4. NOISE

4.1 Introduction

4.1.4 The section presents the assessment on the potential airborne noise impacts likely to arise during the construction and operation phases of the Project. The assessment has been based on the criteria and guidelines for evaluation and assessment of noise impact as stated in Annexes 5 and 13 of the EIAO-TM and has covered the scope outlined in Section 3.4.3 of the EIA Study Brief. Appropriate mitigation measures have been identified to mitigate the potential noise impacts as far as practicable.

4.2 Relevant Legislations, Standards & Guidelines

4.2.1 Noise impacts have been assessed in accordance with the criteria and methodology given in the Technical Memoranda issued under the Noise Control Ordinance (NCO) and Environmental Impact Assessment Ordinance (EIAO).

4.2.2 The NCO provides the statutory framework for noise control. This defines statutory limits applicable to equipment used during the construction and operation phases of the proposed works in the study area. The NCO invokes four Technical Memoranda, which define the technical means for noise assessment:

- Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM):
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM); and
- Technical Memorandum on Noise from Percussive Piling (PP-TM).

4.2.3 The NCO and the accompanying Technical Memoranda provide a mechanism for assessing noise levels and the statutory power to control noise.

Construction Noise

4.2.4 Noise impact arising from general construction activities other than percussive pilling during the daytime period (07:00-19:00 hours of any day not being a Sunday or public holiday) shall be assessed against the noise standards given in Annex 5 of EIAO-TM, which is summarised in **Table 4.1** below.

Table 4.1 : Noise Standards for Daytime Construction Activities

Noise Sensitive Uses	07:00 to 19:00 hours on any day not being a Sunday or general holiday, $L_{eq\ (30\ min)}$, dB(A)
Domestic premises, hotels and hostel	75
Educational institutions (normal teaching periods)	70
Educational institutions (examination periods)	65

Notes:

1) The above noise standards apply to uses, which rely on opened windows for ventilation.
2) The above standards shall be viewed as the maximum permissible noise levels assessed at 1m from the external facade.
3) The above standards shall be met as far as possible. All practicable mitigation measures shall be exhausted and the residual impacts minimized.

Operational Noise

4.2.5 Fixed plant noise sources associated with STW and SPS are controlled by Section 13 of the NCO. For the assessment of fixed plant noise sources, the area sensitivity rating (ASR) of the noise sensitive receivers (NSRs) will be determined in accordance with the IND-TM. Based on the ASR, the appropriate Acceptable Noise Levels (ANLs) can be determined.

4.2.6 The ANL is a function of the type of area within which the NSR is located, and the degree of the effect on the NSR of Influencing Factors (IFs) such as major roads and industrial areas. According to the IND-TM, the ANLs for different ASR of NSRs are given in **Table 4.2**.

Table 4.2 : Acceptable Noise Levels

Time Period	ASR A	ASR B	ASR C
All days during the evening (19:00 to 23:00 hours), and general holidays (including Sundays) during the day-time and evening (0700 to 2300 hours)	60	65	70
All days during the night-time (23:00 to 07:00 hours)	50	55	65

4.2.7 More stringent criteria for fixed plant noise impacts recommended in Table 1A of the EIAO-TM for planning purposes are as follows:

- 5 dB(A) below the appropriate ANL set out in the IND-TM (the ANL-5 dB(A) criterion), or
- The prevailing background noise level where the prevailing background noise level is 5 dB(A) below the appropriate ANL (although during the operation the NCO will be the controlling legislation).

4.2.8 The above-mentioned second criterion would generally apply to areas with low ambient noise levels such as rural and suburban areas. In view of no major nearby noise sources such as road and rail traffic, noise sensitive receivers near Tai O STW, Hang Mei SPS and Fan Kwai Tong SPS would be subject to low ambient noise levels which could be lower than the ANL-5 dB(A) criterion. For those sensitive receivers which were found to experience prevailing noise levels lower than the ANL-5 dB(A) criterion, fixed plant noise impact were assessed against the prevailing background noise levels.

4.2.9 Background noise measurements were undertaken in the vicinity of the proposed new SPS's and Tai O STW in 2008 to determine the prevailing background noise levels. As there has been no major change of the land uses in the vicinity of these sites, the background noise conditions are expected to be unchanged. The measured noise levels during daytime and night-time were compared with the ANL-5 dB(A) criteria, and the more stringent noise assessment criteria were adopted as a conservative approach, and are summarized in **Table 4.3**.

Table 4.3 : Recommended Noise Criteria for Operational Noise

Operation Location	Measured Noise Level (daytime / night-time), dB(A)	ANL-5 dB(A) criterion (daytime / night-time), dB(A)	Recommended Noise Criteria (daytime / night-time), dB(A)
Tai O STW	50 / 49	55 / 45	50 / 45
Fan Kwai Tong SPS	45 / 42	55 / 45	45 / 42
Hang Mei SPS	45 / 39	55 / 45	45 / 39

Notes:
1) In view of no influencing factors in Tai O, Area Sensitivity Rating "A" has been assumed, with reference to Table 1 of IND-TM.

4.2.10 In any event, the Area Sensitivity Rating assumed in this EIA Report is for indicative assessment only. Therefore, 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. Nothing in the EIA study shall bind the Noise Control Authority in the context of law enforcement against any of the fixed noise sources being assessed.

4.3 Description of the Existing Noise Environment

4.3.1 The major land use in the vicinity of the Project area is residential villages, knoll and marine environs. Tai O Road is the only road with vehicles in the area. Tai O Village is generally car-free except the public transport and authorised vehicles on Tai O Road. There are also human noises arising from commercial activities centred near the Tai O Market Street and Tai O Bus Terminus. The ambient noise level increases slightly with the more tourist activities during weekends and public holidays.

4.4 Construction Noise Impact Assessment

Noise Sources Identification

4.4.1 Key noise generating activities during the construction phase can be divided into the following types:

- Works Type 1 - Construction of Sewer (Open Cut Method)
- Works Type 2 - Construction of Sewer (Trenchless Method)
- Works Type 3 - Upgrading of Existing Sewer
- Works Type 4 - Construction of Tai O Sewage Treatment Works and Seawall Construction
- Works Type 5 - Construction of Hang Mei Sewage Pumping Station
- Works Type 6 - Construction of Fan Kwai Tong Sewage Pumping Station
- Works Type 7 - Temporary Working Area at Yim Tin Pok Temporary Playground

4.4.2 The works type and the various works stages involved are given in **Table 4.4**. No restricted hours works are expected for the Project.

4.4.3 An inventory of project specific powered mechanical equipment required has been developed for each works type which is considered to be appropriate and practical for completing works within the proposed works programme, and are detailed in

Appendix 4.1. The associated worst-case sound power levels of the different works stages for the unmitigated scenario are provided in **Table 4.4**.

4.4.4 Whilst it is possible that the future appointed Contractor may propose a different plant inventory, this assessment has been undertaken on the anticipated plant to allow early identification of any potential noise problem and to ensure there are practicable and sufficient noise mitigation measures that can be implemented to alleviate adverse noise impacts. The Contractor will be required to provide and implement sufficient direct noise mitigation measures based on the recommendation in this EIA to achieve acceptable noise levels on the nearby NSRs.

Table 4.4 : Construction Activities Schedule

Works Stage	Construction Activities	Calculated Worst-case SWL, dB(A)
Works Type 1 - Construction of Sewer (Open Cut Method)		
Stage 1	Breaking up of road surface	108
Stage 2	Excavation of soil material	95
Stage 3	Steel fixing & concreting of manholes	109
Stage 4	Laying of bedding material	109
Stage 5	Backfilling and soil compaction	99
Stage 6	Reinstatement of road surface	109
Works Type 2 - Construction of Sewer (Trenchless Method)		
Stage 1	Excavation of Pits	122
Stage 2	Pipe Laid by Trenchless Method	117
Stage 3	Steel fixing and concreting of manholes	80
Stage 4	Reinstatement of road surface	80
Works Type 3 - Upgrading of Existing Sewer		
Stage 1	Breaking up of road surface	108
Stage 2	Excavation of soil material	95
Stage 3	Removal of existing sewers and laying of new sewers	94
Stage 4	Steel fixing & concreting of manholes	109
Stage 5	Laying of bedding material	109
Stage 6	Backfilling and soil compaction	99
Stage 7	Reinstatement of road surface	109
Works Type 4 - Construction of Tai O Sewage Treatment Works & Seawall Construction		
Stage 1	Form part of permanent seawall – by forming rock / Gabion wall	111
Stage 2	Fill the reclamation to 3mPD	111

Works Stage	Construction Activities	Calculated Worst-case SWL, dB(A)
Stage 3	Core boreholes	113
Stage 4	Construction of Substructures in New Reclamation Areas	126
Stage 5	Temporary Treatment Installation	113
Stage 6	Removal of existing structures	124
Stage 7	Construction of new superstructure	119
Stage 8	Installation of major E&M equipments	115
Stage 9	Remove Temporary Treatment Units and construct the new Sludge Dewatering House	119
Stage 10	Installation of ancillary equipments and removal of the temporary platform	110
Works Type 5 - Construction of Hang Mei Sewage Pumping Station		
Stage 1	Site Clearance	94
Stage 2	Piling	99
Stage 3	Excavation	122
Stage 4	Steel fixing & concreting for structure	115
Stage 5	Backfilling and Soil Compaction	105
Stage 6	Installation of E&M equipment	112
Works Type 6 - Construction of Fan Kwai Tong Sewage Pumping Station		
Stage 1	Site Clearance	94
Stage 2	Piling	99
Stage 3	Excavation	122
Stage 4	Steel fixing & concreting for structure	115
Stage 5	Backfilling and Soil Compaction	105
Stage 6	Installation of E&M equipment	112
Works Type 7 - Temporary Working Area at Yim Tin Pok Temporary Playground		
Stage 1	Site clearance	94
Stage 2	Operation of concrete mixer	96

Note:

1) The various stages involved for each work type will not be undertaken concurrently.
2) Note that the works programme is subject to variables such as weather, conflicts with utilities, etc. and is variable upon these conditions.
3) "SWL" is the calculated worst-case total sound power level due to the operation of the plant inventory for that works stage based on the unmitigated scenario.

Noise Sensitive Receivers

4.4.5 Representative first tier noise sensitive receivers (NSRs) located closest to the construction works areas of the Project within 300 m of the Project boundary have been identified and selected for the construction noise impact assessment. These NSRs have been considered to be located at the most critical locations and other NSRs further away are expected to be less affected in comparison. Based on observations made from site visits, review of the Tai O Fringe OZP (Plan No. S/I-TOF/2) dated October 2014 and information available in the Statutory Planning Portal of the Town Planning Board (TPB), existing and planned NSRs within the assessment area have been identified following the requirement of Annex 13 of the EIAO-TM. **Table 4.5** presents a summary of representative NSRs selected for the noise assessment and photographs of these NSRs are provided in **Appendix 4.2**.

Table 4.5 : Representative Noise Sensitive Receivers (Construction Phase)

NSR	Description of NSR	Nature of Use	No. of Floor	Base mPD	Figure No.	Construction Phase Works Type that will affect the NSR						
						1	2	3	4	5	6	7
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers	Rehab Centre	2	5.8	4.1				√			
HST	Hung Shing Temple	Temple	1	3.5	4.2	√						
STP2	No.16 Shek Tsai Po Street	Residential	3	3.2	4.2	√		√				
STP3	No.6 Shek Tsai Po Street	Residential	3	3.2	4.2	√		√				
STP4	No.88 Shek Tsai Po Street	Residential	2	3.0	4.3			√				
STP5	No.21 Shek Tsai Po Street	Residential	2	3.0	4.3	√		√				
STP1	No.391A Shek Tsai Po Street	Residential	3	5.2	4.4	√		√				
KHB2	No.33 Kat Hing Back Street	Residential	2	3.7	4.5	√						
TOM	No.4 Tai O Market Street	Residential	2	3.0	4.5	√						
TOTP1	No.190 Tai O Tai Ping Street	Residential	3	3.2	4.5	√						
TOTP3	No.150 Tai O Tai Ping Street	Residential	3	3.0	4.5	√						
KHH	Kam Hin House	Residential	6	3.9	4.6	√						√
TOTP4	Wing Chor School	School	3	3.0	4.6	√						
TOWO1	No.10 Tai O Wing On Street	Residential	2	3.0	4.6	√						
TOWO2	No.52 Tai O Wing On Street	Residential	2	3.0	4.6	√						
TOWO3	No.100 Tai O Wing On Street	Residential	3	3.0	4.6	√						
LUT1	No.53 Leung UK Tsuen	Residential	3	2.7	4.7	√						

NSR	Description of NSR	Nature of Use	No. of Floor	Base mPD	Figure No.	Construction Phase Works Type that will affect the NSR						
						1	2	3	4	5	6	7
LUT2	No.21A Leung UK Tsuen	Residential	3	4.5	4.7	√						
NCT1	No. 6 Nam Chung Tsuen	Residential	3	4.4	4.8	√						
NCT3	No. 7C Nam Chung Tsuen	Residential	1	3.8	4.8	√						
NCT6	No.10 Nam Chung Tsuen	Residential	2	7.0	4.8	√					√	
NTST1	No.4 Nam Tong Sun Tsuen	Residential	2	3.0	4.8	√						
BCM	Buddhist Cheung Mui Kwai Kindergarten	School	1	4.6	4.9	√						
BHMC	Buddhist Fat Ho Memorial College	School	6	4.2	4.9	√						√
WHV1	Wa Kwong Temple (Wang Hang Village)	Temple	1	3.0	4.10	√						
WHV2	No. 4 Wang Hang Village	Residential	1	3.0	4.10	√						
WHV3	No.1 Wang Hang Village	Residential	1	3.0	4.10	√						
WHV4	No.21 Wang Hang Village	Residential	3	3.1	4.11	√	√			√		
WHV5	No.14 Wang Hang Village	Residential	1	3	4.11	√	√			√		
WHV6	No. 18 Wang Hang Village	Residential	2	3.6	4.11	√	√			√		
WHV7	No. 25 Wang Hang Village	Residential	3	3.6	4.11	√	√			√		

Notes:
Works Type 1 – Construction of sewer (Open Cut Method)
Works Type 2 – Construction of sewer (Trenchless Method)
Works Type 3 – Upgrading of existing sewers
Works Type 4 – Construction of Tai O Sewage Treatment Works & Seawall Construction
Works Type 5 – Construction of Hang Mei Sewage Pumping Station
Works Type 6 – Construction of Fan Kwai Tong Sewage Pumping Station
Works Type 7 – Temporary Working Area at Yim Tin Pok Temporary Playground

Impact Evaluation

4.4.6 Construction noise impact will be assessed based on the following methodology:

- Locate the NSRs which would most likely be affected by noise from construction work;
- Determine the items of Powered Mechanical Equipment (PME) for each discrete construction activity, based on available information or agreed plant inventories;
- Calculate the distance attenuation and screening effects to NSRs from notional noise source. Under the Technical Memorandum on Noise from Construction work other than Percussive Piling (GW-TM), the distance attenuation will be determined by the following formula;

- Distance Attenuation in dB(A) = 20 Log D + 8 [where D is distance in metres];
- A +3 dB (A) façade correction is added to the predicted noise levels to account for the façade effect at each NSR;
- Calculate the unmitigated Predicted Noise Level (PNL) and correct it for façade reflection to obtain the Corrected Noise Level (CNL) at any NSRs;
- If necessary, re-select typical project-specific silenced equipment and other types of mitigation measure to address noise exceedance, e.g. noise barrier and calculate the mitigated noise impact; and
- Compare the mitigated CNL with the noise standards to determine acceptability and the need for further mitigation/ EM&A.

4.4.7 For a conservative approach to assessing the worst-case construction noise impacts, it was assumed that all the proposed PMEs for each construction work stage are operating concurrently. The predicted cumulative worst-case construction noise levels at the NSRs due to overlapping of different works types of the Project are summarised in **Table 4.6**. Detailed calculations are provided in **Appendix 4.3**.

4.4.8 The predicted unmitigated construction noise impacts due to all works types will range from 58 dB(A) to 107 dB(A) which would exceed the EIAO-TM noise standards by up to 32 dB(A). The predicted unmitigated construction noise impacts due to the individual Works Type 4 (Construction of Tai O Sewage Treatment Works) and Works Type 7 (operation of temporary workings area) were found to be within the EIAO-TM noise standard.

Table 4.6 : Predicted Worst-case Cumulative Construction Noise Levels at Representative NSRs - Unmitigated Scenario

NSR	Description of NSR	Predicted Worst-case (Unmitigated) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers				74				74
HST	Hung Shing Temple	**79**							**79**
STP2	No.16 Shek Tsai Po Street	**104**		63					**104**
STP3	No.6 Shek Tsai Po Street	**104**		67					**104**
STP4	No.88 Shek Tsai Po Street			**104**					**104**
STP5	No.21 Shek Tsai Po Street	**104**		**104**					**107**
STP1	No.391A Shek Tsai Po Street	**104**		**87**					**87**
KHB2	No.33 Kat Hing Back Street	**98**							**98**
TOM	No.4 Tai O Market Street	**104**							**104**
TOTP1	No.190 Tai O Tai Ping Street	**98**							**98**
TOTP3	No.150 Tai O Tai Ping Street	**104**							**104**
KHH	Kam Hin House	**83**						47	**83**

NSR	Description of NSR	Predicted Worst-case (Unmitigated) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
TOTP4	Wing Chor School	**89**							**89**
TOWO1	No.10 Tai O Wing On Street	**98**							**98**
TOWO2	No.52 Tai O Wing On Street	**104**							**104**
TOWO3	No.100 Tai O Wing On Street	**104**							**104**
LUT1	No.53 Leung UK Tsuen	**104**							**104**
LUT2	No.21A Leung UK Tsuen	**95**							**95**
NCT1	No. 6 Nam Chung Tsuen	**95**							**95**
NCT3	No. 7C Nam Chung Tsuen	**104**							**104**
NCT6	No.10 Nam Chung Tsuen	**86**					**96**		**97**
NTST1	No.4 Nam Tong Sun Tsuen	**104**							**104**
BCM	Buddhist Cheung Mui Kwai Kindergarten	**70**							**70**
BHMC	Buddhist Fat Ho Memorial College	58						48	58
WHV1	Temple (Wang Hang Village)	**104**							**104**
WHV2	No. 4 Wang Hang Village	**104**							**104**
WHV3	No.1 Wang Hang Village	**104**							**104**
WHV4	No.21 Wang Hang Village	**77**	**83**			**84**			**87**
WHV5	No.14 Wang Hang Village	**85**	**76**			74			**86**
WHV6	No.18 Wang Hang Village	**104**	**83**			**86**			**104**
WHV7	No. 25 Wang Hang Village	**104**	**83**			**86**			**104**

Notes:
Underlined bold figure (e.g. **77**) indicates an exceedance of the 75 dB(A) noise criteria (or 70 dB(A) for schools during normal teaching hours and 65 dB(A) during examination periods)
Noise criteria for TOTP4, BCM and BHMC is 70 dB(A) (65 dB(A) during examination periods).
Works Type 1 – Construction of sewer (Open Cut Method)
Works Type 2 – Construction of sewer (Trenchless Method)
Works Type 3 – Upgrading of existing sewers
Works Type 4 – Construction of Tai O Sewage Treatment Works & Seawall Construction
Works Type 5 – Construction of Hang Mei Sewage Pumping Station
Works Type 6 – Construction of Fan Kwai Tong Sewage Pumping Station
Works Type 7 – Temporary Working Area at Yim Tin Pok Temporary Playground

General Mitigation Measures

4.4.9 Good site practice and noise management can significantly reduce the impact of construction site activities on nearby NSRs. The following mitigation measures should be followed during the construction phase:

- only well-maintained plants should be operated on-site and plants should be serviced regularly during the construction works;
- machines and plants that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plants known to emit noise strongly in one direction should, where possible, be orientated to direct noise away from the NSRs;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilized, where practicable, to screen noise from on-site construction activities.

4.4.10 In view of the high noise exceedances at some NSRs due to the sewerage works, mitigation measures are considered to be implemented at three levels, which involves the adoption of quiet PME and temporary noise barriers; good scheduling of works to avoid concurrent construction activities; and alternative construction method (for breaking of road surface (Works Type 1 and 3 Stage 1)).

Level 1 Noise Mitigation Measures - Quiet PMEs and Temporary Noise Barrier

4.4.11 To reduce construction noise impact on the affected NSRs during the construction phase, quieter equipment shall be adopted as far as possible.

4.4.12 **Table 4.7** shows the possible alternative quieter PME. These quieter PMEs are available in the market and have been successfully applied on other projects and have achieved noticeable noise reductions. The SWLs of quieter PMEs that are to be used for the works shall meet, or be lower than, the values in **Table 4.7**.

Table 4.7 : Silenced Equipments

Description of PME	Equivalent Quiet PME	SWL, dB(A)
Generator	BS 5228 Table C4/78	94
Poker, vibratory, hand-held	BS 5228 Table C4/34	97
Road Roller	BS 5228 Table D8/25	96
Breaker, excavator mounted	BS 5228 Table C9/12	113
Excavator	BS 5228 Table C4/65	99
Excavator, tracked	QPME EPD-02101	90
Crane, mobile mounted	BS 5228 Table C4/50	99
Dumper	BS 5228 Table D3/98	101
Vibratory Compactor	BS 5228 Table D8/25	96
Drill Rig	BS 5228 Table D10/2	112
Hydraulic Vibratory Driver for driving Sheet Piling	BS 5228 Table D4/12	94

4.4.13 For the construction of sewers, use of temporary noise barrier and enclosure have been recommended for PMEs to alleviate the construction noise impacts. In general, temporary noise barrier located close to the noise generating part of the PME would reduce noise level of 5 to 10 dB(A) depending on the actual design while enclosure provided for stationary PME would reduce noise level by 15 dB(A), with reference to Paragraph 4.6 of EIAO Guidance Note No. 9/2010. The noise screening benefit for each plant considered in this assessment has been adopted as follows:

- Enclosure for stationary plant – assuming 15 dB(A) reduction on stationary plant;
- Temporary noise barrier for stationary plant – assuming 10 dB(A) reduction on stationary plants;
- Temporary noise barrier for mobile plant – assuming 5 dB(A) reduction on mobile plants.

4.4.14 In general, temporary noise barrier and enclosure material's surface mass in excess of 7 kg/m^2 is recommended. The contractor shall be responsible for design of the temporary noise barrier/enclosure with due consideration given to the size of the PME and the requirement of intercepting the line of sight between the NSRs and PME. Although the work areas within village area are limited, contractors are recommended to adopt temporary noise barrier/enclosure as far as practicable to minimize noise impact at lower floors of NSRs. **Table 4.8** summarizes the assumed noise reduction achieved by the temporary noise barrier/enclosure for certain PMEs. Detailed mitigated plant inventory is presented in **Appendix 4.4**.

Table 4.8 : Noise Mitigation Measures for Certain PME

Description of PME	Proposed Mitigation Measures	Assumed Noise Reduction, dB(A)
Backhoe (mini)	Noise Barrier (Mobile)	5
Breaker, excavator mounted	Noise Barrier (Mobile)	5
Crane, mobile mounted	Noise Barrier (Mobile)	5
Excavator	Noise Barrier (Mobile)	5
Excavator, tracked	Noise Barrier (Mobile)	5
Dumper	Noise Barrier (Mobile)	5
Breaker, hand-held, mass≥20kg and ≤35kg	Noise Barrier (Stationary)	10
Vibratory compactor	Noise Barrier (Stationary)	10
Piling, earth auger, auger	Noise Barrier (Stationary)	10
Hoist (electric)	Noise Barrier (Stationary)	10
Bentonite Filtering Plant	Noise Barrier (Stationary)	10
Ventilation Fan	Noise Barrier (Stationary)	10
Grout Mixer	Noise Barrier (Stationary)	10
Grout Pump	Noise Barrier (Stationary)	10
Hydraulic Vibratory Driver for driving Sheet Piling	Noise Barrier (Stationary)	10
Welding Machine	Noise Barrier (Stationary)	10
Concrete Pump	Noise Barrier (Stationary)	10
Saw, circular, wood	Noise Barrier (Stationary)	10
Submersible Pump	Noise Barrier (Stationary)	10
Winch (electric)	Noise Barrier (Stationary)	10
Drill/grinder, hand-held	Noise Barrier (Stationary)	10
Road Roller	Noise Barrier (Stationary)	10
Tunnel Boring Machine	Noise Barrier (Stationary)	10
Pulverizer mounted on excavator	Noise Barrier (Stationary)	10
Submersible Pump	Enclosure (Stationary)	15

Description of PME	Proposed Mitigation Measures	Assumed Noise Reduction, dB(A)
Generator	Enclosure (Stationary)	15
Poker, vibratory hand-held	Enclosure (Stationary)	15
Bar bender and cutter (electric)	Enclosure (Stationary)	15

4.4.15 It should be noted that the noise screening effect due to the temporary noise barrier and enclosure and the noise mitigation measures including phasing of the works adopted in this EIA Report are specific to this Project with considerations of specific works types, low-rise houses, specific design of temporary noise barriers in the form of site hoardings and screening without direct line sight between the NSRs and the PMEs. The measures and the noise screening effect should not be lightly applied to other project without careful consideration of the specific construction works, design of barriers and NSR's situations.

4.4.16 The predicted mitigated construction noise levels at the representative NSRs are summarized in **Table 4.9** and detailed in **Appendix 4.5**.

Table 4.9 : Predicted Maximum Construction Noise Levels at Representative NSRs with Level 1 Mitigation Measures

NSR	Description of NSR	Predicted Mitigated (Level 1) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers				71				71
HST	Hung Shing Temple	54							54
STP2	No.16 Shek Tsai Po Street	**80**		39					**80**
STP3	No.6 Shek Tsai Po Street	**80**		43					**80**
STP4	No.88 Shek Tsai Po Street			**80**					**80**
STP5	No.21 Shek Tsai Po Street	**80**		**80**					**83**
STP1	No.391A Shek Tsai Po Street	**80**		63					**80**
KHB2	No.33 Kat Hing Back Street	74							74
TOM	No.4 Tai O Market Street	**80**							**80**
TOTP1	No.190 Tai O Tai Ping Street	74							74
TOTP3	No.150 Tai O Tai Ping Street	**80**							**80**
KHH	Kam Hin House	59						47	59
TOTP4	Wing Chor School	64							64

NSR	Description of NSR	Predicted Mitigated (Level 1) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
TOWO1	No.10 Tai O Wing On Street	74							74
TOWO2	No.52 Tai O Wing On Street	**80**							**80**
TOWO3	No.100 Tai O Wing On Street	**80**							**80**
LUT1	No.53 Leung UK Tsuen	**80**							**80**
LUT2	No.21A Leung UK Tsuen	70							70
NCT1	No. 6 Nam Chung Tsuen	70							70
NCT3	No. 7C Nam Chung Tsuen	**80**							**80**
NCT6	No.10 Nam Chung Tsuen	62					75		75
NTST1	No.4 Nam Tong Sun Tsuen	**80**							**80**
BCM	Buddhist Cheung Mui Kwai Kindergarten	46							46
BHMC	Buddhist Fat Ho Memorial College	33						48	48
WHV1	Temple (Wang Hang Village)	**80**							**80**
WHV2	No. 4 Wang Hang Village	**80**							**80**
WHV3	No.1 Wang Hang Village	**80**							**80**
WHV4	No.21 Wang Hang Village	53	69			63			70
WHV5	No.14 Wang Hang Village	61	62			53			65
WHV6	No.18 Wang Hang Village	**80**	69			65			**80**
WHV7	No. 25 Wang Hang Village	**80**	69			65			**80**

Notes:
Underlined bold figure (e.g. **77**) indicates an exceedance of the 75 dB(A) noise criteria (or 70 dB(A) for schools during normal teaching hours and 65 dB(A) during examination periods)
Noise criteria for TOTP4, BCM and BHMC is 70 dB(A) (65 dB(A) during examination periods).
Works Type 1 – Construction of sewer (Open Cut Method)
Works Type 2 – Construction of sewer (Trenchless Method)
Works Type 3 – Upgrading of existing sewers
Works Type 4 – Construction of Tai O Sewage Treatment Works & Seawall Construction
Works Type 5 – Construction of Hang Mei Sewage Pumping Station
Works Type 6 – Construction of Fan Kwai Tong Sewage Pumping Station
Works Type 7 – Temporary Working Area at Yim Tin Pok Temporary Playground

4.4.17 With the Level 1 noise mitigation measures - adoption of quiet PMEs and temporary barrier, noise exceedances ranging from 5 to 8 dB(A) were still predicted at some

sensitive receivers during construction and upgrading of the sewerage system. The proposed temporary noise barriers will only be in place when the associated PME is in use on the construction works areas and this is anticipated to only be for short durations of time. Therefore, there are no side effects predicted associated with the use of the proposed mitigation measures.

Level 2 Noise Mitigation Measures – Good Scheduling of Works

4.4.18 For NSRs which would be affected by more than one works types, good scheduling of the construction works is recommended to further mitigate the potential construction noise impacts. This will include avoidance of undertaking different works types at the same time near the NSRs. However, noise exceedances were still predicted at some of the NSRs due to certain individual works type (sewerage construction Works Types 1 and 3). Further noise mitigation measures were considered.

4.4.19 With the implementation of Level 1 and Level 2 noise mitigation measures, exceedances of the daytime construction noise criterion are still predicted at some NSRs located close to the works of the village sewers.

Level 3 Noise Mitigation Measures – Alternative Construction Method

4.4.20 Alternative construction method was considered for the breaking up of road surface (Stage 1) of Works Type 1 (Construction of sewer (open cut method)) and Works Type 3 (Upgrading of existing sewer). Drill with chemical agent is proposed to be adopted for this works stage for Works Type 1 and 3 instead of pulverizer mounted on excavator and generator. The mitigated plant inventory with alternative construction method is presented in **Appendix 4.6** and predicted mitigated construction noise levels at the representative NSRs are summarized in **Table 4.10** and detailed in **Appendix 4.7**.

Table 4.10 : Predicted Maximum Construction Noise Levels at Representative NSRs with Level 1, 2 and 3 Mitigation Measures

NSR	Description of NSR	Predicted Mitigated (Level 1) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers				71				71
HST*	Hung Shing Temple	49							49
STP2	No.16 Shek Tsai Po Street	75		34					75
STP3	No.6 Shek Tsai Po Street	75		38					75
STP4	No.88 Shek Tsai Po Street			75					75
STP5	No.21 Shek Tsai Po Street	75		75					75(1)
STP1	No.391A Shek Tsai Po Street	75		58					75
KHB2*	No.33 Kat Hing Back Street	69							69
TOM	No.4 Tai O Market Street	75							75

NSR	Description of NSR	Predicted Mitigated (Level 1) Construction Noise Level of different Works Type, dB(A)							
		1	2	3	4	5	6	7	Total
TOTP1*	No.190 Tai O Tai Ping Street	69							69
TOTP3	No.150 Tai O Tai Ping Street	75							75
KHH*	Kam Hin House	54						47	55
TOTP4*	Wing Chor School	59							59
TOWO1*	No.10 Tai O Wing On Street	69							69
TOWO2	No.52 Tai O Wing On Street	75							75
TOWO3	No.100 Tai O Wing On Street	75							75
LUT1	No.53 Leung UK Tsuen	75							75
LUT2*	No.21A Leung UK Tsuen	66							66
NCT1*	No. 6 Nam Chung Tsuen	66							66
NCT3	No. 7C Nam Chung Tsuen	75							75
NCT6*	No.10 Nam Chung Tsuen	57					75		75
NTST1	No.4 Nam Tong Sun Tsuen	75							75
BCM*	Buddhist Cheung Mui Kwai Kindergarten	41							41
BHMC*	Buddhist Fat Ho Memorial College	28						48	48
WHV1	Temple (Wang Hang Village)	75							75
WHV2	No. 4 Wang Hang Village	75							75
WHV3	No.1 Wang Hang Village	75							75
WHV4*	No.21 Wang Hang Village	48	69			63			70
WHV5*	No.14 Wang Hang Village	56	62			53			63
WHV6	No.18 Wang Hang Village	75	69			65			75(2)
WHV7	No. 25 Wang Hang Village	75	69			65			75(2)

Note: NSR ID marked with * represents the predicted noise level at NSR with proposed Level 1 and Level 2 mitigation measures is comply with the relevant noise criteria.
(1) The presented total construction noise level at STP5 includes good scheduling of works to avoid concurrent construction activities for Works Type 1 and 3.
(2) The presented total construction noise level at WHV6 and WHV7 includes good scheduling of works to avoid concurrent construction activities for Works Type 1, 2 and 5.

4.4.21 With the adoption of Level 1 and 3 noise mitigation measures - adoption of quiet PMEs and temporary barrier and alternative construction method for Works Type 1 and 3 Stage 1 works, all sensitive receivers has predicted construction noise level

and comply with the relevant noise criteria during construction and upgrading of the sewerage system.

4.4.22 For NSRs STP5, WHV6 and WHV7, it must be noted that the predicted construction noise levels due to the individual Work Types comply with the relevant noise criteria. With good scheduling of works to avoid the concurrent construction activities (Works Type 1 and 3 near NSR STP5, and Works Type 1, 2 and 5 near NSR WHV6 and WHV7), the construction noise levels at these NSRs are predicted to comply with the relevant noise criteria.

Cumulative Impact

4.4.23 The following discusses the potential cumulative interface issues between concurrent projects as indicated in **Section 2.16**.

Improvement of Works at Tai O – Design and Construction

4.4.24 Based on the information provided by CEDD on this project and as elaborated in Section 2.16, the remaining works undertaken by CEDD, including the improvement to existing streetscapes in Tai O such as re-paving of Market Street, Wing On Street and Tai Ping Street, which might have interface with DSD's future sewer laying works, is currently under Review Stage with no confirmed programme. The contractor should liaise with the correspondent party to ensure concurrent works are avoided as far as possible.

Natural Terrain Hazard Mitigation Works

4.4.25 Based on the information provided by CEDD/GEO on this project, the contracts were scheduled tentatively to complete in December 2017. No cumulative impact would be expected.

Water Supply from Tung Chung to Tai O (Previously name as Improvement of Water Supply for Tai O Facelift)

4.4.26 Based on the information provided by WSD, the construction programme under this project is being reviewed and is not available at the time of preparation of this Report. No conflicts with this project concerning construction programme can identified at the current stage. Coordination meetings with WSD will be arranged to confirm the interface location and consider rearrangement of water main alignment if there is conflict with the proposed Hang Mei Sewage Pumping Station.

Replacement and Rehabilitation of Water Mains Stage 4, Mains on Hong Kong and Islands – Investigation, Design and Construction

4.4.27 The construction of Stage 4 works commenced in Mid 2012 and is anticipated for completion by Mid of 2016. No interfacing issue is expected.

HZMB and related projects, including HKLR, HKBCF and TM-CLKL

4.4.28 As the proposed works under HZMB and related projects would be sufficiently for away from the Tai O STW, no cumulative noise impact would be anticipated.

Environmental Monitoring and Audit Requirements

4.4.29 The results of the assessment suggest that the construction noise activities would comply with the EIAO-TM standards. An EM&A programme is recommended to be established according to the expected occurrence of noisy activities. All the recommended mitigation measures should be incorporated into the EM&A

programme for implementation during construction. Details of the EM&A requirements are provided in the EM&A Manual.

Conclusion

4.4.30 Construction noise assessment has been conducted. The assessment results indicate that there would be no noise exceedances with the implementation of the proposed Level 1, 2 and 3 mitigation measures and compliance to the relevant construction noise criteria at all NSRs will be able to be achieved.

4.4.31 A construction noise EM&A programme is recommended to check the compliance of the noise criteria during normal daytime working hours.

4.5 Operational Noise Impact Assessment

Noise Sources Identification

4.5.1 Potential operational fixed plant noise impact will be associated with the Tai O STW, Hang Mei SPS and Fan Kwai Tong SPS. The noisy equipment inventory at the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS are provided in **Table 4.11** and have been confirmed by the Engineer and the Project Proponent. The typical Sound Power Levels (SWL) associated with these equipments are also provided. **Figure 4.1** to **Figure 4.3** show the general location of noisy equipment for the Tai O STW, Hang Mei SPS and Fan Kwai Tong SPS.

Table 4.11: Major Noise Generating Equipment (Operational Phase)

Location	Equipment	No. of Units	Typical Sound Power Level, dB(A)	Sub-total Sound Power Level, dB(A)
Hang Mei Sewage Pumping Station				
Plant Room	Submersible pump (Ref. 1)	1	85	85
	Deodourization fan (Ref. 2)	1	85	85
	Exhaust Fan (Ref. 3)	1	79	79
Fan Kwai Tong Sewage Pumping Station				
Plant Room	Submersible pump (Ref. 1)	1	85	85
	Deodourization fan (Ref. 2)	1	85	85
	Exhaust Fan (Ref. 3)	1	79	79
Tai O Sewage Treatment Works				
Sewage Treatment Facilities Facilities	Submersible pump (Ref. 1)	16	85	97
	Mechanically raked fine screen (Ref. 4)	2	92	95
	Deodourization fan (Ref. 2)	14	85	96
	Exhaust Fan (Ref. 3)	45	79	96
	Mechanical pump (Ref. 5)	25	92	106
	Blower (Ref. 6)	6	85	93

Notes:
Only noisy equipments have been included. Other equipments which do not have significant noise emissions have not been included.
(Ref 1) SWL of plant referenced to CNP283
(Ref 2) SWL of plant refers to Good Practices on Ventilation System Noise Control based on the flow rate of 17,000 m^3/hr and 125 Pa.
(Ref 3) SWL of plant referenced to approved EIA of Harbour Area Treatment Scheme (HATS) Stage 2A (EIA-148/2008) and Good Practices on Ventilation System Noise Control based on the flow rate of 1,300m^3/hr.
(Ref 4) SWL of plant has referenced to the approved EIA Report on Tai Po Sewage Treatment Works Stage V (EIA-097/2004).
(Ref 5) SWL of plant refers to Good Practices on Pumping System Noise Control based on the horsepower of pumpset 20hp at 1800 rpm.
(Ref 6) SWL of plant refers to the tender specification for Shatin STW Stage 3 Upgrading and approved EIA of Harbour Area Treatment Scheme (HATS) Stage 2A (EIA-148/2008).

4.5.2 Standby equipment would only be used in case of failure or maintenance of duty units. Therefore, concurrent operation of both duty and standby equipment will not occur under normal operation. It is anticipated that the maximum sound power levels

generated during operation phase would be when all duty equipment are in operation and these are presented in **Table 4.11**.

Noise Sensitive Receivers

4.5.3 Representative first tier NSRs closest to the Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS have been selected following the requirement of Annex 13 of the EIAO-TM have been identified for the noise impact assessment during the operational phase of the Project. Other NSRs further away from these NSRs are expected to be less affected in comparison.

4.5.4 Planned NSRs within the assessment area have been identified with reference to the latest Outline Zoning Plans (OZP), Tai O Fringe OZP (Plan No. S/I-TOF/1) dated May 2013. **Table 4.12** summarises the selected representative NSRs for the operational phase fixed plant noise assessment and photographs of these NSRs are provided in **Appendix 4.2**.

Table 4.12: Representative Noise Sensitive Receivers (Operational Phase)

<table>
<tr><th rowspan="2">NSR</th><th rowspan="2">Description of NSR</th><th colspan="3">Approximate Nearest Horizontal Separation(1)</th></tr>
<tr><th>Tai O STW</th><th>Hang Mei SPS</th><th>Fan Kwai Tong SPS</th></tr>
<tr><td>SST</td><td>CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers</td><td>211m</td><td rowspan="2">No direct line of sight (over 800m)</td><td>No direct line of sight (over 1.4km)</td></tr>
<tr><td>NCT6</td><td>No.10 Nam Chung Tsuen</td><td rowspan="5">No direct line of sight (over 1.5km)</td><td>11m</td></tr>
<tr><td>WHV4</td><td>No.21 Wang Hang Village</td><td>46m</td><td rowspan="3">No direct line of sight (over 800m)</td></tr>
<tr><td>WHV6</td><td>No.18 Wang Hang Village</td><td>35m</td></tr>
<tr><td>WHV7</td><td>No. 25 Wang Hang Village</td><td>41m</td></tr>
<tr><td>PT2(2)</td><td>GIC Site (currently occupied as Nam Chung Village Aqua Privy)</td><td>No direct line of sight (over 800m)</td><td>14m</td></tr>
</table>

Notes: (1) Measured from the nearest site boundary
(2) Planned NSR

Operational Noise Impact Evaluation

4.5.5 All identified noisy equipment of the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS would be confined within the existing site boundary and housed inside the STW and SPS building structures. For the assessment of the worst-case unmitigated operational noise, it was assumed that all duty equipment would be operated at the same time and located outdoors without cover.

Table 4.13: Predicted Worst-case Maximum Operational Noise Levels at Representative NSRs – Without Mitigation Measures

NSR	NSR Description	Predicted Unmitigated Noise Level, dB(A)	Night-time (2300 – 0700) Noise Criterion, dB(A)	Day-time (0700 – 1900) & Evening time (1900 – 2300) Noise Criterion, dB(A)
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers	56	45	50
NCT6	No.10 Nam Chung Tsuen	59	42	45
WHV4	No.21 Wang Hang Village	50	39	45
WHV6	No.18 Wang Hang Village	53	39	45
WHV7	No. 25 Wang Hang Village	51	39	45
PT2(1)	GIC Site (currently occupied as Nam Chung Village Aqua Privy)	58	42	45

Note: (1) Planned NSR

4.5.6 The predicted worst-case unmitigated noise levels due to the operation of the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS at the identified NSRs for the assessment are presented in **Table 4.13** and detailed in **Appendix 4.8**. The predicted worst-case unmitigated noise levels would exceed the daytime, evening time and night time noise criteria at the selected representative NSRs.

Possible Noise Mitigation Measures and Mitigated Impacts

4.5.7 The assessment has been carried out with the assumption that all the noisy equipment for the SPS and STW are located outdoors without covering. The equipments are designed to be installed inside the respective building structures and a reduction of 20 dB(A) can be achieved if the building enclosure is built using suitable material such as concrete with surface density of 25 kg/m^2.

4.5.8 The provision of acoustic louver at ventilation fans can provide significant reduction in noise levels. It is recommended that acoustic louvers be provided at the discharge point of ventilation fans with a minimum noise reduction of 10 dB(A). A 10 dB(A) reduction has also been applied to noise sources which are blocked and do not have a direct line of sight to the NSR.

4.5.9 The recommended mitigation measures for the equipment used for the operation of the Tai O STW, Hang Mei SPS and Fan Kwai Tong SPS and the proposed noise mitigation measures are summarized in **Table 4.14**.

Table 4.14: Proposed Noise Mitigation Measures for Equipments during Operation Phase

Location	Equipment	Mitigation Measures	Noise Reduction
Hang Mei Sewage Pumping Station	Submersible pump	enclosed inside SPS building structure	-20 dB(A)
	Deodourization fan	enclosed inside SPS building structure	-20 dB(A)
	Exhaust fan	noise source does not have direct line of sight to NSR	-10 dB(A)
Fan Kwai Tong Sewage Pumping Station	Submersible pump	enclosed inside SPS building structure	-20 dB(A)
	Deodourization fan	enclosed inside SPS building structure	-20 dB(A)
	Exhaust fan	noise source does not have direct line of sight to NSR	-10 dB(A)
Tai O Sewage Treatment Works	Submersible pump	enclosed inside treatment unit building structure	-20 dB(A)
	Mechanically raked fine screen	enclosed inside STW building structure	-20 dB(A)
	Deodourization fan	enclosed inside STW building structure	-20 dB(A)
	Exhaust Fan	Noise source does not have direct line of sight to NSR	-10 dB(A)
	Mechanical Pump	enclosed inside STW building structure	-20 dB(A)
	Blower	enclosed inside STW building structure	-20 dB(A)

4.5.10 By incorporating the recommended noise mitigation measures, the predicted worst-case mitigated noise levels at the identified NSRs due to the operation of the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS would comply with the noise criteria at the daytime (0700 – 1900), evening time (1900 – 2300) and night time (2300 – 0700) periods. The predicted noise levels at representative NSRs are summarized in **Table 4.15** and detailed in **Appendix 4.9**.

Table 4.15 : Predicted Maximum Operational Noise Levels at Representative NSRs – With Mitigation Measures

NSR	NSR Description	Predicted Mitigated Noise Level, dB(A)	Night-time (2300 – 0700) Noise Criterion, dB(A)	Day-time (0700 – 1900) & Evening time (1900 – 2300) Noise Criterion, dB(A)
SST	CZSA Drug Treatment and Rehabilitation Centre for Male Drug Abusers	38	45	50
NCT6	No.10 Nam Chung Tsuen	41	42	45
WHV4	No.21 Wang Hang Village	33	39	45
WHV6	No.18 Wang Hang Village	36	39	45

NSR	NSR Description	Predicted Mitigated Noise Level, dB(A)	Night-time (2300 – 0700) Noise Criterion, dB(A)	Day-time (0700 – 1900) & Evening time (1900 – 2300) Noise Criterion, dB(A)
WHV7	No. 25 Wang Hang Village	34	39	45
PT2(1)	GIC Site (currently occupied as Nam Chung Village Aqua Privy)	41	42	45

Note: (1) Planned NSR

4.5.11 With the incorporation of the recommended noise mitigation measures, the predicted worst-case mitigated noise level at the planned NSR PT2 due to the operation of the proposed Fan Kwai Tong SPS is 49 dB(A), exceeding the noise criteria at the daytime (0700 – 1900), evening time (1900 – 2300) and night time (2300 – 0700) periods. With the provision of acoustic louver at the exhaust fan of this SPS, the predicted worst-case mitigated noise level at planned NSR PT2 would comply with the noise criteria at the daytime, evening time and night time periods (detailed in **Table 4.15** and **Appendix 4.9**). This proposed acoustic louver would only be required to be installed at the exhaust fan before the occupation of the identified planned GIC Site at Fan Kwai Tong and it is not anticipated that there will be side effects associated with the installation and operation of this acoustic louver.

4.5.12 The maximum sound power level of equipment would be specified in the tender specification to ensure that the operational noise impact complies with the relevant noise criteria. The supplier of equipment should guarantee the specified SWLs including the characteristics of tonality, impulsiveness and intermittency, if any. If necessary, the suppliers should apply attenuation measures (e.g. use of silencers) to achieve the recommended noise levels during the detailed design stage.

Residual Impact

4.5.13 Residual noise impacts due to the operation of the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS are not anticipated provided that the maximum permissible sound power level of equipment is met through appropriate design and the recommended noise mitigation measures are adopted.

Environmental Monitoring and Audit Requirements

4.5.14 Operational fixed plant noise impacts due to the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS can be effectively mitigated by implementing noise control treatment at source. Results of the assessment conducted indicate that the predicted impacts are within the EIAO-TM requirements. EM&A during operational phase is not required. In order to ensure compliance of the operational airborne noise impacts with the relevant noise standards, the requirement for carrying out a noise commissioning test for all major fixed noise sources should be included in the tender document.

Conclusion

4.5.15 Operational fixed plant noise impacts due to the upgraded Tai O STW, proposed Hang Mei SPS and Fan Kwai Tong SPS can be effectively mitigated by implementing noise control treatment at source. Results of the assessment conducted indicate that the predicted impacts are within the EIAO-TM requirements.