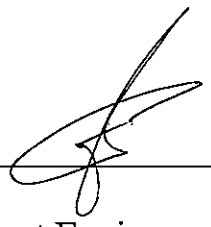
MTR Corporation Limited

West Island Line Project

Contract No. 703 - SHW to SYP Tunnels Construction Groundborne Noise Monitoring Plan (Rev A)

Certified by: 

Position: Independent Environmental Checker

Date: 8 September 2011

MTR Corporation Limited

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Construction Groundborne Noise Monitoring Plan
(Rev A)

Certified by: Glenn Fromes

Position: Environmental Team Leader

Date: 8 September 2011

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MTR WIL Contract 703 – SHW to SYP Tunnels

Construction Groundborne Noise

Monitoring Plan

for

Environmental Monitoring and Audit Submission

Report No.: 10095-13

For

Dragages - Maeda - BSG Joint Venture
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North Point
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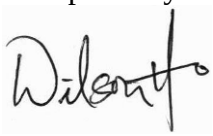
Prepared by:



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Contents **Pages**

1. Introduction

The Dragages-Maeda-BSG Joint Venture (the JV) is appointed by MTR Corporation Limited (MTRC) to commence the Contract No. 703 – SHW to SYP Tunnels (the Contract). The Contract involves the construction of a tunnel from the existing Sheung Wan Station westwards towards a new Sai Ying Pun Station (to be constructed by others) for West Island Line (WIL). Environmental monitoring and auditing for goundborne noise issues during TBM operation shall be carried out to ensure that all recommended mitigation measures are fully and effectively implemented. The construction project started in September 2009 and expected to be completed in August 2013. TBM will be operated from October 2011 to June 2012.

Wilson Acoustics Limited (WAL) is commissioned to conduct TBM groundborne noise (GBN) monitoring for construction of MTR WIL Contract No. 703 – SHW to SYP Tunnels. As required by ***West Island Line (WIL) EM&A manual-Section 3.1 Ground-borne Noise Monitoring for TBM- Table 3.1 Construction Ground-borne Noise Monitoring Location***, groudborne noise monitoring will be conducted at three critical Noise Sensitive Receivers (NSRs) located along the TBM tunnels of MTR WIL Contract No. 703, including Kian Nan Mansion, 81-85 Bonham Strand West, 106 Des Voeux Road West and Hongway Garden. TBM GBN monitoring on other NSRs shown in ***WIL EM&A manual - Table 3.1 Construction Ground-borne Noise Monitoring Location*** is not necessary since tunnel construction closed to those NSRs will not be conducted by TBM.

This document presents the monitoring plan as stipulated in ***West Island Line (WIL) EM&A manual-Section 3.1 Ground-borne Noise Monitoring for TBM***. This monitoring plan proposes monitoring locations, monitoring period, noise parameters and instrumentation for both baseline and impact ground-borne noise monitoring during TBM operation.

2. Environmental Organisation

Project Organisation

The roles and responsibilities of the various parties involved in the construction phase EM&A process and the organisational structure of the organisations responsible for implementing the EM&A programme for MTR WIL Contract No. 703 are outlined below.

Engineer or Engineer's Representative (ER)

The Engineer is responsible for overseeing the construction works and for ensuring that the work undertaken by the Contractor in accordance with the specification and contractual requirements. The duties and responsibilities of the Engineer with respect to EM&A may include:

- Supervise the Contractor's activities and ensure that the requirements in this Manual are fully complied with;
- Inform the Contractor when action is required to reduce impacts in accordance with the Event and Action Plans;
- Participate in joint site inspection, monitoring location undertaken by the ET if necessary; and
- Adhere to the procedures for carrying out complaint investigation.

Independent Environmental Checker (IEC)

The IEC shall advise the Engineer's Representative on environmental issues related to ground-borne noise issue. The duties and responsibilities of the IEC are:

- Review the EM&A works under this plan performed by the ET;
- Audit the monitoring activities and results;
- Review the construction ground-borne noise monitoring reports submitted by the ET;
- Review the proposal on mitigation measures submitted by the Contractor in accordance with the Event and Action Plans; and
- Adhere to the procedures for carrying out complaint investigation as required in this Plan.

The Contractor

The Contractor shall report to the Engineer. The duties and responsibilities of the Contractor are:

- Provide assistance to ET in carrying out the construction ground-borne noise monitoring;
- Submit proposals on mitigation measures in case of exceedances of Action and Limit levels in accordance with the Event and Action Plans;
- Implement measures to reduce impact where Action and Limit levels are exceeded; and Adhere to the procedures for carrying out complaint investigation as required in the Plan.

Environmental Team

The ET should conduct the ground-borne noise monitoring program and ensure the Contractor's compliance with the project's environmental performance requirements during construction. The ET should plan, organise and manage the implementation of this Plan and ensure that the EM&A works in this plan are undertaken to the required standards. The duties and responsibilities of the ET are:

- Analysis the ground-borne noise monitoring parameters with reference to the approved ground-borne noise monitoring plan;
- Environmental site surveillance;
- Inspection and audit of compliance with noise control ordinance;
- Assess the effectiveness of the TBM ground-borne noise mitigation measures implemented;
- Review work methodologies when TBM ground-borne noise exceeded the limit level during the construction phase and comment as necessary;
- Complaint investigation, evaluation and identification of corrective measures;
- Liaison with the IEC on TBM ground-borne noise matter and timely submission of monitoring data in EM&A report for IEC's approval; and
- Advice to the Contractor on ground-borne noise mitigations, awareness and enhancement matters, etc.

MTR Corporation Limited's Head of Sustainability Development is the Environmental Team Leader and Wilson Acoustics Limited will be responsible for undertaking the TBM groundborne noise monitoring during construction stage of MTR WIL Contract No. 703.

3. Statutory Noise Criteria

According to the WIL EIA, the Area Sensitivity Rating (ASR) of the critical NSRs is "B". The corresponding Acceptable Noise Levels (ANLs) for ground-borne are 65dB(A) during daytime (0700 – 1900 hours), 55dB(A) during evening (1900 – 2300 hours) and 40dB(A) during nighttime (2300 – 0700 hours) as shown in Table 3.1 below.

Table 3.1: Construction Ground-borne Noise Criteria

NSR Description	Construction Ground-borne Noise Criteria, dB(A)		
	Day-time (0700-1900 hrs) (except general holidays & Sunday)	**All days during the evening (1900-2300 hrs), and general holidays (including Sundays) during the day-time and evening (0700-2300 hrs)**	**All days during the night-time (2300-0700 hrs)**

NSR	Construction Ground-borne Noise Criteria, dB(A)		
Domestic Premises	65 ($L_{Aeq,30mins}$)	55 ($L_{Aeq,5mins}$)	40 ($L_{Aeq,5mins}$)

Between 1900 and 0700 hours and all day on Sundays and public holidays (restricted hours), TBM operation is prohibited unless a Construction Noise Permit (CNP) has been obtained. If TBM operation is carried out during restricted hours, valid CNP will be applied and GBN monitoring plan for CNP application will be adopted accordingly.

4. Measurement Location

Site visit to the monitoring locations was conducted on 29 Dec 2010. For MTR WIL Contract 703 – SHW to SYP Tunnels, total of 3 TBM GBN monitoring locations, including Kian Nan Mansion, 81-85 Bonham Strand West, 106 Des Voeux Road West and Hongway Garden, are identified in the ***West Island Line EM&A manual-Section 3.1 Ground-borne Noise Monitoring for TBM- Table 3.1 Construction Ground-borne Noise Monitoring Location***. The three representative NSRs for TBM GBN monitoring are shown in Figure 1 and Table 4.1 below. Photo of NSRs and measurement locations are shown in Annex A.

TBM GBN monitoring on 4 other NSRs (Chinese Rhenish Church (Lai Yin Church) at Bonham Road, Main Building of the University of Hong Kong, Hon Wah Middle School at Ching Lin Terrace, Po Shu Lau, 35-43 Sands Street) shown in ***WIL EM&A manual - Table 3.1 Construction Ground-borne Noise Monitoring Location*** is not necessary since tunnel construction closed to those NSRs will not be conducted by TBM. Figure 2 and 3 shows the tunnel construction closed to those 4 NSRs to be done by either drill and blast method or mechanical excavation.

Figure 1: Three TBM GBN Monitoring Locations

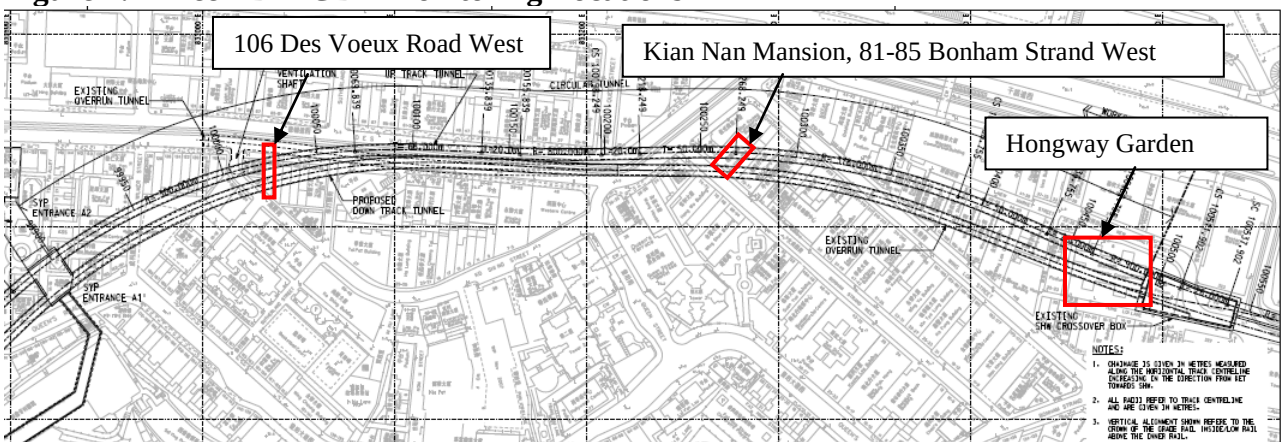

Figure 2: Tunnel Construction Methods, Drill and Blast- SYP to KET Tunnel, UNI Station and SYP Station

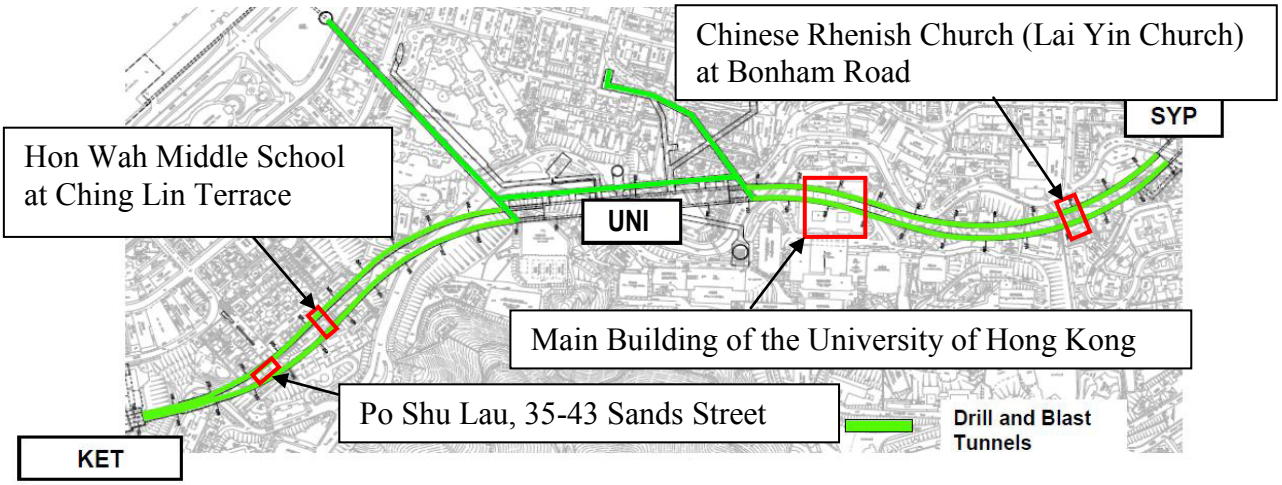

Figure 3: Tunnel Construction Methods, Drill and Blast- KET Station and Overrun Tunnel

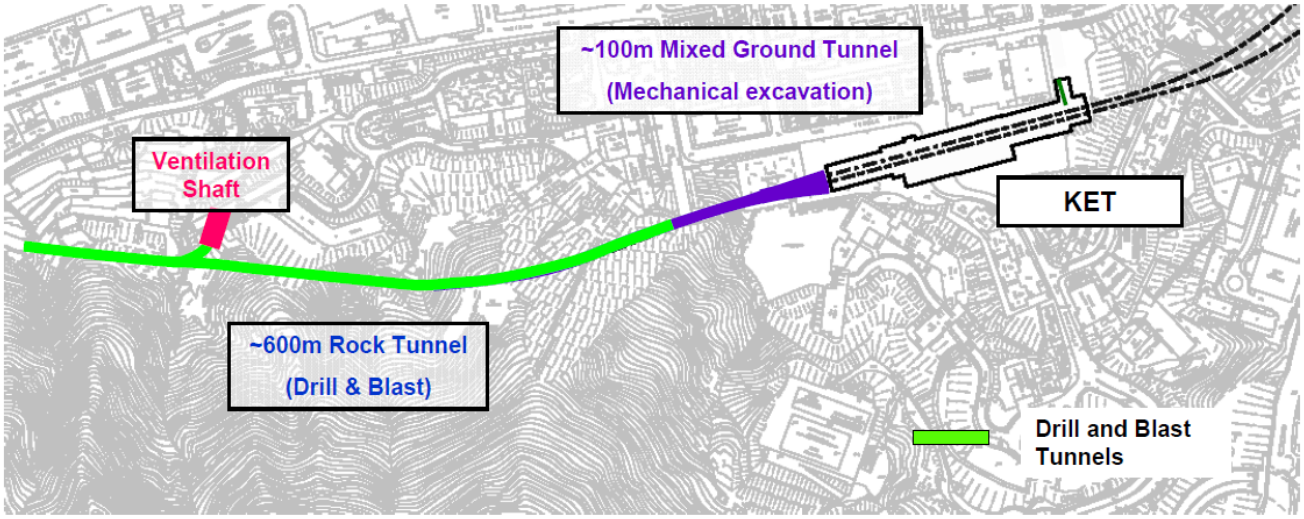

Table 4.1: Groundborne Noise Monitoring Location

GBNSR	Location	Function	Lowest Occupied Floor	Ground-borne Noise Criteria, dB(A) Daytime (0700-1900) (except General Holidays &Sunday)
1	Kian Nan Mansion, 81-85 Bonham Strand West	Residential	1	65
2	106 Des Voeux Road West	Residential	1	65
3	Hongway Garden	Residential	2	65

Noise measurements will be taken at the staircase or lift lobby of the critical NSRs. Microphone will be placed at approximately 1.2 to 1.5m above floor level; accelerometer will be placed on the floor and wall where appropriate.

5. GBN Measurement Methodology

Baseline and Impact Monitoring

Baseline and impact monitoring (ground-borne noise & vibration) are proposed to be conducted at the 3 NSRs. Before the operation of TBM and other vibration construction activities, half-hour baseline monitoring at different period (within 0700 –1900 hours) of a day will be conducted at six consecutive days (Mon –Sat) at each of the 3 critical NSRs as shown in Table 4.1.

Impact ground-borne noise will be monitored for half hour at each identified NSR when the TBM is operating underneath the NSRs. Background ground-borne noise measurement will be conducted for half hour on the same day before TBM operation. Background noise correction would be applied to TBM operation period according to acoustic principle.

Monitoring Conditions

GBN measurement will be conducted within the enclosure environment due to GBN is affected by ambient noise, where the monitoring location is accessible. If an enclosure environment is not available at NSRs, ground-borne noise level will be projected from measured vibration level at the NSR.

Ground-borne Noise Projection Methodology

The GBN projection is based on measured vibration levels and the methodology is briefly described as below:

GBN = Lv + CTN

Where
Lv Vibration Level measured on ground in dB re μin/s
CTN Conversion to Noise level from floor vibration velocity level (re μin/s), +2dB for typical receiver rooms,

6. Noise Measurement Parameters and Duration

Six consecutive 5 minutes overall equivalent A-weighted continuous sound pressure levels ($L_{eq\ 5min}$) and the 30 minutes overall equivalent A-weighted continuous sound pressure levels ($L_{eq\ 30min}$) will be presented in the Ground-borne Noise Monitoring Report for both baseline and impact ground-borne noise monitoring.

7. Instrumentation and Measurement Parameters

An analyzer, one accelerometer, one microphone, one acoustic calibrator and one vibration calibrator were used for the noise and vibration measurements. The instrumentation is listed in Table 7.2 below.

Table 7.2: Instrumentation

Equipment	Manufacturer	Model	Serial Number
4-Channel Sound and Vibration Analyzer	Svantek	SVAN958	14210
Accelerometer	CTC	AC135-1A	3328
Microphone	GRAS	40AE	82234
Pre-Amplifier	SVANTEK	SV12L	13062
Acoustic Calibrator	Svantek	SV30A	10841
Vibration Calibrator	PCB	699A02	989

The instrumentations are maintained with regular laboratory calibrations. The calibrations are traceable to international standard. The calibration certificates of the noise and vibration measurement equipment will be included in the respective EM&A report.

8. Reporting

Baseline Monitoring Reports

Baseline monitoring result will be incorporated in the monthly EM&A reports prepared by ET. The form and content of the report and the representation of baseline monitoring data would be in a format to the satisfaction of EPD and include, but not limited to the following:

- brief project background information;
- drawings showing locations of the baseline monitoring stations;
- monitoring results together with the following information:
- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations;
- monitoring date, time, frequency and duration; and
- details of influencing factors, including:
- major activities, if any, being carried out on the site during the period;
- weather conditions during the period; and
- other factors which might affect results;
- determination of the Action and Limit Levels for each monitoring parameter and statistical analysis of the baseline data, the analysis shall conclude if there is any significant difference between control and impact stations for the parameters monitored;
- revisions for inclusion in the EM&A Manual; and
- comments, recommendations and conclusions.

Impact Monitoring Reports

The monitoring results and findings will be reported and submitted within 10 working days of the end of monitoring and the monitoring result will be incorporated in the monthly EM&A report prepared by ET. The form and content of the report and the representation of impact monitoring data would be in a format to the satisfaction of EPD and include, but not limited to the following:

- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations (and depth);
- monitoring date, time, frequency and duration;
- graphical plots of the monitoring parameters in the month annotated against the following;
  (a) major activities being carried out on site during the period;
  (b) weather conditions during the period;
  (c) any other factors which might affect the monitoring results; and

9. Interim Notification of Environmental Quality Limit Exceedances

With reference to the Event and Action Plan, when the ground-borne noise limits are exceeded, the ET Leader shall immediately notify the IEC and EPD, as appropriate. The notification shall be followed up with advice to IEC and EPD on the results of the investigation, proposed actions and success of the actions taken, with any necessary follow-up proposals. A sample template for the interim notifications is presented in Annex B.

10. Event and Action Plan for Construction Noise Monitoring

The Action and Limit levels for WIL Contract no.703 TBM ground-borne noise are defined in Table 10.1. Should non-compliance of the noise quality criteria occur, actions in accordance with the Event and Action Plan in Table 10.2 shall be taken.

Table10.1 Action and Limit Levels for TBM Ground-borne Noise

Time Period	Action	Limit
0700-1900 hrs on normal weekdays	When one documented complaint is received	65dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days		55dB(A)
2300-0700 hrs of next day		40dB(A)

To account for cases where ambient noise levels as identified by baseline monitoring approach or exceed the stipulated Limit Levels prior to commencement of construction, a Maximum Acceptable Impact Level may be defined and agreed with EPD, which incorporates the baseline noise levels and the identified construction noise Limit Level. The amended level will therefore be greater than 65dB(A) and will represent the maximum acceptable noise level at a specific monitoring station.

Table 10.2 Event and Action Plan for TBM Ground-borne Noise Monitoring

Event	ACTION			
	ET	IEC	ER	JV
Action Level	1. Notify IEC and ER 2. Carry out investigation 3. Report the results of investigation to the IEC and ER 4. Discuss jointly with the ER and Contractor and formulate remedial measures 5. Increase monitoring frequency to check mitigation effectiveness	1. Review the analysed results submitted by the ET 2. Review the proposed remedial measures by the Contractor and advise the ER accordingly 3. Supervise the implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analysed noise problem 4. Ensure remedial measures are properly implemented	1. Submit noise mitigation proposal to ER with copy to IEC. 2. Implement ground-borne noise mitigation proposal
Limit Level	1. Notify IEC, ER, EPD and Contractor 2. Identify source 3. Repeat measurement to confirm findings 4. Increase monitoring frequency 5. Carry out analysis of Contractor's working procedure to determine possible mitigation to be implemented 6. Inform IEC, ER, EPD the causes and actions taken for the exceedances 7. Assess effectiveness of Contractor's remedial action and keep IEC, EPD and ER informed of the results 8. If exceedance stops, cease additional monitoring	1. Discuss amongst ER, ET and Contractor on the potential remedial actions 2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly 3. Supervise the implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analyses ground-borne noise problem 4. Ensure remedial measures are properly implemented 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial action to ER with copy to IEC 3. Implement the agreed ground-borne noise mitigation proposals 4. Revise and resubmit proposals if problem still not under control 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated.

11. Mitigation Measures

The EIA report indicated that TBM operation would not cause groundborne noise exceedance at NSRs, therefore, no mitigation measure is anticipated to be implemented. In case the measured noise exceeding the limit, reduction of TBM thrusting pressure and rotational speed of TBM cutter discs are recommended. The Contractor shall be responsible for the design and implementation for these measures.

If the above measures are not sufficient to restore the construction noise quality to acceptable levels upon the advice of ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose them to ER for approval, and carry out the mitigation measures.

Annex A: Measurement Location Photo

Photo 1: GBNSR 1, 106 Des Voeux Road

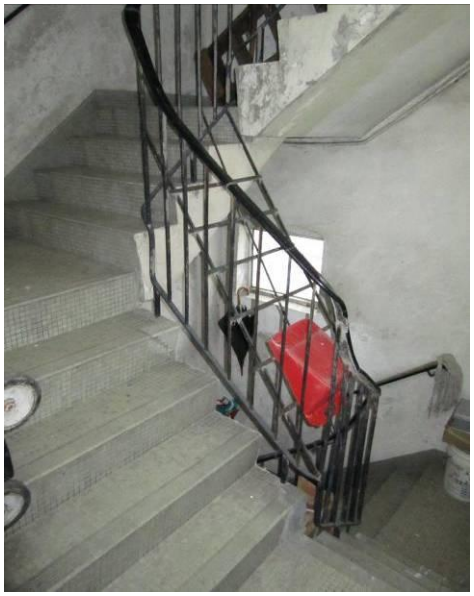

Photo 2: Measurement Location in GBNSR 1

Photo 3: GBNSR 2, Kian Nan Mansion, 81-85 Bonham Strand West West

Photo 4: Measurement Location in GBNSR 2

Photo 5: GBNSR 3, Hongway Garden

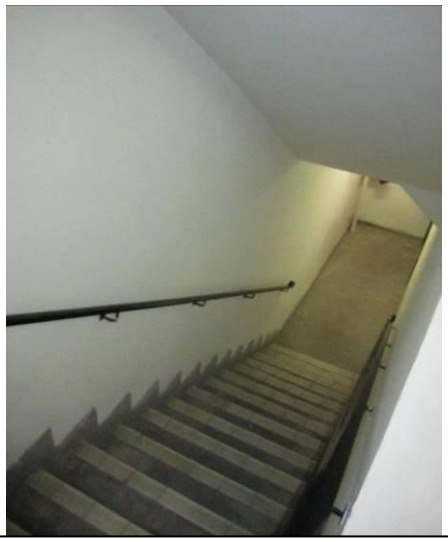

Photo 6: Measurement Location in GBNSR 3

Annex B: Sample Template for the Interim Notifications

Project	
Date	
Time	
Monitoring Location	
Parameter	
Action & Limit Levels	
Measured Level	
Possible reason for Action or Limit Level Non-compliance	
Actions taken / to be taken	
Remarks	

Location Plan

Prepared by : _____

Designation : _____

Signature : _____

Date : _____