NOISE GUIDANCE: DEVELOPING A NOISE MANAGEMENT PLAN

In LTA Projects

Land Transport Authority

We Keep Your World Moving

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1 INTRODUCTION

1.1 Purpose of the Guidance

The purpose of this guidance is to guide the parties involved in Land Transport Authority (LTA) construction projects in understanding the fundamental steps in devising a comprehensive Noise Management Plan (NMP) in accordance to statutory and LTA's requirements.

1.2 Overview of Noise Management

An overview of noise management at LTA construction sites is as below:

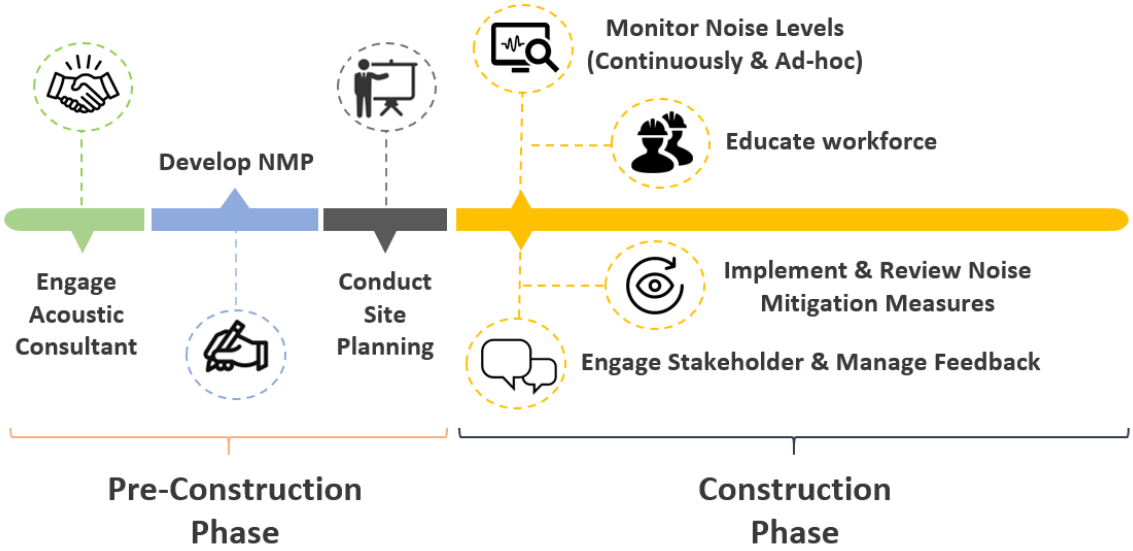


Figure 1: Overview of noise management for LTA projects

1.3 Scope of the Guidance

This guidance contains the following sections:

Section 2 highlights the key legislative requirements stated in the construction noise-related regulations and Singapore Standard. It is advisable to refer to these legislation and code of practice for more details.

Section 3 describes the roles and responsibilities of key personnel involved in noise management throughout the duration of the project.

Section 4 introduces the key contents required in preparation of a good NMP.

Section 5 compiles the list of references applied in the guidance.

2 LEGISLATION AND SINGAPORE STANDARD

Construction noise in Singapore is regulated by the following legislation and Singapore Standard:

2.1 Environmental Protection & Management Act (Chapter 94A, Section 77) Control of Noise at Construction Sites

2.1.1 Permissible Noise Limits

This Act stipulates the permissible noise limits, as shown in Table 1 and 2, which construction projects have to abide by:

Table 1: NEA permissible noise limits for Mondays to Saturdays

Types of affected buildings	7am - 7pm	7pm -10pm	10pm - 7am
a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq 12hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5mins)	55 dBA (Leq 5min)	
b) Residential buildings located less than 150m from construction site	75 dBA (Leq 12hrs)	65 dBA (Leq 1hr)	55 dBA (Leq 1 hr)
	90 dBA (Leq 5 mins	70 dBA (Leq 5mins)	55 dBA (Leq 5 mins)
c) Buildings other than those in (a) and (b)	75 dBA (Leq 12hrs)	65 dBA (Leq 12hrs)	
	90 dBA (Leq 5 mins	70 dBA (Leq 5mins)	

Table 2: NEA permissible noise limits for Sundays and Public Holidays

Types of affected buildings	7am - 7pm	7pm -10pm	10pm - 7am
a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq 12hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5mins)	55 dBA (Leq 5min)	
b) Residential buildings located less than 150m from construction site	75 dBA (Leq 12hrs)		
	75 dBA (Leq 5 mins	55 dBA (Leq 5min)	
c) Buildings other than those in (a) and (b)	75 dBA (Leq 12hrs)	65 dBA (Leq 12hrs)	
	90 dBA (Leq 5 mins	70 dBA (Leq 5mins)	

2.1.2 No Work Rule on Sundays and Public Holidays

In addition to the permissible noise limits, NEA has also mandated a prohibition of work on Sundays and Public Holidays for construction sites located within 150m away from residential and noise-sensitive premises. The requirements are as follow:

a) Construction work commenced on or after 1st September 2010

No work allowed from 10.00pm on Saturday/eve of Public Holiday to 10.00am on Sunday/ Public Holiday.

b) Construction work commenced on or after 1st September 2011

No work allowed from 10.00pm on Saturday/eve of Public Holiday to 7.00am on the following Monday/day after the Public Holiday.

Since 1 January 2017, NEA grants permission to certain construction sites to carry out quieter construction works on selected Sundays and Public Holidays. Contractors must obtain a permit from NEA before carrying out such works, which will be allowed for specific construction phases and on a case-by-case basis, subject to stringent conditions. For more information, you may refer to NEA's **Application Form for Permit to Carry Out Quieter Construction Work on Specific Sundays and Public Holidays.**

2.2 SS 602: 2014 Code of Practice for Noise Control on Construction & Demolition Sites

This Singapore Standard lists the measures which can be adopted by contractors to establish good noise control for construction and demolition sites. Contractors are encouraged to refer to this code for useful information such as methods of monitoring, estimation of construction noise levels, noise control techniques and selection of quieter construction equipment and methods.

3 ROLES AND RESPONSIBILITIES

In a project, various key personnel have different parts to play in ensuring effective noise management on site. Their roles are as shown in Table 3 below.

Table 3: Overview of the required personnel and their responsibilities in noise management

Roles	Responsibilities
Project Manager (PM)	• Appoints ECO • Engages Acoustic Consultant (for contracts above S$20 million in value) • Provides necessary resources and support for NMP to be effectively implemented
Acoustic Consultant	• Prepares site-specific NMP before construction commences • Conducts site inspections to check on the adequacy of noise mitigation measures and submits inspection reports • Reviews NMP as and when required
Public Relation Officer (PRO)	• Plans, develops and implements PR strategies • Liaises with and responds to enquiries from stakeholders • Fosters good community relations through events before and during the construction works • Engages affected stakeholders
Environmental Control Officer (ECO)	• Ensures mitigation measures are implemented and maintained according to NMP • Monitors noise levels and ensures they are kept within permissible noise limits • Informs respective construction teams if noise limits are breached • Monitors the effectiveness of noise mitigation measures on site • Informs PM and respective construction teams if existing measures are inadequate

4 12 COMPONENTS OF EFFECTIVE NMP

The purpose of an NMP is to help contractors identify the noise sensitive receptors (NSRs) around their sites, assess the impact on the NSRs, as well as plan mitigation measures to ensure compliance with the permissible noise limits and to minimise noise disturbance to the NSRs.

The Contractor shall submit a comprehensive site-specific NMP to LTA within 3 months after project award date for review prior to submission to NEA for acceptance. The plan shall be submitted before any construction works start. Essentially, a NMP consists of 12 components in the following order:

Figure 2: 12 components of an NMP

The content of the above will be further elaborated in the subsequent sections.

4.1 Project Information

Project information should include the following:

a) Project duration

b) Brief write up on the contract

c) Locations of station, entrances and launch shafts/escape shafts site area

d) Alignment of tunnels (TBM / cut and cover)

e) Type of construction (top down / bottom up)

4.2 Acoustic Consultant Profile

The background of the appointed acoustic consultant (e.g. relevant experience and track records) shall be provided in this section.

4.3 Project Work and Mitigation Measures Implementation Schedule

The installation of perimeter noise barriers should be planned well in advance and integrated with the construction sequence to ensure seamless implementation.

Figure 3 shows a sample schedule of various construction activities with the implementation of noise mitigation measures (e.g. noise barriers, enclosures).

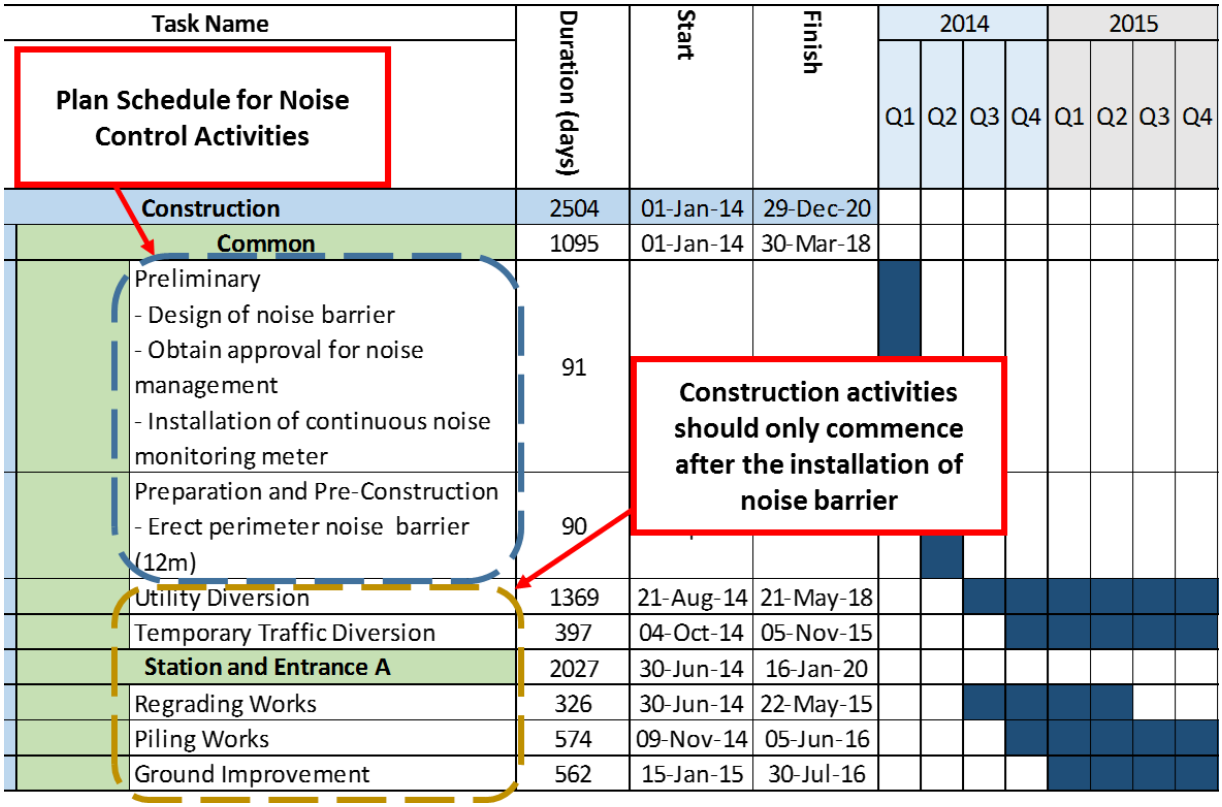


Figure 3: Working schedule illustrating the detailed activities including noise control activities.

Note

- Ensure installation of continuous noise monitoring meter are included into the schedule.
- Ensure noisy construction activities only commence after the installation of noise barriers and other noise mitigation measures.

4.4 Identification of Noise Sensitive Receptors (NSRs)

Noise Sensitive Receptors (NSRs) are defined as premises that are sensitive to noise and require protection. These include hospitals, schools, nursing homes, residential estates within 150m radius from the worksite, commercial buildings, etc.

Contractor and acoustic consultant shall identify the NSRs around the worksites (including entrances and shafts) and indicate them on a map as shown in Figure 4.

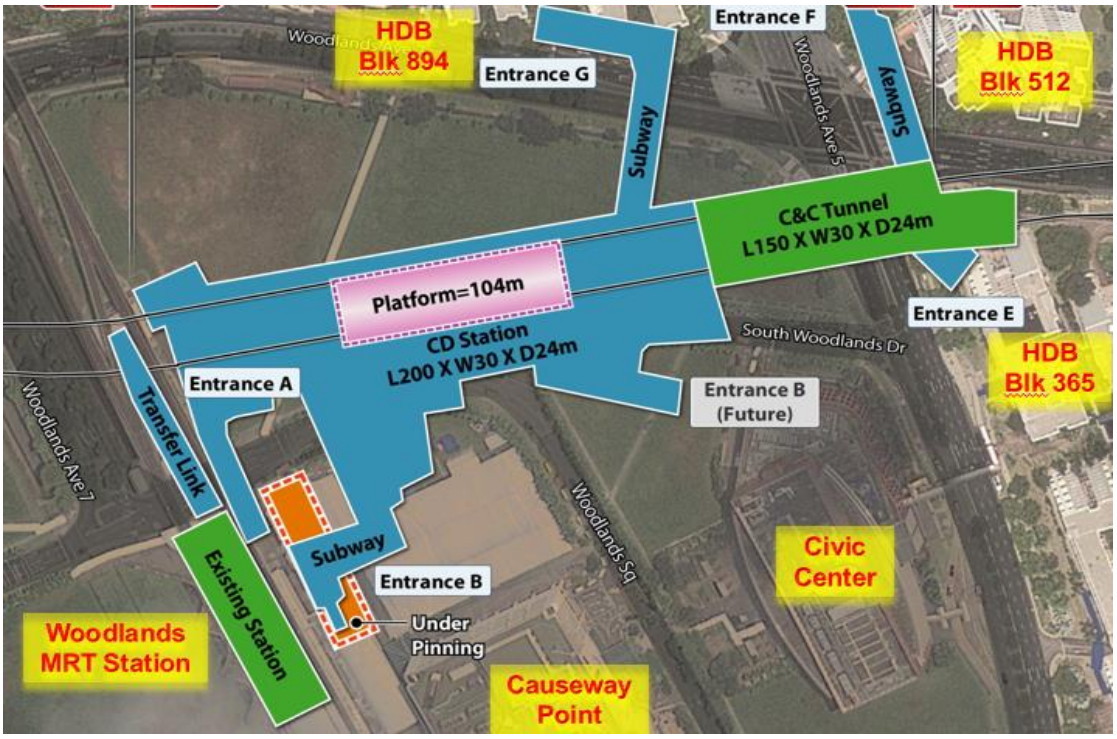


Figure 4: NSRs identified around the construction site on layout map

In addition to the map, information about the NSRs such as the type of building (school / hospital / residential / commercial), number of storeys, estimated distance from the work site, etc. should be provided as shown in Table 4.

Table 4: List of NSRs and their relevant information

S/No.	Affected Buildings	Type of Buildings	Number of Storey	Estimated Distance to Alignment	Construction Method at Nearest Worksite
NSR 1	HDB Blk 894B	Residential	12	10m	Cut & Cover and Under Pass (Top-Down)
NSR 2	HDB Blk 894D	Residential	12	15m	Cut & Cover and Under Pass (Top-Down)
NSR 3	HDB Blk 365	Residential	12	30m	Cut & Cover and Under Pass (Top-Down)
NSR 4	HDB Blk 512	Residential	12	110m	Cut & Cover and Under Pass (Bottom- up)
NSR 5	ABC Shopping Mall	Commercial	5	85m	Cut & Cover

4.5 Baseline Noise Monitoring and Permissible Limits Adjustment

Prior to the start of construction work, noise monitoring shall be carried out to establish the baseline noise levels around the site. Baseline noise readings of Leq 5min, Leq 1h and Leq 12h should be taken continuously for 7 days, on a 24-hour basis.

The baseline noise monitoring should be taken at the nearest NSRs around the site and at a higher ground, e.g. roof-top. There should be a direct line of sight from the noise meter to the construction site, and there should not be any obstruction (e.g. barrier or partition) between the equipment and the site as illustrated in Figures 5 and 6. As such, the noise meter is recommended to be placed 1m away from solid walls and 1.5m above grade.

Figure 5: Proposed noise monitoring locations before commencement of construction

Figure 6: Positioned noise meter towards a direct line of sight to the site location

With reference to the 1-week baseline noise readings, the acoustic consultant or contractor shall determine the background noise levels for each time period of every noise meters and tabulate them in a graph as shown in Figure 7.

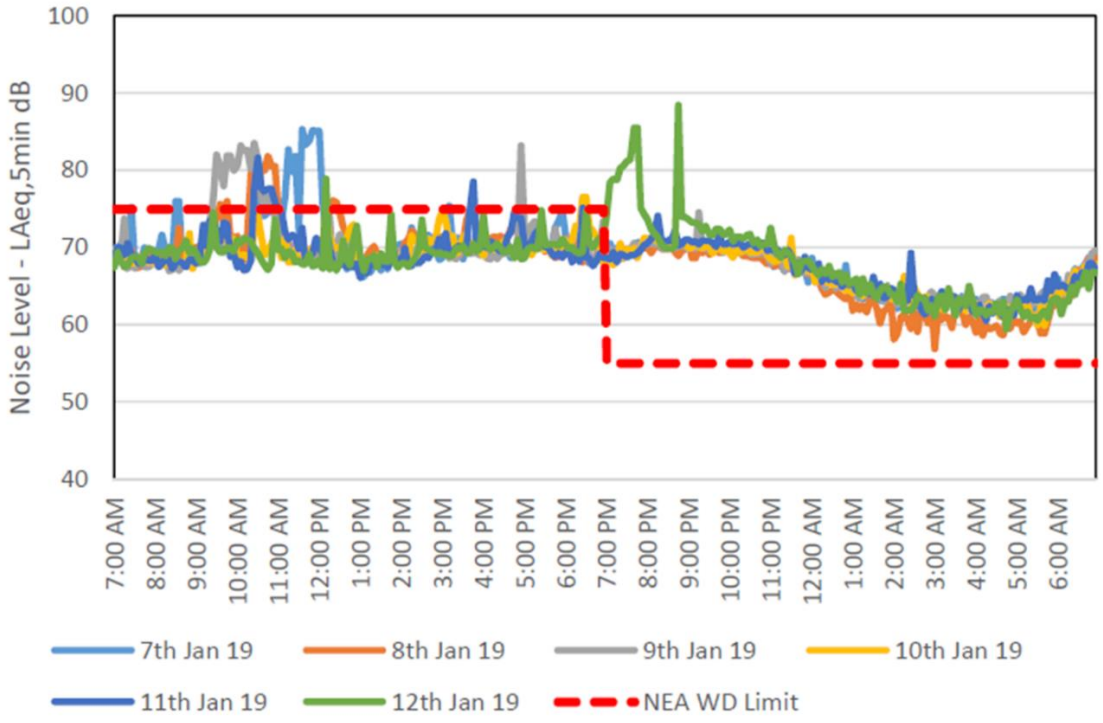


Figure 7: Summary of results for 7-days baseline study

Then, the proposed adjusted noise limits can be derived by adding the correction factor (as shown in Table 5) to either:

a) The maximum permissible noise level, or

b) The background noise level,

whichever is higher of the 2 noise levels.

Table 5: Correction factor table

Difference between 2 noise levels in decibels (A)	Correction factor in decibels (A)
Below 2	3
2 to less than 4	2
4 to less than 10	1
10 and above	0

The acoustic consultant or contractor should calculate the adjusted noise limits for Leq 5min, Leq 1h and Leq 12h for all the noise meters. Table 6 shows how the adjusted noise limits should be calculated using the background noise levels at various time periods.

Table 6: Sample of adjusted permissible limits calculations based on Leq 5min readings

(Monday – Saturday)	Time Period				
	7am-7pm	7pm-10pm	10pm-12am	12am-7pm	10pm-7am
Background Noise Level	73	67	66	61	62
Permissible Limit (Leq 5min)	90	70	55	55	55
Difference between permissible and average noise level recorded	17	3	11	6	7
Correction factor	0	2	0	1	1
Proposed Adjusted Permissible Limit (Leq 5min)	90	72	66	62	63

Thereafter, the acoustic consultant or contractor should tabulate the adjusted noise limits, as illustrated in Table 7, and submit to NEA for approval. In addition, the access details of the online noise monitoring platform should also be provided to NEA.

Table 7: Sample of adjusted noise level limits for various noise monitoring meters

Noise Meter Location	Mon-Sat				Sun & Public Holiday				Category
	7am-7pm	7pm-10pm	10pm-12am	12am-7am	7am-7pm	7pm-10pm	10pm-12am	12am-7am	
NMS 1 - Land House along Street 21	90 dBA (Leq 5 min)	72 dBA (Leq 5 min)	66 dBA (Leq 5 min)	62 dBA (Leq 5 min)	76 dBA (Leq 5 min)	68 dBA (Leq 5 min)	66 dBA (Leq 5 min)	63 dBA (Leq 5 min)	Residential
	76 dBA (Leq 12hr)	72 dBA (Leq 1hr)	66 dBA (Leq 1hr)	62 dBA (Leq 1hr)	76 dBA (Leq 12hr)				
NMS 2 - ABC building	90 dBA (Leq 5 min)	70 dBA (Leq 5 min)	70 dBA (Leq 5 min)	70 dBA (Leq 5 min)	90 dBA (Leq 5 min)	70 dBA (Leq 5 min)	70 dBA (Leq 5 min)	70 dBA (Leq 5 min)	Commercial
	75 dBA (Leq 12hr)	65 dBA (Leq 12hr)			75 dBA (Leq 12hr)	65 dBA (Leq 12hr)			
NMS 3 - Primary school	77 dBA (Leq 5 min)	69 dBA (Leq 5 min)			78 dBA (Leq 5 min)	63 dBA (Leq 5 min)			School
	72 dBA (Leq 12hr)	66 dBA (Leq 12hr)			74 dBA (Leq 12hr)	62 dBA (Leq 12hr)			

During the construction phase, if noise levels frequently exceed the adjusted noise limits despite having no work on site, contractor should conduct another round of noise

monitoring to re-establish the ambient noise levels and re-adjust the permissible noise limits. When carrying out such noise monitoring, there should be no or minimal work on site.

Note

- The background noise level is derived from the logarithm average of noise readings, and not established from the highest noise level measured.
- Access details of online noise monitoring platform include the web link, login ID and password.
- For any addition of noise meters during the construction phase, ensure that adjusted permissible noise limits are acquired from NEA.

4.6 Noise Simulation

Noise simulation predicts noise levels generated during each construction phase (including major traffic diversion) and analyses the impacts to NSRs. The simulation should also include the predicted noise levels after the installation of proposed mitigation measures. Essentially, the simulation shall take into account the baseline noise levels, nature of land use in the area (e.g. slope and building height), site utilisation plan (e.g. machine distribution and location), and duration of works as shown in Figure 8.

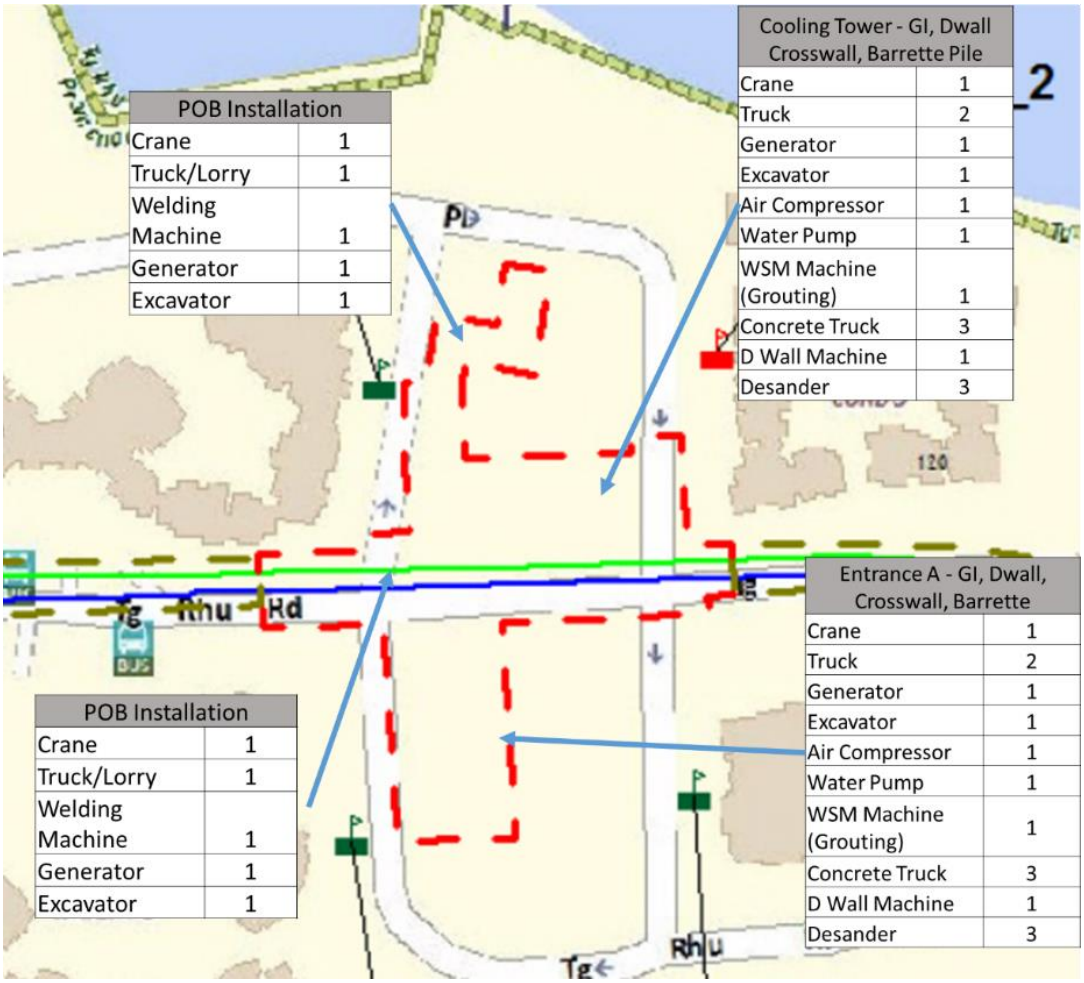


Figure 8: Site map indicating the machineries required at different locations in the construction site

Figure 9 presents the 3D simulation results of a proposed construction site before and after mitigation measures are in place during a certain construction phase. The predicted noise levels experienced by various NSRs are clearly shown and presented in colour codes.

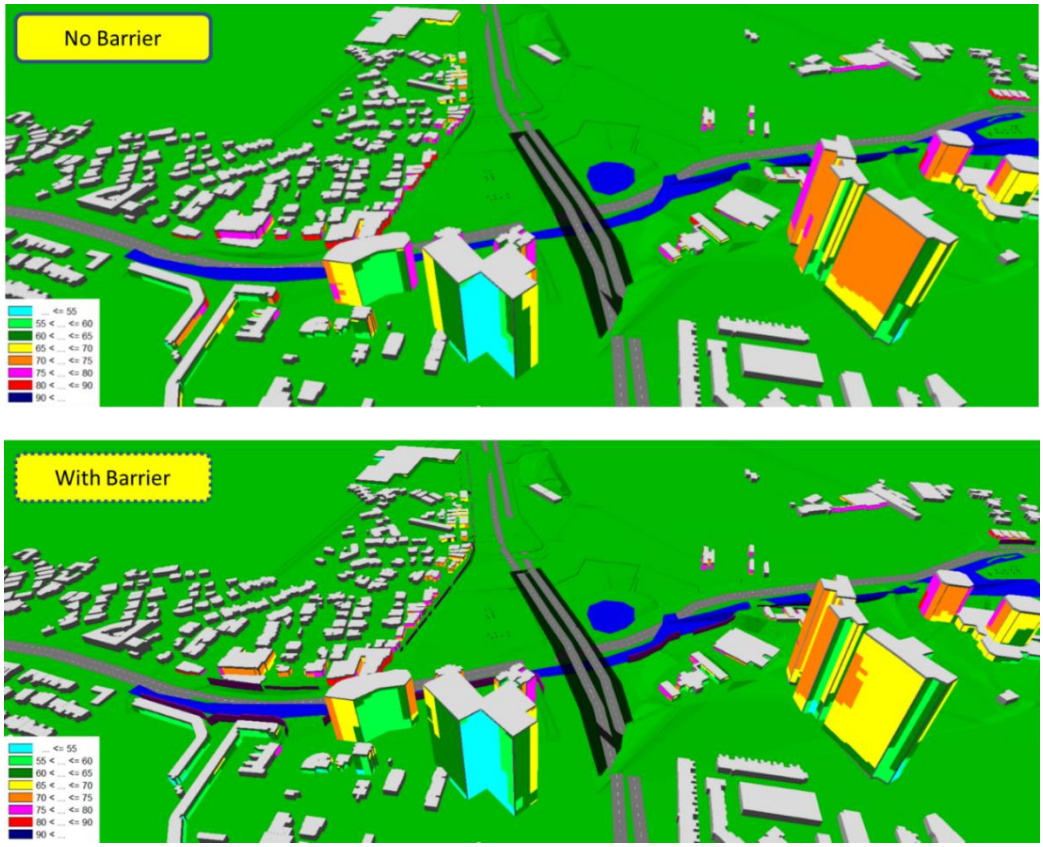


Figure 9: Modelling of the noise levels at the site and impacts to nearby NSRs

Note

- Contractor shall provide details such as surrounding topography, site utilisation plan and construction sequence to the acoustic consultant for a representative noise simulation.
- Contractor and acoustic consultant shall discuss and propose practicable noise barrier layout and height at various construction phases to be used in the simulation.
- Acoustic consultant shall provide recommendations and noise mitigation measures/controls for any predicted noise level exceedances identified from the modelling exercise.
- Acoustic consultant shall highlight the NSRs that will still have residual impact.

4.7 Noise Monitoring

There are 2 types of noise monitoring - continuous and ad-hoc noise monitoring.

4.7.1 Continuous Noise Monitoring

Continuous noise monitoring must be carried out for the entire project duration and the noise meters are typically installed at the same locations as baseline monitoring. These locations must be approved by NEA with permissible noise limits adjusted. Figure 10 presents a plan indicating the locations of noise meters around a site.

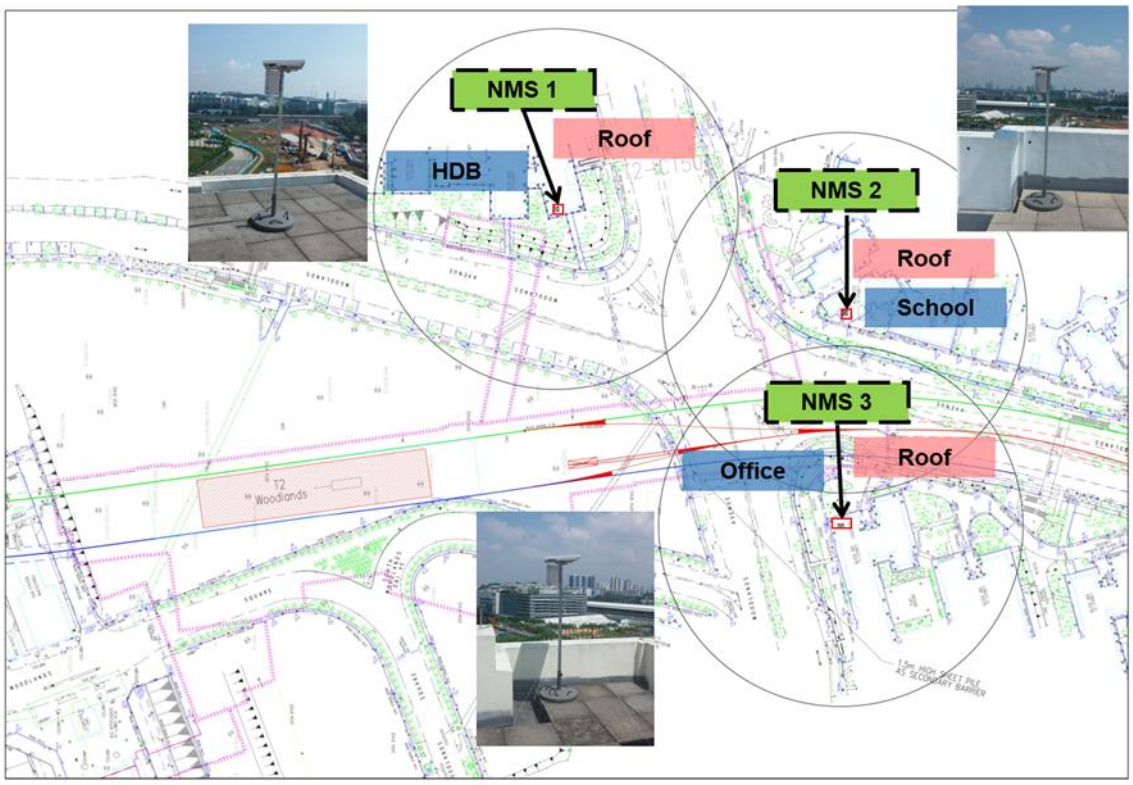


Figure 10: Location and photo of the noise meters

There should be a direct line of sight from the noise meter to the construction site as shown in Figure 11. It is also recommended for the noise meter to be placed 1m away from solid walls and 1.5m above grade.

Figure 11: A real-time noise meter installed on the rooftop with microphone facing the construction site

The system shall be equipped with a SMS-alert feature to alert the ECO and relevant personnel when permissible limits are exceeded. Please refer to Section 4.12 for more details on response measures to be taken when noise levels exceed limits.

Note

- Monitoring must be carried out by Class 1 sound level meter that is in compliance with IEC 61672 standards.
- Noise meters should be calibrated on yearly basis.
- LTA and NEA should also have the access to these online noise readings for monitoring purpose.
- Some noise monitoring systems are able to send pre-emptive notifications when noise levels are close to exceeding the limits for contractors to take preventive actions.

4.7.2 Ad-hoc Noise Monitoring

Ad-hoc noise monitoring must be carried out by trained personnel whenever work progresses into the night, weekends or during noisy operations. Once noise levels are approaching permissible limits, ECO and relevant personnel shall investigate if the works should be stopped or additional mitigation measures should be deployed to reduce the noise level.

Figure 12: Ad-hoc noise monitoring (left) and Class 1 certified handheld noise meter (right)

Note

- The handheld noise meter must be certified as Class 1 sound level meter that is in compliance with IEC 61672 standards and should be calibrated on yearly basis.
- Microphone of the noise meter should point towards the direction pointing toward the work activity.
- The noise measurement should be done at 1m from the noise source and/or at the NSR end.
- The trained personnel should set the noise meter settings to:
  - A-weighted
  - At minimum Leq 5min

4.8 Noise Mitigation Measures

To minimise the disturbance of our projects to the nearby environment, appropriate noise measures must be adopted for all LTA project. These mitigation measures can be categorised into the following hierarchy of controls:

I. Elimination
II. Substitution
III. Engineering Controls
IV. Administrative Controls

4.8.1 Elimination

Elimination of noise source is the most effective way to control construction noise by removing the noise sources completely and optimising construction sequence, methods and site layout.

Site Planning

Contractors should plan the construction works to minimise noise sources on site through optimisation of construction sequence and methods. Contractors should also plan the site layout such as optimising vehicular accesses to minimise reversing of vehicles and making use of structures on site to act as a form of noise shield. For example, contractors can utilise rows of silos, trees and site offices as noise shields to minimise noises propagating from static noisy equipment (e.g. pumps, generators, compressors, air ventilation, batching plants) to sensitive noise receivers.

Figure 13: Silos was positioned to act as noise mitigation barrier.

Scheduling of Work

The sequencing and scheduling of construction operations is equally important in addressing and mitigating construction-related noise. For example, contractors should minimise noisy works, such as pilling, hacking and excavation during sensitive hours, and plan such works in the day when permissible noise limits are higher.

4.8.2 Substitution

Some construction activities such as piling, hacking and excavation generate high noise levels and can cause noise disturbance to the surrounding stakeholders. This can be greatly reduced by substituting conventional construction techniques with quieter construction equipment or techniques. Below are some examples of the various quieter alternatives that contractor should adopt.

Table 8: List of quieter construction alternatives and their advantages

Quieter Construction Alternative for Sheet Piling	
1. Silent Piler 	❖ This equipment utilises the press-in effect to perform piling with minimal noise. ❖ Noise reduction: ~ 20 dB(A)
Quieter Construction Alternative for Removal of Pile Cap	
1. Crack Inducer 	❖ This technique facilitates the removal of pile cap by inducing crack through chemical reactions. ❖ Noise reduction: ~ 20 dB(A)

Quieter Construction Alternatives for Demolition of Concrete and Rock	
 **1. Crusher**	❖ Demolition carried out through crushing using a hydraulic pincer. ❖ Noise reduction: ~ 20 dB(A)
2. Diamond Wire Saw Cutter 	❖ Demolition carried out through a continuous sawing process using diamond blades. ❖ Noise reduction: ~ 30 dB(A)
3. Hydraulic Splitter 	❖ Demolition of large rock and concrete blocks using strong splitting forces. ❖ Noise reduction: ~ 20 dB(A)
4. Coring Machine 	❖ Demolition by high frequency vibration. ❖ Noise reduction: ~ 20 dB(A)

5. Non-Explosive Chemical Cartridge  	❖ Demolition carried out through quick chemical reaction by creating shear effect. ❖ Noise reduction: ~ 20 dB(A)
Quieter Construction Alternative for Material Sorting	
1. Screening Bucket 	❖ Sorting of soil by trommel effect. ❖ Noise reduction: ~ 10 dB(A)

4.8.3 Engineering Controls

Engineering controls can be administered at source or along the transmission path to mitigate construction noise.

Noise Controls at Source

Mitigating noise at source is effective as a single noise source is controlled before it adds on to the overall noise disturbance. There are different mitigation measures at

source that contractor can explore, such as installing noise enclosure at machineries, maintaining machineries regularly to prevent loose parts or engine from making excessive noise, attaching silencer onto ventilation fans, etc.

Figure 14: Machine fixed with muffler to minimise beeping noise

Figure 15: Machineries shrouded with noise proofing enclosures

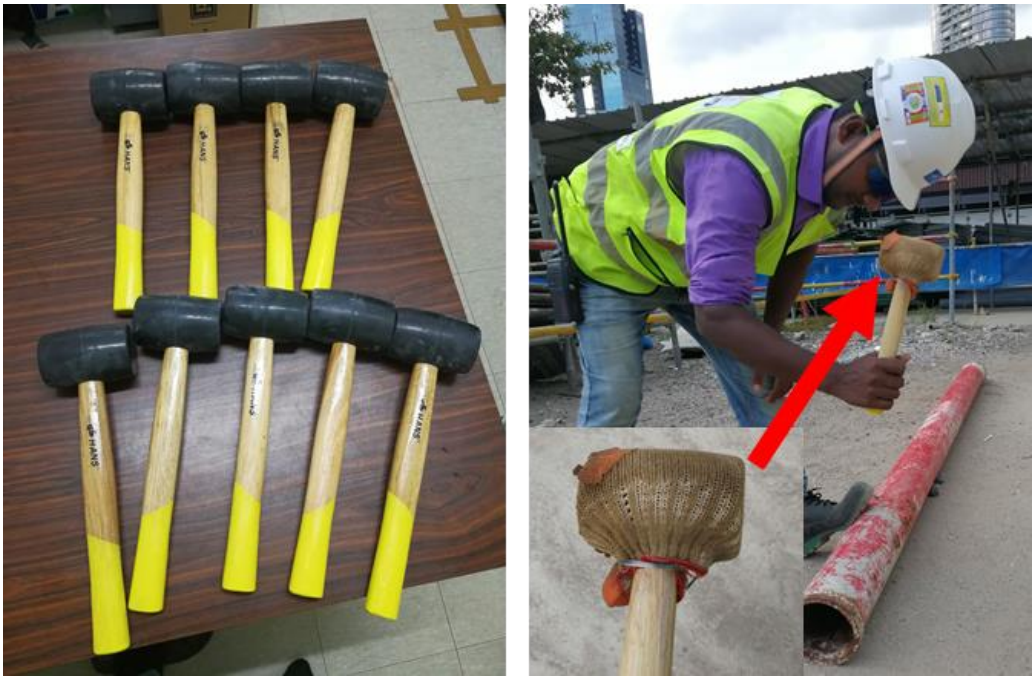


Figure 16: Use rubber mallet to minimise knocking noise

Figure 17: Installation of acoustic material in machineries

Noise Controls along Transmission Path

By intervening the transmission path of sound with acoustic barriers, the noise transmitted to the stakeholders can be minimised further to certain extent. Some of the mitigation measures for controlling sound transmission path are highlighted below.

1. **Noise Enclosure**

   A full noise enclosure should be installed at launch shafts to reduce the noise emitted from noisy tunnelling works. As described in LTA's GS, the design

specifications of the full enclosure such as material, dimensions and orientation of enclosure shall be stated in the NMP. Figure 19 shows retractable noise enclosure which allows multiple TBM launches and ease of moving materials.

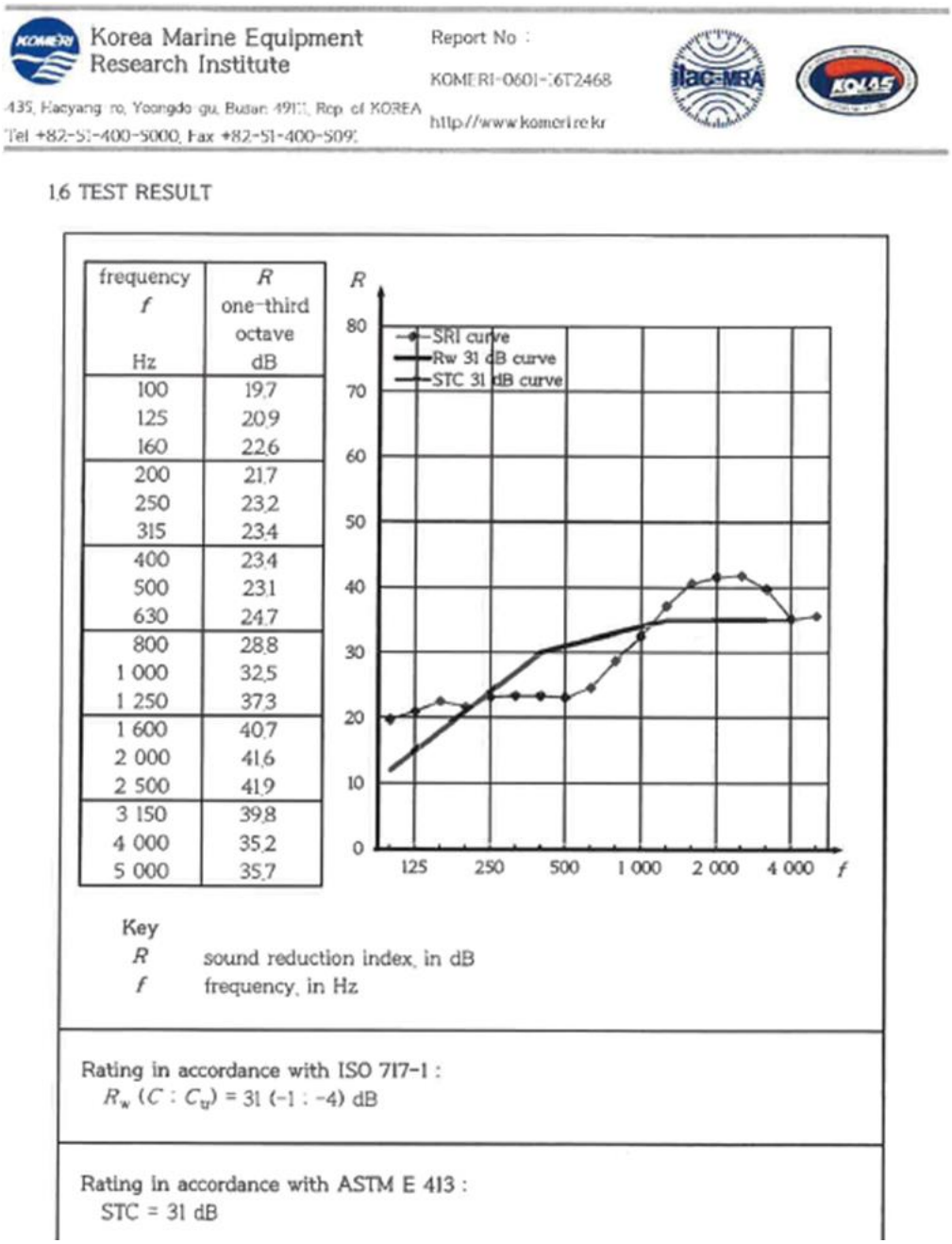
Figure 18: Full noise enclosure with rolling shutter installed at launch shafts for noisy tunnelling works

Figure 19: Retractable noise enclosure installed at launch shafts for noisy tunnelling works

2. Perimeter Noise Barrier

Perimeter noise barriers shall be erected with a 45-degree cantilever extension at the top of the barriers as shown in Figure 20. Barrier shall have a minimum of Sound Transmission Class (STC) 20 with test report submitted as shown in Figure 21.

Figure 20: Flat Wedged Noise Barrier installed to mitigate noise.



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1.6 TEST RESULT

frequency f Hz	R one-third octave dB
100	19.7
125	20.9
160	22.6
200	21.7
250	23.2
315	23.4
400	23.4
500	23.1
630	24.7
800	28.8
1 000	32.5
1 250	37.3
1 600	40.7
2 000	41.6
2 500	41.9
3 150	39.8
4 000	35.2
5 000	35.7

Key
R sound reduction index, in dB
f frequency, in Hz

Rating in accordance with ISO 717-1 :
R_w (C ; C_{tr}) = 31 (-1 ; -4) dB

Rating in accordance with ASTM E 413 :
STC = 31 dB

Figure 21: Test result reflecting the performance of noise barrier

For sites that have space constraint in erecting high noise barriers, contractors should propose inventive ideas to overcome this obstacle. For example, a work site is right below a HDB block and there is no space to install a 10m noise barrier. Hence, noise panels were installed as a roof canopy along the corridor of the second storey which provides noise reduction for the residents (Figure 22).

Figure 22: Noise panels was used to construct roof canopy along the corridor

Likewise, in order to overcome the space constraint, the perimeter noise barriers were erected with narrow strip footing (Figure 23).

Figure 23: Noise barrier constructed with a narrow strip footing to overcome space constraint

3. Portable Noise Barrier

Contractor should prepare portable or inflatable noise barriers on site for localised noise mitigation shown in Figures 24 and 25.

Figure 24: Portable and inflatable noise barriers are in place for localised works.

Figure 25: Portable noise barriers erected for localised road works

4. Noise Blanket

Noise blanket with acoustic foams is another option to temporarily intervene the transmission of sound (Figure 26). This blanket is relatively light-weight, capable of absorbing sound and easy to install at areas with space constraints.

Figure 26: Noise blanket with acoustic foam erected to reduce noise from generator

Heightened Engineering Controls During Sensitive Hours

There are some activities that can only be carried out in the middle of the night (e.g. road diversion on expressway, maintenance works on roads/MRT/LRT) due to the nature of works and time constraints. While NEA understands the need for these works, heightened mitigation measures and PR efforts are required to demonstrate the contractor's efforts in minimising noise during sensitive hours.

Figure 27: Localised noise enclosure erected for drilling works on existing LRT station

Figure 28: Portable noise barrier in place for works on existing MRT viaduct (bottom)

4.8.4 Administrative Controls

Workers also play a part in reducing noise generated on site. Through training and reminders, workers are educated on proper working procedures and behaviours that will not create unnecessary noise disturbance. For example, workers are frequently reminded during toolbox meeting to refrain from throwing rebars and shouting at night.

Figure 29: Briefing conducted during toolbox meeting

Piling operators should also be educated on noise impact and are trained not to do excessive jerking of the bucket when dislodging soil as this action causes unnecessary noise pollution.

Figure 30: Boring rig operator who received adequate training from BCA and supplier

Contractor can appoint noise watchman to monitor the noise level at night when construction activities are still ongoing, promptly highlight if there is any exceedance and advise on the provision of additional mitigation measures when necessary.

Figure 31: Noise watchman monitoring the noise level during night works

Note

- Ensure that mitigation measures are implemented before the start of the noisy works.
- Contractor shall avoid scheduling noisy work at night.
- Grey noise curtain should not be used on site.

4.9 Site Layout

It is useful to provide an overview of noise control measures on a site layout map. As shown in Figure 32, all the perimeter noise barriers and noise enclosures should be indicated with their heights. Furthermore, it can also show the NSRs within close proximity to the construction sites.

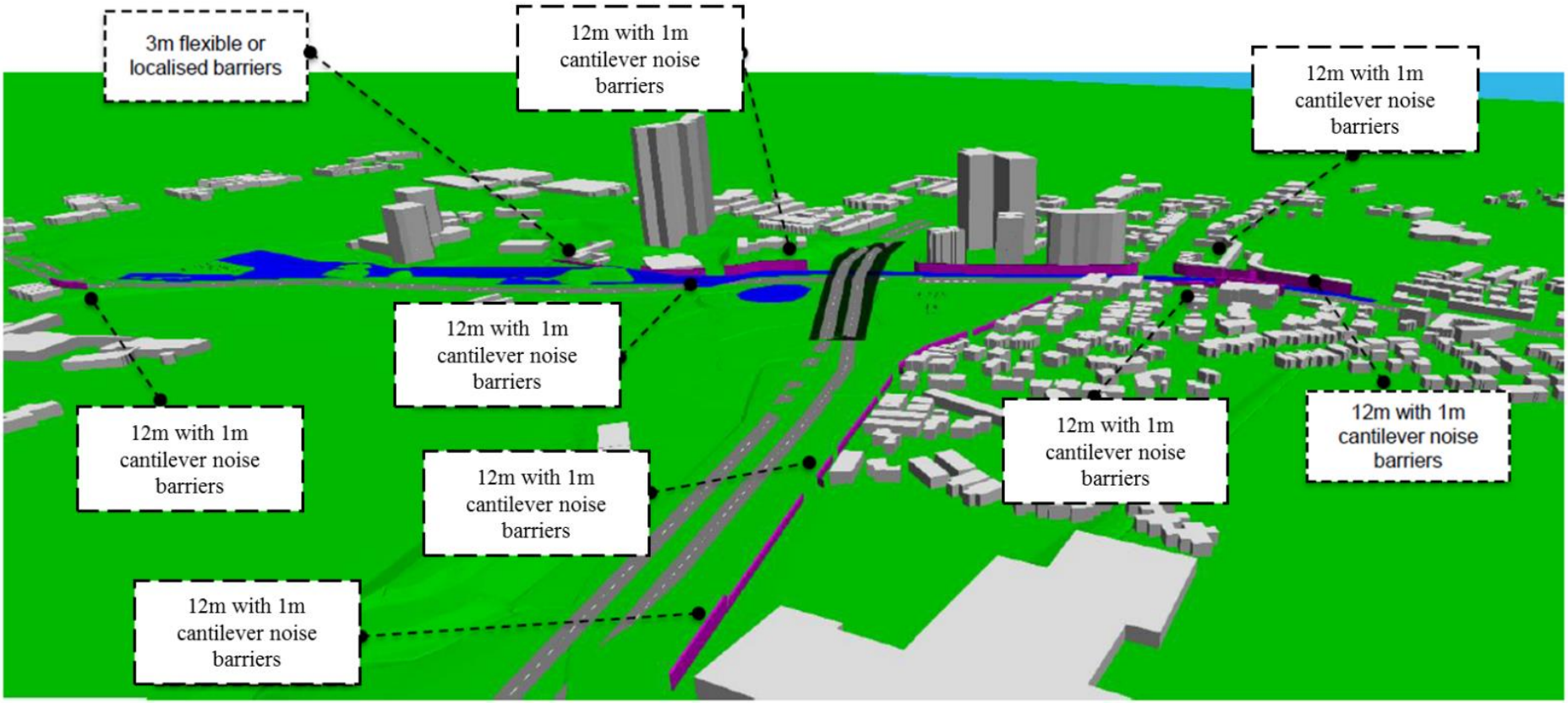


Figure 32: Example of the overall site layout illustrating the NSRs and mitigation measures provided

4.10 Public Relation Efforts

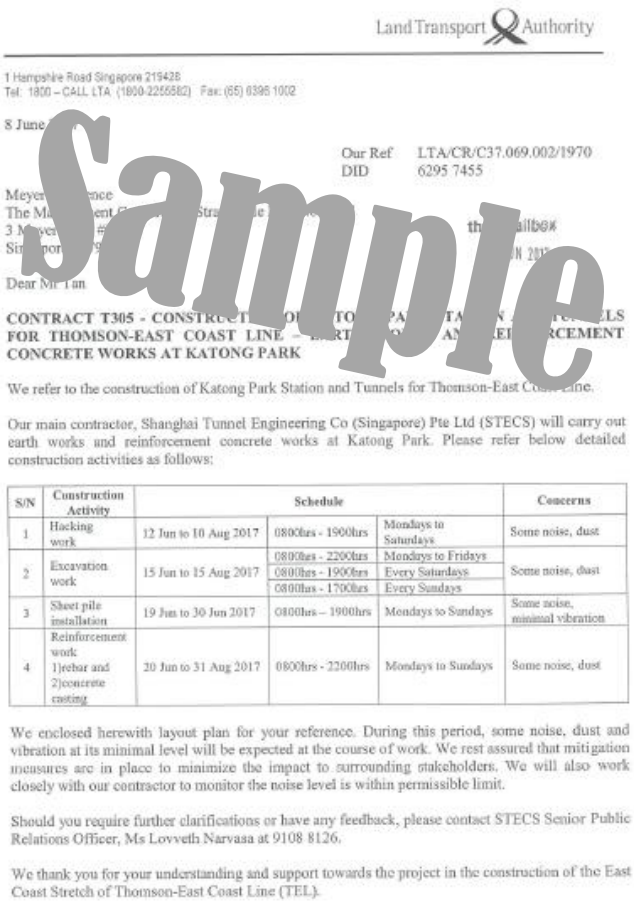
However, even with all the mitigation measures, noise disturbance to the public will still be inevitable. Hence, a critical component in noise management is stakeholder engagement. In this section, the contractor needs to introduce their strategies in managing public's expectations, promoting responsive 2-way communication channel and allowing faster resolution of issues. The NMP should include:

I. Details of designated Public Relations Officer (PRO) and personnel that will manage feedback and investigative works

II. Samples of circulars and publications to notify stakeholders about upcoming works and pre-empt them on the possible disturbances and inconveniences

III. Samples of banners for feedback hotline

IV. Proposed schedule of engagement sessions, such as meet-the-resident session and door-to-door engagement.



Land Transport Authority

1 Hampshire Road Singapore 219428
Tel: 1800 – CALL LTA (1800-2255582) Fax: (65) 6396 1002

8 June

Our Ref: LTA/CR/C37.069.002/1970
DID: 6295 7455

Sample

Dear Mr Tan

CONTRACT T305 - CONSTRUCTION OF TUNNELS FOR THOMSON-EAST COAST LINE – EARTH WORKS AND REINFORCEMENT CONCRETE WORKS AT KATONG PARK

We refer to the construction of Katong Park Station and Tunnels for Thomson-East Coast Line.

Our main contractor, Shanghai Tunnel Engineering Co (Singapore) Pte Ltd (STECS) will carry out earth works and reinforcement concrete works at Katong Park. Please refer below detailed construction activities as follows:

S/N	Construction Activity	Schedule			Concerns
1	Hacking work	12 Jun to 10 Aug 2017	0800hrs - 1900hrs	Mondays to Saturdays	Some noise, dust
2	Excavation work	15 Jun to 15 Aug 2017	0800hrs - 2200hrs	Mondays to Fridays	Some noise, dust
			0800hrs - 1900hrs	Every Saturdays	
			0800hrs - 1700hrs	Every Sundays	
3	Sheet pile installation	19 Jun to 30 Jun 2017	0800hrs – 1900hrs	Mondays to Sundays	Some noise, minimal vibration
4	Reinforcement work 1)rebar and 2)concrete casting	20 Jun to 31 Aug 2017	0800hrs - 2200hrs	Mondays to Sundays	Some noise, dust

We enclosed herewith layout plan for your reference. During this period, some noise, dust and vibration at its minimal level will be expected at the course of work. We rest assured that mitigation measures are in place to minimize the impact to surrounding stakeholders. We will also work closely with our contractor to monitor the noise level is within permissible limit.

Should you require further clarifications or have any feedback, please contact STECS Senior Public Relations Officer, Ms Lovveth Narvasa at 9108 8126.

We thank you for your understanding and support towards the project in the construction of the East Coast Stretch of Thomson-East Coast Line (TEL).

Figure 33: Sample of circulars to stakeholders to inform about noisy or night works and apologise of the noise disturbance and inconvenience caused

Figure 34: Sample of visible signboard/banner displaying the contact details for any feedbacks and concern relating to the project

Figure 35: Engagement with resident and update on project status.

Note

- Stakeholder engagement should start before construction begins and continue throughout the construction period.
- Ensure stakeholders are regularly informed of the upcoming major construction activities that could cause inconvenience or noise disturbance to them.

4.11 Feedback Management

Contractor should have a feedback management system, preferably shown in a chart format as shown in Figure 36, to detail the actions to be taken when a noise feedback

is received. For all NEA noise feedback, LTA has to make the first engagement while PRO can make the subsequent engagements, subjected to stakeholders' consent.

Essentially, it is important to educate residents on the reasons for unavoidable night works, which involve safety critical works (i.e. diaphragm wall construction and concrete pouring), scheduled road works and emergency works.

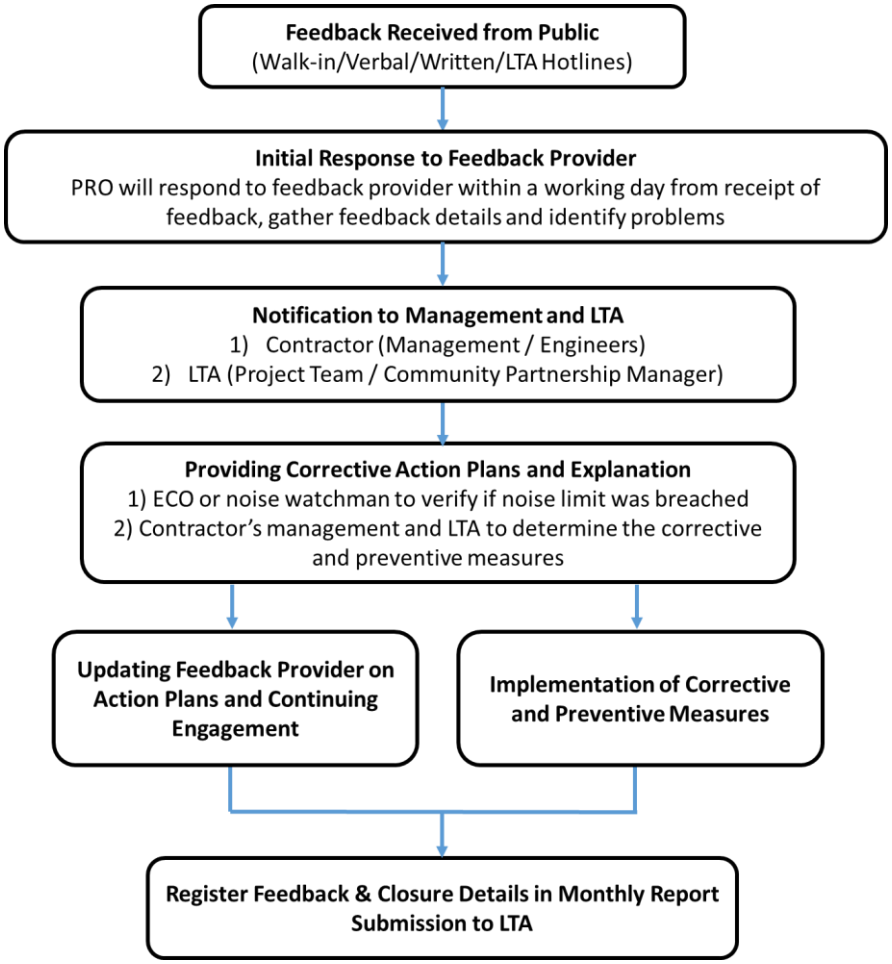


Figure 36: Feedback management chart illustrating the procedures upon receiving a feedback

Note

- Ensure the involved personnel are adequately trained with the feedback management chart.
- Feedback shall be addressed through proper channels.
- The respective personnel shall update LTA with the status of the feedback.

4.12 Response Plan

Noise Exceedance Observed

In an event when noise levels exceed the permissible limit, the ECO and relevant personnel (e.g. noise watchman, site supervisor and engineer-in-charge) are required to investigate and determine if certain activities can be stopped or additional mitigation measures should be deployed to reduce the noise level.

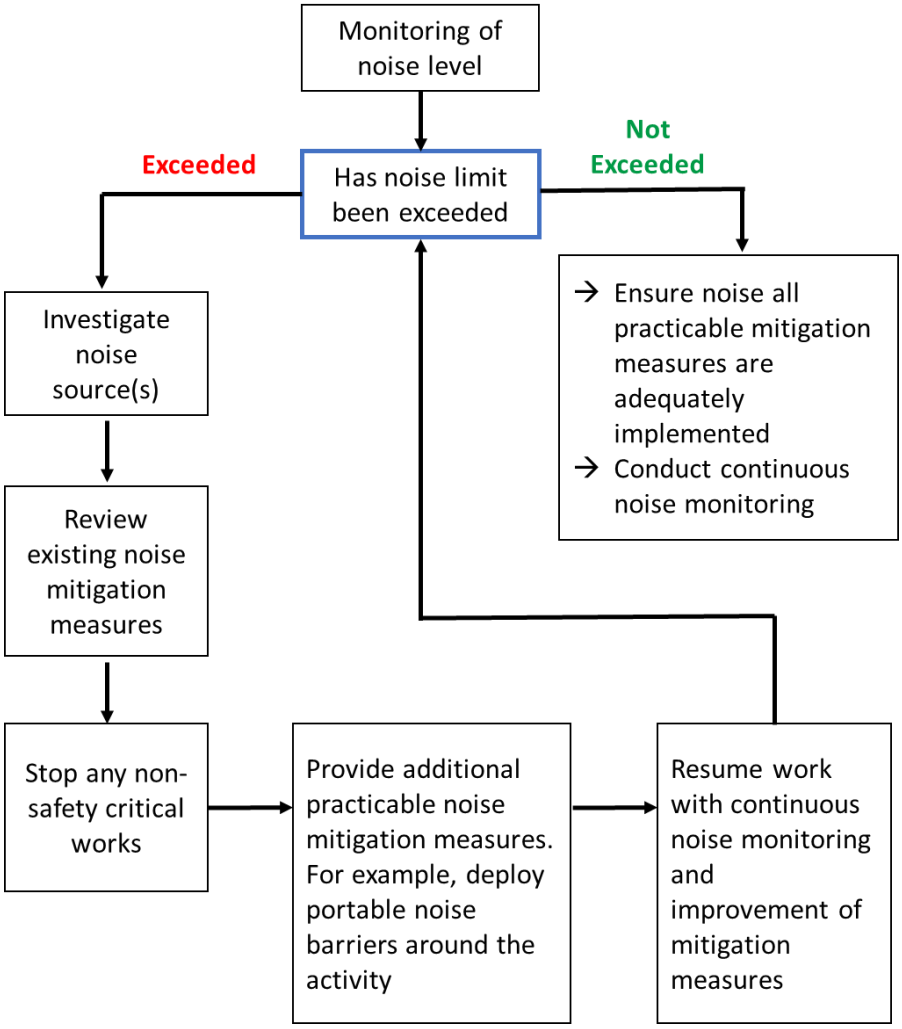


Figure 37: Response plan for noise exceedance

5 REFERENCES

5.1 Legal and other requirements

1. Environmental Protection and Management Act
2. Environmental Protection and Management (Control of Noise at Construction Sites) Regulations
3. SS602:2014 Code of Practice for Noise Control on Construction and Demolition Sites

5.2 LTA Contractual Specification

1. Annex A – g: Environmental Considerations of the General Specification (February 2013 Edition)

5.3 Websites

1. http://www.nonoise.org
2. http://www.catseyeservices.com/handbooks/cd/references/references.htm
3. http://www.epd.gov.hk/epd/english/environmentinhk/noise/noise_maincontent.html
4. http://citysoundproofing.com/
5. http://www.noisenet.org
6. http://www.techniconacoustics.com/acoustic-101/glossary