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5 NOISE ASSESSMENT

5.1 INTRODUCTION

This section provides an evaluation of the noise impacts arising from the construction and operation of the LNG terminal proposed on South Soko Island. Activities during the construction phase, including reclamation, site formation and building construction and fixed plant noise sources during the operational phase, have the potential to cause noise impacts to the surrounding area. Appropriate mitigation measures will be recommended, where necessary, in order to mitigate any adverse impacts.

5.2 LEGISLATION REQUIREMENT AND EVALUATION CRITERIA

5.2.1 Construction Phase

General

The noise impacts associated with the LNG terminal construction will be assessed according to the *Environmental Impact Assessment Ordinance (Cap.499)* and its *Technical Memorandum, EIAO-TM*. The assessment criteria are defined in *Annex 5* of the *EIAO-TM* and the principal legislation for controlling construction noise is the *Noise Control Ordinance, Cap. 400 (NCO)*. A number of technical memoranda (TMs) have been issued under the *NCO* to stipulate control approaches and criteria and those that may be relevant to the construction of the terminal include the following:

- *Technical Memorandum on Noise from Construction Work Other than Percussive Piling (GW-TM)* which provides the guidelines for controlling the construction noise from power mechanical equipment (PME) in general construction works.
- *Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM)* which deals with control of noise generated by specified powered mechanical equipment (SPME) and prescribed construction work (PCW) within designated areas.
- *Technical Memorandum on Noise from Percussive Piling (PP-TM)* which addresses the control of noise from percussive piling in addition to issuance of Construction Noise Permit (CNP).

Percussive Piling

Under the *PP-TM*, percussive piling is prohibited at any time on Sundays and public holidays and during evening and night-time hours (1900 - 0700 hours), Monday through Saturday. A CNP is required in order to carry out such work during daytime hours (0700 - 1900 hours) Monday through Saturday.

In addition, percussive piling is prohibited at any time on Sundays and public holidays and during evening and night-time hours (1900 - 0700 hours), Monday through Saturday.

As the issuance of a CNP by the *Noise Control Authority* would depend on the submission of an application by the contractor, and therefore on the contractor's compliance with the percussive piling noise limits set out within the *PP-TM*, the assessment of this type of noise has not been included in this EIA.

General Construction Works During Restricted Hours

The *NCO* provides statutory controls on general construction works during restricted hours (i.e., 1900 - 0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of PME for carrying out construction works during these restricted hours would require a CNP. The *Noise Control Authority* will assess all CNP applications on a case-by-case basis and, in doing so, the authority advises that they will be guided by the *GW-TM*.

When assessing an application for the use of PME, the *Noise Control Authority* will compare the Acceptable Noise Levels (ANLs) specified in the *GW-TM* with the CNLs (adjusted for any barrier and reflection effects) associated with the proposed PME operations. The *NCO* requires that noise levels from construction at affected NSRs be less than the specified ANL. The ANLs are related to the inherent noise sensitivity of the noise receiver areas in question, which in turn relate to the background noise characteristics of these areas. Each noise receiver area is then assigned an Area Sensitivity Rating (ASR) based on its predominant land use and the presence, if any, of Influencing Factors (IFs) such as nearby industrial areas, major roads or airports. The relevant ANLs are shown in *Table 5.1*. Factors influencing the outcome of a CNP application, such as the assigning of ANLs, would be determined by the *Noise Control Authority* at the time of the application review based on the prevailing site conditions which may change from time to time. It should be noted that nothing in this report shall bind the *Noise Control Authority* in making their decision. If a permit is to be issued, the Authority shall include any condition it thinks fit, and such conditions shall be followed while the works covered by the permit are being carried out. Failure to comply with any conditions could result in the cancellation of the permit and prosecution action under the *NCO*.

Table 5.1 *Acceptable Noise Levels (ANLs) for General Construction Works to be carried out during Restricted Hours*

Time Period	Area Sensitivity Rating ^(a)		
	L _{Aeq, 5 min} (dB(A))		
	A	B	C
All days during the evening (1900 - 2300 hours) and general holidays (including Sundays) during the daytime and evening (0700 - 2300 hours)	60	65	70
All days during the night-time (2300 - 0700 hours)	45	50	55

Note:
(a) The standards apply to uses which rely on opened windows for ventilation.

General Construction Works During Normal Working Hours

Although the NCO does not provide for the control of noise from construction activities during normal working hours (0700 - 1900, Monday to Saturday), Annex 5 of the EIAO-TM specifies a limit of L_{eq, 30 min} 75 dB(A) for residential NSRs. Annex 5 also provides construction noise limits of L_{eq, 30 min} 70 dB(A) and 65 dB(A) for schools during normal teaching periods and examination periods respectively.

5.2.2 *Operational Phase*

Fixed plant noise is controlled under Section 13 of the NCO and the predictions will be undertaken in accordance with the *Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM)*. The criteria noise limits are set out in the EIAO-TM as follows:

- The total fixed source noise level at the facade of the nearest NSR is at least 5 dB(A) lower than the appropriate ANL (as shown in Table 5.2) as specified in the IND-TM; or
- Where the prevailing noise level in the area is 5 dB(A) or more below the appropriate ANL, the total fixed source noise level must not exceed this noise level.

The criteria noise limits stipulated in the IND-TM apply for all days and general holidays and are dependent on the Area Sensitivity Rating (ASR) of the NSRs, as shown in Table 5.2.

Table 5.2 *ANLs to be used as Operational Noise Criteria*

Time Period	L _{Aeq 30min} (dB(A))		
	ASR "A"	ASR "B"	ASR "C"
Daytime (0700 - 1900)	60 (55)	65 (60)	70 (65)
Evening (1900 - 2300)	60 (55)	65 (60)	70 (65)
Night-time (2300 - 0700)	50 (45)	55 (50)	60 (55)

L_{Aeq 30min} (dB(A))

Note:

The number in brackets indicates the noise limit (ANL -5) for operational noise impact assessment.

As the site is located in a rural area and no influencing factors affect the NSRs, which are located at more than 6 km away from the site, an ASR “A” has been assumed for the NSR located in the vicinity of the proposed site. Baseline noise measurement has been conducted to investigate the prevailing noise levels at Shek Pik (the nearest sensitive area) and to establish the noise limit for the assessment of the operational noise impact. Details of the noise measurement will be further discussed in *Section 5.3.3*.

The Area Sensitive Rating assumed in this Report is for an indicative operational noise assessment only. It should be noted that fixed noise sources are controlled under *Section 13* of the *NCO*. At the time of investigation, the *Noise Control Authority* shall determine noise impact from concerned fixed noise sources on the basis of prevailing legislation and practices being in force, and taking account of contemporary conditions / situations of adjoining land uses.

5.3 BASELINE ENVIRONMENTAL CONDITIONS AND NOISE SENSITIVE RECEIVERS

5.3.1 Baseline Environmental Conditions

The area of the proposed site is in an uninhabited rural area. Siu A Chau (North Soko Island) is located at approximately 1 km away to the north of the proposed site and is now uninhabited. The background noise environment is dominated by the noise from marine vessel traffic.

5.3.2 Noise Sensitive Receivers

No NSR has been identified on the islands (South Soko and North Soko). The nearest NSR is identified as the Staff Quarters of the Shek Pik Prison on Lantau Island (N1) which is located approximately 6 km away from the site. The location of the NSR is shown in *Figure 5.3a*. According to the Concept Plan for Lantau prepared by Lantau Development Task Force and other plans implemented by other bureaux and government departments, there are no planned or committed uses within 7 km from the site. The headland at North Soko located between the proposed site and the NSR N1 will act as a substantial barrier to reduce the potential construction and operational noise impact to N1. The terrain profile between N1 and the LNG terminal presented in *Annex 5-A* is derived by Digital Elevation Model (DEM) basing on the Land Information Centre (LIC) data from the Lands Department.

An approximately 40-km long submarine gas pipeline linking the proposed LNG terminal at the South Soko Island to the existing Black Point Power Station and gas receiving station (GRS) will be constructed (*Figure 5.4a*). The



Figure 5.3a

Location of Noise Sensitive Receiver at Shek Pik

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installation of the submarine gas pipeline will use a combination of dredging and jetting methods. The nearest NSRs that may be affected by the installation of gas pipeline and GRS are identified as the Tai O Barracks (N2) at Tai O (Figure 5.3b) and the village house at Lung Kwu Sheung Tan (N3) (Figure 5.3c) respectively. The village house (N3) at Lung Kwu Sheung is used as an office for the outdoor karting track, according to the approved EIA Report for Proposed Karting Track in D.D.134, Lung Kwu Sheung Tan, Tuen Mun (EIA-116/2005). To present a worse case scenario, the construction noise impact at this village house has also been assessed.

5.3.3 Baseline Noise Measurement

To investigate the prevailing noise levels at Shek Pik area, two sets of continuous 24-hour noise measurement were made from 19 to 20 January 2006 at the roof top of Block J of the Staff Quarters (N1a) and at the 4/F of Block K of Staff Quarters (N1b) from 13 to 14 July 2006 (Figure 5.3d). The noise measurements were conducted using Solo 01 Premium Sound Level Meter (Type 1) and were calibrated using B&K Sound Level Calibrator Type 4231 with a calibration signal of 94.0 dB(A) at 1 kHz. The measurements were conducted with reference to the calibration and measurement procedures as stated in the *IND-TM*.

The measurement results are summarised in *Tables 5.3 and 5.4* and timeline charts showing the prevailing noise levels are presented in *Figures 5.3e and 5.3f*.

Table 5.3 Measured Prevailing Facade Noise Level at N1a

Period	L _{Aeq, 30min} dB(A)		
	Minimum	Average	Maximum
0700 – 2300 hours	51	55	59
2300 – 0700 hours	50	52	54

Table 5.4 Measured Prevailing Facade Noise Level at N1b

Period	L _{Aeq, 30min} dB(A)		
	Minimum	Average	Maximum
0700 – 2300 hours	54	56	63
2300 – 0700 hours	53	55	56

The minimum measured prevailing noise levels at the Shek Pik Staff Quarter are in the range of 50 -53 dB(A) during night-time period, which are higher than the (ANL-5) criterion, and therefore the (ANL – 5) criterion, i.e., 45 dB(A) L_{Aeq, 30min} for the night-time period will be adopted as the stipulated noise limit for the assessment of operational noise impacts.

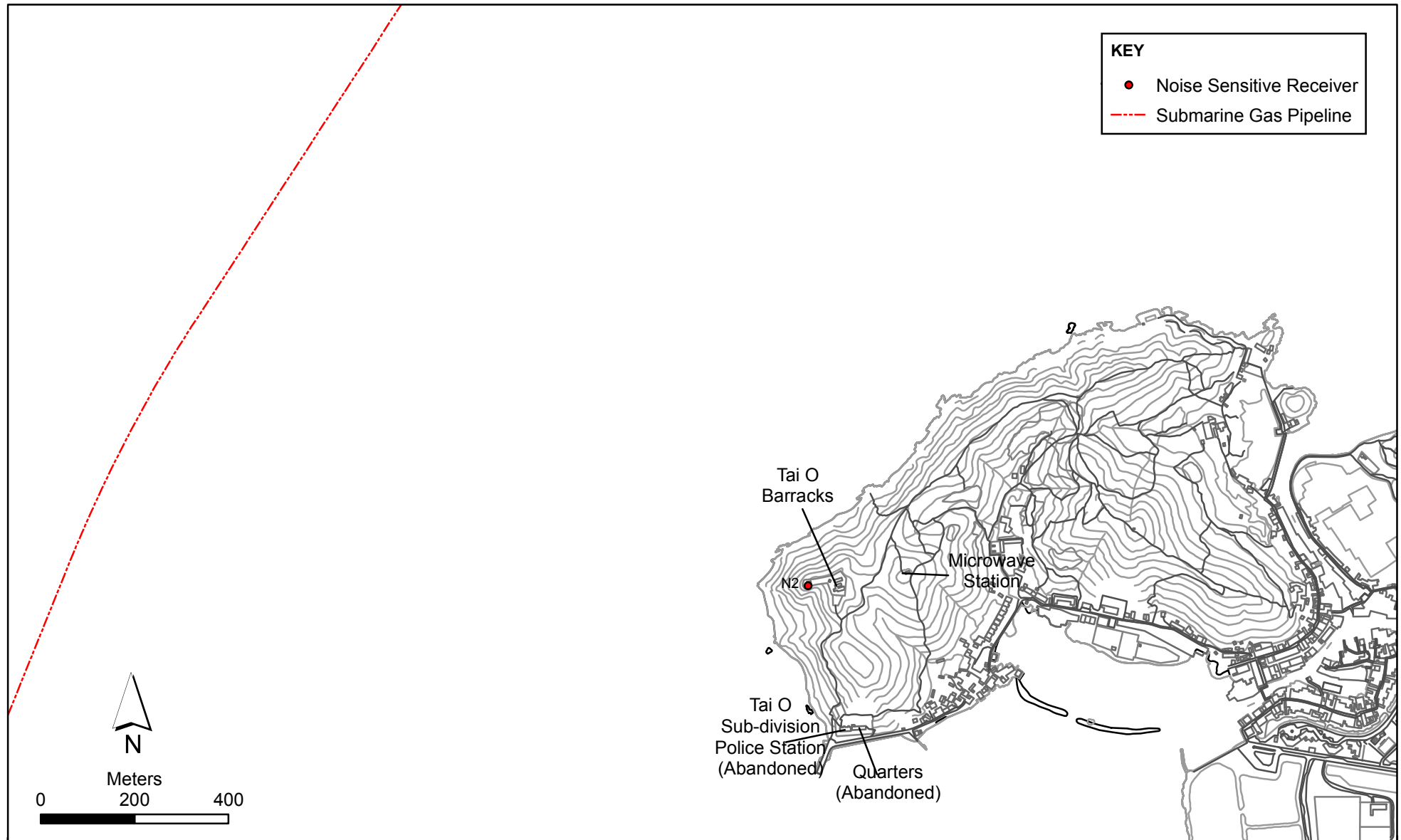


Figure 5.3b

Location of Noise Sensitive Receiver
(Tai O)

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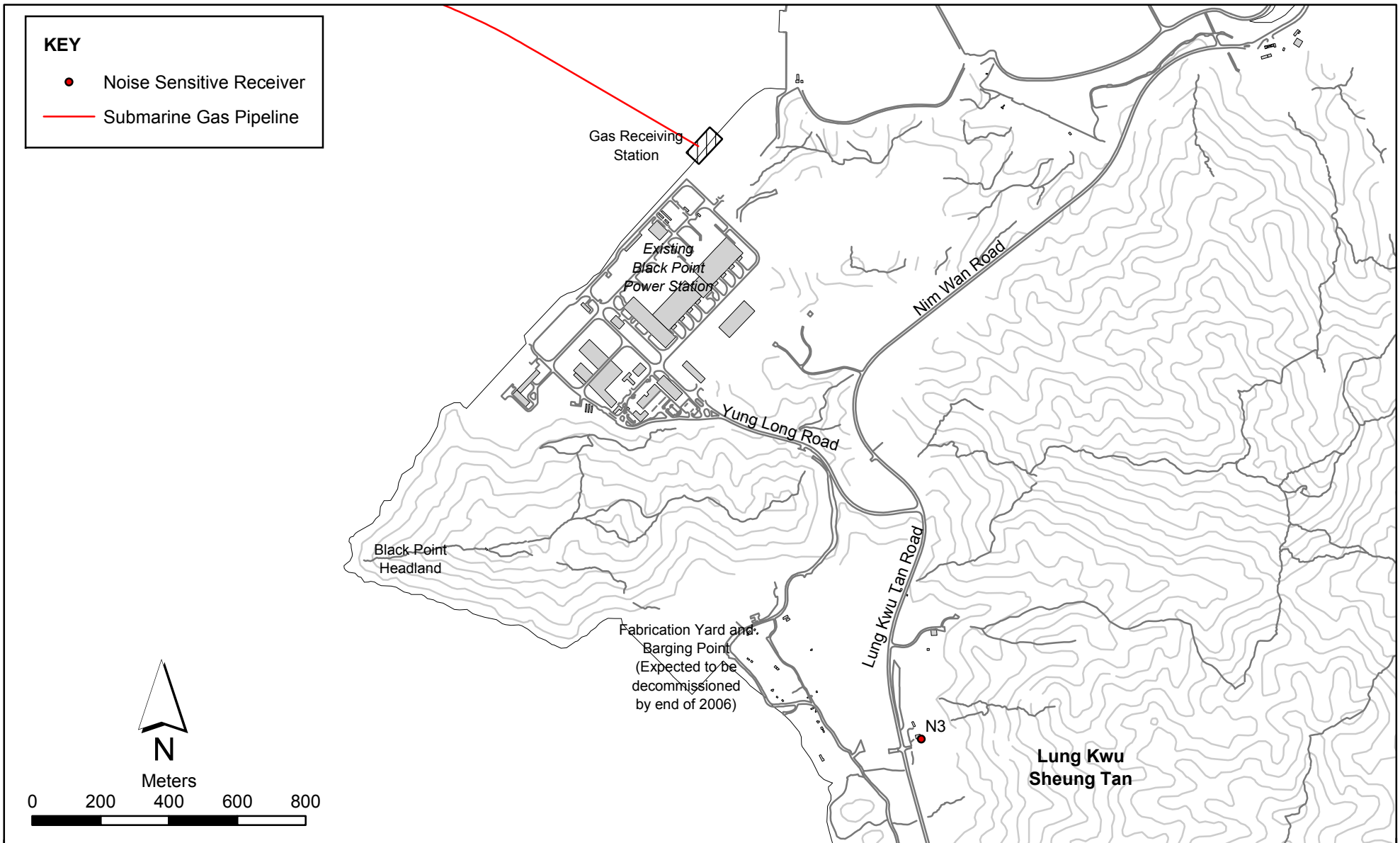


Figure 5.3c

Location of Noise Sensitive Receiver at Black Point

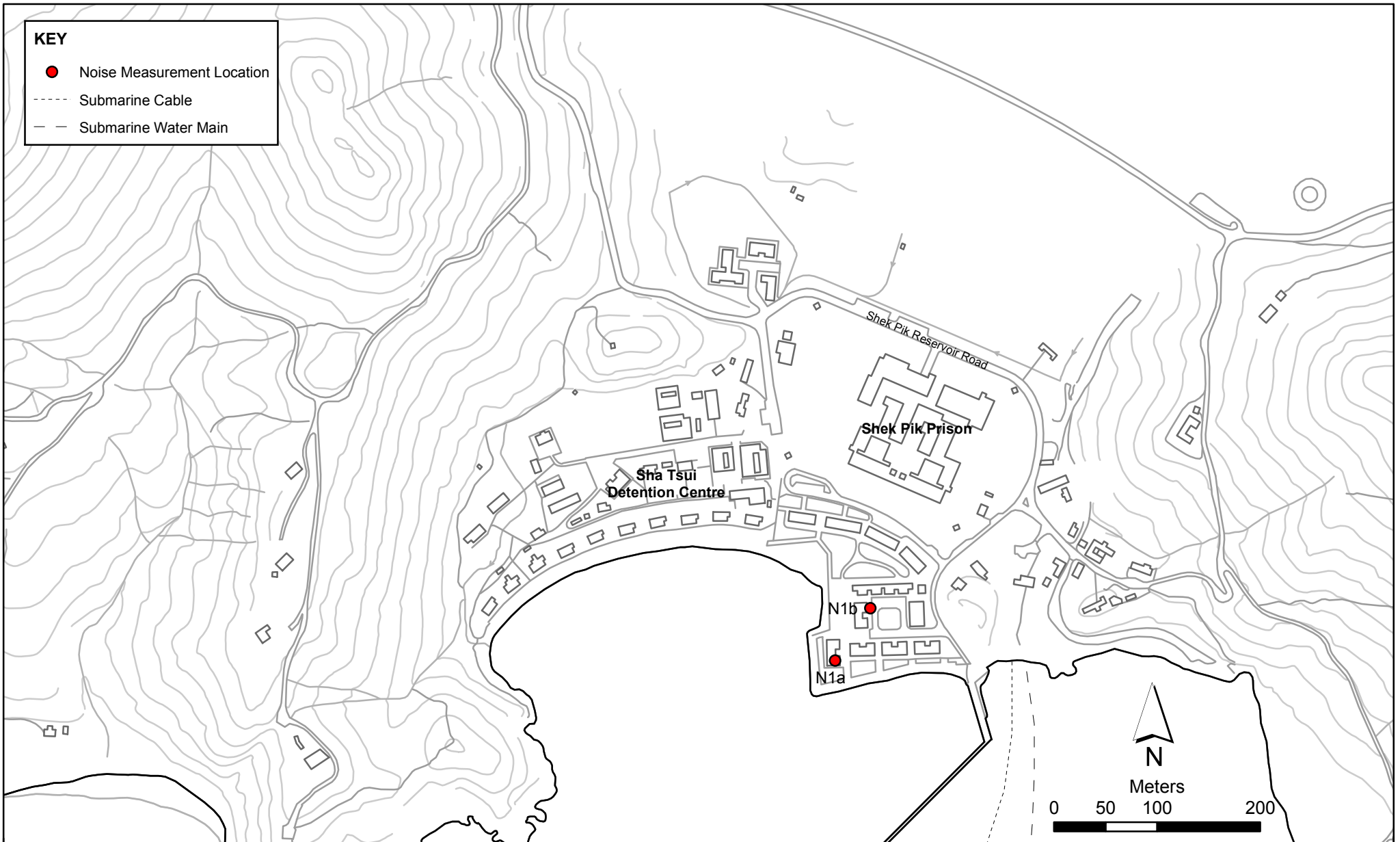


Figure 5.3d

Locations of Prevailing Noise Measurement
in Shek Pik

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**Measured Prevailing Noise Levels at N1a (Shek Pik Prison - Staff Quarter Block J)
(19 - 20 January 2006)**

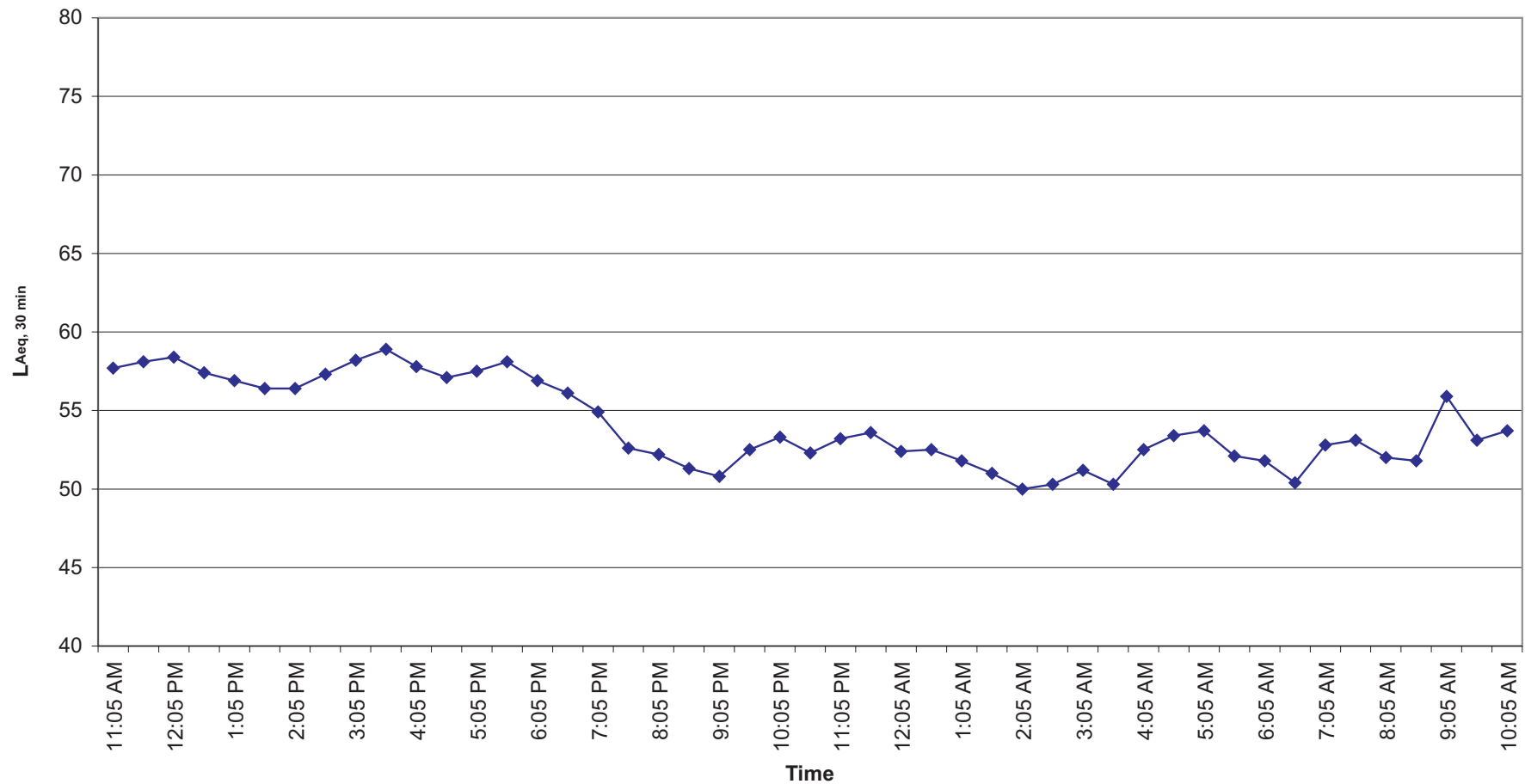


Figure 5.3e

Measured Prevailing Noise Levels at N1a (Staff Quarter Block J)

**Measured Prevailing Noise Levels at N1b (Shek Pik Prison - Staff Quarter Block K)
(13 - 14 July 2006)**

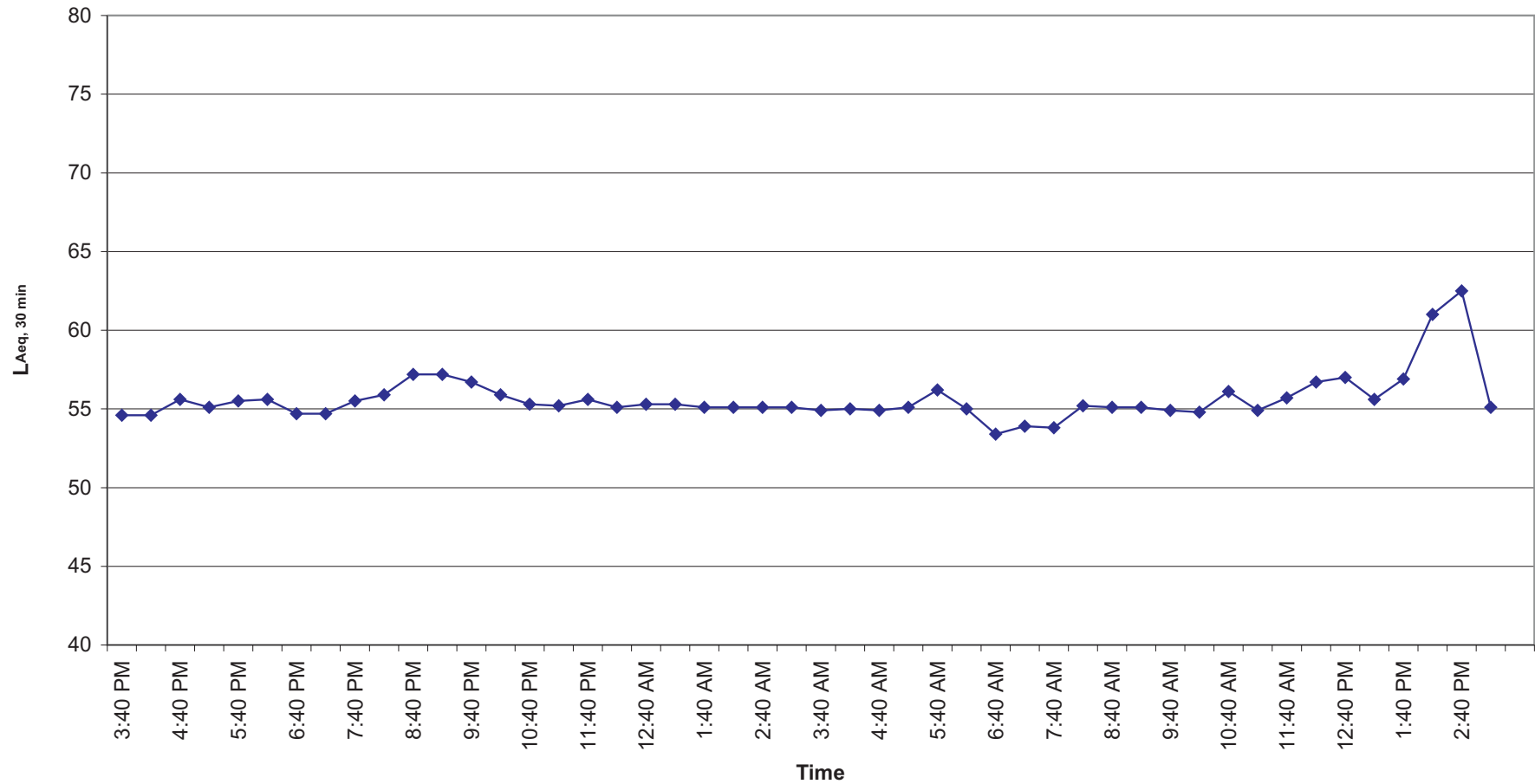


Figure 5.3f

Measured Prevailing Noise Levels at N1b (Staff Quarter Block K)

5.4 POTENTIAL SOURCES OF IMPACTS

5.4.1 Construction Phase

Potential noise sources during the construction phase of the LNG terminal will mainly arise from PME operating at the construction work sites. As discussed in Part 1, an LNG terminal located at South Soko will necessitate the installation of a submarine electricity circuit and a submarine water supply pipeline from Shek Pik Reservoir in South Lantau to the western shore on South Soko Island, a natural gas pipeline and a Gas Receiving Station (GRS) located at the existing GRS for the Yacheng Pipeline (*Figure 5.4a*). The major construction work will include the following key activities:

- Land based works at South Soko Island:
 - Site clearance;
 - Soil compaction; and
 - Blasting and excavation.
- Reclamation:
 - Dredging;
 - Seawall construction;
 - Placing fill; and
 - Drainage works.
- Main Jetty works:
 - Ground investigation;
 - Construction of jetties and access bridge;
 - Dredging of approach channel and turning basin; and
 - Intake and outfall construction.
- Civil works at terminal:
 - Civil and structural construction works for the terminal facilities.
- Installation of Water Main & Cable
- Installation of Submarine gas pipeline
- Installation of Gas Receiving Station:
 - Dredging;
 - Seawall construction; and
 - Placing fill.

The construction noise assessment will be undertaken based on the construction programme and plant inventories summarised in *Annexes 5-B* and *5-C* respectively.

The plant inventory has been checked by Project Proponent and is confirmed to be practical and feasible to complete the project within the scheduled

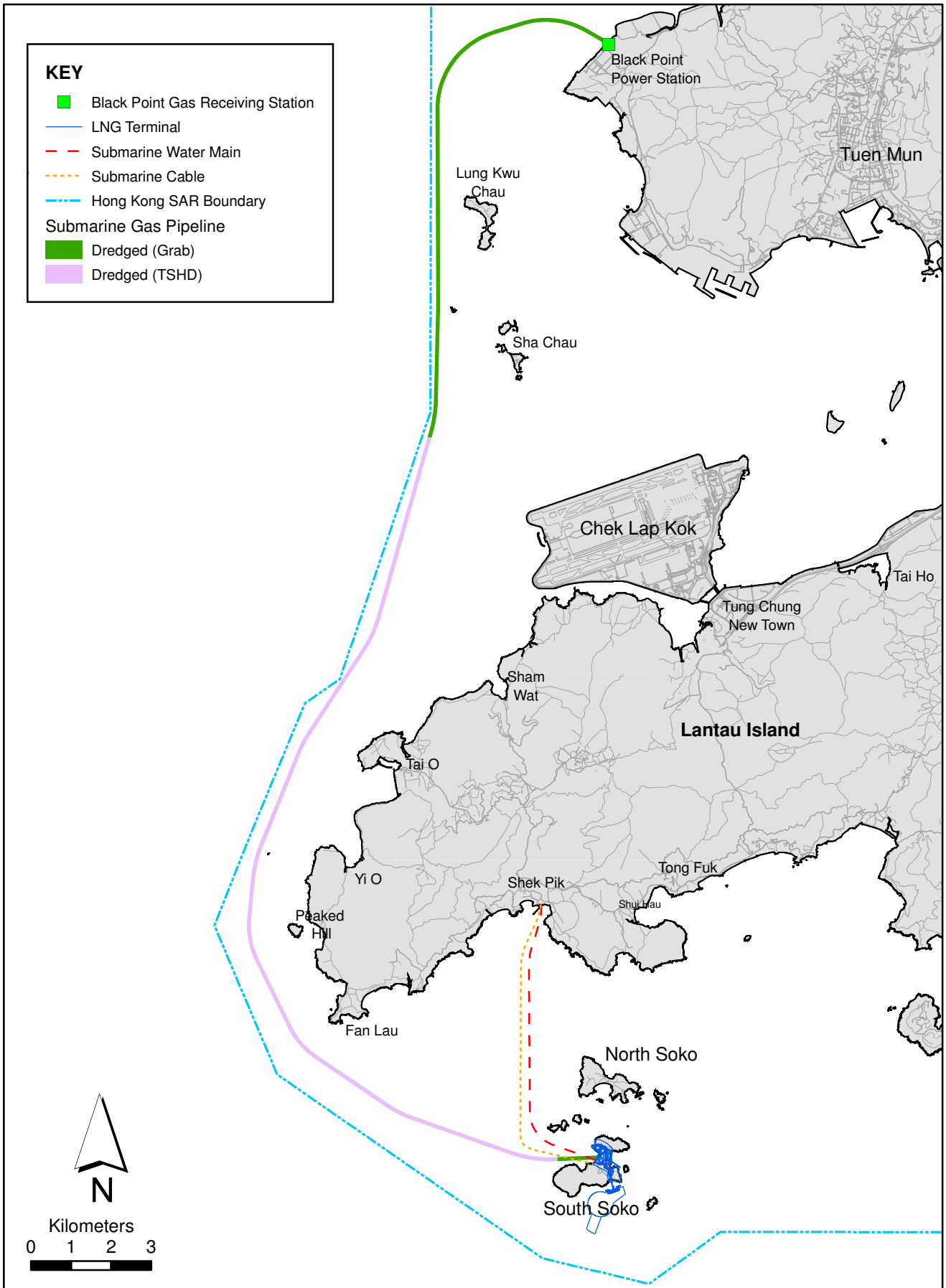


FIGURE 5.4a

Proposed Alignment and Associated Works
of the Submarine Gas Pipeline,
Water Main and Cable

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timeframe and the PMEs are available in the market. Liaisons on the blasting works are being conducted with the Mines Division of GEO and CEDD in the preparation of the report. No opencast blasting will be carried out during evening and night-time periods (1900 – 0700 hours).

The standard working hours will be from 0800 to 1800 hours. However, the following works may be carried out during the evening or the night-time periods:

- Blasting and excavation works;
- Dredging by the larger Trailing Suction Hopper Dredger (TSHD);
- Clearing and crushing of the blasted rocks and their transportation off site during the evening;
- Installation of gas pipeline;
- Occasional large concrete pours on the jetty head or the intake and outfalls being carried out overnight, especially if daytime temperatures are high; and
- Facility construction works for the terminal facility including tank construction.

It should be noted that the onshore installation of the water main and cable circuit will not be carried out during the restricted hours.

5.4.2 *Operational Phase*

Noise associated with the operational phase of the LNG terminal would mainly arise from the plant at the terminal site. There will be no plant emitting noise in the GRS and the dominant noise sources are mainly from the machines at the LNG terminal on South Soko including the following equipment:

- Heat exchangers, including LNG submerged combustion vaporizers;
- Compressors and diesel emergency generators;
- Various kind of pumps; and
- Special equipment such as unloading arms and nitrogen generator.

The noise data for the equipment have made reference to manufacturers' data and the results of field measurement conducted at overseas LNG terminals. To minimise the noise impact to the environment, most of the noise sources will be housed within individual enclosures or claddings. As a conservative approach, it is assumed that all equipment will be operated on a 24-hour basis. With reference to the overseas LNG terminals, the equipment inventory are

developed by the Engineers and their respective sound power levels (SWLs) in one-one octave bands provided by the Project Proponent are presented in *Annex 5-D*.

The suppliers of equipment should guarantee the specified SWL and the equipment should be free of the characteristics of tonality, impulsiveness and intermittency, by providing certificate of measurement and verify the SWL during testing and commissioning in accordance with international standard procedures. With such guarantee included in LNG Procurement Contract, the noise emission from the equipment should comply with the tender specification. If necessary, the suppliers should apply attenuation measures to achieve the guaranteed noise levels determined during the detailed design stage. The proposed equipment is also confirmed to be available in the market.

5.5 ASSESSMENT METHODOLOGY

5.5.1 Construction Phase

Construction Works Carried out During Normal Working Hours

The methodology for the noise impact assessment is in accordance with the procedures outlined in the *GW-TM*, which is issued under the *NCO* and the *EIAO-TM*, and is summarized as follows:

- Identifying the likely type, sequence and duration of principal noisy construction activities required for the implementation of the project;
- Identifying a list of construction plant likely to be required for each construction activity;
- Calculating the maximum total SWL for each construction activity using the plant list and SWL data given for each plant in the technical memorandum. When the PME is not listed in the TMs, SWLs provided in the document prepared by the *Noise Control Authority* (http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf) and *British Standard 5228, Noise and Vibration Control on Construction and Open Sites - Part 1* (BS5228: Part 1: 1997) ⁽¹⁾ are referred;
- Identifying representative NSRs as defined by the *EIAO-TM* based on existing and committed land uses in the Study Area that may be affected by the worksite;
- As a conservative approach, calculating the distance attenuation to an NSR from nearest worksite; and

(1) British Standard 5228, Noise and Vibration Control on Construction and Open Sites - Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration Control

- Predicting construction noise levels at NSRs in the absence of any mitigation measures.

Using a conservative approach, each work activity has been assumed to operate simultaneously and the time schedule of each activity has been provided in *Annex 5-B*. Based on the construction programme, cumulative noise impact throughout the construction phase has been assessed.

Due to the large separation distance between the construction site and the NSR (approximately 6 km), the noise will be reduced due to energy lost through atmospheric absorption during transmission, therefore, a correction factor for the atmospheric absorption has been calculated based on the ISO 9613⁽¹⁾ procedure. Additionally, a facade correction of +3 dB(A) is applied. Predictions are made of the most conservative case construction noise levels at the identified representative NSR.

Construction Works Carried out During Restricted Hours

Considering the construction programme of the Project, night-time construction works will need to be carried out. The site is located outside designated areas as defined in *DA-TM* and the construction noise assessment for night-time works has been carried out in accordance with the requirements of the *GW-TM* in the context of programming only.

5.5.2 *Operational Phase*

The methodology for the noise impact assessment is in accordance with the procedures outlined in the *ISO 9613-1* and *IND-TM*, which is issued under the *NCO* and the *EIAO-TM*. The methodology for the fixed plant noise assessment is presented below:

- Identifying types of equipment and the number of equipment;
- Calculating the maximum total SWL for each type of equipment;
- Identifying representative NSRs as defined by the *EIAO-TM* based on existing and committed land uses in the Study Area that may be affected by the worksite;
- Calculating the distance attenuation to the NSRs from noise sources; and
- Presenting the results in terms of $L_{Aeq(30min)}$ dB, as specified in the *TM*.

With the considerable separation between the site and the noise sensitive receivers, the atmospheric absorption during sound transmission is considered as one of the major factors that will have a significant impact on the noise prediction. Assessment results have been predicted in a

(1) ISO9613-1 Acoustics - Attenuation of Sound during Propagation Outdoors - Part 1 : Calculation of the Absorption of Sound by the Atmosphere

conservative approach without other attenuations due to foliage of trees and shrubs, ground effects and buildings/claddings in which the equipment are placed.

The predicted noise levels at the NSR are compared with the criteria set out in Section 5.3.3. Mitigation measures will be proposed should any exceedance be predicted.

5.6 EVALUATION OF IMPACTS

5.6.1 Construction Phase

Construction Works Carried out During Normal Working Hours

The unmitigated construction noise levels at the NSRs (Staff Quarter of Shek Pik Prison, Tai O Barrack and village house at Lung Kwu Sheung Tan) have been predicted and are presented in Annex 5-E. The predicted construction noise levels at the identified NSRs are in the range of 20 – 70 dB(A), which are below the daytime construction noise criterion of 75 dB(A) throughout the construction period and utilized the conservative set of assumptions in the analysis.

Percussive Piling

Percussive piling will be utilised for the construction of the trestle and LNG jetty. As the issuance of a CNP for percussive piling by the Noise Control Authority would depend on the submission of an application by the contractor, and therefore on the contractor's compliance with the percussive piling noise limits set out within the PP-TM, the assessment of this type of noise has not been included in this assessment. However, the contractors will follow the procedure set out in the PP-TM, as described in Section 5.2.1 to assess the noise impact in the application of the CNP.

Construction Works Carried out During Restricted Hours

The predicted noise levels for the installation of the water main and electric cable, which will be conducted during the daytime period, comply with the stipulated noise criterion of 75 dB(A). As mentioned in Section 5.4.1, some of the construction activities may be carried out during restricted hours (1900 – 0700 hours), the predicted noise levels as shown in the Annex 5-E are within the ANLs stipulated in GW-TM throughout the restricted hours. A CNP, as described in Section 5.2.1, is required for the construction works being carried out during the evening and night-time period (1900 - 0700 hours) Monday through Saturday.

Based on the preliminary implementation programme, some of the construction works may be carried out during restricted hours. Without evening and night-time works, the project will be delayed by 16 - 19 months. Assessment on the construction works to be carried out during restricted

hours (1900 – 0700 hours) is included to preliminarily appraise the feasibility in the context of programming. However, it should be noted that the assessment provided here is for indicative purpose only and serves as a reference for the future design and construction stage. Whether a CNP could be issued would be subject to the discretion of the Authority taking into account the details and information provided and the circumstance when the CNP application is filed. The actual amount of construction work and the resultant noise levels would comply with the requirement of CNP.

Cumulative Impact

The construction of the karting track (as mentioned in *Section 5.3.2*) has been completed and is operational in August 2006. In addition, the village house (NSR N3) within the karting track site is used as an office.

As mentioned in *Section 3.7*, there will be no concurrent major projects to be constructed in the vicinity of the NSRs, and therefore there will be no cumulative impact from the construction of the LNG terminal and other major projects.

5.6.2 *Operational Phase*

The most conservative case noise levels at the NSR N1 (Staff Quarter of Shek Pik Prison) during the operational phase of the LNG terminal have been predicted. The detailed calculation of the predicted noise levels is presented in *Annex 5-F*. The predicted noise levels is 29 dB(A) and is below the ANLs stipulated in the *IND-TM* during both daytime and night-time period.

Cumulative Impact

No major projects are identified in the vicinity of the NSR N1, and therefore there will be no cumulative impact at the NSR during the operational phase.

5.7 *MITIGATION MEASURES*

5.7.1 *Construction Phase*

The predicted noise levels are low and below the daytime and night time criteria as a result of the considerable separation distance between the NSR and the Project. Mitigation measures are therefore not required.

5.7.2 *Operational Phase*

The predicted noise levels are below the daytime and night time criteria as a result of the considerable separation distance between the NSR and the Project. Mitigation measures are therefore not required.

5.8 ENVIRONMENTAL MONITORING AND AUDIT

5.8.1 Construction Phase

Given the compliance with the stipulated noise criterion, noise monitoring is not anticipated to be required during the construction phase.

5.8.2 Operational Phase

Given the compliance with the stipulated noise criterion, noise monitoring is not anticipated to be required during the operational phase.

5.9 CONCLUSIONS

The identified noise sensitive receivers will not be affected by the construction activities with the predicted construction noise levels at the NSRs in the range of 20 – 70 dB(A), which is within the stipulated noise criterion of 75 dB(A). In view of the insignificant construction noise impact, mitigation measures are not anticipated during the construction phase.

Based on the most conservative case, the noise levels generated from the equipment at the LNG terminal have been predicted. Due to the large separation distance between the NSR at Shek Pik and the noise source, the predicted operational noise level is 29 dB(A), which is within daytime and night-time noise criteria. Therefore mitigation measures are not anticipated required during the operational phase.

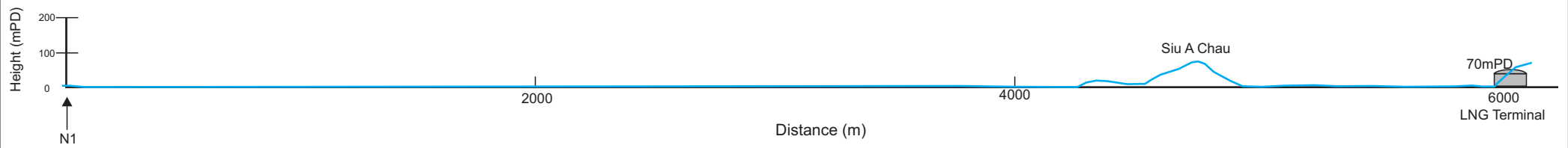
In view of the anticipated insignificant noise impact in both construction and operational phases, noise monitoring is not considered to be necessary.

Annex 5

Noise Assessment Supporting Information

Annex 5-A

Terrain Profile



Remark : Shape of Tank is indicative only

Figure 5-A1

Terrain Profile Between (N1) and LNG Terminal

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Annex 5-B

Construction Programme for Noise Assessment

Annex 5-C

Construction Plant Inventory

Annex 5-C - Preliminary Construction Plant Inventory

SOUTH SOKO OPTION

LAND BASED WORKS

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Earthwork					
- Site Clearance	Bulldozer / Excavator	2	CNP 030	115	118
	Backactor mounted with Breaker	3	CNP 027	122	127
	Truck	1	CNP 067	117	117
	Mobile Crane	4	CNP 048	112	118
	Water Pump	2	CNP 282	103	106
				<i>Sub-total SWL =</i>	128
- Soil Compaction	Pneumatic Roller	1	CNP 185	108	108
	Mobile Crane	4	CNP 048	112	118
	Water Pump	2	CNP 282	103	106
				<i>Sub-total SWL =</i>	119
- Blasting and Excavation	Bulldozer / Excavator	10	CNP 030	115	125
	Backactor mounted Drilling Rig	10	CNP 027	122	132
	Backactor mounted with Breaker	4	CNP 027	122	128
	Truck	18	CNP 067	117	130
	Electric Generator	4	CNP 101	108	114
	Concrete crushers, excavator mounted	2	.. ⁽¹⁾	103	106
	Mobile Crane	1	CNP 048	112	112
	Air Compressor	2	CNP 003	104	107
	Water Pump	2	CNP 282	103	106
	Derrick Lighter	14	CNP 061	104	115
					<i>Sub-total SWL =</i>
- Slope Stabilization and Drainage Works	Backactor mounted Drilling Rig	3	CNP 027	122	127
	Water Pump	2	CNP 282	103	106
	Backactor mounted with Breaker	3	CNP 027	122	127
	Concrete Pumps	2	CNP 047	109	112
	Grout Pump w/Mixer	2	.. ⁽¹⁾	105	108
				<i>Sub-total SWL =</i>	130

RECLAMATION

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Dredging					
	Dredger - Grab	1	CNP 063	112	112
	Tug Boat / Motor Boat	1	CNP 221	110	110
	Split Bottom Barge	1	CNP 061	104	104
				<i>Sub-total SWL =</i>	115
Seawall Construction					
Placing Seawall Core	Tug Boat / Motor Boat	2	CNP 221	110	113
	Derrick Ligher	2	CNP 061	104	107
				<i>Sub-total SWL =</i>	114
Placing Seawall Rock Armour	Derrick Lighter	1	CNP 061	104	104
	Backactor	1	CNP 027	122	122
				<i>Sub-total SWL =</i>	122
Placing Fill					
	Derrick Lighter / Pelican Barge	1	CNP 061	104	104
	Water Pump	2	CNP 282	103	106
				<i>Sub-total SWL =</i>	108
Drainage Works					
Install of Temporary Work	Backactor mounted with Vibrator	2	CNP 027	122	125
	Cutter, circular, steel (electric)	2	.. ⁽¹⁾	112	115
	Grinding Machine	2	CNP 065	98	101
	Water Pump	1	CNP 282	103	103
				<i>Sub-total SWL =</i>	125
Laying of Drainage Pipes	Backactor	2	CNP 081	112	115
	Truck	1	CNP 067	117	117
	Water Pump	1	CNP 282	103	103
				<i>Sub-total SWL =</i>	119
Backfilling	Pneumatic Roller	1	CNP 185	108	108
	Backactor	2	CNP 081	112	115
	Water Pump	1	CNP 282	103	103
				<i>Sub-total SWL =</i>	116

Main Jetty

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL	
Ground Investigation	SI Barge + Generator	2	CNP 061+CNP 101	109	112	
	Split Bottom Barge	2	CNP 061	104	107	
				Sub-total SWL =	113	
Jetties and Access Bridge						
- Steel Piles Construction	Crawler Crane	2	CNP 048	112	115	
	900 CFM Air Compressor	1	CNP 002	102	102	
	Mobile Crane	1	CNP 048	112	112	
	350 CFM Air Compressor	1	CNP 001	100	100	
	Tugboat	4	CNP 221	110	116	
	Truck	1	CNP 067	117	117	
	Generator	2	CNP 101	108	111	
	SI Barge + Generator	5	CNP 061+CNP 101	109	116	
	Water Pump	3	CNP 282	103	108	
	Derrick Ligher	7	CNP 061	104	112	
	Automatic Grinder Machine	2	CNP 065	98	101	
	Poker, vibratory	2	CNP 170	113	116	
	Piling, earth auger	3	CNP 167	114	119	
				Sub-total SWL =	125	
	- Concrete Caps, Slabs and Foundations	Crawler Crane	2	CNP 048	112	115
900 CFM Air Compressor		2	CNP 002	102	105	
Mobile Crane		1	CNP 048	112	112	
350 CFM Air Compressor		2	CNP 001	100	103	
Tugboat		7	CNP 221	110	118	
Truck		1	CNP 067	117	117	
Generator		8	CNP 101	108	117	
Water Pump		11	CNP 282	103	113	
Derrick Ligher		7	CNP 061	104	112	
Concrete Pump		2	CNP 047	109	112	
Bar bender and cutter		4	CNP 021	90	96	
				Sub-total SWL =	124	
Dredging of Approach Channel and Turning Basin						
- Dredging of Approach Channel and Turning Basin		Dredger - Grab	3	CNP 063	112	117
		Trailing Suction Hopper Dredger	1	Penny Bay EIA ⁽²⁾	109	109
	25 Ton Mobile Crane	1	CNP 048	112	112	
	Tugboat	4	CNP 221	110	116	
	Generator	1	CNP 101	108	108	
	Dredger, chain bucket	2	CNP 062	118	121	
	Derrick Ligher	2	CNP 061	104	107	
			Sub-total SWL =	124		
Intake and Outfall Construction						
- Intake and Outfall Construction	Dredger - Grab	1	CNP 063	112	112	
	Tug Boat / Motor Boat	1	CNP 221	110	110	
	Split Bottom Barge	1	CNP 061	104	104	
	Derrick Ligher	1	CNP 061	104	104	
			Sub-total SWL =	115		

LNG TERMINAL CIVIL, M&E WORK

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Terminal Civil Work	Machanich & Lub. Service Truck	3	CNP 141	112	117
	Derrick Barge	9	CNP 061	104	114
	Tugboat	5	CNP 221	110	117
	Crawler Crane	15	CNP 048	112	124
	Drill Rig	3	Table C.10 Ref No. 2 ⁽³⁾	112	117
	Backhoe – Track	2	CNP 081	112	115
	Forklift	11	Penny Bay EIA ⁽²⁾	113	123
	Dump truck, with grab	1	-- ⁽¹⁾	105	105
	Track Drill	1	Table C.3 Ref No. 123 ⁽³⁾	128	128
	Generator	18	CNP 101	108	121
	Air Compressor 375 cfm, Portable	13	CNP 001	100	111
	Air Compressor 900 cfm, Portable	1	CNP 002	102	102
	Air Compressor 1200 cfm, Portable	2	CNP 003	104	107
	Winch – Hoist 2 Drum	1	CNP 263	102	102
	Pump – Submersible	2	CNP 283	85	88
	Water jetting unit	1	-- ⁽¹⁾	107	107
	Pump – Concrete	4	CNP 047	109	115
	Grout Pump w/Mixer	1	-- ⁽¹⁾	105	105
	Tractor with Trailer	2	CNP 222	118	121
	Tower Crane	2	CNP 049	95	98
	Automatic Grinder Machine	8	CNP 065	98	107
	Air blower	3	-- ⁽¹⁾	95	100
	Winch (Power & Pneumatic/3 ton)	8	CNP 261	110	119
	Discharging Pump	4	CNP 282	103	109
	Batching Plant 60 CM/HR	2	CNP 022	108	111
	Concrete Mixer	10	CNP 046	96	106
	Water Pump	14	CNP 282	103	114
	Bar bender and cutter	8	CNP 021	90	99
	Poker, vibratory	8	CNP 170	113	122
				Sub-total SWL =	133

Installation of Water Main & Cable

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Dredging	Dredger - Grab	1	CNP 063	112	112
	hydraulic rock breaker	1	Table C.8 Ref No. 12 ⁽³⁾	106	106
				<i>Sub-total SWL =</i>	113
Water Pipeline Installation	Derrick Barge	1	CNP 061	104	104
Post Trenching Jetting	Derrick Barge	1	CNP 061	104	104
Backfilling	Dredger - Grab	1	CNP 063	112	112
Submarine Cable Installation	Derrick Barge	1	CNP 061	104	104

Installation of Submarine Gas Pipeline

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Pipeline Installation by Dredging	Trailing Suction Hopper Dredger	1	Penny Bay EIA ⁽²⁾	109	109

Installation of Gas Receiving Station

Activity	Plant Required	No. of PME	CNP / BS5228 Ref.	SWL	Overall SWL
Dredging	Dredger - Grab	1	CNP 063	112	112
	Tug Boat / Motor Boat	1	CNP 221	110	110
	Split Bottom Barge	1	CNP 061	104	104
				<i>Sub-total SWL =</i>	115
Seawall Construction					
Placing Seawall Core	Tug Boat / Motor Boat	2	CNP 221	110	113
	Derrick Lighter	2	CNP 061	104	107
				<i>Sub-total SWL =</i>	114
Placing Seawall Rock Armour	Derrick Lighter	1	CNP 061	104	104
	Backactor	1	CNP 027	122	122
				<i>Sub-total SWL =</i>	122
Placing Fill	Derrick Lighter	1	CNP 061	104	104

(1) SWL refer to the document prepared by the Noise Control Authority (http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf)

(2) SWL refer to the approved EIA Report for the Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures

(3) SWL refer to the BS 5228 : Part 1: 1997

Annex 5-D

Equipment Inventory during Operational Phase

Annex 5-D - Equipment Inventory during Operational Phase												
SOUTH SOKO OPTION												
A-Weighted Correction			26.2	16.1	8.6	3.2	0.0	-1.2	-1.0	1.1		
			Octave and Center Frequency Hz								SWL	
Data Source ⁽¹⁾			63	125	250	500	1000	2000	4000	8000	dB(A)	No. of plant
Heat Exchangers												
E-301A-D	LNG Seawater Vaporizers (& Spare)	F	105	103	97	88	85	85	82	74	94	4
E-302 A-C	LNG Submerged Combustion Vaporizer	M	97	107	113	121	116	113	108	100	121	3
Blowers, Compressors and Generator (Note 9)												
K-301 A/B	Boil-off Gas Compressors (450 kW)	E	101	101	101	101	103	99	95	92	106	2
K-302	Ship Unloading Compressor (900 kW)	E	107	107	107	107	109	105	101	98	112	1
K-303	Pipeline Compressor (800 kW)	E	101	101	101	101	103	99	95	92	106	1
K-401 A/B	Instrument/Plant Air Compressor & spare	M	59	73	83	88	89	86	81	74	93	2
G-401 A-C	Gas Turbine Generators (& spare) (South Soko Op only)	M	80	84	86	87	86	92	94	85	98	5
G-402	Emergency Generator-Diesel Driven	M	80	84	86	87	86	92	94	85	98	1
Pumps												
P-201 A-D	LNG Send-out Pumps – in LNG Tank (two per tank)	M	94	96	97	96	95	94	91	88	101	4
P-301 A-D	HP LNG Booster Pumps (& Spare)	F	90	92	93	93	93	98	88	81	101	4
P-401 A-C	Seawater Pumps (& Spare)	M	80	84	86	87	86	92	94	85	98	3
P-402 A-D	Firewater Pumps – 2 Electric & 2 Diesel	M	80	84	86	87	86	92	94	85	98	4
P-403 A/B	Firewater Jockey Pump (& Spare)	M	51	62	72	80	82	81	77	70	86	2
P-404 A/B	Service Water Pump (& Spare)	M	51	62	72	80	82	81	77	70	86	2
P-405 A/B	Drinking Water Pump (& spare)	M	51	62	72	80	82	81	77	70	86	2
P-406	Submerged Combustion Vaporizer Water Overflow Pump	M	87	89	90	89	88	87	84	81	94	1
P-407	CPI Oily Water Sump Pump	M	87	89	90	89	88	87	84	81	94	1
P-408 A/B	Process Area Sump Pumps, 2 x 100%	M	87	89	90	89	88	87	84	81	94	2
Special Equipment												
N-101 A-D	LNG Unloading Arms (& Spare)	M	65	68	69	69	71	66	60	52	74	4
N-102	LNG Vapor Return Arm	M	65	68	69	69	71	66	60	52	74	1
N-401	Nitrogen Package for Terminal	M	70	76	82	88	94	98	94	88	102	1
N-402	Instrument Air Drier and Package	M	79	83	85	77	75	74	74	71	83	1
Expansion Case - 1000 MSCFD												
E-301 E/F	LNG Seawater Vaporizer	F	105	103	97	88	85	85	82	74	94	2
E-302 D/E	LNG Submerged Combustion Vaporizer	M	97	107	113	121	116	113	108	100	121	2
P-201 E/F	LNG Send-out Pumps - in T-201 C	M	94	96	97	96	95	94	91	88	101	2
P-301 H-J	HP LNG Booster Pumps	F	90	92	93	93	93	98	88	81	101	2
P-401 D	Seawater Pump	M	80	84	86	87	86	92	94	85	98	1
Note:												

(1) F indicates noise data obtained from the field measurement conducted at other LNG Terminal, and M indicates the noise data provided by Manufacturers.

Annex 5-E

Construction Noise Assessment

Annex 5-F

Operational Noise Assessment

Annex 5-F - Operational Noise Impact Assessment																	
SOUTH SOKO OPTION																	
NSR:	Staff Quarter of Shek Pik Prison																
Octave and Center Frequency Hz																	
		63	125	250	500	1000	2000	4000	8000								
<i>A-Weighted Correction</i>		26.2	16.1	8.6	3.2	0.0	-1.2	-1.0	1.1								
<i>Atmospheric absorption (dB/km)</i>		0.079	0.302	1.04	2.77	5.15	8.98	21.3	68.6								
<i>(at 20°C & 80%RH)⁽¹⁾ (ref. ISO 9613-1:1993(E))</i>																	
<i>Distance from NSR to Source</i>		6.4	km	<i>to the nearest site boundary</i>													
<i>Atmospheric absorption (dB)</i>		0.5	1.9	6.7	17.7	33.0	57.5	136.3	439.0								
Octave and Center Frequency Hz																	
										Overall SWL	Correction, dB(A)				SPL at NSR		
										dB(A)	No. of plant	No. of Plant	Distance	Barrier ⁽²⁾	Facade	dB(A)	
Heat Exchangers		Data Source ⁽³⁾	63	125	250	500	1000	2000	4000	8000							
E-301A-D	LNG Seawater Vaporizers (& Spare)	F	105	103	97	88	85	85	82	74	87	4	6.0	-84.1	0	3	12
E-302 A-C	LNG Submerged Combustion Vaporizer	M	97	107	113	121	116	113	108	100	102	3	4.8	-84.1	0	3	26
Blowers, Compressors and Generator (Note 9)																	
K-301 A/B	Boil-off Gas Compressors (450 kW)	E	101	101	101	101	103	99	95	92	89	2	3.0	-84.1	0	3	10
K-302	Ship Unloading Compressor (900 kW)	E	107	107	107	107	109	105	101	98	95	1	0.0	-84.1	0	3	13
K-303	Pipeline Compressor (800 kW)	E	101	101	101	101	103	99	95	92	89	1	0.0	-84.1	0	3	7
K-401 A/B	Instrument/Plant Air Compressor & spare	M	59	73	83	88	89	86	81	74	71	2	3.0	-84.1	0	3	0
G-401 A-C	Gas Turbine Generators (& spare) (<i>South Soko Op only</i>)	M	80	84	86	87	86	92	94	85	73	5	7.0	-84.1	0	3	0
G-402	Emergency Generator-Diesel Driven	M	80	84	86	87	86	92	94	85	73	1	0.0	-84.1	0	3	0
Pumps																	
P-201 A-D	LNG Send-out Pumps – in LNG Tank (two per tank)	M	94	96	97	96	95	94	91	88	84	4	6.0	-84.1	0	3	9
P-301 A-D	HP LNG Booster Pumps (& Spare)	F	90	92	93	93	93	98	88	81	80	4	6.0	-84.1	0	3	5
P-401 A-C	Seawater Pumps (& Spare)	M	80	84	86	87	86	92	94	85	73	3	4.8	-84.1	0	3	0
P-402 A-D	Firewater Pumps – 2 Electric & 2 Diesel	M	80	84	86	87	86	92	94	85	73	4	6.0	-84.1	0	3	0
P-403 A/B	Firewater Jockey Pump (& Spare)	M	51	62	72	80	82	81	77	70	61	2	3.0	-84.1	0	3	0
P-404 A/B	Service Water Pump (& Spare)	M	51	62	72	80	82	81	77	70	61	2	3.0	-84.1	0	3	0
P-405 A/B	Drinking Water Pump (& spare)	M	51	62	72	80	82	81	77	70	61	2	3.0	-84.1	0	3	0
P-406	Submerged Combustion Vaporizer Water Overflow Pump	M	87	89	90	89	88	87	84	81	77	1	0.0	-84.1	0	3	0
P-407	CPI Oily Water Sump Pump	M	87	89	90	89	88	87	84	81	77	1	0.0	-84.1	0	3	0
P-408 A/B	Process Area Sump Pumps, 2 x 100%	M	87	89	90	89	88	87	84	81	77	2	3.0	-84.1	0	3	0
Special Equipment																	
N-101 A-D	LNG Unloading Arms (& Spare)	M	65	68	69	69	71	66	60	52	56	4	6.0	-84.1	0	3	0
N-102	LNG Vapor Return Arm	M	65	68	69	69	71	66	60	52	56	1	0.0	-84.1	0	3	0
N-401	Nitrogen Package for Terminal	M	70	76	82	88	94	98	94	88	71	1	0.0	-84.1	0	3	0
N-402	Instrument Air Drier and Package	M	79	83	85	77	75	74	74	71	71	1	0.0	-84.1	0	3	0
Expansion Case - 1000 MSCFD																	
E-301 E/F	LNG Seawater Vaporizer	F	105	103	97	88	85	85	82	74	87	2	3.0	-84.1	0	3	9
E-302 D/E	LNG Submerged Combustion Vaporizer	M	97	107	113	121	116	113	108	100	102	2	3.0	-84.1	0	3	24
P-201 E/F	LNG Send-out Pumps - in T-201 C	M	94	96	97	96	95	94	91	88	84	2	3.0	-84.1	0	3	6
P-301 H/J	HP LNG Booster Pumps	F	90	92	93	93	93	98	88	81	80	2	3.0	-84.1	0	3	2
P-401 D	Seawater Pump	M	80	84	86	87	86	92	94	85	73	1	0.0	-84.1	0	3	0
TOTAL SPL at NSR																29	
Note:																	
(1) Atmospheric attenuation coefficients at 20°C and RH 80% are applied in the calculation with reference to the "The Year's Weather - 2005" issued by Hong Kong Observatory.																	
(2) As a conservative assessment, the screening effect by the building in which the equipment located has been omitted.																	
(3) F indicates noise data obtained from the field measurement conducted at other LNG Terminal, and M indicates the noise data provided by Manufacturers.																	