

A Study of the Airborne Noise aspects of the  
Proposed Dublin Metro North  
Railway Development

for  
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### **The Proposed Project**

The proposal, by the Railway Procurement Agency (RPA) is for a new Metro Railway line from St. Stephens Green to Belinstown, north of Swords. It is to be 18km long, with nine underground Stops and eight ground level (at grade) stops. It will involve both ground level construction activities, and underground construction. Airborne noise is of concern only from the overground works and from excavations which have not been roofed in. Construction compounds along the alignment will also generate noise. These serve all the stop locations and the tunnelling works by providing storage for both materials, plant and equipment, as well as facilities for spoil extraction from the tunnels via the Albert College Park Compound and the South Portal Airport Tunnel Compound 8. The compounds will also house the necessary site offices and provide essential services for the construction workers.

### **Summary**

The Airborne Noise element of the Environmental Impact Statement (EIS) on the proposed Metro North railway is quite comprehensive. There are some data deficits in relation to the current ambient noise levels, but it is expected that these will be rectified by the appointed contractor. With the proposed EIS safeguards in place, and with the recommendations in this report, we are confident that the project can be both built and operated in a manner that is consistent with good environmental practice.

### **1. The Environmental Impact Statement (Airborne Noise Component)**

The Environmental Impact Statement (EIS) on the proposed Metro North railway is quite comprehensive in overall terms. However, the Noise Ambient Baseline data is very sparse. Some further noise baseline data produced in the Further Information submitted by the applicant added only slightly to the original set of data. This approach seems to be based on the premise that the initial EIS requires only simple 'snapshot' readings of noise level in order to assess the environmental noise impact of the proposal. It was stated on behalf of the RPA that much more detailed noise baseline surveying would be done by the appointed contractor for the purpose of noise impact control during the construction phase.

This approach was defended on the basis that the EIS is but the first step in what is called a 'dynamic process' known as EIA (Environmental Impact Assessment).

Some legal decisions and statements by judges in Irish Courts were referenced by the applicant's legal team. These references underlined the value and acceptability of the dynamic nature of the process, whereby an EIS is tested and modified, and indeed improved, by the process of analysis and criticism inherent in the assessment process.

We acknowledge the value of submitting any EIS to in depth scrutiny in order to test its merits. We also accept the clear distinction between an EIS and the EIA process, and acknowledge the essential nature and the benefits of this process. But we maintain that a fuller scrutiny and assessment would be possible if a fuller picture of the existing noise climate were available for inspection, for each significant work site, and its environs.

It is stated in the RPA/Rotunda Hospital agreement dated 2 March 2010, paragraph 2.4.4 'The approach being taken on the Metro North Project is to limit the effects of construction rather than to specify precise work methods and construction plant.'

Because of the options on construction methods and the actual sound power levels of the actual plant to be used, there is the question of the precision of the noise levels predicted, and there is a consequent lack of specificity in the noise mitigation measures which will be used.

However, the EIS and the data gleaned during the Oral Hearing process combine to show that it is indeed possible to construct the Metro North project with control of the noise levels from the construction plant, when the range of potential noise reduction options is borne in mind.

There are, however, some locations, for example Leo St., and St. Josephs Avenue, Drumcondra, where the houses are so close to the proposed Stop construction sites, it may not be possible to achieve the noise limits recommended, by construction site mitigation measures alone.

Such locations may then require a consequent upgrade of house sound insulation, or other offsetting measure. In Leo St. it is not clear that the limited space available will be sufficient to allow placement of the barrier screening likely to be required. Thus some other options may need to be explored, such as (a) temporary relocation of residents until the Stop construction deck is in place (b) upgrading of the sound insulation values of the houses (doors, windows and roof/attic spaces), or (c) other offsetting measures e.g. possible purchase of some houses. Noise levels in the range of 75 to 80+ LAeq may be likely, for significant periods of time, and we cannot recommend noise levels over 70 LAeq<sub>period</sub>, without appropriate safeguards for nearby residents.

In St. Joseph's Avenue in Drumcondra, a row of about 16 cottages fronts onto the proposed Drumcondra Stop site at about 8 metres away. Here also some options other than onsite physical mitigation of the noise levels may be required. Here the options for physical mitigation are different than in Leo St, because here it is the fronts of the houses which are close to the proposed site perimeter. So both the initial demolition works and the excavation of the proposed Drumcondra Stop are just a few metres from the front doors which open directly onto a public footpath and roadway.

However, after the initial demolition work has been done, there is an option for a substantially higher noise barrier on the construction site boundary than the proposed 2m (EIS, Volume 2, Book 6, paragraph 4.4.2.1) height. With suitable design it is possible that a noise barrier of height 4 metres or more, could be built here and might suffice to screen the nearby houses adequately from construction noise. No entrance to the construction site is proposed from St. Josephs Avenue.

Other locations, for example in Nevinstown, will need alert and ongoing attention to noise control, as there are some houses there which are close, or very close, to the proposed works. There are also a number of locations where rooms and residents are located at 2<sup>nd</sup> or 3<sup>rd</sup> or 4<sup>th</sup> floor level, and where there will be clear line of sight to the proposed works. Some hotels and the Gaelscoil in Parnell Square are examples of this situation. These receptors will also need protection from the likely construction noise.

The three main hospitals with wards at higher floor levels have individual agreements with the RPA.

**2. Data Deficits** – The main area of information deficit is the noise baseline data presented in the EIS and in the Further Information on the proposal. The data is very sparse. A noise climate cannot be adequately described by one or two 15-minute 'snapshot' measurements. For example, the essentially quiet rural nature of the depot area (Belinstown) is not shown in the data provided. Nor is the quiet virtually rural nature of the environs of the Hampstead Private Hospital and the Elmhurst Convalescent Home shown in the respective data sets for those two noise-sensitive receivers. The two latter locations are in the environs, respectively, of the southern Tunnel launch site and major compound in Albert College Park, and the Griffith Avenue Stop location.

The rural character of Lissenhall nor the noisy urban character of O'Connell Street or Area MN107 have not been adequately documented. And while the Dublin City Council 'Noise Maps' were used to obtain an initial view of the range of noise levels that occur within the Dublin City

Council parts of the study area' no indication of this range (modelled/calculated) is shown in the EIS. (Volume 1, paragraph 12.2.3) In any event there is no real substitute for actual measured noise levels.

A consequence of the sparse baseline data, is that the construction noise criteria, presented in the EIS, cannot be related to the pre-existing ambient noise level in any location, as was done for the current Crossrail project in London. Rather, absolute noise values have been proposed as the criteria for acceptability, without regard to how quiet any area currently is.

It is worth noting that there are some locations where, in order to establish what the actual construction noise levels will be, in order to meet the construction noise limits required, the contractors will be aware that they must first establish what the pre-existing ambient noise levels are – since the noise measured by any proposed measuring microphones, at any work site, will be the sum total of the pre-existing ambient noise levels and the construction noise levels. And no contractor will want to be held responsible for the other local noise sources over which they have no control.

In general, it will not be possible to measure only pure construction noise alone, at many of the unattended noise monitors in, for example, areas MN105, MN106, and MN107.

However, along much of the alignment, the ambient noise levels are likely to be sufficiently low that the levels recorded by any microphone will be, for the most part, simply construction noise. This statement is based on the brief readings reported in the EIS, Volume 3, Book 2, Table 1.5. It is mainly from the Mater Hospital into St. Stephens Green that some (not all) ambient noise levels are likely to be of similar order of magnitude to the construction noise level. At all such sites care will be needed to establish the actual ambient noise levels.

**NOTE 1 :** There are locations where, due for example to changes in road traffic pattern, the ambient level is likely to change. Parnell Square East may be one such location. It will be necessary to distinguish between the current ambient noise levels in a location, and a new ambient noise scenario, in such locations, e.g. where road changes essential to progressing the construction, are put in place thus causing a change in the traffic pattern, for example the volume or speed, and consequently in the road traffic noise level. This situation will need alert, ongoing monitoring in order to facilitate accurate determination of the construction noise alone.

Thus the noise monitoring and control process, for the proposed development, will for the currently noisier sites, mainly in areas MN105, MN 106 and MN107, require the subtraction of the pre-existing ambient noise level from the total noise level, in order to quantify the construction noise level. And the pre-existing ambient noise level can only be known, with any accuracy, by a noise measurement survey process conducted over an adequate and appropriate period of time.

In any event, since the daily ambient noise level may change, it will be important at some sites, to have ongoing spot checks on the non-construction ambient noise level. At the Mater Stop site, the existing project construction noise level, at the Leo St. houses, will need to be known and taken into account, if that project has not been completed before the Mater Stop works begin.

The latter spot checks could prove very difficult, if not impossible, without tedious and costly stoppages of the Mater Stop construction programme. Thus, should it be that both construction projects are under way at the same time, it is likely to be important that a mutually agreed procedure be adopted by both contractors to minimise the noise impact on the Leo St. residents. In particular, notice should be taken of the recommendations 24(F), 24(G), 24(H) and 24(J).

NOTE 2 : Since the perceptibly noisy works will take place mostly by day, or in the evening time, any unusually quiet moments in the ambient noise level are likely to occur at night, when there should be no noisy construction work taking place. Some brief exceptions to this scenario are likely when the footbridges are being dismantled or replaced, or when some viaduct components are being erected, and when some very large loads are required on a site.

We have the assurance of the RPA that such night time events will be rare at any given site. We have the further assurance that for any such preplanned events the local residents will be informed in advance. Furthermore, we understand that such events will only take place with the knowledge and approval of the Local Authority.

NOTE 3 : We expect that there will be both (a) Unattended long term noise monitoring, and (b) Attended noise monitoring for short time periods (up to 15 minutes or longer), with the latter being used to confirm the readings obtained for either ambient or construction noise, in conjunction with the long term monitors. Attended monitoring will be required at many locations where unattended monitoring is not recommended. Such locations include receptors near Stop sites, near major compounds, near the proposed Bailey Bridge, near the footbridges to be demolished and their replacement structures, near the proposed new bridges and structures in areas MN101 and MN102 and near the ongoing work sites for cut & cover operations, for Viaduct construction and for tracklaying. This monitoring must be done, of course, when the works are happening, whether day or night.

Attended noise monitoring will also be needed for the operational scheme in its initial stages and for fixed plant and equipment commissioning at each location where such plant is located.

Since the proposed development is to be financed by a Public Private Partnership (PPP) it is understood that the RPA must consider that the contractor to be appointed may prefer some methods of construction, over other alternatives, and cannot be 100% prescriptive of the methodology to be used during the course of the project. However we accept that the RPA and the Contractor, through the use of the technical expertise on hand, and the auditing and controls proposed, will meet and mitigate any noise occurrence, to the satisfactory compliance with the noise limits required.

We also expect that no phase of the works will be initiated without having on hand, and on-site, the types and amount of portable noise mitigation materials, barriers and devices which are likely to be needed on that site. In this latter statement we include those locations where noise emission will occur only over a few nights, as for example dismantling of the footbridges and demolition of any concrete bases to be removed, and the construction of the replacement bridges or crossings.

### **Data Comment**

Except for the emergency ventilation fans little attention has been devoted, in the Metro North EIS, to fixed and permanent plant on the proposed alignment.

In paragraph 4.4.2.2 of the EIS Volume 2, Book 1, is stated, in relation to noise from fixed plant – ‘It has been assumed insignificant if noise is less than NC25 inside neighbouring buildings at night (to avoid sleep disturbance) or to not exceed the existing LA90 background noise.’ and ‘Noise criteria (NC) curves are used to specify sound levels across a range of frequencies, and NC25 is an acceptable level for internal areas. Since all fixed plant is to be designed to meet these standards, it has not been necessary to define magnitudes of impact since no significant residual effects are expected.’ This statement is not tenable. NC25 may be acceptable by day, but not so at night.

**Comment** – The emphasis seems to be mainly on the NC25 criterion, and not on the pre-existing ambient levels in people’s bedrooms at night. Internal noise ambient levels, at night, in many houses, both rural and suburban, around Dublin are of the order of 18 – 25 LA90, and even in daytime are not much higher. Since the proposed fixed plant will operate for many years to come, it is very important that the noise due to that plant does not cause undue discomfort or any significant sleep disturbance. It is thus important that due cognisance be taken of the existing ambient noise levels and that the increase in this be minimised. A maximum increase of 3 dBA should be the objective.

NC25 is a graph of sound levels at different frequencies. Textbooks show these levels for NC20, NC25, NC30, etc. For example Figure 4.1 in ‘Noise Control in Building Services’ By Sound Research Laboratories Ltd. (Pergamon Press) shows them. When the individual Octave band sound levels are added up the total sound level for NC25 is seen to be c.35.6 dBA.

If the prior ambient noise level in a bedroom is e.g. 30 dBA, the total new noise level would be c.36.7 dBA. This is about 6.7 dBA higher than the WHO (World Health Organisation) Guidelines (1999) indicates for good sleeping conditions.

If the prior ambient noise level in a bedroom is 35 dBA, the total new noise level would be c.38.2 dBA. This is about 8.2 dBA higher than the WHO Guideline for good sleeping conditions. NC25 would exceed the night time LA90<sub>15min</sub> values in many rural and suburban bedrooms by 10 to 15 dBA, where night time (and some daytime) LA90 values of 20 to 25 dB are commonplace.

BS 8233:1999 ‘Sound insulation and noise reduction for buildings – Code of practice’ in Table 5, gives 30 LAeq<sub>T</sub> as a ‘Good’ standard, and 35 LAeq<sub>T</sub> as a ‘Reasonable’ standard for bedrooms.

These values are collected in the following Table 1.

Table 1 - Noise Levels and Sleep

Existing Level in Bedroom dBA	+ NC25 Added	Comment
30	c.36.6	Likely to be intrusive
35	c.38.3	Poor quality sleep likely
30	-----	A ‘Good’ standard *
35	-----	A ‘Reasonable’ standard *
30	-----	WHO guideline value
18-23 rural  closed)	-----	Existing night time LA90 in many and suburban bedrooms (windows

\* As per BS 8233:1999 ‘Sound insulation and noise reduction for buildings – Code of practice’

The Crossrail railway scheme, currently underway, crosses London from east to west. The Crossrail Information Paper D25 ‘Noise from Fixed Installations’, paragraph 2.7, states that Local Authorities (in London) prefer a sound rating level, for fixed plant, ( $L_R$  (Fixed plant)) which is no greater than  $L_{A90T} - 5$  dB. The rating sound level of a plant ( $L_R$ ), at a given location, is the measured noise level LAeq + a correction for tonality or impulsive character, if any. This correction factor, if required, would normally be +5 dB.

The  $L_{A90T}$  parameter is the ambient background noise level which is exceeded for 90% of any relevant 5 minute assessment period at night, in the absence of the noise under assessment, and (in the Crossrail scheme) is agreed with the Local Authorities.

The Crossrail scheme is expected to result in **substantially lower** indoor noise levels than NC25, due to fixed plant, at least in the quieter areas on that alignment.

The RPA INDOOR proposed noise level value of NC25, (or 35.6 dBA), for fixed plant, would be as high as many OUTDOOR ambient noise levels currently are. It is simply not an acceptable night time indoor noise level due to the proposed fixed plant, at any inhabited location.

It is considered, in this report, that NC25 is unacceptable as an additional indoor noise due to fixed plant which will operate on a 24/7 basis throughout the year, and for years to come. Such an indoor plant noise level would have an oppressive character, and a significant impact on sleep quality, particularly in the quieter areas along the alignment. Our recommendations are given in paragraphs 25(D), 25(E) and 25(F).

The quieter areas along the proposed alignment are expected to include houses or noise-sensitive receptors around the following proposed work sites :

Depot Site

Lissenhall Stop

Compound 2, Options 1 and 2

Compound 5 / Fosterstown Park & Ride

Compounds 12a and 12 b, Albert College Park

Compound 13 / Griffith Avenue Stop

Compound 14 / St. Patricks College Intervention shaft

Compound 15 / Drumcondra Stop

Other such low noise ambient locations may be seen when the background noise surveys are done.

### Conclusion

However, despite the data points noted previously, one can conclude, in the light of the following facts, that the Metro North project can be completed in compliance with the stipulated noise limits, and with adequate consideration of any noise-related community problems which may arise, and a speedy response to, and mitigation of, any noise excess identified. The facts referred to are :

- (1) the understanding that environmental impact assessment is a dynamic process – with the inputs and clarifications arising out of the assessment process, in this case in particular the Oral Hearing, and the contributions made by various contributors to the Oral Hearing;
- (2) the commitment from the RPA (Railway Procurement Agency) that the Contractor to be appointed will be contractually bound to undertake the additional ambient noise surveying needed, prior to any construction activity;
- (3) the commitment from the RPA that the Contractor to be appointed will be contractually bound to implement the steps and procedures indicated in the EIS and confirmed during the Oral Hearing, to ensure good management and effective control of construction noise impacts;
- (4) the range of noise abatement options available to the contractor;
- (5) the range of technical expertise and controls to be employed by the RPA and the contractors, and
- (6) the proposals by the RPA to maintain good communications and good relations with the local communities around each work site.

### **3. Pre-Construction Ambient Noise Surveys – External & Internal**

It is recommended that a Pre-Construction Ambient Noise Survey be done at each one of the proposed unattended external noise monitoring locations. The recommended minimum duration of these ambient noise surveys is one week (although 2 weeks would be better). The surveys should be continuous for the full duration of the survey, with measurements/readings taken at hourly intervals. These ambient noise surveys are required to be completed, in each such location, before any construction activity begins at that site or at any other nearby proposed Metro North construction site or compound within 0.5 kilometre.

It is recommended that these ambient noise surveys be completed, in each such location, before any enabling or utility works construction activity begins. However, where traffic flow changes are planned, it is considered appropriate that a 2 week duration survey can be composed of 1 week in the original situation + 1 week in the new traffic scenario.

**NOTE 4 :** The term 'Construction site' includes the proposed major construction compounds, the proposed park and ride sites, and the site for the proposed Bailey Bridge.

**(a) External pre-existing ambient Noise levels** will need to be established at a representative set of locations, for each significant work site. This will include residences, Schools, Hospitals (including the Veterinary Hospital at Ceim Dearg, Swords) Hotels and theatres – except for those establishments where agreements have been reached, with the RPA, which cover all relevant aspects of noise impact, where it is expected that the agreements will determine the course of action.

The appropriate ambient conditions, for accuracy of determination of the construction noise level, are those obtaining with each new road traffic scenario as required for the Metro North project.

**(b) Internal pre-existing ambient Noise levels** may need to be established in Hospitals and Theatres, except for those establishments where agreements have been reached, with the RPA, which cover all relevant aspects of noise impact. Here also the appropriate ambient conditions, for accuracy of determination of the construction noise level, are those obtaining with each new road traffic scenario as required for the Metro North project. However, both the original background ambient noise level and the new ambient level should be clarified for completeness of record, as it is considered appropriate to have a good record of the ambient noise conditions obtaining before any Metro North works begin.

For internal ambient noise readings in theatres, continuous monitoring is not considered essential, and averaging periods may be less than an hour – as little as 5 minutes - if desired, for daytime (0700-1900 hours) or rehearsal or show performance times.

What is recommended here is that an adequate and representative set of ambient noise readings be obtained, in the main auditoria and rehearsal rooms, at appropriate times. These may then be used for reference in assessment of future noise conditions. Internal bedroom ambient noise levels should be either estimated carefully, or measured if need be, over an adequate period, in reference to proposed fixed plant noise levels. The LA90 increase should not exceed 3 dBA,

**4. Recording and playback capability** It may be desirable to include recording and playback capability in the noise monitoring systems installed at some locations, in order to confirm, on analysis, the actual nature of any intrusive noise which may occur at some sensitive time in either an external or internal noise-sensitive location. Such recording/playback facilities are technically feasible, and can be triggered by a predetermined noise or vibration level or event.

**5. The Noise-related Role of the Contractor** – The contractor to be appointed will be contractually committed, it is understood :

- (1) To include an adequate Ambient Noise Baseline Survey in the pre-construction works. These construction works will include, at any worksite, any necessary utility or enabling works, which must precede the main project construction works. It will be necessary also to distinguish between the current pre-project ambient and the ambient with any necessary changes in the road and road traffic scenario which may change the ambient noise level during the construction phase. This latter ambient is what will need to be allowed for in determination of the construction noise level.

- (2) To implement and maintain the required noise measurement and processing instrumentation. This may include a web-based facility for community relations, which allows people to inspect the noise level scenario and history, at any given worksite. Such a system can have an option, also, to include a complaint registration facility by an affected local resident. Such a monitoring system can also have an option to include cameras, to aid in identification of the cause of any undesired or unexplained noise event.
- (3) To report on the measured and derived noise data monthly, to each Local Authority.
- (4) It is stated in 'Environmental Report for the Revised Design of Mater Stop', December 2009, paragraph 10.2.3, 'Mitigation Measures' that 'the contractor will be required to discuss proposed measures with RPA and the respective Stakeholders and residents as to how best achieve the limits'.

**NOTE 5 :** The contractor may decide to subcontract any or all of the required noise monitoring and processing and reporting to a specialist Noise Management service provider.

### **6. Noise Measurement Periods**

The tradition in some countries, including Ireland and the UK, is that daytime noise levels are measured in hourly periods. Nighttime noise measurement periods have usually been 15 minutes in Ireland, and 5 minutes (BS 4142) or 1 minute (Night Noise Act 1996) in the UK.

Periods of 15 or 20 or 30 minutes have also been used on occasion, in daytime, when it was deemed that the noise situation could be usefully analysed by such measurement periods.

Longer periods have also been used on occasion, for example 8 hours for night noise levels, and 12 hours for daytime construction noise levels. Twenty-four hour measures such as  $L_{den}$  in the EC, and  $L_{Day-Night}$  ( $L_{dn}$ ) in the USA are also used.

'Long-term' averages of these parameters are specified by some authorities, for example, the yearly average.

These longer periods give more blunt noise parameters, in that significant variations in noise level throughout the period are masked in the longer term average measures. The longer the averaging period is, the more extreme the individual variations can be. Thus in order to know when any high noise peaks occurred, and in order to take appropriate remedial action, the relevant required data is usually not accessible from such longer term measures (unless appropriate extra facilities are included in the instrumentation).

Our view is that the measurement and reporting periods should be short enough to be useful, without overburdening the system with a mass of figures, yet not so long that there is little detail to inspect. It is considered that 1-hour periods are the optimum basic measurement and readout time unit. These readings can then be used to compute period noise values as indicated in the conditions. In any event 1-hour time periods are required in any measurement related to, or which may be used for, assessment of noise levels within hospitals. One hour periods are also referred to in the Metro North EIS, in relation to comparison of the proposed tram operating noise levels, and the pre-existing hourly road traffic noise levels, on a 24-hour basis.

### **7. Creeping Background Noise Levels**

A 'creeping background' noise level means a gradual and often imperceptible increase in noise level over a period of time.

Every noise source in any given area, or which is audible in any location, adds a contribution to the total noise level in that place. Each place has its own recognisable normal soundscape, made up from

the types of noise and their respective levels, which go to make up the composite existing sound environment and noise level pattern there.

The characteristics of each contributing noise source vary. Sources may be long term or transient, steady in level or highly variable. They may be relatively bland (or featureless) in character, like

distant road traffic, or clearly tonal like the sound of a large saw in a sawmill. They may be of pleasant character like the trickling of a nearby stream, or highly unpleasant and disturbing like the sound of hammering nearby or of repetitive gunfire.

Sounds may be very welcome like that of a friend approaching, or most unwelcome like the steady unrelenting thump of a nearby music venue, coming through the structure of one's dwelling, at night, especially on a repetitive or ongoing basis.

A current noise climate which is acceptable at night – outside one's house - may be, for example, a level of 40 dBA Leq

NOTE 6 : dBA, A-weighted decibels, is the most common unit of noise measurement, although it is not appropriate in every situation. Leq is the equivalent continuous level, or the average level. These two symbols are often combined to read LAeq (the equivalent continuous, or average, A-weighted noise level).

A proposal to locate a new noise source in the area which would also generate a noise level of 40 dBA at that receptor location, would result then in a new total noise level of c.43 dBA Leq. (Due to the logarithmic nature of decibels and their addition). This is a distinct increase which may be clearly noticeable.

In order to minimise the increase in overall noise level, a planning authority may stipulate a limit of 35 dBA Leq for the proposed new source. The addition of 35 dBA to the pre-existing 40 dBA would result in an overall c.41 dBA Leq. If the new noise source were restricted to no more than 30 LAeq, the new total would be circa 40.4 LAeq. An increase of 0.4 LAeq is unlikely to be noticed on its own, unless there are some other disturbing aspects to the new noise source.

However, it is worth noting, that in relation to an industrial estate scenario, three noise sources causing a level of 30 LAeq each, at any given house or sensitive receptor, are equivalent to one such source of 35 LAeq. Similarly three sources of noise contribution 35 LAeq from each at any location, are equivalent to one noise source of 40 LAeq at that location.

A new noise source may be a new factory or quarry or sawmill or transport depot or motorway or airport runway or music venue or food takeaway venue or construction site. It may also be an extension of an existing plant, or an increase in hours of operation, or an increase in product throughput with concomitant increase in haulage traffic. Intensification of one kind or another will often result in an increased noise burden, and/or the associated noise levels.

It is desirable to minimise this increase in ambient noise level (this 'creeping background noise level') as much as possible. The values referred to above may be summarised in Table 2.

<u>Table 2 – Addition of Noise Levels (Creeping Noise Background)</u>			
	<u>Existing Noise Level</u>	<u>Additional Noise Level</u>	<u>Resulting Total *</u>
	40	40	43
	40	35	41
number	40	30	40 (40.4)
	35	30	36
	35	35	38
	35	35 + 35	40

In the context of Creeping Noise background, it is worth noting that in the Crossrail Information Paper D25 'Noise from Fixed Installations', paragraph 2.7, is stated that Local Authorities (in London) prefer a sound rating level, for fixed plant, ( $L_R$  (Fixed plant)) which is no greater than  $L_{A90T} - 5$  dB. The rating sound level of a plant ( $L_R$ ), at a given location, is the measured noise level

$L_{Aeq}$  + a correction for tonality or impulsive character, if any. This correction factor would normally be +5 dB.

The  $L_{A90T}$  parameter is the ambient background noise level which is exceeded for 90% of any relevant 5 minute assessment period at night, in the absence of the noise under assessment, and (in the Crossrail scheme) is agreed with the Local Authorities.

**NOTE 7 : BS 4142:1997** ‘Method for Rating industrial noise affecting mixed residential and industrial areas’ requires that, at night, the reference time interval for determining the specific noise level (of a noise source) is 5 minutes. That is  $T = 5$  minutes. Readings over 5 minute periods usually give some lower values of  $L_{A90}$  than those over longer periods.

## **8. Noise Impacts and Sleep Disturbance**

By definition noise is unwanted sound. It is unwanted because it either distracts people from activities which require concentration (like work or study), or it intrudes on other necessary activities (like sleep, rest or recreation). It can also interfere with face-to-face conversation, use of the phone, and enjoyment of music. Noise is a stressor, whereas a quiet natural environment, in any given location, is usually regarded as an asset, a place where rest & recuperation are facilitated. The quiet nature of the Belinstown area (the proposed Depot location) was commented on, by some of the local residents, in the course of evidence to the Oral Hearing.

Noise which has impulsive character like hammering, gunfire, loud shouting, heavy objects dropping on the ground, slamming of doors, strong revving of engines, use of car or train horns (especially at night) or the repetitive ‘thumping’ character of some music is often particularly disturbing and objectionable. Sounds which are tonal in character (such as a whistle, hiss, drone, or hum) can also be distinctly jarring to the human nervous system, and disturbing and tiring.

The most serious effect of intruding noise is often sleep disturbance. This is quite widespread in occurrence. It occurs from a variety of sources. It often occurs on a continuing basis. An occasional disturbance of one’s sleep is of relatively minor consequence, on a medium to long-term perspective. Such a sleep loss can usually be taken in one’s stride and later compensated for. The situation for many people, however, is where sleep disturbance is repetitive and ongoing, in some cases for years. This can occur on, for example, two or three nights a week from a music venue, or every night, and every weekend from an airport, or a roadway with little distance between house and road. Fans and cooling plant on factories, shops and food establishments can also cause noise related nuisance on a daily basis. Ongoing repetitive sleep disturbance from any noise source can have serious consequences for an exposed person, either in adverse health effects or one’s home life, or work life, or in terms of safety on the roads (for example when driving). Falling asleep at the wheel, by drivers, from fatigue or drowsiness, is reported to be relatively common, having, in some cases, fatal consequences. (See Table 1 – Noise levels and sleep)

## **9. Night time Noise - The Night Noise Guidelines for Europe (NNGE) 2009**

The Night Noise Guidelines for Europe 2009 are summarised as follows :

Night Noise Guideline	$L_{Night, Outside}$	40 dB
Interim Target (IT)	$L_{Night, Outside}$	55 dB

$L_{Night}$  is the night noise indicator described in the EC Directive 2002/49/EC relating to the assessment and management of environmental noise.

The Abstract of the NNGE states :

‘The WHO Regional Office for Europe set up a working group of experts to provide scientific advice to the Member States for the development of future legislation and policy action in the

area of assessment and control of night noise exposure. (Note - WHO is the World Health Organisation)

The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. In December 2006, the working group and stakeholders from industry, Government and non-governmental organisations reviewed and reached general agreement on the guideline values and key texts for the final document of the Night noise guidelines for Europe.'

'These guidelines are applicable to the Member States of the European Region, and may be considered as an extension to, as well as an update of, the previous WHO Guidelines for Community noise (1999).'

The Foreword of the NNGE states :

'The WHO Regional Office for Europe developed the Night noise guidelines for Europe to provide expertise and scientific advice to the Member States in developing future legislations in the area of night noise exposure control and surveillance, with the support of the European Commission.'

'Although these guidelines are neither standards nor legally binding criteria, they are designed to offer guidance in reducing the health impacts of night noise based on expert evaluation of scientific evidence in Europe.'

'The review of scientific evidence and the derivation of guideline values were conducted by outstanding scientists.

The contents of the document were peer reviewed and discussed for a consensus among the experts and the stakeholders from industry, government and nongovernmental organisations. We at WHO are thankful for those who contributed to the development and presentation of this guidelines and believe that this work will contribute to improving the health of the people in the Region.'

On the document cover page World Health Organisation 2009 is stated :

'The views expressed by authors, editors, or expert groups do not necessarily represent the decisions or the stated policy of the World Health Organisation.'

It is considered that the authority and value of the NNGE is, without question, widely accepted, internationally.

It is considered that the 2009 NNGE will come to be as widely regarded as the de-facto standard to be used for night time noise assessment, as was the preceding and complementary, and widely referenced, 1999 WHO guidelines.

It is considered also that the experts involved in producing the NNGE understand the minimal likelihood that overall night noise levels of  $40L_{Aeq_{Night}}$  will be widely attained in the near future. Thus the choice of 55 dB as an Interim Target.

What is desirable is that the current levels of night time environmental noise should, for the foreseeable future, not worsen significantly. It would be better if they could be reduced. However, in order to avoid significant deterioration of the night noise environment, alert proactive policies are required from planning authorities, which will limit the stealthy creeping up of night noise levels.

This requires the lowest possible additions to the night time noise load. In other words new night time long term noise sources should be required to contain their noise emissions to levels of, for example, 35  $L_{Aeq}$  or lower – at any noise sensitive receiver - in currently quiet areas.

We therefore consider that in areas which are essentially quiet rural in nature, in terms of soundscape an appropriate upper night time limit, outdoors, for new noise sources of a permanent nature is 35 LAeq<sub>15 Mins.</sub> (2200-0700) hours.

For construction sites, an appropriate upper night noise limit, in those very quiet areas, is considered to be 40 LAeq<sub>1 hour.</sub> (This will effectively rule out any external, or above ground level, use of heavy plant or machinery). For construction works in urban and suburban areas the Limit of 45 LAeq<sub>1 hour</sub> (2200-0700) hours is considered appropriate.

It has been stated elsewhere that perhaps the main weakness of the WHO NNGE document is that it fails to consider the practicality of actually being able to achieve any of the stated guideline values.

We consider that while they do not refer to creeping background noise levels as such, the WHO experts are aware of this stealthy process.

The WHO guidance on health based noise effects indicates what the desirable ambient night time noise levels are, and thereby shows how the noise limits for new sources could be derived. This will facilitate planners to minimise the creeping background noise effect. And for this guidance the Night Noise Guidelines for Europe (2009) is a valuable document.

However, even without any major academic studies on the subject, the widely experienced sense of peace and calm in what may be termed 'very quiet areas' is clear evidence that those areas, at least, are worthy of protection from the stealthy ingress of the creeping background noise effect. It is also of note that, by and large, the existing high night noise levels are mainly due to road traffic. This source is often quite bland in nature, and many people have found it to be an integral and even acceptable part of the sound environment in their locality.

Many other noise sources such as industrial or commercial sources have a quite different character – for example a tonality or an impulsiveness – which is more noticeable and intrusive than traffic noise of the same average level.

Thus, it is not a comparison of like with like to compare road traffic noise with other noise types of different character, (such as construction noise) without taking account of this different character.

#### **10. Noise Mitigation (Reduction) Measures**

The RPA have shown a clear commitment to control the levels of airborne noise, through design and mitigation, from within each of the respective work sites in this proposed project. Furthermore we have heard evidence, during the Oral Hearing, that where this is not fully possible, other mitigation options will be available, such as temporary relocation of residents. In some cases the application of extra sound insulation to an affected residence may be the preferred and agreed solution to an excessive noise level.

**British Standard BS 5228-1 : 2009** 'Code of practice for noise and vibration control on construction and open sites – Part 1 : Noise' gives a range of mitigation measures for noise control. These include Site planning, Control of noise at source, Controlling the spread of noise, noise of reversing alarms, haul routes, the use of distance, Screening, and other useful data. This includes a Table B.1 on 'Methods of reducing noise levels from construction plant'

The **RPA Construction Noise Management Plan** likewise gives guidance on a wide range of measures which will be actioned as needed. Most of the Noise Mitigation measures can and should be designed and built in before construction work begins. However there are some works which will not be confined to a simple clearly defined site. Examples of this are road works, utilities diversions, viaduct construction, tracklaying, and perhaps also, to some extent, the dismantling of old footbridges and replacing those with the proposed new bridges or crossings.

Accessibility or ready availability of suitable – and portable - noise barriers, or enclosures, will be important at times, particularly where, as in utilities diversions, mobile plant or normal operations are not confined to a definite location, but move along past numbers of premises at a rate determined by the nature of the work itself. Appropriate on-site management decisiveness and specialist supervision of mitigation measures on an alert ongoing basis will be needed to maintain effective control of noise emissions to minimise impacts – especially for any occasional night working which will be needed. And it is worth bearing in mind that any such portable barriers used during the initial utilities diversions will be available for later use during the main construction phases of the project.

Furthermore, it is considered that the standard site-boundary barriers of proposed height 2 metres, will not suffice in a number of noise mitigation situations. Higher barriers, up to 4 or 5 metres, or even 6 metres, as the EIS proposes in Albert College Park, may at times be needed. It will be virtually essential, for good noise control during night demolition of footbridges, for example, to have suitable portable barriers on hand, in sufficient quantity, in order to effectively minimise noise levels as far as possible, since such works have the potential to generate noise levels over 70 dBA at numerous houses, and even on a short term basis such noise levels could be very disturbing at night, particularly since those works are likely to be significantly impulsive.

It will be important that there be an adequate supply available, of those barriers deemed necessary to progress this project without undue negative feedback about the associated construction noise. Suitably rugged construction and a means of moving barriers on demand, will also be needed. There may be benefit in some places for the use of bi-planar awning-type barrier constructions – if there are local constraints on barrier height. Any barriers in place for the medium to long term future may also benefit people from having suitable murals on them. These can act to ameliorate any negative impact felt by residents who live nearby.

**11. Construction Noise :** Construction activities are a common source of noise. These by their nature are usually of limited duration, since, when a structure is built and finished, the associated noise usually ends.

People realise, too, that the building or improvement of a road, or bridge, is for the common good – for everyone's benefit. Likewise people realise that a railway line and its associated stops or stations, is intended for their benefit as well as everybody else's.

For these reasons people have a greater tolerance for construction noise than for industrial noise, or for transport noise. This means that planning authorities can allow higher noise levels to occur at noise-sensitive premises, from construction, than they do from more permanent noise sources. There is, of course, a limit to what people can tolerate, particularly when the noise persists for long periods of time. Construction of Metro North at many of the proposed sites is projected to last up to 3 or 4, or even 5 years – although the noisier phases of work may only last for c.12 to 15 months. This is a long time for people to be exposed to high construction noise levels, all day, every day, for 6 days per week, and every effort should be made to minimise those levels as far as possible.

And with such sustained works in prospect it is important to allow as much as possible of the weekends to be free of such noise - Saturday afternoons, Sundays and Bank Holidays particularly.

**NOTE 8 :** In this context it is considered that there is merit in considering the option of allowing construction work to proceed on Saturdays at the Monday to Friday pace (Noise limit) for shorter hours, say up to 1400 hours, rather than allowing it to proceed to 1630 hours at reduced pace (lower noise limit).

**12. Train and Railway noise** have some characteristics which have resulted, over the years, in train noise being the most acceptable type of transport noise. Both road traffic noise and aircraft flight noise are more annoying than railway noise for the same average noise level. Thus a

railway track causing an average noise level of, say, 55 LAeq is as generally acceptable as a road traffic or aircraft noise source generating a level of 50 LAeq over a given period of time. This is called the 'Rail bonus' of c.5 dBA. It has been established by research by a number of authorities over the years.

This applies only to normally running train noise. It does not apply to noise from train shunting, or from parked trains with engines running, or from loading/unloading activities in rail yards, nor from the public address system in a railway station. Neither would it cover noise from any unnecessary use of train horns. Likewise any similar activities from road vehicles in freight yards, or from ground running of aircraft engines, are not covered by the term 'transport noise'. Those other activities are normally regarded as Industrial type noise. Similarly, trains which generate an unusual or raucous noise, over and above the normal sound of running trains, are not excused such noise by virtue of the 'Rail Bonus'.

**NOTE 9 :** 5 dBA is an approximate figure for the 'rail bonus'. International Standard ISO 1996-1:2003 'Acoustics – Description, measurement and assessment of environmental noise' – Part 1 states that the Railway 'Level adjustment' can be from -3 to -6 dB, depending on the type of train. It also states that 'The Railway adjustments do not apply to long diesel trains or to trains travelling in excess of 250 km/h.'

It is understood that if the operational noise emissions from any trains or trams should be of abnormal or disturbing character, that is having some distinctly **unusual** tonality or impulsive character, then any such unusual noise emissions should be assessed in the same way as industrial noise, excluding also any Railway Level Adjustment. This is particularly important during night time hours.

This is to acknowledge (i) that any such unusual tonality or impulsive character takes such a noise source out of the pure transportation noise category, putting it into a more disturbing noise type, and (ii) the Environmental Protection Agency (EPA) recommendation for industrial sources (Scheduled Activities), that, at night time, there should be no audible tones or impulsive character from any such industrial noise, irrespective of the noise level. (EPA Guidance Note for Noise in Relation to Scheduled Activities, 2<sup>nd</sup> Edition, paragraph 3.2)

In EIS, Volume 2, Book 4, paragraph 4.4.2.2 'Operation' is stated ' – for mitigation to be considered. In adopting this (NRA) guidance for the proposed scheme, it is considered only appropriate where ambient noise levels are to be increased by noise from LMVs in operation.'

Also -

'Hence the condition for the design goal to be applied to railway noise shall be that railway noise must be above road traffic noise as measured in any hour of the day or night, in terms of LAeq<sub>1hour</sub>.'

It is here considered appropriate to recommend that an adequate road traffic noise survey be conducted, at each sensitive receptor where Metro North noise could exceed road traffic noise – in terms of LAeq<sub>1hour</sub>, before construction starts. This survey could be incorporated in the pre-construction ambient noise survey recommended, with appropriate emphasis on the road traffic component of the levels measured – especially the night time levels. The purpose of this survey is to determine whether a modified track form might be required in any location to achieve, in any night hour especially, an acceptable LAeq<sub>1hour</sub> due to railway noise.

### **13. Road Traffic Noise**

Road traffic noise is now an inevitable part of everyday life for most people in the developed world. It is generally regarded as acceptable, unless the levels are very high, especially at night

time, and more especially if there is a noticeable fraction of heavy trucks or buses, or at times, tractors.

For many people road traffic noise has become such an accepted part of life that they literally do not notice it normally. And, importantly, it does not disturb or intrude on their daily activities, or cause them any nuisance or worry. However, when there is appreciable increase in traffic noise, it can become disturbing. Apart from the simple noise factor, there can be other aspects of traffic which cause more concern, such as safety of children or walkers or cyclists, on what was previously a quiet road, particularly if there are no footpaths. This aspect, and the noise factor, is magnified if there are substantial numbers of heavy vehicles involved.

The Metro North project is expected to cause some traffic changes, which in some areas will cause extra traffic on previously quieter roads. In some cases this will involve construction HGV traffic. On some other roads it will not include any construction traffic.

It takes substantially greater volumes of road traffic to cause significant increases in road traffic noise. For example, if traffic speed remains the same, it takes a doubling of traffic numbers to increase the noise level by 3 dBA. In purely noise terms, this is usually a just detectible noise increase. However there are some locations where the projected traffic volume increases could cause noise level increases which might require remediation. Such a road is Glasnevin Drive, (Table P15, Scheme Traffic Management Plan, Version 8, Appendix P).

Construction Heavy Goods Vehicular traffic is unlikely to add appreciably to road traffic noise, as the designated travel routes, for the most part, are either on roads, such as the R132 and M1, with existing high traffic volumes which will tend to 'swamp' the construction traffic noise, or on roads with little residential content, as through the Phoenix Park.

**14. Noise Parameters :** It is recommended that noise be measured in 1-hour intervals, as required in connection with assessment of internal noise levels in hospitals, and that this measurement regime be applied throughout the proposed scheme at all unattended noise monitoring locations. (An exception to this is the internal noise ambient in theatres, where we do not envisage a need for 24/7 noise monitoring, nor is it considered that 1 hour periods are ideal for this purpose.)

**Ambient Background noise and Construction Noise :** The parameters to be recorded/computed and reported (24/7) for these noise surveys at each location should be as follows :

**Monday to Sunday :** Location, Date and Time, LAeq<sub>1hour</sub>, L<sub>Amax</sub><sub>Fast 1Hour</sub>, LA10<sub>1Hour</sub>, LA90<sub>1Hour</sub>, all to be measured, on the 'Fast' meter response setting, (0000-2400 Hours,);

**Monday-Friday :** LAeq<sub>12 Hour (0700-1900 Hours)</sub>, and LAeq<sub>3Hour (1900-2200 Hours)</sub>.

**Saturdays :** LAeq<sub>8.5Hour (0800-1630 Hours)</sub>, and LAeq<sub>5.5Hour (1630-2200 Hours)</sub>,

**Alternatively -** LAeq<sub>6Hour (0800-1400 Hours)</sub>, and LAeq<sub>8Hour (1400-2200 Hours)</sub>, external to theatres and/or generally

**Sundays & Bank Holidays :** LAeq<sub>8.5Hour (0800-1630 Hours)</sub>, and LAeq<sub>5.5Hour (1630-2200 Hours)</sub>

The 2-week long pre-construction noise level averages are required to be derived at the end of each week, for each of the following two parameters :

Weekly Weekday(Mon-Fri) LAeq<sub>12Hour (0700-1900 Hours)</sub>, and

Weekly Weekday(Mon-Fri) LAeq<sub>3 Hour (1900-2200 Hours)</sub>.

The pre-construction noise level records and averages should be forwarded to the relevant Planning Authority, at the end of each relevant period of each survey.

**15. Microphone Placement :** 'Façade' noise levels have historically been measured, not at the façade itself, but rather at 1 metre out from it.

The reason for this is that if a window were used for microphone locations, for unattended noise measuring, the window reveals were likely to give sound reflections which increased the readings

unacceptably. Thus Microphones were often fitted to poles which protruded out through the windows at 1m out from the facades, to avoid the undesirable inaccuracy likely from the window reveal reflections. Alternatively they were mounted on tripods at 1 metre from the facades.

However this practice is impractical in some of the locations along the proposed railway alignment. For example, in St. Joseph's Avenue, Drumcondra, the one-storey houses front on to a public road and footpath which is to remain open during the construction works. It is quite impractical to have microphones standing out 1m from the facades. Likewise at Nevinstown Lodge.

It is possible also, at some other locations, that a neater arrangement may be preferable.

In some of the potential unattended monitoring locations microphones standing out 1m from the walls would constitute an increased security risk, whereas microphones mounted on a façade would be more discreet, less noticeable, and therefore less likely to attract unwanted attention. It is therefore recommended that the new type of Surface mounted microphones be attached directly to those facades, in the middle of the larger areas of brickwork available for such attachment – not on either windows or doors. These microphones can be readily connected, via suitable cabling, to the required instrumentation, which could be located on the very close construction site. This would avoid any need to place boxes inside residents' homes, with a need for ongoing inspection visits. The microphones would likely also need to be protected by a suitable type of protective screen, which screens are available in suitable form. This arrangement may also be suitable for the houses in Leo Street and the very close Mater Stop site.

#### **Noise Monitor/Microphone Locations**

It is recommended that (a) Microphone height above ground level should be from 1.5 to 1.8 metres; (b) that unattended noise monitors be placed at or on the most construction noise-exposed house and façade, which has a window or door, of each such house, in each of the following locations :

(Most of these locations are to be found in the Noise Impact Drawings in the EIS, Volume 3, Book 1, with the exception of the two hotels in Ballymun, Area MN104, St. Alphonsus Road/Avenue locations, and the North Circular Road location, in Area MN106, and the multi-level multi-receptor (MLR) locations in Parnell Square East.

The Clifton Court Hotel, in Area MN107, another MLR receptor, should be treated in the same way as the other MLR receptors on the alignment. This, and other such receptors, may be adequately monitored by a representative programme of attended monitoring in or outside sensitive rooms indicated by the management.

#### Table 3 – Recommended Unattended Noise Monitoring Locations.

Area MN101\*: House adjacent to NML 1 in 'Noise Impact' Sheet 1 of 4, EIS Vol.3, Book 1

MN101 C1, Batter Lane, opposite multistorey car park

MN101 C2, Batter Lane, adjacent to proposed Mounds

MN101 C4, Residence close to alignment

MN101 C7, Close to alignment

MN101 C11, Newcourt, close to alignment

MN101 C12, Seatown West, close to alignment

MN101 C23, Seatown Walk,

MN101 C24, Seatown Walk

MN101 C25, Castle Park

MN101 C26, Ashley Grove

MN101 C28, Ashley Avenue

MN101 C29, Foxwood

\* See Recommendations 24(T) and 24(U).

Note 10 : It is recommended that representative attended monitoring should be done at any other location considered necessary. In particular we recommend that representative attended monitoring should cover any noisy night work, especially at those houses without ongoing monitoring, for the demolition and removal of the Estuary and Seatown and Chapel Lane and Malahide Footbridges, and the construction of their replacement structures. For night time monitoring the microphone height near noise-sensitive (2-storey) receivers should be at least 4 metres above ground.

We also recommend that representative attended noise monitoring should include the Tigin Montessori School when operational, during the works on the nearby bridges and tracklaying.

Area MN102\* :MN102 C1, Carlton Court  
MN102 C3, Carlton Court  
MN102 C4, Carlton Court  
MN102 C5, Travelodge Motel east of Pinnock Hill Roundabout  
Ceim Dearg Veterinary Clinic  
Ceim Dearg Residence  
MN102 C6, Close to alignment  
MN102 C7, Willows  
MN102 C9, Junction of Dublin Road and Nevinstown Lane  
Nevinstown Lodge, adjacent to works  
MN102 C11, Residence adjacent to Compound

Area MN 104\*: MN104 C3, Santry Lodge West, close to compound  
MN104 C4, Residence on Ballymun road  
MN104 C5, Residence on Ballymun road  
MN104 C6, Residence on Dual Carriageway

Area MN 105\*: Day's Hotel, Ballymun Road/Santry Avenue (MLR)  
Travelodge Hotel, Ballymun (MLR)  
MN105 C5 Ballymun Civic Centre (MLR)  
MN105 C6, Gateway View Flats, Ballymun Road (MLR)  
MN105 C7, School on Ballymun Road  
MN105 C8, Shanliss Road/Ballymun Road Junction  
MN105 C9, Library and/or School, Ballymun Road  
MN105 C10, Ballymun Road residence  
MN105 C11, Ballymun Road/Glasnevin Avenue Junction  
MN105 C12, Ballymun Road, Church  
MN105 C13, Ballymun Road residence  
MN105 C14, Ballymun Road residence

MLR                      Albert College Drive                      The Albert College estate is an  
at a                      Albert College Court                      area, with noise reception likely  
and                      MN105 C15, Albert College Grove                      number of houses on each road.  
                         MN105 C16, Ballymun Road/St. Pappins Road                      Liaison with the Local Authority  
recommended.                      MN105 C17, Albert College Crescent                      or the residents is

Albert College Lawn

\* See Recommendations 24(T) and 24(U).

Note 11 : (MLR) – These venues are Multi-level, and/or Multi room/resident Receptor locations. It is advised that the Local Authority and/or the management, or residents, be consulted in regard to the optimum monitoring locations in each venue, and the optimum mix of attended and/or unattended noise monitors.

**Area MN 106\*:** MN106 C5 The Rise

MN106 C6 Griffith Avenue

MN106 C7 Griffith Avenue

MN106 C8 Walnut Rise

Griffith Lawns, at a representative house

MN106 C9 St. Patricks College (At rear of a suitable Ferguson Road Residence recommended)

MN106 C10 St. Patricks College (At rear of a suitable Ferguson Road Residence recommended)

MN106 C11 St. Patricks College (MLR)

MN106 C12 St. Alphonsus Road/Avenue - 7 Monitors \*

Rear of No.52 Lower Drumcondra Road

MN106 C13 St. Josephs Avenue – 9 Monitors \*

MN106 C15 Mater MUH – Has agreement with RPA

MN106 C17 Leo St. – 15 Monitors \*

North Circular Road, at a representative house opposite the work site/HGV exit location

MN106 C18 Mater Private Hospital; has an agreement with RPA

\* See Recommendations 24(T) and 24(U).

**Area MN 107\*:** MN107 C1 Findlaters Church (MLR)

Cassidys Hotel, Cavendish Row (MLR)

St. George Hotel , 7 Parnell Square East (MLR\*)

Charles Stewart Guesthouse, 5/6 Parnell Square East (MLR\*)

Colaiste Mhuire Gaelscoil , 4 Parnell Square East (MLR\*)

MN107 C2 Parnell Sq./Gardiner Row

MN107 C3 Gate Theatre (MLR)

MN107 C4 Parnell Sq. East

MN107 C5 O'Connell St.

MN107 C6 O'Connell St.

MN107 C7 O'Connell St.

MN107 C8 O'Connell St.

MN107 C9 Westmoreland Street, Hotel (MLR)

MN107 C10 Westmoreland Street

MN107 C11 Fitzwilliam Hotel – Has agreement with RPA

MN107 C12 RCSI (MLR)

MN107 C13 St. Stephens Green North

(MLR\*) Although these three venues are close to one another, the proposed works are so close that each venue will require individual appropriate noise monitoring, whether attended or unattended. It is recommended that, as with the other (MLR) venues, the Local Authority and /or the venue management be consulted as to the best mix of attended and/or unattended noise monitors to use, and the most sensitive locations.

The Clifton Court Hotel, Eden Quay, with bedrooms on 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> floors, is a multilevel multireceptor (MLR) location, virtually overlooking the proposed Bailey Bridge site at c.50 metres away. It is recommended that, as with the other (MLR) venues, the Local Authority and /or the venue management be consulted as to the best mix of attended and/or unattended noise monitors to use, and the most sensitive locations.

\* See Recommendations 24(T) and 24(U).

**Table 4 – Some Recommended Locations for Attended Representative Noise Monitoring**

- |  |                              |
|--|------------------------------|
| 1. St. Stephens Green North                      | 2. Gaiety Theatre            |
| 3. Trinity College                               | 4. Abbey Theatre             |
| 5. Gresham Hotel                                 | 6. Eccles Street (West side) |
| 7. Houses on the West side of Ballymun Road      |                              |
| 8. Halting Site in Area MN103                    |                              |
| 9. Tigin Montessori School                       |                              |
| 10. Any business premises where it is requested. |                              |

**16. Maintenance Works**

Maintenance works will be required in two respects (a) for plant and equipment used in the construction phase of the works, and (b) for the permanent infrastructure (the railway lines) and associated power and support plant, including sound systems, ventilation equipment, electrical substations, as well as for the wheels of the trains, the rail tracks, and train washing plant. Maintenance is required to correct for any excessive noise due to wear and tear, as well as for any broken engine silencers, mufflers, covers, or any barriers or enclosures which may need repair. Such causes of unnecessary extra noise generation are usually relatively simple to repair or replace.

**17. Management and Supervision**

The RPA it is understood, will have overall management and ongoing supervision of the proposed works. The RPA has proposed, and confirmed during the Oral Hearing, a multi-tier system of project management. There will be on-site management and supervision by the Contractor; there will be an RPA team of 60+ people liaising with the contractor and monitoring and auditing the day-to-day, and week-to-week, activities; and there is proposed an ‘Expert Panel’ who may be consulted when a more difficult problem or situation arises.

In the RPA ‘Construction Noise Management Plan’, in paragraph 4.1 is stated ‘RPA has put in place a continuous improvement process for noise as part of the detailed site design process and continues to implement all reasonable and feasible noise source controls necessary to reduce noise from plant and equipment.’ This clearly requires alert ongoing attention to what is occurring on each, and every site, and attention to the noise monitoring results, with the capacity and authority to respond promptly to any noise excess. It is important that there be at least one (1) named person, on each major work site, with the appropriate knowledge, and sufficient authority to make any changes deemed essential for any noise problem which may arise.

It is also proposed to appoint suitably qualified people who will be assigned ‘ownership’ of each specific type of risk, at each site.

Noise is, of course, only one of the factors to be managed. But there is proposed a team of specialists, including noise specialists, who will be on hand, and at short notice, it is understood, to advise on noise related matters which require effective decisions to be made rapidly.

**18. Demolition Works**

Demolition is another aspect of construction which requires to be done, in order to clear a site for the actual planned construction. A significant demolition operation is required on the site for the Drumcondra Stop. The existing structures must be removed before construction of the actual stop

can commence. This work will cause some noise generation which will require to be controlled in the normal way. At places like St. Josephs Avenue, where the site boundary wall to be demolished is very close to the houses, it is important that any upgrade of residential sound insulation deemed necessary, as per Recommendation 24(H), should be completed before the demolition work begins.

**Enabling Works** : In some areas, for example in Areas MN105, MN106 and MN107, it will be necessary to relocate water pipes or telecommunications lines, power cables or a transformer. Such works require excavation of roads and may necessitate traffic diversions. Noise will be generated in the course of these works, and it will be necessary to control the consequent noise levels to avoid any undue noise nuisance. Where Barriers might be the optimum mode of noise control they should be in place in sufficient quantity, and of appropriate design, to be as effective as is needed. These barriers will then be available for use during the main project works. There is potential for unmitigated noise levels at times, at some residences/receptors, in excess of 75 dBA. Thus appropriate noise monitoring, and control will also be needed at these work locations, particularly during any evening work, more especially still, should there be any night working required. It should be borne in mind that there are a number of hotels, near the alignment, in areas MN105 and MN107, as well as the hospitals in areas MN105, MN106 and MN107, in addition to the ordinary residences along the alignment.

#### **19. Bailey Bridge**

The site of the temporary Bailey-type Bridge to be built just East of O'Connell Bridge is close to the Clifton Court Hotel, which virtually overlooks the proposed site at c.50 metres. The Abbey Theatre is located at just c.70 metres away.

Construction of this bridge will involve a range of plant, including a Piling Rig. It is understood that piling may be of the percussive type. There is potential for unmitigated noise levels at times, in excess of 75 dBA. Thus appropriate noise monitoring, and control will be essential at this location, particularly during any evening work (from 1900 to 2200 hours) or early morning work (0700-0800 hours). It may be necessary at this location, to fix noise barriers on to the river wall, or on scaffolding along the wall. This is one of the numerous locations where protection of hotel and other residents who live or sleep or work on the 2<sup>nd</sup>, 3<sup>rd</sup> or 4<sup>th</sup> floors of a building will be required.

#### **20. Instrumentation**

The noise measuring instrumentation (microphone and signal processing equipment) should be of Class 1 precision grade, as per Irish Standard I.S. EN 61672-1:2003 'Electroacoustics – Sound Level Meters – Part 1 : Specifications (IEC 61672-1:2002). Measurements of airborne noise should be taken with the 'Fast' meter response setting. This is important, especially for the LAmax parameter.

The system should be calibrated as per manufacturer's instructions and/or International Standards.

Unattended long-term monitoring needs to be supplemented by short-term attended monitoring, which allows for confirmation of the construction noise level, and identifies any significant other noise contributor sources, which may or may not have been previously identified. Thus the accuracy of both the current baseline noise level reading and the construction noise level can be confirmed as and when this may be needed.

#### **21. Significance of Noise Impact**

The Oxford Dictionary defines 'significant' as 'sufficiently great or important to be worthy of attention' or as 'noteworthy'.

BS 5228:2009 'Code of practice for noise and vibration control on construction and open sites – Part 1 : Noise' defines construction noise levels to be 'significant' when the total noise (pre-

construction ambient noise plus construction noise) exceeds the pre-construction ambient noise level by 5 dB or more. This is subject to lower cut-off values of 65 (daytime), 55 (evenings), and 45 (Night time) LAeq<sub>period</sub>. It has a minimum time requirement of either (a) 10 working days in any 15 consecutive day period, or (b) over 40 days in any 6 month period (unless shorter works are likely to result in significant impact.)

In other words it does not consider specifying for daytime levels lower than 65 LAeq<sub>period</sub>, evening levels lower than 55 LAeq<sub>period</sub> and night time levels below 45 LAeq<sub>period</sub>.

The EIS for the proposed Metro North project defines 'Significance' of daytime construction noise as follows :

The proposed Noise Criteria are 75 LAeq<sub>Period</sub> (Urban areas) and 70 LAeq<sub>Period</sub> (Rural areas) 'Significance' is defined as the boundary between 'Slight impact' and 'Moderate impact' or 3 dB in excess of the criterion. Thus daytime construction noise is considered to be 'significant' when the level reaches 78 LAeq<sub>Period</sub> in Urban areas, and 73 LAeq<sub>Period</sub> (Rural areas) The period is 12 hours (0700-1900 hours).

It is considered that these levels are well in excess of those that could be described simply as 'noteworthy'. We consider that 73 LAeq<sub>12hr</sub> is a High noise level, and that 78 LAeq<sub>12hr</sub> is verging on intolerable, for the proposed construction durations.

The Metro North EIS 'significance' level is at least 3 dB higher than that defined in BS 5228:2009, in all but the initially very noisiest locations.

NOTE 12 : In view of the applicant's request for a noise criterion of 75 LAeq<sub>12 hr</sub> – and bearing in mind the importance of this application - we recently (June 2010) took the opportunity to acquaint our senses anew with Levels of 72 LAeq (+ or – 1dB), and 74 LAeq (+ or – 2 dB) from a Drilling Rig on a building site, seeking some confirmation of the acceptability of the requested 75 LAeq. However, based on that experience, any noise level higher than 70 LAeq<sub>Period</sub>, can not be recommended without safeguards for affected residents, for a project likely to generate substantial noise for many months. (The periods to be as defined in this report.)

NOTE 13 : The recommendation is for a daytime Criterion of 75 LAeq<sub>0700-1900</sub>, along with safeguards for permanent residents when a level over 70 LAeq<sub>0700-1900</sub> is predicted, or occurs, at any residential facade.

NOTE 14 : In the Inspector's report dated June 2007 on the Oral Hearing for the Northern Parallel Runway (Ref Proposed. 06F.217429) at Dublin Airport, R.T.Taylor in the Recommended Conditions, stated that 'No construction work shall be carried out except when the noise levels do not exceed the maximum permissible noise levels at the façade of occupied dwellings set out in the National Roads Authority publication "Guidelines for the Treatment of Noise & Vibration in National Road Schemes (Revision 1, 25 October 2004)" or as subsequently amended or replaced.'

Damian Kelly, of AWN Consulting, in his Brief of evidence, October 2006, to the Northern Parallel Runway Oral Hearing, stated :

'In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the National Roads Authority (NRA) publication Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Revision 1, 25 October 2004), which indicates criteria and hours of operation as set out in Table A.1.

‘Given the nature of the proposed development’s construction activities, these noise limits are considered appropriate in this instance. They are based on values adopted in respect of other major infra-structural projects and have been previously conditioned by An Bord Pleanala (e.g. M50 Motorway Upgrade Scheme 2004, planning decision reference 06D.ER.2034).’

Table A.1

Days and Times	Noise Levels dB(A)	
	LAeq <sub>1hr</sub>	LA <sub>max</sub>
Monday to Friday 0700 to 1900	70	80
Monday to Friday 1900 to 2200	60	65
Saturdays 0800 to 1630	65	75
Sundays and Bank Holidays 0800 to 1630	60	65

Table A.1 Maximum Permissible Noise Levels at the Façade of Dwellings during Construction

### Significant Noise levels in Crossrail Project in London

The Crossrail project is a new railway line across London from East to West, currently under construction. This project is considerably larger than the proposed Metro North railway line, passing through 23 London Boroughs.

BS 5228:2009 defines construction noise levels to be ‘significant’ when the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more. The Crossrail Environmental Statement (ES) uses the BS 5228:2009 definition of significance.

In Volume 6(a) of the Crossrail ES, Appendix B3, Noise and Vibration, in Tables are given the Noise Survey results for 7 day ambient noise monitoring at 88 sites along the alignment, along with the results for 24-hour and 3-hour noise surveys, at a further 42 and 80 sites, respectively.

Based on the 12 hour Day (0700-1900) results, and the above 5 dB increase, it can be deduced that the average construction noise level, for the 5 weekdays (Monday-Friday), over the 210 sites measured, at which 12 hour daytime construction noise becomes ‘significant’ is c.69 LAeq<sub>Daytime</sub>.

This Crossrail average ‘significance’ value, of 69 LAeq<sub>12hour</sub> for construction noise, is c.9 dBA lower than the proposed Metro North ‘significance’ figure of 78 LAeq<sub>12hour</sub>.

It should be pointed out that the range of daytime ambient noise levels LAeq, given in the Crossrail EIS was from 49.5 to 78.9 – a range of almost 30 dBA. The corresponding ‘significant’ construction noise levels could range from 65 LAeq to c.82 LAeq.

Of course there are locations where, based on high ambient noise levels, a high construction noise level is reasonably considered as simply ‘significant’. But it is not at all appropriate to consider 78 LAeq as just ‘significant’ in an obviously sheltered and quiet area like St. Joseph’s Avenue, Drumcondra, nor in a number of other clearly quiet areas along the proposed alignment.

In St. Josephs Avenue the proposed ‘significant’ noise level of 78 LAeq would be 20 to 22 dB above the brief ambient readings shown in the EIS for NML27 (Vol.3, Book 2, Table 1.5). The proposed ‘significance’ level of 78 LAeq is also 13 dB higher than the 65 LAeq which would apply if the BS 5228 procedure were followed.

It is therefore considered that the 78 LAeq ‘significance’ level is distinctly too high, and that 78LAeq<sub>Period</sub> is more likely to be considered ‘Intolerable’ than ‘Significant’ by most people.

For these reasons we consider that the appropriate daytime construction noise criterion in St. Josephs Avenue, and in other locations, without further safeguards, should be 70 LAeq<sub>period</sub>. (The periods to be as defined in the recommended conditions.) For the recommended 75 LAeq<sub>period</sub> it is

considered essential that this must be accompanied by a suitable level of normal residential sound insulation (excluding hotels and guesthouses – overnight venues).

## 22. Some Noise Levels in Context

It is difficult to appreciate the nature and implication of various noise levels, especially for the non-technical ‘layman’. Therefore the following table is given to help in such appreciation.

Table 5 - Some Noise Levels in Context

Noise Level	Description	Reference
70 LAeq <sub>1Hour</sub>	Limit at dwelling facades, 0700-1900Hours, Monday-Friday, Construction	NRA(National Roads Authority)
55-63 LAeq <sub>0700-2300</sub>	Planning Conditions for new dwellings should ensure an adequate level of protection against noise	PPG24 (UK) for Road Traffic *
63-72 LAeq <sub>0700-2300Hours</sub>	Planning permission should not normally be granted for new dwellings	PPG24 (UK) for Road Traffic *
70-75 L <sub>dn</sub> (dBA) Second	Residential use compatible, IF sound insulation=30 dB, for Ground vehicle noise	Karl Kryter ‘The Effects of Noise on Man’, edition, Table 12.11,
70 LAeq <sub>1hour</sub>	Noise Insulation Trigger level 0700-0800,(Mon-Sat); 1800-1900;(Mon-Fri)	Crossrail Criteria (C.C.)
65 LAeq <sub>3hour</sub>	Noise Insulation Trigger level 1900-2200,(Mon-Fri); 1400-2200;(Sat)	Crossrail Criteria (C.C.)
78 LAeq <sub>c.15Min.</sub>	Virtually intolerable, Drilling Rig noise	Personal experience (c.1980)
74 LAeq <sub>c.5min</sub>	Very uncomfortable, Drilling Rig noise	Personal experience (June 2010)

\* PPG24 is Planning Policy Guidance 24 : Noise (1994). This indicated that the maximum external noise level which the noise insulation package detailed in the Noise Insulation Regulations can reduce to acceptable internal levels was 72 dBA. (Institution of Civil Engineers Briefing Sheet, July 1996). (Consequently higher external noise levels would ideally involve a higher specification sound insulation package, such as, perhaps, that used around Schipol Airport in Amsterdam.)

NOTE 15 : 70-75 L<sub>dn</sub> means 70-75 LAeq<sub>16hr Daytime</sub> and 60-65 LAeq<sub>8hr Night time</sub> (USA)

NOTE 16 : The above PPG24 noise level of 72 dBA is a ‘Freefield’ level. It is equivalent to a ‘Façade’ level of c.74.5 dBA. (A façade noise level includes the reflected sound). (C.C.) These trigger noise levels have some accompanying noise duration requirements also.

**23. Hours of work** for construction sites are regulated by planning authorities. A twelve hour day (0700-1900 hours) is common. Occasionally evening work is also allowed, up to 2200 hours. Night work (2200 to 0700 hours) is usually restricted to emergency works, or works which require temporary curtailment of road traffic. In relation to this proposal, it is acknowledged that the Railway Procurement Agency, in recognition of the importance of undisturbed sleep for potentially affected people along the proposed alignment, have stated their commitment to avoidance, as much as possible, of night work which would have a noisy character. It is recognised, however, that works within tunnels, and within Stop ‘boxes’ which have been ‘roofed in’, and which therefore do not disturb any person’s sleep in any nearby premises, are acceptable.

It should be understood that these ‘works’ include the use of any and all vehicles used by workers going to or from the sites concerned. Thus it is expected that there will be no disturbing engine noise or noisy door slams or other disturbing noise from any such vehicles at night. Likewise loud voices, at locations where residents could be disturbed, are to be avoided at night.

The normal work hours proposed for the Metro North project, and understood to be agreeable to both Dublin City Council, and to Fingal County Council, are as follows :

Monday to Friday      0700-1900 hours, daytime, and 1900-2200 hours, evenings.

Saturdays              0800-1630 hours

On Sundays & Bank Holidays and outside the above hours, it is understood that any works needing to be done, will need the explicit approval of the relevant Local Authority – except for any emergency works which may be needed.

On Saturdays lower noise limits are recommended from 1400 hours onwards, in order to facilitate matinee performances in theatres and cinemas, where construction noise might intrude.

Indeed, it is considered that there is merit in allowing the same noise limits on Saturdays, as on Monday to Friday, and that those Saturday noise limits be generally limited to 0800-1400 hours.

Acknowledging that there are core hours of work as indicated above, the general approach adopted in setting the noise level conditions is, following the proposal in the EIS, to recommend appropriate noise levels for daytime, evening and night time, and to allow the contractor to work as he wishes, within those recommended noise criteria. For example it is clearly not necessary to restrict work within tunnels or enclosed stop boxes, when such work is unlikely to be heard, via airborne pathways, by any local residents. Thus, in so far as airborne noise impact is the issue, such work may be undertaken on a 24/7 basis if so desired.

**NOTE 17 :** The given noise criteria are to be understood in the context of ‘The aim is to achieve as soon as possible’. If there are exceptional circumstances whereby these limits may not be achieved in the early stages of construction work, at any site, the contractor should investigate the reasons for the exceedance, and within one (1) week make whatever corrections are necessary to achieve the relevant limit. This time period for remedial corrections applies to the first week of each medium or longterm (greater than 1 week duration) major construction site only. It does not apply during subsequent works. Except for the first week of work at any major construction site for Metro North, any subsequent remedial works required to correct a noise level higher than the relevant noise limit, should be done within 1 day of the occurrence of the above-limit incident.

**NOTE 18 :** However, we stress again, the importance of also ensuring effective noise control on works not confined to a well defined site. Such works include utilities diversions, road works, and tracklaying – and especially at night, when noise should really be non-tonal and non-impulsive.

#### **24. Noise Level Recommendations for the Proposed Construction Phase of Metro North**

(A) It is recommended that unattended noise monitoring systems be installed on or at all recommended receptors, at least one week (preferably 2 weeks) before the start of any construction activities, including enabling works or utilities diversions, at each projected Stop site, and each significant compound, in order to establish the existing ambient noise level at those sensitive locations. The recommended receptors are indicated in Table 3. The contractor may install any further such monitors as is deemed useful. The report on each receptor location should include the Met Eireann hourly wind speed and direction data for the relevant days, at Dublin Airport.

Reason – To establish (i) the pre-construction ambient noise levels at important noise receptor locations, and (ii) to monitor the construction noise levels.

(B) It is recommended that an adequate road traffic noise survey be conducted, at each sensitive receptor where Metro North operational noise could exceed road traffic noise – in terms of

$L_{Aeq1hour}$ , before construction starts. This survey should be conducted at the receptor façade currently most impacted by Road traffic noise.

This survey could be partly done in conjunction with the pre-construction ambient noise survey recommended in paragraph (A) above, although there is not a lot of overlap between the two sets of locations. There should be appropriate emphasis on the road traffic component of the levels measured – especially the night time levels.

In those quieter locations where there is no significant road traffic noise, the ambient noise level should also be properly established, at the receptor façade to be most impacted by Metro noise. The report on each receptor location should include the Met Eireann hourly wind speed and direction data for the relevant days, at Dublin Airport.

Reason – To help determine if a modified track form might be needed in any of those locations.

(C) Construction Noise Level Criteria at any Façade of a Normal Residence

	<u>Urban areas</u>	<u>Rural Areas (Note 18)</u>
Monday to Friday	75 $L_{Aeq0700-1900Hours}$ 65 $L_{Aeq1900-2200Hours}$ *45 $L_{Aeq1Hr(2200-0700Hours)}$	70 $L_{Aeq0700-1900}$ 60 $L_{Aeq1900-2200}$ ** 40 $L_{Aeq1Hr(2200-0700)}$ Non tonal, non impulsive.
Saturdays	70 $L_{Aeq0800-1630Hours}$ <b>75 <math>L_{Aeq0800-1400Hours}</math></b> *55 $L_{Aeq1630-2200Hours}$ *45 $L_{Aeq1Hr(2200-0800Hours)}$	65 $L_{Aeq0800-1630}$ <b>70 <math>L_{Aeq0800-1400Hours}</math></b> 50 $L_{Aeq1630-2200}$ 40 $L_{Aeq1Hr(2200-0800)}$ Non tonal, non impulsive.
Sundays * & Bank Holidays *	60 $L_{Aeq0800-1630Hours}$ 50 $L_{Aeq1Hr(1630-2200Hours)}$ 45 $L_{Aeq1Hr(2200-0700Hours)}$	60 $L_{Aeq0800-1630}$ 45 $L_{Aeq1Hr(1630-2200)}$ *** 40 $L_{Aeq1Hr(2200-0700)}$ Non tonal, non impulsive.

Note 19 : Rural locations are considered to be all locations from Belenstown Depot area to Estuary Stop, adjacent to any Metro North work site. Places from Estuary Stop to St. Stephens Green Stop are regarded as urban.

\* Construction activity at these times, except for that required for emergency works, will normally require the explicit permission of the relevant Local Authority.

\*\* On Fridays 45  $L_{Aeq1Hr(2200-0800Hours)}$  40  $L_{Aeq1Hr(2200-0800Hours)}$

\*\*\* On Sundays before

Bank Holidays 45  $L_{Aeq1Hr(2200-0800Hours)}$  40  $L_{Aeq1Hr(2200-0800Hours)}$

Reason – In the interest of residential amenity

(D) Noise Criteria at any Façade of any School or Church

Monday to Saturday 65  $L_{Aeq0700-1900Hours}$  ; 60  $L_{Aeq1900-2200Hours}$   
(For Schools during class times)

Sundays & Bank Holidays\* 60  $L_{Aeq0800-1630Hours}$  ; 50  $L_{Aeq1Hr(1630-2200Hours)}$   
Venues not normally sensitive at night.

\* Construction activity at these times, except for that required for emergency works, will normally require the explicit permission of the relevant Local Authority.

Reason – In the interest of community amenity

(E) Noise Criteria at any Façade of any Theatre or Cinema

Monday to Friday 75  $L_{Aeq Daytime Hours}$  ; 65  $L_{Aeq1900-2200Hours}$   
(Venue working hours)

Saturdays 70  $L_{Aeq0800-1400Hours}$  ; 60  $L_{Aeq1Hr(1400-2200Hours)}$  To allow for Matinees  
Venues not normally sensitive at night.

Sundays & Bank Holidays\* 60  $L_{Aeq6Hr(0800-1400Hours)}$  ; 50  $L_{Aeq1Hr(1400-2200Hours)}$  To allow for Matinees

(F) Noise Criteria at the Façade of any Urban Hotel or Guesthouse

Monday to Friday	70 LAeq <sub>1Hr</sub> (0700-0800 Hours) ; 75 LAeq <sub>Period</sub> (0800-1900 Hours) 65 LAeq <sub>1900-2200 Hours</sub> ; 45 LAeq <sub>1Hr</sub> (2200-0700Hour)
Saturdays	70 LAeq <sub>Period</sub> (0800-1630Hours) ; 60 LAeq <sub>1Hr</sub> (1630-2200Hours)
<b>Alternatively</b>	<b>75 LAeq<sub>0800-1400Hours</sub> 55 LAeq<sub>1400-2200Hours</sub></b> 45 LAeq <sub>1Hr</sub> (2200-0800Hours)
Sundays & Bank Holidays*	60 LAeq <sub>0800-1630Hours</sub> ; 50 LAeq <sub>1Hr</sub> (1630-2200Hours)

(G) In the case of percussive tools such as Rockbreakers, Jackhammers (manual or mechanical), and Poker vibrators, the following maximum noise levels, at sensitive receptors, are recommended :

	<u>Urban areas</u>	<u>Rural Areas</u>
Monday to Friday	85 LA <sub>MaxFast</sub> 0700-1900Hours 75 LA <sub>MaxFast</sub> 1900-2200Hours	80 LA <sub>MaxFast</sub> 0700-1900 70 LA <sub>MaxFast</sub> 1900-2200
It is recommended that there be no usage of percussive tools, which is audible at any noise sensitive receptor, between the hours 2200-0700 (2200-0800 at Hotels & Guesthouses).		
Saturdays	80 LA <sub>MaxFast</sub> 0800-1630Hours <b>Alternatively 85 LA<sub>MaxFast</sub> 0800-1400Hours</b> 65 LA <sub>MaxFast</sub> 1400/1630-2200Hours	75 LA <sub>MaxFast</sub> 0800-1630 <b>80 LA<sub>MaxFast</sub> 0800-1400Hours</b> 60 LA <sub>MaxFast</sub> 1400/1630-2200

It is recommended that there be no usage of percussive tools, which is audible at any noise sensitive receptor, on Sundays or Bank Holidays

(H) (i) At any normal residential façade (excluding overnight accommodations) , where the construction noise level is expected to be in excess of 70 LAeq<sub>0700-1900Hours</sub>, it is recommended that the contractor be required to upgrade the sound insulation of any façade and/or attic- roof space requiring upgrade, so that the internal noise level due to the construction does not exceed 45 LAeq<sub>1Hour</sub>, in more than one (1) out of seven (7) 1-hour periods, chosen at random, which are spread over at least 3 working days, after one week has elapsed from the start of operations on any major construction site; and it is recommended that -

(ii) Any such proposed upgrade work should be clearly described, in writing, before any such work is done, and a copy of this description given to each affected resident. In doing any checking measurements, account should be taken of the internal ambient noise background level (excluding any internally generated noise), which level may be estimated from the external façade ambient noise background level, for the time of day, which data should be available from either the contractor or the Local Authority.

Reason – In the interest of reasonable residential amenity.

( I) Should it be agreeable to any resident, the contractor may decide to offer such resident, the reasonable cost of having the sound insulation upgrade work, referred to in paragraph 24(H), done independently.

(J) It is recommended that any upgrade of sound insulation needed, as per recommendation 24(H), on any residence near a proposed Metro North work site be completed before any construction, or demolition work starts on the site, except where the resident concerned has opted to organise the upgrade themselves, and has received the determined reasonable cost thereof.

(K) It is recommended that, should the result of any independent internal noise survey, as per condition 24(H), show an excessive noise level, the contractor should be required to pay the cost of such noise survey, within one month of the survey date.

(L) If it should be that both construction projects are under way at the same time, at the Mater Stop site, it is recommended that a mutually agreed procedure be adopted by both contractors to minimise the noise impact on the Leo St. residents. In particular, notice should be taken of the preceding recommendations 24(H), 24(I) and 24(J). If necessary, it is recommended that, if possible, the good offices of the Local Authority be utilised to effect such an agreement.

(M) It is recommended that the contractor be requested to decorate any semi-permanent (in place for over one (1) month) construction site boundary wall or noise barrier, on the side facing the nearby residences, with a tasteful Mural chosen after liaison with the nearby residents, and/or with appropriate professional advice.

Reason – To ameliorate the effect of the noise and the barrier.

Note 20 : At the previously noted MLR (Multi Location Receptor) locations (Table 3) it is recommended that the Local Authority and/or the venue management be consulted to decide the optimum way to progress the noise surveys.

(N) It is recommended that attended noise monitoring be done at the locations indicated in Table 4, and at any other locations deemed necessary.

(O) At locations such as Albert College Grove or Albert College Crescent, where the gable wall has a window, and where the house is likely to receive noise, from the site works, on both front and rear facades, as well as on the gable wall, the noise monitor should be on the most sensitive exposed facade, as indicated by the residents of the house. If the noise exposed gable wall option is chosen, the microphone height should be 4 metres minimum, where dense vegetation or a wall screens a lower position. The Albert College Estate is a MLR location also, and the advice of Note 11 applies also.

(P) It is recommended that nine (9) monitoring and optimally spaced microphones be installed on the front facades of houses, from No.4 to No.19, plus the three-storey apartment block, in St. Josephs Avenue, Drumcondra, to monitor both pre-construction ambient noise levels, and the construction noise levels initially. The microphone on the apartment block should preferably be fixed at a height of 4.2 metres or more above ground (first floor level).

Reason – This number of monitors is needed due to the very near location of the proposed construction works, the nature of the works, and the length of St. Joseph's Avenue.

(Q) It is recommended that seven (7) monitoring and optimally spaced microphones be installed on the rear facades of houses, from No.12 to No.20, in St. Alphonsus Road, Drumcondra, and the more sensitive facades in St. Alphonsus Avenue, plus the rear of No. 52 Lower Drumcondra Road, to monitor both pre-construction ambient noise levels, and the construction noise levels initially. It is recommended that the monitors be placed on the most sensitive facades as indicated by the residents.

Reason – This number of monitors is needed due to the very near location of the proposed construction works, and the nature of the works.

Note 21 : It is understood that there are no overnight residents in any building on Lower Drumcondra Road, which back directly on to the proposed Drumcondra Stop Site.

(R) It is recommended that fifteen (15) monitoring microphones, optimally spaced, be installed on the rear facades of houses along Leo Street, Mater Stop site, to monitor both pre-construction ambient noise levels, and the construction noise levels initially.

Reason – This number of monitors is needed due to the very near location of the construction works, the nature of the works, and the length of Leo Street.

(S) It is recommended that a monitoring microphone be installed on the front facade of a suitable house on North Circular Road, opposite the Mater Stop site and HGV exit, to monitor both pre-construction ambient noise levels, and the construction noise levels initially.

Note 22 : It is recommended that the reports on all ambient noise survey locations should include a list of all the significant noise contributors in each location.

(T) It is recommended that noise monitoring results be examined by both Fingal County Council and Dublin City Council, after six (6) months, in order to examine whether fewer noise monitors might suffice in any of the areas within their jurisdiction. Should either Local Authority be satisfied that fewer monitors would suffice, they may then advise the contractors of this decision, and the details thereof, so that they may take the appropriate removal action. It is also considered appropriate, that if at any future subsequent date, either Local Authority considers that fewer monitors would suffice for effective noise control, they may similarly advise the contractor.

Reason – To avoid unnecessarily burdensome monitoring by the contractor.

(U) It is recommended that noise monitoring results be examined Dublin City Council, after the Stop Box construction deck or ‘roof’ is in place, at both Mater Stop and Drumcondra Stop, in order to examine whether fewer noise monitors might suffice around either location. On St. Alphonsus Road, at least one (1) monitor should remain after this review; likewise on St. Alphonsus Avenue. In neither St. Josephs Avenue nor in Leo Street should fewer than three (3) monitors, optimally spaced along the street, remain after this review. Should the City Council be satisfied that fewer monitors would suffice, they may then advise the contractors of this decision, and the details thereof, so that they may take the appropriate removal action.

Reason – To avoid unnecessarily burdensome monitoring by the contractor.

(V) It is recommended that consideration be given to the placement of Visual Noise alert signs, Automatically Triggered at suitable Warning levels, at suitable locations, at each major worksite, as an aid to good noise control. This could, for example, take the form of a Green/Yellow/Red system.

(W) It is recommended that, as an aid to good noise control, consideration be given to having Unattended Noise Monitors send Text Messages as Alerts/Alarms to the Mobile Phones of the relevant noise control personnel, on occurrence of a preset Noise Alarm level at any given work site.

(X) It is recommended that, as an aid to good noise control, consideration be given to the use of Vehicle Reversing Alarms which are of the less intrusive Broadband types, or a Visual/Lights type.

(Y) It is recommended that, should any transport of supplies or spoil by train, be used in any overground location, that any such trains would be operated within the same recommended noise limits as for the operational phase of this proposed development.

(Z) It is recommended that the agreed noise limits and procedures and mitigation measures agreed between the RPA and those bodies which have an agreement with the RPA, should govern the outcome at each such venue. These bodies include the Mater Misericordiae Hospital, The Mater Private Hospital, The Rotunda Hospital, Fitzwilliam Hotel, and Bank of Scotland (Ireland). In addition a specific commitment, dated February 25, 2010, on monitoring has been given by RPA to Abbey Presbyterian Church.

(A2) It is recommended that if, in any Theatre, airborne noise intrusion causes problems, during any production week or during any live performance, despite compliance with conditions 24(E) & 24(G) above, that the contractor would appoint an appropriately qualified person who would promptly respond to any complaint of such noise intrusion, and who would make a rapid assessment of the situation, and who would have the authority to (i) suspend the relevant construction operations for an appropriate time period, if such action were deemed necessary, and/or (ii) recommend any suitable venue sound insulation measures warranted, to prevent recurrence of the problem.

(B2) It is recommended that appropriate safeguards be in place, to ensure good communications on each Metro North work site, particularly for workers whose hearing, when wearing the required Ear Protectors, may not be good, or whose comprehension of English, or whatever is the predominant language on any site, may not be good, especially for Management and Supervisory staff

## **25. Recommendations for the Proposed Operational Phase of Metro North**

(A) It is recommended that the operational airborne normal noise levels from the proposed Metro system should not exceed 55 LAeq(Period) 0700-2300Hours and 45 LAeq(Period) 2300-0700Hours , at any sensitive receptor. These are free-field values.

(B) It is recommended that, when operational, the operational noise emissions from the proposed Metro trams should be of normal non-disturbing character, that is without any unusual tonality or impulsive character, and that any such unusual noise emissions be investigated and corrected promptly. Any such unusual tonality or impulsiveness should be assessed as industrial noise.

(C) It is recommended, in relation to recommendation 25(B) above, that the proposed Metro tram noise levels and their representative 1/3-octave frequency spectra, for the pristine track and wheel conditions, be measured and recorded at ten locations minimum, for both (i) ground level track locations, and (ii) for elevated track locations, at such locations as noted in Tables 7.1, 7.2, 7.3, 7.4, and 7.5 of EIS Volume 3, Book 2.

The readings should include as many of the noted operational speeds as possible, from 30 km/hour to 70 km/hour, for each track type. The measurement report should include (a) precise location of microphone and its height above ground level; (b) distance from track; (c) train running speed;

(d) Direction of travel; (e) Carriage or engine numbers; (f) date & time, and (g) weather conditions, including Met Eireann wind speed and direction data at Dublin Airport, for the relevant hours.

This work will need to be done in cooperation with the Metro Operating Company, so that precise speeds and other data can be obtained. The report should also include (h) a summary

description and/or numerical data set on (i) the wheel condition of each relevant carriage and (ii) the track condition for each relevant stretch of track, on which noise readings were obtained. A copy of the report should be forwarded to both Fingal County Council and Dublin City Council.

Reason – To have a set of reference noise levels and frequency spectra against which to compare any subsequent noise readings taken in response to any complaints there may be, of unusual tram operational noise emissions.

(D) It is recommended that the façade noise level from all combined permanent Trackside Equipment, or Depot or Stop equipment, including electrical equipment and any normally running ventilation fans, which are on at night (2200-0700 hours), at any sensitive receptor, should not exceed the lower of 45 LAeq<sub>15Mins.</sub> or the lowest recurring night time ambient level LA<sub>90 15Min.</sub> during the night, in urban and suburban areas, and the lower of 35 LAeq<sub>15Mins.</sub> or the lowest recurring night time ambient level LA<sub>90 15Min.</sub> during the night in quiet rural locations (Belinstown Depot to Estuary Stop). Night noise should be Non-tonal and non-impulsive, especially as heard indoors with windows partially open (e.g. opening up to c.100mm wide). It is recommended that the indoor LA<sub>90</sub> increase, due to fixed Metro North plant, should not exceed 3 dBA.

It is also recommended that the relevant LA<sub>90</sub> level should be determined jointly with the Local Authority and/or agreed with the authority. It is recommended also that the Met Eireann hourly wind speed and direction data, at Dublin Airport, for the relevant hours be included with the relevant ambient noise survey reports.

For any such equipment which runs in daytime only, the recommended façade noise limits are 45 LAeq<sub>1Hour</sub> in urban and suburban areas, and 40 LAeq<sub>1hour</sub> in quiet rural areas.

(E) It is recommended that the emergency ventilation fans should not generate a noise level, inside any sensitive receiver location, greater than NC 25 (c.36 dBA) as stated, for fan testing, in the EIS.

(F) It is recommended that all ventilation fan testing be done during daylight hours, as proposed by the RPA, and that any nearby residents would be advised in advance of the proposed test times for this process. A regular test day and time of test would facilitate such advance notice.

Note 23 : The stated indoor noise limit for such fan testing of NC25, is equivalent to c.35.6 dBA. This is likely to be audible. Thus it is desirable that such testing should not, therefore, be done outside the hours of 0800 to 1900. That is, it should only be done in daytime hours.

(G) Rail Track Maintenance : It is recommended that grinding of rail tracks be done at times and in a manner which does not cause undue disturbance to any residents. Similarly for any other track-based ‘occasional maintenance activities’ referred to in EIS Book 1, which is required. This is important especially on the viaduct sections of the alignment.

(H) It is recommended that **Public Address systems at Stops** be set up so that sound levels at any nearby residence do not cause any noise nuisance, particularly in the evening or night time. This may be facilitated by the use of suitably placed visual signage in conjunction with the P.A. system. The LA<sub>maxFast</sub> at any façade of any residence from the Stop Public Address system should not normally exceed 60 dBA. It is further recommended that the criteria for these and any audible warning systems on the alignment be agreed with the Local Authority. A suggested criterion is LA<sub>eq 1minute</sub> < 40 dB, and LA<sub>Max Fast</sub> < 60 dB, outside any residential window or door façade, particularly for the late evening and night time..

Reason - To avoid unnecessary Metro operational noise disturbance to any neighbouring resident.

(I) Some proposed Stops, for example, Drumcondra, have Air Intakes, Vent exhausts, 'ESB Rooms', 'Louvres' (Intake or exhaust), a Roller Shutter Door, and a 'Mesh Screen' on the proposed building facade which faces, or could impact, the nearby residents. All such items are to be included in the totality of all trackside or Stop plant, for assessment at any sensitive receptor, as per paragraph 25(D) above.

(J) It is recommended that opening or closing of any Roller Shutter door should be restricted to daytime hours (0800-1900) , and should be kept closed if it has a noise containment function.

(K) Drumcondra Stop also has a proposed 'Access Road' off St. Josephs Avenue, which could be a source of noise nuisance. It is recommended that this access road be used for vehicular access to the Stop site only between the hours 0800-2200, except for emergency use. Likewise for the proposed Access Roads to (i) St. Patrick's College intervention shaft, off Millbourne Avenue, and (ii) the proposed substations near any sensitive receptor.

(L) It is recommended that all normal Railway Regulations be followed, including any such regulations or procedures which discourage the excessive use of Tram Horns or Hooters, especially at night. It is further recommended that consideration be given to (i) optimising, where possible, the sound level of tram horns, and (ii) the possible use of flashing lights, in conjunction with Horns, with the objective of minimising the potential for noise-induced sleep disturbance of residents close to the overground parts of the alignment.

(M) It is recommended that appropriate signage, lighting and CCTV be installed (a) at each stop where patrons leaving the stop at night might disturb local residents by loud talking or noisy congregating, in order to discourage such nuisance behaviour, and (b) at each Park & Ride and Car Park, requesting or encouraging motorists to leave the Car Park as quietly and responsibly as possible.

(N) It is recommended that a Remote alarm be fitted in the business premises of Mr. Boland at Nevinstown, so that he can hear it, during nearby construction works, if and when his house alarm, across the road, is triggered. (As agreed by the RPA at the Oral Hearing).

(O) It is recommended that attended noise monitoring be done on the operational scheme in its initial stages and for fixed plant and equipment commissioning at each location where such plant is located. This should include all Ancillary systems such as power supply systems, all ventilation plant and vents, and Public address systems. It is recommended that the relevant reports on such system commissioning and initial noise measurements be furnished to both Fingal County Council and Dublin City Council.

(P) It is recommended that appropriate signage, and/or management arrangements, be put in place to ensure that service vehicles using the service bays, or service areas, at Metro North Stops, do not leave engines running for unnecessarily long time periods. Likewise for buses in Bus waiting Bays.

26. References

1. The Metro North EIS Volumes 1, 2 and 3
  2. RPA / Rotunda Hospital agreement of 2 March 2010
  3. RPA Environmental report for the revised Design of Mater Stop, December 2009
  4. Crossrail Information Paper D25 'Noise from Fixed Installations'
  5. The WHO (World Health Organisation) Guidelines for Community Noise (1999)
  6. 'Noise Control in Building Services' By Sound Research Laboratories Ltd. (Pergamon Press).
  7. British Standard BS 8233:1999 'Sound insulation and noise reduction for buildings – Code of practice'
  8. British Standard BS 4142:1997 'Method for Rating industrial noise affecting mixed residential and industrial areas'
  9. The Night Noise Guidelines for Europe 2009 (World Health Organisation)
  10. EC Directive 2002/49/EC relating to the assessment and management of environmental noise.
  11. British Standard BS 5228-1 : 2009 'Code of practice for noise and vibration control on construction and open sites – Part 1 : Noise'
  12. Railway Procurement Agency 'Construction Noise Management Plan' 2009
  13. International Standard ISO 1996-1:2003 'Acoustics – Description, measurement and assessment of environmental noise' Part 1
  14. Environmental Protection Agency Guidance Note for Noise in relation to Scheduled Activities, 2<sup>nd</sup> edition, 2006
  15. Irish Standard IS EN 61672-1:2003 'Electroacoustics – Sound Level Meters – Part 1: Specifications (IEC 61672-1:2002)
  16. National Roads Authority 'Guidance for the treatment of Noise and Vibration in National Road Schemes' October 2004.
  17. Northern Parallel Runway Oral Hearing Report (An Bord Pleanála Ref. PL06F.217429)
  18. PPG 24 (Planning Policy Guidance 24 : Noise (UK)
- Karl Kryter 'The effects of Noise on Man', Second edition, 1985, Academic Press Inc.