lowering) and from traffic passing over the bridge has not been considered and should be undertaken.

## 6.5 EN39

### WDC and SCC Representation

6.5.1 Amend the recommendation by adding an additional paragraph for Noise to read:

10) If planning permission is granted, a full review of eligibility for further sound insulation under the NIR must be completed to protect the future amenity of the most affected residential receptors.

### Applicant Response

6.5.2 The Applicant is fully aware of its obligations as a highway authority under the Noise Insulation Regulations 1975, with which it will continue to comply. As they are a legal obligation, no explicit reference is needed to them in the DCO or the interim CoCP.

6.5.3 This matter has been agreed with SCC/WDC in the SoCG.

### PBA Response

6.5.4 We have no comments on this point.

## 6.6 LD29

### NWL Representation

6.6.1 Insufficient detail to ensure that the final form CoCP will mitigate the effects of the construction activities on NWL's operations at Trinity House and the measures to be taken to ensure no disruption to connectivity of services to the building, or those aimed at minimising the effects of noise and vibration.

### Applicant Response

6.6.2 Landowner engagement is ongoing with a view to fully understanding how the Scheme may impact day to day operations of all affected parties who remain in situ during the construction of the Scheme.

6.6.3 The mitigation that has been proposed within the ES (document reference 6.1 / PINS document reference APP-136) and the Interim CoCP (Appendix 5A of the ES (document reference 6.3 / PINS document reference APP-163)) has been informed by a worst-case scenario with plant working at a single point at the centre of the closest working area to the receptor for 80 % of the working day and this is unlikely to occur frequently.

6.6.4 With regard to vibration, the assessment within the ES has identified negligible significance of effects at all receptors that have been assessed and no further measures are considered necessary.

6.6.5 Notwithstanding that, the Applicant is receptive to considering further information or further measures that NWL may identify as necessary to safeguard the continuity of their operations. The parties are working collaboratively towards putting in place a Land and Work Agreement that assists the landowners as far as possible in mitigating business disturbance (which the landowner has a duty to do under the Compensation Code).

6.6.6 This matter has been agreed with SCC/WDC in the SoCG.

**PBA Response**

6.6.7 Insufficient information has been provided in the ES to verify the potential impact associated with construction noise and vibration at Trinity House and it is considered that the assessment does not adequately address the sensitivity of Trinity House.

6.6.8 Recommendations with respect to safeguarding the continuity of the operations at Trinity House can be made following receipt of an adequate assessment.

# 7 Summary and Conclusions

7.1.1 This Report has been prepared by PBA on behalf of NWL following a review of the application by SCC for an Order Granting Development Consent for the proposed new bridge crossing over Lake Lothing Lowestoft (Planning Inspectorate Reference TR010023) (Lake Lothing Third Crossing).

7.1.2 NWL has always been supportive of the principles of the Scheme, which will relieve traffic congestion and assist the development and regeneration of Lowestoft. However, it is essential to NWL that a series of matters are clarified and resolved in relation to NWL's land interests and operational activities at Trinity House both during construction and operation.

7.1.3 PBA has carefully reviewed the DCO application documents and identified a number of issues of concern to NWL in relation to noise and vibration impacts from the Scheme.

7.1.4 The concerns are associated principally with the:

- Lack of clarity in assessment methodology leading to concerns over the adequacy of the assessment;
- Failure to identify Trinity House as a sensitive receptor with respect to operational impacts resulting in a failure to assess operational noise impacts on Trinity House operations;
- Inadequate assessment of potential construction noise impacts on Trinity House; and
- Consequential failure, in both construction and operational phases, to detail appropriate mitigation measures to protect the noise environment within Trinity House.

# Appendix A Glossary of Acoustic Terminology

| Parameter | Description |
|---|---|
| Ambient Noise Level | The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$). |
| Daytime | The period 07:00-23:00 hours. |
| Decibel (dB) | A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds $s_1$ and $s_2$ is given by 20 $\log_{10}$ ($s_1/s_2$). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions. |
| dB(A), $L_{Ax}$ | Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A). |
| Fast Time Weighting | Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds. |
| Free-field | Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres |
| Façade | Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade. |
| $L_{Aeq,T}$ | A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. |
| $L_{max,T}$ | A noise level index defined as the maximum noise level recorded during a noise event with a period T. $L_{max}$ is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall $L_{eq}$ noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response. |
| $L_{10,T}$ | A noise level index. The noise level exceeded for 10% of the time over the period T. $L_{10}$ can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A –weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00. |
| $L_{90,T}$ or Background Noise Level | A noise level index. The noise level exceeded for 90% of the time over the period T. $L_{90}$ can be considered to be the "average minimum" noise level and is often used to describe the background noise. |
| Night-time | The period 23:00-07:00 hours. |
| Noise Indices | Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out. |
| Sound Pressure | Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure. |
| Sound Pressure Level, $L_p$ | The sound pressure level, $L_p$ is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale. |

# Appendix B Environmental Sound Survey Report

now part of

Stantec

# Lake Lothing Third Crossing

## Environmental Sound Survey Report

On behalf of **Northumbrian Water Limited**

Project Ref: 42498/3002 | Rev: 00 | Date: January 2019

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## Document Control Sheet

**Project Name:** **Lake Lothing Third Crossing**
**Project Ref:** **42498/3002**
**Report Title:** **Environmental Sound Survey Report**
**Doc Ref:** **R002**
**Date:** **January 2019**

| | Name | Position | Signature | Date |
|---|---|---|---|---|
| **Prepared by:** | Daniel Turner | Acoustician | DT | January 2019 |
| **Reviewed by:** | Matt Barlow | Senior Associate | MB | January 2019 |
| **Approved by:** | Ron Henry | Director Midlands and East | RH | January 2019 |
| **For and on behalf of Peter Brett Associates LLP** | | | | |

| Revision | Date | Description | Prepared | Reviewed | Approved |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

This report has been prepared by Peter Brett Associates LLP ('PBA') on behalf of its client to whom this report is addressed ('Client') in connection with the project described in this report and takes into account the Client's particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

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## Figures



## Tables



## Appendices

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# 1 Introduction

## 1.1 Background

1.1.1 Peter Brett Associates LLP (PBA, now part of Stantec) has been commissioned by Northumbrian Water Ltd. to undertake an environmental sound survey and internal sound measurements at Trinity House to assist with the review of the noise and vibration assessment (as set out in the ES noise chapter) for the Third Lake Lothing Crossing in Lowestoft, Suffolk.

1.1.2 The Third Lake Lothing Crossing is a proposed road and pedestrian lifting bridge that would connect Waveney Drive on the south side to Denmark Road and Peto Way on the north side of Lake Lothing. The development is categorised as a Nationally Significant Infrastructure Project and as such, a Development Consent Order is being sought.

1.1.3 Trinity House is an office and call centre facility operated by Northumbrian Water Limited. It is located at the Riverside Business Park, north of Waveney Drive.

1.1.4 This report should be read in conjunction with the report titled 'Acoustic Assessment' produced by PBA (document reference R001, dated January 2019).

## 1.2 Scope of Report

1.2.1 The scope of this report is as follows:

- To outline the methodology of the environmental sound survey undertaken at Trinity House in December 2018;
- To present the results of the environmental sound survey undertaken.

## 1.3 Acoustic Terminology

1.3.1 A glossary of acoustic terminology used within this report is contained within **Appendix A**.

# 2 Standards and Guidance

## 2.1 Standards

### BS7445:2003 Part 1 – Description and Measurement of Environmental Noise. Guide to Quantities and Procedures

2.1.1 BS 7445-1 describes methods and procedures for measuring noise from all sources which contribute to the total noise climate of a community environment, individually and in combination. The results are expressed as equivalent continuous A-weighted sound pressure levels, $L_{Aeq,T}$.

2.1.2 BS 7445-1 states that the sound level meters, used for measuring environmental noise, should conform to Class 1 (or Class 2 as a minimum) as described in BS EN 61672-1:2013 'Electroacoustics. Sound Level Meters. Specifications.' (Ref 10-17) and should be calibrated according to the instructions of the manufacturer. It is recommended that field calibration should be undertaken before and after each series of measurements.

2.1.3 Key aspects of the outdoor measurement procedure are as follows:

- Whenever possible the measurements should be undertaken at a distance of more than 3.5 m from a reflective structure other than the ground;
- The ideal measurement height is between 1.2 m and 1.5 m; and
- Measurement time intervals should be chosen so that measurements are completed within specified meteorological conditions.

2.1.4 BS 7445-1 also provides advice on selecting appropriate parameters when recording various types of noise, e.g. steady noise, fluctuating noise, etc.

## 2.2 Guidance

### Calculation of Road Traffic Noise (CRTN)

2.2.1 The measurements of road traffic noise at nearby noise sensitive receptors has been undertaken in accordance with this document.

2.2.2 The CRTN memorandum, produced by the Department of Transport (1988), details guidance covering the measurement and calculation of road traffic noise.

2.2.3 Paragraph 43 in Section 3 details the methodology to be employed when calculating the $L_{A10,18hour}$ noise level using the shortened measurement procedure. It is necessary to measure the $L_{A10}$ noise levels of 3 consecutive one hour periods between 10:00 and 17:00 hours.

2.2.4 The measured $L_{A10,1hour}$ noise levels are arithmetically averaged to give a single figure $L_{A10,3hour}$ value. **Equation 1** is then used to calculate the $L_{A10,18hour}$ noise level.

$$L_{10,18hour} = L_{10,3hour} - 1dB(A) \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (1)$$

2.2.5 The $L_{A10,18hour}$ is then converted to the $L_{Aeq,16hour}$ daytime and $L_{Aeq,8hour}$ night-time sound levels using the non-motorway conversion formulas outlined within Section 4.6 of 'Converting the UK Traffic Noise Index $L_{A10,18hour}$ to EU Noise Indices for Noise Mapping' document (TRL Limited, 2002).

# 3 Environmental Sound Survey Methodology

## 3.1 Unattended Survey

3.1.1 An unattended environmental sound survey was undertaken from approximately 07:15 hours on Tuesday 04 December 2018 to approximately 16:00 hours on Thursday 13 December 2018 in order to determine the existing sound climate at Trinity House.

3.1.2 The survey was undertaken over a 10-day period, in order to obtain representative façade incident daytime and night-time sound levels at Trinity House during both weekday and weekend periods

3.1.3 Measurements were undertaken at two locations at the site, selected to be representative of the front-facing and rear-facing façade of Trinity House. The location of the measurement positions are indicated in **Figure 1** and described in **Table 3.1**.

Figure 1: Unmanned Environmental Sound Survey Locations (Image Contains Ordnance Survey © Crown Copyright and Database Right 2018)

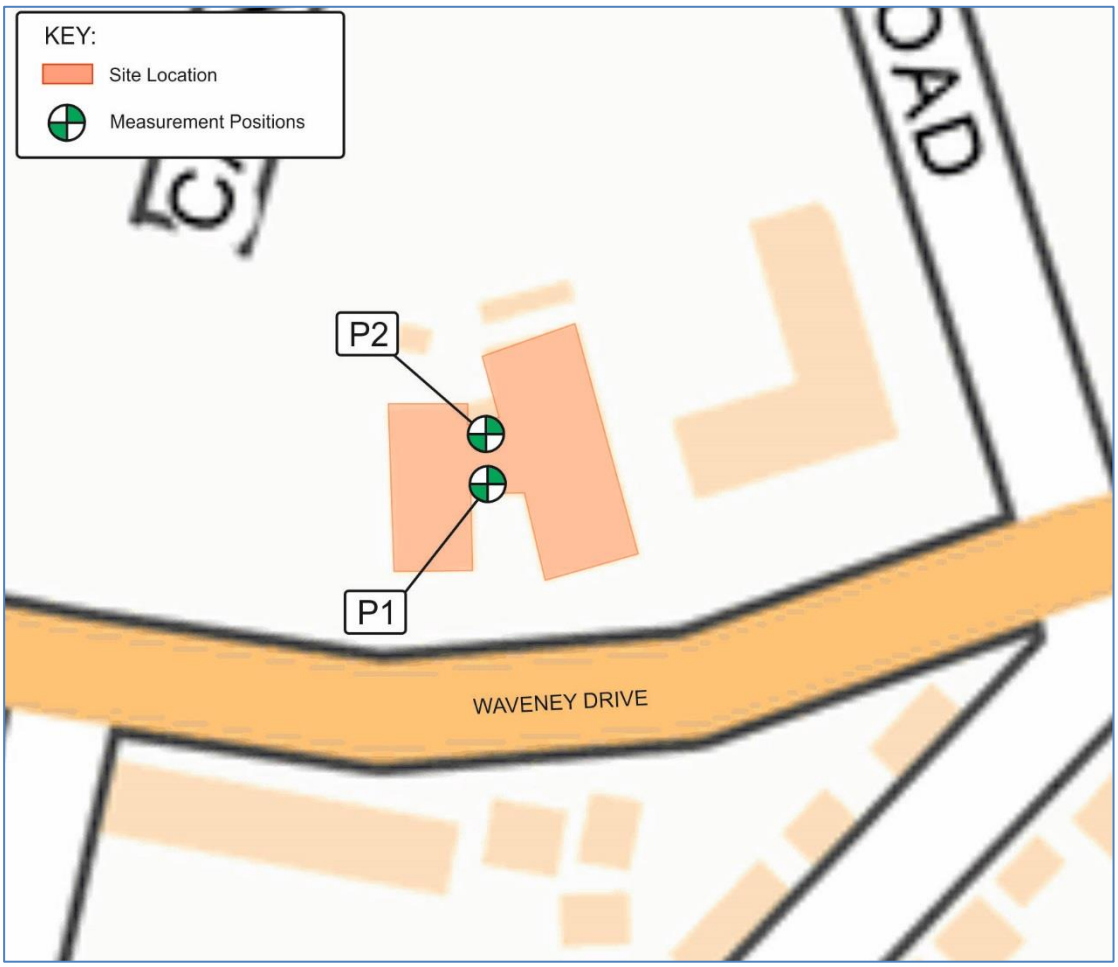


Table 3.1: Description of Unmanned Environmental Sound Survey Locations

| Position | Description |
|---|---|
| P1 | The microphone was positioned at a height of approximately 2.0 m above roof level, in a free field position, on the front-facing roof edge of the atrium area of Trinity House, approximately 30 m from the kerbside of Waveney Drive. The microphone was considered to have line of sight to Waveney Drive. |
| P2 | The microphone was positioned at a height of approximately 2.0 m above roof level, in a free field position, on the rear-facing roof edge of the atrium area of Trinity House, approximately 40 m from the kerbside of Waveney Drive. |

3.1.4 The fast time weighted $L_{Aeq}$, $L_{A90}$, $L_{A10}$ and $L_{Amax}$ sound pressure levels were measured over 5 minute periods. Audio recordings were made to assist with post survey analysis of the results. The survey was undertaken in general accordance with '*BS7445:2003 Part 1 – Description and Measurement of Environmental Noise. Guide to Quantities and Procedures'*.

3.1.5 The sound level meters were located in an environmental case, with the microphones connected to the sound level meters through a microphone extension cable. The microphones were fitted with the manufacturer's windshield.

## 3.2 Weather Conditions

3.2.1 The weather conditions at the site were monitored, using weather data from a weather station located approximately 650 m to the south of the site. A time history graph detailing observations of the temperature, wind speed and rainfall amount observed can be found in **Appendix B**.

3.2.2 Based on the weather data observed, it is likely that the onsite wind speed exceeded 5 m/s between approximately 08:00 hours on Thursday 06 December 2018 to approximately 01:00 hours on Saturday 08 December 2018. Furthermore, it is likely that notable periods of precipitation occurred onsite on Wednesday 05th December and Saturday 08th December 2018. Analysis of the sound survey results suggest that wind speed and periods of precipitation have not significantly influenced the results obtained. Therefore, the weather conditions were considered suitable for obtaining representative sound level measurements.

## 3.3 Attended Survey

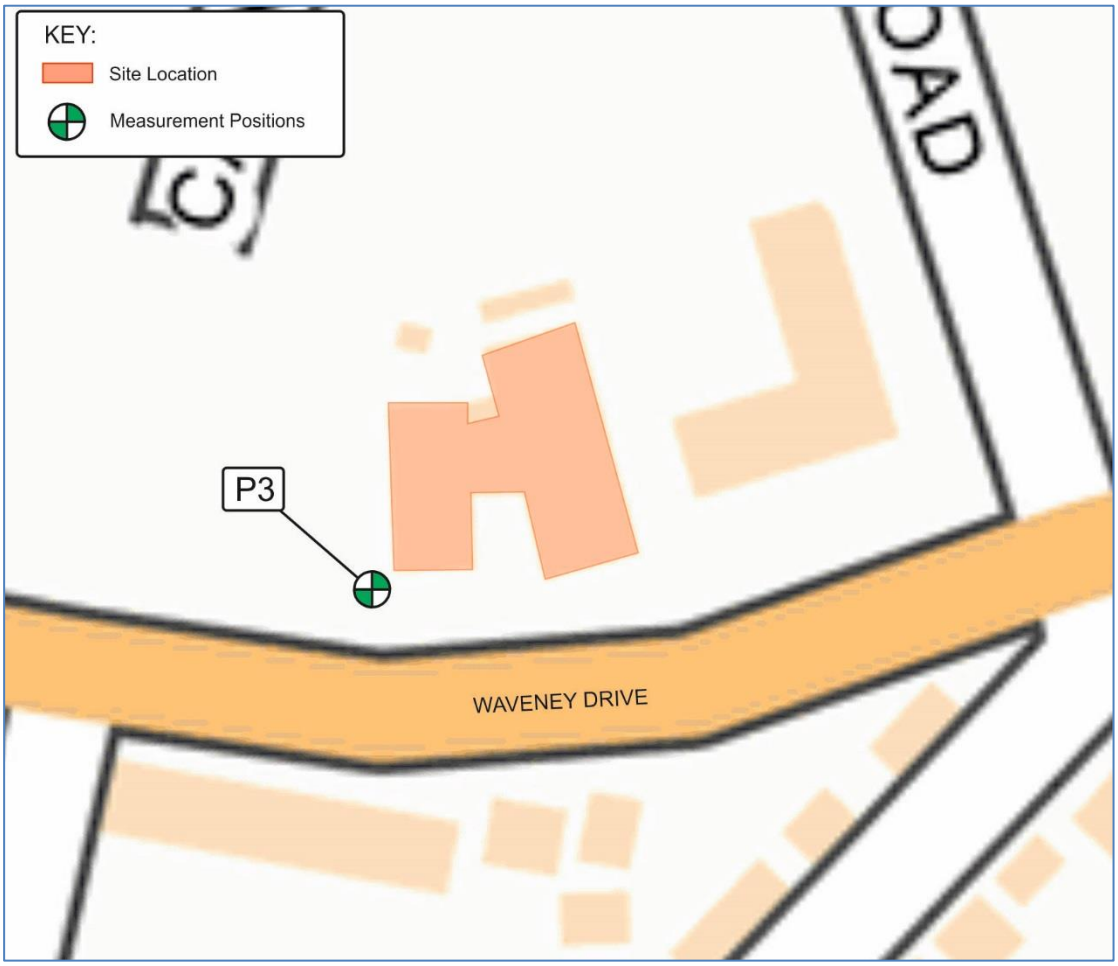
3.3.1 In addition to the unattended survey, attended measurements were also taken, to assist with the verification of roof measurements and to ascertain internal sound levels associated with call centre activity and the performance of the building façade.

### CRTN Measurements

3.3.2 An attended environmental sound survey was undertaken from approximately 11:30 hours to 14:30 hours on Thursday 13 December 2018 in order to determine existing sound levels associated with vehicular movements on Waveney Drive.

3.3.3 Measurements were undertaken at a single position at the site, at a position considered representative of the front-facing façade at Trinity House. The location of the measurement position is indicated in **Figure 2**.

Figure 2: CRTN Measurement Location (Image Contains Ordnance Survey © Crown Copyright and Database Right 2018)




3.3.4 The microphone was positioned at a height of approximately 1.5 m above ground level, in a free field position and approximately 12 m from Waveney Drive and approximately 13 m from the building façade of Trinity House.

3.3.5 The sound level meter was fixed to a tripod, with the microphone connected directly to the sound level meter. The microphone was fitted with the manufacturer's windshield.

3.3.6 The fast time weighted $L_{Aeq}$, $L_{A90}$, $L_{A10}$ and $L_{Amax}$ sound pressure levels were measured over 15 minute periods for the duration of the 3-hour survey period and were undertaken in accordance with the shortened measurement procedure outlined in Paragraph 43 of CRTN.

3.3.7 For the duration of the 3-hour survey period, the temperature was cold (between 6 and 7 °C) with a gentle breeze from an easterly direction (between 3 and 5 m/s) and approximately 50 % cloud cover. No precipitation occurred during the survey period.

### Internal Call Centre Measurements

3.3.8 Attended measurements were undertaken from approximately 19:10 hours to approximately 19:40 on Tuesday 04 December 2018 at 4 positions in order to determine existing internal sound levels associated with no activity occurring within the call centre areas.

3.3.9 Attended measurements were also undertaken from approximately 15:10 hours to 15:40 hours on Thursday 13 December 2018 at 8 positions in order to determine existing internal sound levels associated with general activity occurring within the call centre area.

3.3.10 The microphone was positioned at a height of approximately 1.5 m above floor level. The sound level meter was fixed to a tripod, with the microphone connected directly to the sound level meter.

3.3.11 The fast time weighted $L_{Aeq}$, $L_{A90}$ and $L_{Amax}$ sound pressure levels were measured for between 1 and 5 minute periods at each position. The measurements were paused to exclude extraneous noise events occurring within the call centre (e.g. door closings, elevated speech). Measurements were taken of the typical ambient sound level, away from nearby sound sources.

## Façade Measurements

3.3.12 Attended measurements were undertaken from approximately 18:15 hours to 19:30 hours on Thursday 13 December 2018 in order to determine the existing sound insulation performance of the building façade of Trinity House.

3.3.13 Measurements were undertaken at 8 positions in order to determine both the façade incident noise levels associated with vehicular movements on Waveney Drive and internal noise levels associated with external noise ingress at different positions on the front-facing building façade. The measurement locations were selected to represent noise ingress through the glazed areas of the façade. The location of the measurement positions is indicated in **Figure 3** and described in **Table 3.2**.

Figure 3: Façade Measurement Locations (Image Contains Ordnance Survey © Crown Copyright and Database Right 2018

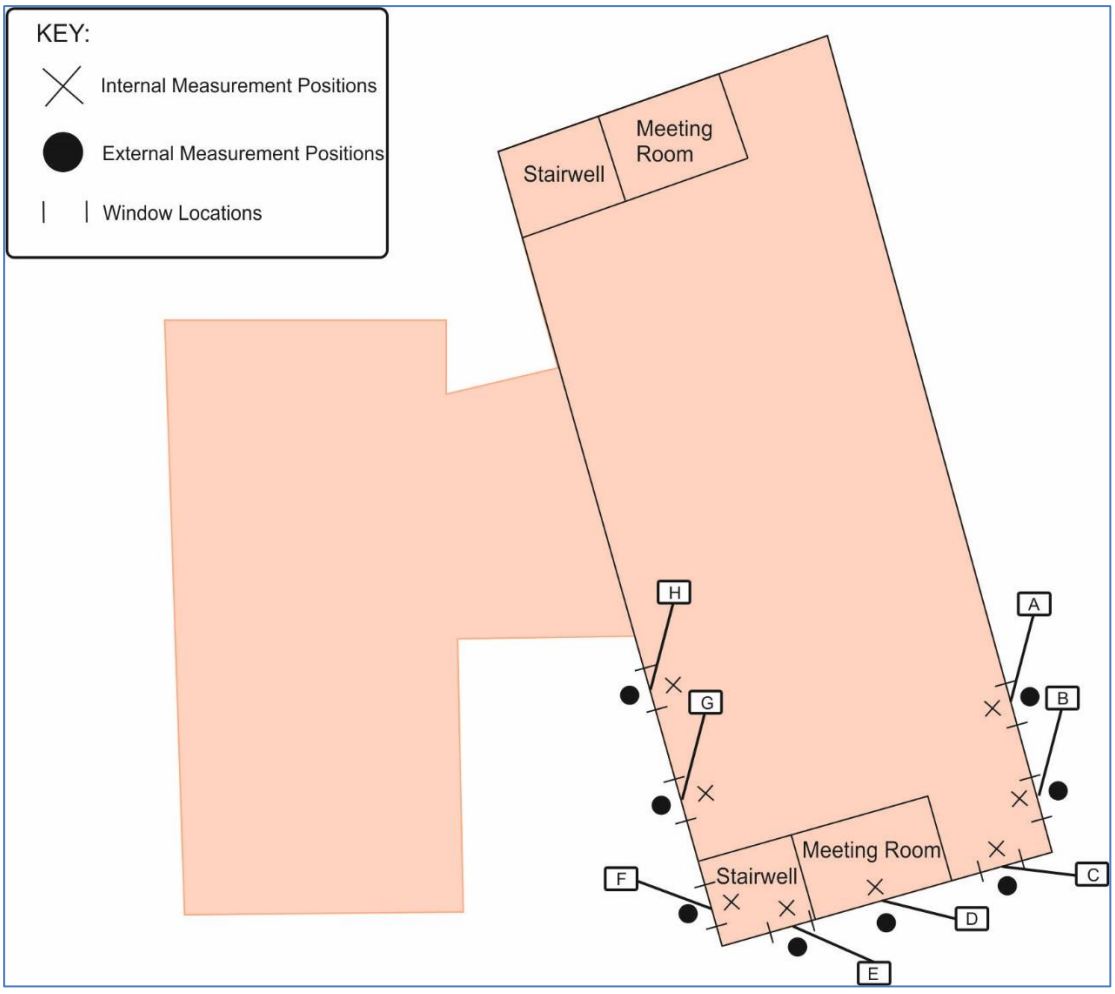


Table 3.2: Description of Façade Measurement Locations

| Position | Description |
|---|---|
| A | The microphones were positioned both internally within the call centre at first floor level and externally at ground floor level, approximately 1 m from a window on the eastern façade and approximately 25 m from Waveney Drive. |
| B | The microphones were positioned both internally within the call centre at first floor level and externally at ground floor level, approximately 1 m from a window on the eastern façade and approximately 20 m from Waveney Drive. |
| C | The microphones were positioned both internally within the call centre at first floor level and externally at ground floor level, approximately 1 m from a window on the southern façade and approximately 15 m from Waveney Drive. |
| D | The microphones were positioned both internally within a meeting room at first floor level and externally at ground floor level, approximately 1 m from the southern façade and approximately 15 m from Waveney Drive |
| E | The microphones were positioned both internally within the stairwell at first floor level and externally at ground floor level, approximately 1 m from a window on the southern façade and approximately 15 m from Waveney Drive. |
| F | The microphones were positioned both internally within the stairwell at ground floor level and externally at ground floor level, approximately 1 m from a window on the western façade and approximately 15 m from Waveney Drive. |
| G | The microphones were positioned both internally within the call centre at first floor level and externally at ground floor level, approximately 1 m from a window on the western façade and approximately 20 m from Waveney Drive. |
| H | The microphones were positioned both internally within the call centre at first floor level and externally at ground floor level, approximately 1 m from a window on the western façade and approximately 25 m from Waveney Drive. |

3.3.14 Measurements were taken simultaneously at each measurement position at both an external and internal location at the same point on the facade. The microphones were positioned at a height of approximately 1.5 m above ground/floor level and were approximately 1 m from the window.

3.3.15 The sound level meters were fixed to a tripod, with the microphone connected directly to the sound level meter. The microphone used for the external measurements were fitted with the manufacturer's windshield.

3.3.16 The fast time weighted $L_{Aeq}$, $L_{A90}$ and $L_{Amax}$ sound pressure levels were measured over 5 minute periods. Audio recordings were made to assist with post survey analysis of the results.

3.3.17 For the duration of survey period, the temperature was cold (between 5 and 6 °C) with a gentle breeze from an easterly direction (approximately 5 m/s) and approximately 60 % cloud cover. No precipitation occurred during the survey period.

## 3.4 Instrumentation

3.4.1 The instrumentation used for the surveys described above are listed in **Table 3.3**. Field calibrations were performed before and after each survey period, with no significant fluctuations recorded (these were observed to be less than 0.3 dB). Calibration certificates are available upon request.

Table 3.3: Instrumentation

| Description | Manufacturer | Type | Serial Number | Laboratory Calibration Date |
|---|---|---|---|---|
| Sound Level Meter | Rion | NL-52 | 1043457 | 06/02/2017 |
| ½" Pre-polarised microphone | | UC-59 | 07232 | |
| Pre Amplifier | | NH-25 | 43486 | |
| Sound Level Meter | Rion | NL-52 | 542903 | 17/02/2017 |
| ½" Pre-polarised microphone | | UC-59 | 06480 | |
| Pre Amplifier | | NH-25 | 42931 | |
| Sound Level Meter | Brüel & Kjær | 2250 | 3012156 | 27/09/2018 |
| ½" Pre-polarised microphone | | 4189 | 3130464 | |
| Pre Amplifier | | ZC0032 | 27836 | |
| Calibrator | Brüel & Kjær | 4231 | 2389171 | 08/05/2018 |

## 3.5 Assumptions/Limitations

3.5.1 The environmental sound survey was undertaken during weekday and weekend periods when traffic flows can be expected to be typical (i.e. not during school holidays).

3.5.2 Nothing unusual was noted in terms of the noise climate at the beginning and end of the survey. This report refers, within the limitations stated, to the environment of the site in the context of the surrounding area during the engineer's visit to site.

# 4 Environmental Sound Survey Results

## 4.1 Environmental Sound Climate

4.1.1 Due to the nature of the unattended survey, it is not possible to accurately comment on the dominant noise sources or specific noise events throughout the entire duration of the survey period.

4.1.2 However, at the beginning and end of the survey period and for the duration of the external attended measurements, the dominant noise source at positions P1, P2 and P3 and external façade measurements was noted to be vehicular movements on Waveney Drive. Distant traffic noise from vehicular movements on the A12 was dominant in the absence of traffic movements on Waveney Drive.

4.1.3 Condenser and ventilation plant was in operation on the roof of Trinity House. Positions P1 and P2 were therefore selected in order to minimise the effect of noise from these units on the measurements. It should be noted that, although noise from the operational plant was audible at both Positions P1 and P2, it was not considered to be the dominant noise source at these positions and was not audible when traffic on Waveney Drive was passing. Therefore, the results at these positions are considered to be representative of noise from vehicular movements on Waveney Drive incident on Trinity House.

## 4.2 Unattended Survey

4.2.1 A summary of the unattended environmental sound survey results at Positions P1 and P2 are presented in **Tables 4.1 and 4.2**. Time history graphs detailing the full results of the 10-day unattended survey can be found in **Appendix C**.

Table 4.1: Summary of Environmental Sound Survey Results at Position P1

| Date | Ambient Sound Level, dB $L_{Aeq,T}$ | | | dB $L_{A10,18hour}$ |
|---|---|---|---|---|
| | Daytime (07:00 – 23:00 hours) | Night-Time (23:00 – 07:00 hours) | Call Centre Operational Hours (08:00 – 20:00 hours) | |
| Tuesday 04th December 2018 | 60 | 54 | 60 | 64 |
| Wednesday 05th December 2018 | 61 | 51 | 62 | 64 |
| Thursday 06th December 2018 | 60 | 53 | 60 | 63 |
| Friday 07th December 2018 | 61 | 56 | 62 | 64 |
| Saturday 08th December 2018 | 60 | 54 | 61 | 64 |
| Sunday 09th December 2018 | 58 | 51 | 59 | 60 |
| Monday 10th December 2018 | 59 | 50 | 60 | 62 |
| Tuesday 11th December 2018 | 60 | 50 | 61 | 63 |
| Wednesday 12th December 2018 | 60 | 54 | 61 | 63 |
| Thursday 13th December 2018 | 62 | - | 62 | 64 |

Table 4.2: Summary of Environmental Sound Survey Results at Position P2

| Date | Ambient Sound Level, dB $L_{Aeq,T}$ | | | dB $L_{A10,18hour}$ |
|---|---|---|---|---|
| | Daytime (07:00 – 23:00 hours) | Night-Time (23:00 – 07:00 hours) | Call Centre Operational Hours (08:00 – 20:00 hours) | |
| Tuesday 04th December 2018 | 56 | 52 | 56 | 54 |
| Wednesday 05th December 2018 | 56 | 52 | 57 | 54 |
| Thursday 06th December 2018 | 56 | 53 | 57 | 53 |
| Friday 07th December 2018 | 57 | 55 | 58 | 54 |
| Saturday 08th December 2018 | 58 | 55 | 58 | 54 |
| Sunday 09th December 2018 | 55 | 49 | 56 | 53 |
| Monday 10th December 2018 | 57 | 49 | 58 | 55 |
| Tuesday 11th December 2018 | 57 | 49 | 58 | 55 |
| Wednesday 12th December 2018 | 57 | 55 | 57 | 55 |
| Thursday 13th December 2018 | 59 | - | 59 | 57 |

## 4.3 Attended Surveys

### CRTN Measurements

4.3.1 A summary of the results of the 3-hour attended shortened CRTN measurement undertaken on Thursday 13 December 2018 is presented in **Table 4.3**. Full details of the results of the attended survey can be found in **Appendix D**.

Table 4.3: Summary of Attended CRTN Measurements

| Start Time | Duration | dB $L_{A10,1hour}$ | dB $L_{A10,3hour}$ | Calculated dB $L_{A10,18hour}$ |
|---|---|---|---|---|
| 11:30 | 1 hour | 68 | 67 | 66 |
| 12:30 | 1 hour | 67 | | |
| 13:30 | 1 hour | 67 | | |

### Internal Call Centre Measurements

4.3.2 A summary of the results of the attended internal measurements within the call centre is presented in **Table 4.4.** Full details of the results of the attended survey can be found in **Appendix E.**

Table 4.4: Summary of Internal Call Centre Measurements

| Description | Averaged Internal Reverberant Sound Pressure Level (dB $L_{Aeq,T}$) |
|---|---|
| General Call Centre Activity | 51 |
| Inside Call Centre with No Activity | 33 |

### Façade Measurements

4.3.3 Based on the results of the façade measurements outlined above, the level difference ($D$) at each measurement position has been calculated in order to help determine the sound

insulation performance of the existing façade. This has been determined by using the following equation:

$$D = L_1 - L_2$$

where $D$ is the calculated level difference, $L_1$ is the ambient sound level measured externally (corrected for façade reflections) and $L_2$ is the ambient sound level measured internally.

4.3.4 A -3dB façade correction has been applied to the external noise measurements.

4.3.5 A summary of the results of the attended internal and external façade measurements at Positions A, B, C, D, E, F, G and H and the calculated level difference, $D$ are presented in **Table 4.5**.

Table 4.5: Summary of External and Internal Façade Measurements

| Position | Ambient Sound Level, dB $L_{Aeq,5minute}$ | | Calculated Level Difference, $D$ |
|---|---|---|---|
| | External | Internal | |
| A | 56 | 37 | 19 |
| B | 55 | 35 | 20 |
| C | 57 | 35 | 22 |
| D | 58 | 30 | 28 |
| E | 59 | 31 | 28 |
| F | 57 | 31 | 26 |
| G | 58 | 35 | 23 |
| H | 60 | 36 | 24 |
| Average | 58 | 34 | 24 |

# 5 Summary

5.1.1 Peter Brett Associates LLP (PBA, now part of Stantec) has been commissioned by Northumbrian Water Ltd. to undertake an environmental sound survey and internal sound measurements to assist with the review of the noise and vibration ES chapter associated with the Third Lake Lothing Crossing in Lowestoft, Suffolk.

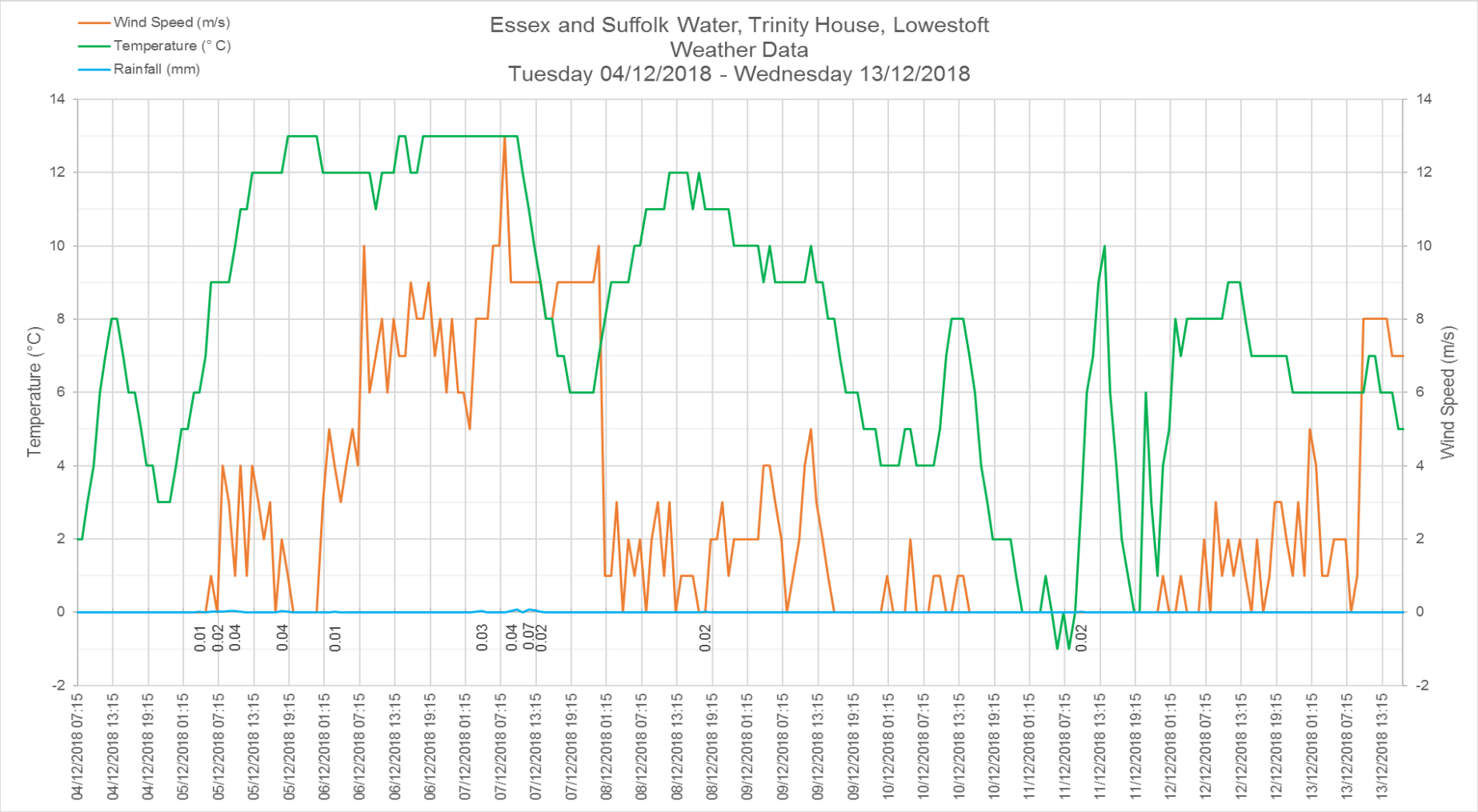
5.1.2 This report details the methodology and results of the environmental sound surveys undertaken at Trinity House in December 2018.

5.1.3 This report should be read in conjunction with the report titled 'Acoustic Supporting Evidence for NWL' produced by PBA (document reference R001, dated January 2019).

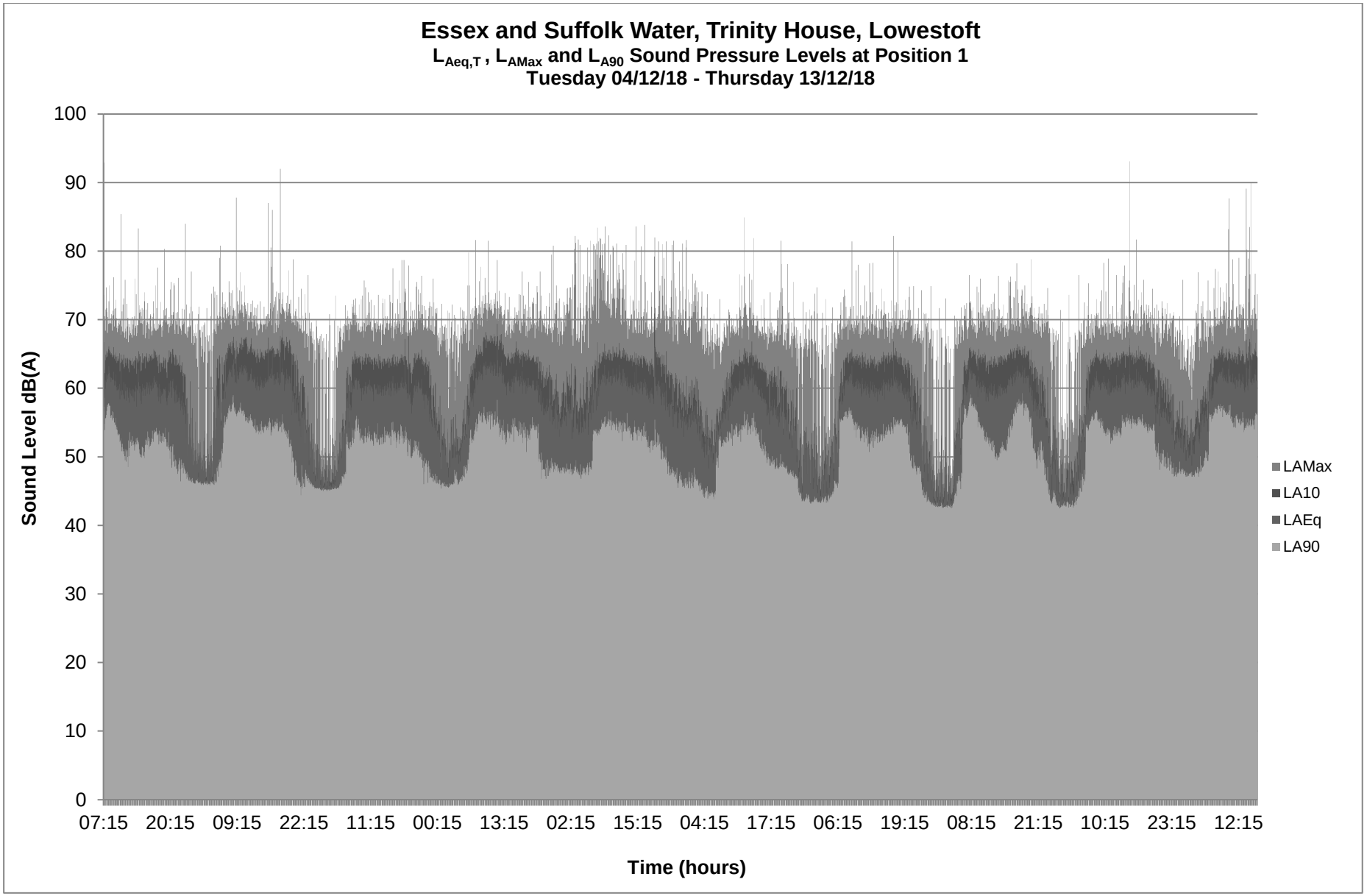
# Appendix A Glossary of Acoustic Terminology

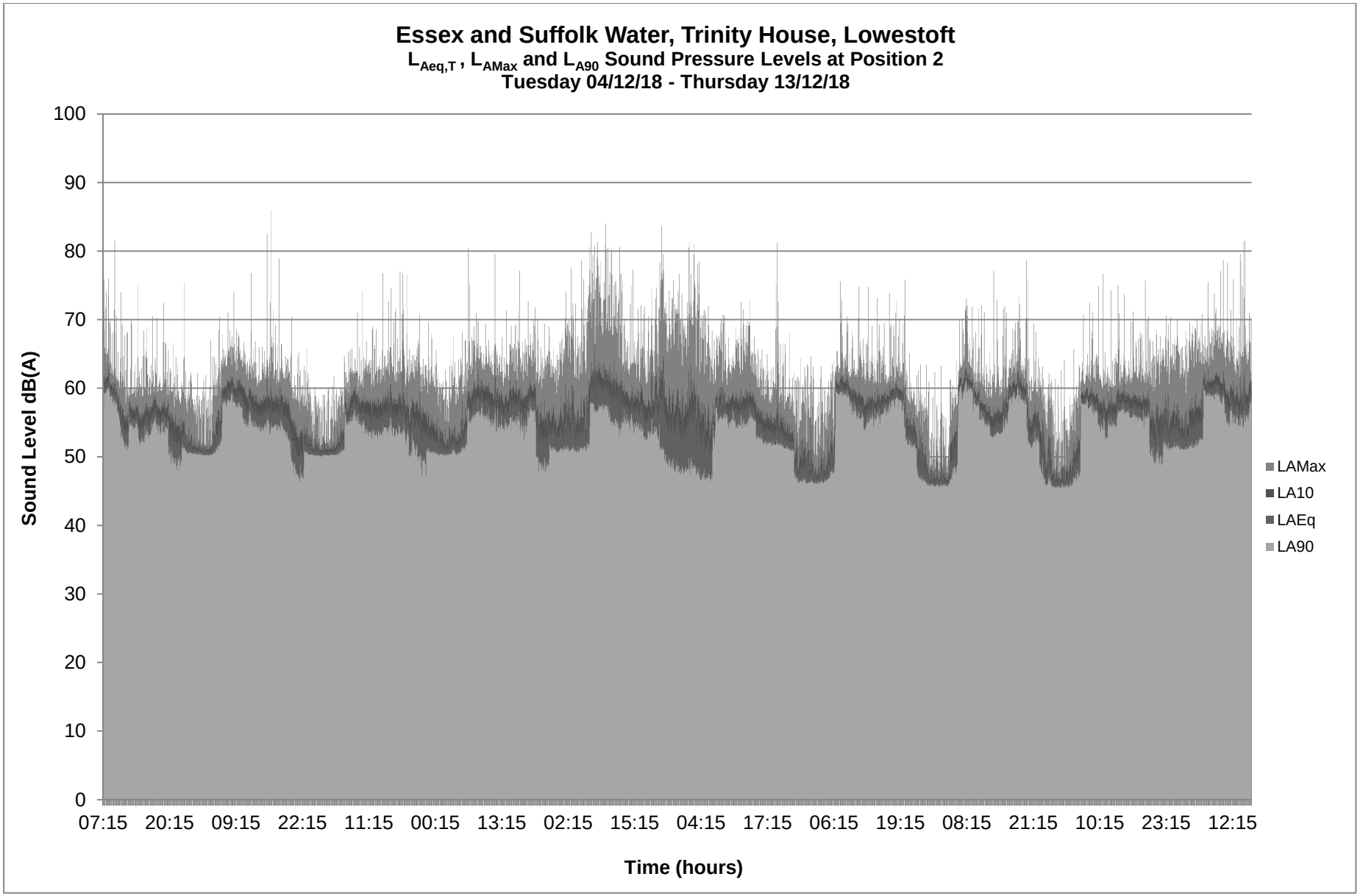
| Parameter | Description |
|---|---|
| Ambient Noise Level | The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$). |
| Daytime | The period 07:00-23:00 hours. |
| Decibel (dB) | A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds $s_1$ and $s_2$ is given by 20 $\log_{10}$ ($s_1/s_2$). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions. |
| dB(A), $L_{Ax}$ | Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A). |
| Fast Time Weighting | Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds. |
| Free-field | Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres |
| Façade | Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade. |
| $L_{Aeq,T}$ | A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. |
| $L_{max,T}$ | A noise level index defined as the maximum noise level recorded during a noise event with a period T. $L_{max}$ is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall $L_{eq}$ noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response. |
| $L_{10,T}$ | A noise level index. The noise level exceeded for 10% of the time over the period T. $L_{10}$ can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A –weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00. |
| $L_{90,T}$ or Background Noise Level | A noise level index. The noise level exceeded for 90% of the time over the period T. $L_{90}$ can be considered to be the "average minimum" noise level and is often used to describe the background noise. |
| Night-time | The period 23:00-07:00 hours. |
| Noise Indices | Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out. |
| Sound Pressure | Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure. |
| Sound Pressure Level, $L_p$ | The sound pressure level, $L_p$ is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale. |

# Appendix B Weather Time History Graph



# Appendix C Sound Time History Graphs


Essex and Suffolk Water, Trinity House, Lowestoft
LAeq,T , LAMax and LA90 Sound Pressure Levels at Position 1
Tuesday 04/12/18 - Thursday 13/12/18
Sound Level dB(A)
100
90
80
70
60
50
40
30
20
10
0
07:15
20:15
09:15
22:15
11:15
00:15
13:15
02:15
15:15
04:15
17:15
06:15
19:15
08:15
21:15
10:15
23:15
12:15
Time (hours)
LAMax
LA10
LAEq
LA90


Essex and Suffolk Water, Trinity House, Lowestoft
LAeq,T , LAMax and LA90 Sound Pressure Levels at Position 2
Tuesday 04/12/18 - Thursday 13/12/18
Sound Level dB(A)
100
90
80
70
60
50
40
30
20
10
0
07:15
20:15
09:15
22:15
11:15
00:15
13:15
02:15
15:15
04:15
17:15
06:15
19:15
08:15
21:15
10:15
23:15
12:15
Time (hours)
LAMax
LA10
LAEq
LA90

# Appendix D CRTN Measurement Results

| Date and Start Time | Measurement Duration | dB $L_{Aeq,T}$ | dB $L_{AFMax}$ | dB $L_{A10,T}$ | dB $L_{A90,T}$ |
|---|---|---|---|---|---|
| 13/12/2018 11:30 | 00:15:00 | 71.1 | 62.4 | 51.2 | 66.8 |
| 13/12/2018 11:45 | 00:15:00 | 73.8 | 63.5 | 52.8 | 67.4 |
| 13/12/2018 12:00 | 00:15:00 | 73.3 | 63.4 | 51.5 | 67.4 |
| 13/12/2018 12:15 | 00:15:00 | 73.6 | 64.3 | 52.3 | 68.5 |
| 13/12/2018 12:30 | 00:15:00 | 72.2 | 63.6 | 51.4 | 67.5 |
| 13/12/2018 12:45 | 00:15:00 | 74.3 | 63.1 | 51.8 | 67.1 |
| 13/12/2018 13:00 | 00:15:00 | 76.4 | 64.1 | 52.0 | 68.0 |
| 13/12/2018 13:15 | 00:15:00 | 74.8 | 62.8 | 51.0 | 67.2 |
| 13/12/2018 13:30 | 00:15:00 | 76.6 | 62.6 | 50.4 | 66.6 |
| 13/12/2018 13:45 | 00:15:00 | 82.9 | 64.7 | 51.6 | 67.8 |
| 13/12/2018 14:00 | 00:15:00 | 75.0 | 62.9 | 50.5 | 67.2 |
| 13/12/2018 14:15 | 00:15:00 | 82.8 | 64.6 | 52.4 | 68.2 |

# Appendix E Internal Call Centre Measurement Results

| Date and Start Time | Measurement Duration | dB $L_{Aeq,T}$ | dB $L_{AFMax}$ | dB $L_{A90,T}$ |
|---|---|---|---|---|
| 04/12/2018 19:10 | 00:05:00 | 33.97 | 50.99 | 31.98 |
| 04/12/2018 19:20 | 00:05:00 | 33.60 | 50.62 | 32.27 |
| 04/12/2018 19:30 | 00:05:00 | 30.77 | 41.51 | 29.73 |
| 04/12/2018 19:40 | 00:05:00 | 34.45 | 45.67 | 33.72 |

| Date and Start Time | Measurement Duration | dB $L_{Aeq,T}$ | dB $L_{AFMax}$ | dB $L_{A90,T}$ |
|---|---|---|---|---|
| 13/12/2018 15:13 | 00:01:00 | 54.42 | 66.02 | 49.26 |
| 13/12/2018 15:18 | 00:01:00 | 54.59 | 65.78 | 49.09 |
| 13/12/2018 15:21 | 00:01:00 | 51.82 | 61.47 | 46.76 |
| 13/12/2018 15:24 | 00:01:00 | 50.82 | 60.61 | 45.60 |
| 13/12/2018 15:27 | 00:01:00 | 50.36 | 62.66 | 43.90 |
| 13/12/2018 15:29 | 00:01:00 | 50.32 | 61.07 | 43.03 |
| 13/12/2018 15:34 | 00:01:00 | 53.43 | 62.38 | 47.30 |
| 13/12/2018 15:36 | 00:01:00 | 52.63 | 63.35 | 45.79 |
| 13/12/2018 15:39 | 00:01:00 | 46.11 | 55.35 | 41.09 |

# Appendix F Façade Measurement Results

### External Measurements

| Position | Date and Start Time | Measurement Duration | dB $L_{Aeq,T}$ | dB $L_{AFMax}$ | dB $L_{A10,T}$ | dB $L_{A90,T}$ |
|---|---|---|---|---|---|---|
| A | 13/12/2018 18:15:00 | 00:05:00 | 59.04 | 71.72 | 62.10 | 54.31 |
| B | 13/12/2018 18:25:00 | 00:05:00 | 58.08 | 68.24 | 60.95 | 53.97 |
| C | 13/12/2018 18:35:00 | 00:05:00 | 60.07 | 68.83 | 63.81 | 52.88 |
| D | 13/12/2018 18:45:00 | 00:05:00 | 61.30 | 72.93 | 66.15 | 52.40 |
| E | 13/12/2018 19:15:00 | 00:05:00 | 62.51 | 73.17 | 66.97 | 50.93 |
| F | 13/12/2018 19:25:00 | 00:05:00 | 60.33 | 70.78 | 65.16 | 46.77 |
| G | 13/12/2018 18:55:00 | 00:05:00 | 61.32 | 72.68 | 65.55 | 49.37 |
| H | 13/12/2018 19:05:00 | 00:05:00 | 62.83 | 77.47 | 66.65 | 49.68 |

### Internal Measurements

| Position | Date and Start Time | Measurement Duration | dB $L_{Aeq,T}$ | dB $L_{AFMax}$ | dB $L_{A10,T}$ | dB $L_{A90,T}$ |
|---|---|---|---|---|---|---|
| A | 13/12/2018 18:15:00 | 00:05:00 | 36.7 | 44.4 | 37.9 | 35.4 |
| B | 13/12/2018 18:25:00 | 00:05:00 | 34.9 | 40.2 | 36.0 | 33.7 |
| C | 13/12/2018 18:35:00 | 00:05:00 | 35.1 | 40.5 | 36.1 | 33.9 |
| D | 13/12/2018 18:45:00 | 00:05:00 | 29.9 | 35.1 | 30.5 | 29.3 |
| E | 13/12/2018 19:15:00 | 00:05:00 | 31.2 | 44.3 | 34.6 | 25.8 |
| F | 13/12/2018 19:25:00 | 00:05:00 | 31.1 | 43.9 | 34.6 | 24.8 |
| G | 13/12/2018 18:55:00 | 00:05:00 | 34.9 | 47.0 | 36.0 | 33.0 |
| H | 13/12/2018 19:05:00 | 00:05:00 | 36.0 | 46.6 | 36.6 | 35.0 |