5.0 NOISE

5.1 Introduction

5.1.1 The following section provides an assessment of the potential noise impacts during both the construction and operation of the project and highlights mitigation measures required to reduce noise levels to acceptable levels. Residual noise impacts that may occur after implementation of proposed mitigation measures have been determined and are provided at the end of this section.

5.2 Noise Sensitive Receivers

5.2.1 Representative Noise Sensitive Receivers (NSRs) have been identified in accordance with criteria set out in the Technical Memorandum on the Environmental Impact Assessment Process.

5.2.2 The construction noise sensitive receivers are the same as the air sensitive receivers and are shown in Table 5.1 below and Drawings 4.1a to 4.1h in Section 4.0 of this report.

Table 5.1: Construction Noise Sensitive Receivers

NSR ID (as in Drawing 4.1)	Name of sensitive receivers	Types of usage
C1	Siu Lam Correctional Institution	Clinic
C2	Customs and Excise Training School	School
C3	Siu Lam Hospital	Hospital
TC1 - TC21	Tai Lam Chung Tsuen	Residential
LC1 - LC13	Lok Chui Street	Residential
LT1	School in Luen On San Tsuen	Education
LT2	Kindergarten in Luen On San Tsuen	Education
LT3 - LT8	Luen On San Tsuen	Residential
WU1 - WU3	Wu Uk	Residential
WK1 - WK4	Wong Uk	Residential
P1 - P3	Planned Receiver in Siu Lam (Palatial Coast)	Residential
ST1 - ST18	So Kwun Wat Tsuen	Residential
SS1 - SS5	So Kwun Wat San Tsuen	Residential

5.2.3 The operational noise sensitive receivers are shown in Table 5.2 and also on Drawings 4.1a to 4.1h. The future potential green belt area, denoted by N2 in Drawing 4.1h, in the proposed Area 56 development is an air sensitive receiver only and thus not considered in the operational noise assessment. It should be noted that as operational noise impacts relate only to noise from the operation of the pumps in the pumping stations, only a few representative NSRs close

to the proposed pumping station locations have been selected.

Table 5.2 Operational Noise Sensitive Receivers

NSR ID (as in Drawing 4.1)	Relevant Pumping Station	Type of usage
C1	Tai Lam Chung Correctional	Clinic
TC1, TC2	Tai Lam Chung Tsuen	Residential
TC21	Tai Lam Valley	Residential
LC6, LC7	Castle Peak Villas	Residential
LT1, LT2, LT4	Luen On San Tsuen	School, Residential
N1(1)		CDA site in Tai Lam Chung Tsuen, high rise residential
ST18	So Kwun Wat Tsuen	Residential
N3(1)		Area 56 in So Kwun Wat, Mixed including high rise residential

Note(1): denotes future sensitive receiver

5.3 Existing Conditions

5.3.1 There are three types of developments present in the project study area, namely village properties, low rise and high rise buildings.

5.3.2 The villages to be sewered are located within quiet rural areas, with the surrounding land used for open storage space and agriculture. These villages include Tai Lam Chung Tsuen, Luen On San Tsuen, Wong Uk, Wu Uk, So Kwun Wat Tsuen and So Kwun Wat San Tsuen. Noise levels are, generally, very low in these villages and are not, overall, influenced by noise generated outside of the village. The major contributions to noise in the rural villages include agricultural activities and construction of new village houses. However, in the Tai Lam Valley area, the firing range of the Customs and Excise Training School can be a notable noise source when in use.

5.3.3 Low rise buildings located along the major Castle Peak Road and Tuen Mun Road include Fiona Garden, Castle Peak Villas, the Castle Bay, Ivanhole Villa and Kings Park Villa. The housing units that face the roadway are subject to noise from traffic. However, the residential units that are set back from the road are generally quiet as they are screened by the houses closer to the road.

5.3.4 The Palatial Coast, a new high rise residential development in Siu Lam, which is current under construction, is located along the Tuen Mun Road. These housing units face the Tuen Mun Road and will be subject to noise from traffic.

5.4 Potential Construction Noise Impacts

5.4.1 Noise may be generated from different stages of the construction works. Indicative worst case construction equipment and works programming for each stage of the project has been developed for use as a basis for the noise impact assessment. The sound power level of the equipment has been extracted from the *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling* (TM) or British Standard 5228 where the equipment is not specified in the TM. All equipment specified are suitable for their intended use and are available in Hong Kong.

5.4.2 The assessment of noise from construction activities can be divided into the pumping stations, the main sewer alignment and the sewers within the villages themselves. Details on the predicted equipment to be used for each element of the project and noise levels of the equipment are discussed separately in the sections below. The scenarios provided represent some of the worst case activities in terms of noise that will occur and are not intended to represent all activities that will be carried out or equipment that will be used continuously during the construction period.

5.5 Pumping Station Construction Noise Impacts

5.5.1 The key activities associated with the construction of the pumping stations will include concrete breaking, where existing paved surfaces need to be broken, and excavation. Powered mechanical equipment will be used for these works. The sound power levels of typical equipment that will be used for pumping station construction are provided in Table 5.3 below. In practice all the equipment will not be used concurrently and, thus, typical construction scenarios have been determined.

Table 5.3 : Sound Power Level (SWL) of Equipment used for Pumping Station Construction

Scenario	Equipment	Technical Memorandum ID	No. of Equipment	SWL per item	Total SWL (by scenario)
Concrete /Asphalt Breaking	Breaker, hand held	CNP 025	2	111	114
	Air Compressor	n/a(1)	1	95	
Site Formation / FoundationExcavation	Excavator	CNP 081	1	112	115
	Lorry	CNP141	1	112	
Building Fabrication	Crane	CNP048	1	112	112
Earth Compaction	Compactor	CNP050	1	105	105
Concrete Laying	Vibratory poker	n/a(2)	1	112	114

	Concrete Lorry mixer	CNP044	1	109	

Note (1): BS 5228 (1997) Part 1, Table C.7, Item 24
(2): BS 5228 (1997) Part 1, Table C.6, Item 29

5.5.2 For the pumping station installation, the NSRs are largely limited to village housing units and, thus, the construction noise criteria is 75 dB(A). However, LT1 and LT2, as detailed in Table 5.1, represent the Luen On San Tsuen School and kindergarten respectively and the standards of 70dB(A) during normal hours and 65dB(A) during exam periods are relevant. The noise levels at each of the representative NSRs shown in Drawings 4.1a-h have been assessed based on the methodology specified in BS 5228. The unmitigated noise levels predicted during pumping station construction are presented in Table 5.4 below:

Table 5.4: Predicted Unmitigated Noise Levels from Pumping Station Construction

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	114.1	115.0	112.0	105.0	114.0
C1	27 m	80	81	78	71	80
C2	38 m	78	78	75	68	77
C3	300 m	60	60	57	50	59
TC1	26 m	81	82	79	72	81
TC2	40 m	77	78	75	68	77
TC3	54 m	74	75	72	65	74
TC4	62 m	73	74	71	64	73
TC5	81 m	71	72	69	62	71
TC6	87 m	70	71	68	61	70
TC7	124 m	67	68	65	58	67
TC8	148 m	66	67	64	57	66
TC9	102 m	69	70	67	60	69
TC10	83 m	71	72	69	62	71
TC11	135 m	66	67	64	57	66
TC12	200 m	63	64	61	54	63
TC13	114 m	68	69	66	59	68
TC14	123 m	67	68	65	58	67
TC15	32 m	79	80	77	70	79
TC16	87 m	70	71	68	61	70
TC17	57 m	74	75	72	65	74
TC18	120 m	68	68	65	58	67
TC19	172 m	64	65	62	55	64
TC20	200 m	63	64	61	54	63
TC21	18 m	84	85	82	75	84
LC1	140 m	66	67	64	57	66

Table 5.4 Cont'd.....

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	114.1	115.0	112.0	105.0	114.0
LC2	120 m	68	68	65	58	67
LC3	105 m	69	70	67	60	69
LC4	125 m	67	68	65	58	67
LC5	65 m	73	74	71	64	73
LC6	20 m	83	84	81	74	83
LC7	23 m	82	83	80	73	82
LC8	48 m	75	76	73	66	75
LC9	58 m	74	75	72	65	74
LC10	113 m	68	69	66	59	68
LC11	150 m	66	66	63	56	65
LC12	152 m	65	66	63	56	65
LC13	125 m	67	68	65	58	67
LT1(1)	42 m	77	78	75	68	77
LT2(2)	22 m	82	83	80	73	82
LT3	72 m	72	73	70	63	72
LT4	47 m	76	77	74	67	76
LT5	60 m	74	74	71	64	73
LT6	73 m	72	73	70	63	72
LT7	133 m	67	68	65	58	67
LT8	153 m	65	66	63	56	65
WU1	234 m	62	63	60	53	62
WU2	214 m	62	63	60	53	62
WU3	184 m	64	65	62	55	64
WK1	183 m	64	65	62	55	64
WK2	172 m	64	65	62	55	64
WK3	200 m	63	64	61	54	63
WK4	154 m	65	66	63	56	65
P1	300 m	60	60	57	50	59
P2	300 m	60	60	57	50	59
P3	300 m	60	60	57	50	59
ST1	155 m	65	66	63	56	65
ST2	175 m	64	65	62	55	64
ST3	175 m	64	65	62	55	64
ST4	145 m	66	67	64	57	66
ST5	172 m	64	65	62	55	64
ST6	165 m	65	66	63	56	65
ST7	202 m	63	64	61	54	63
ST8	250 m	61	62	59	52	61

Table 5.4 Cont'd.....

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	114.1	115.0	112.0	105.0	114.0
ST9	270 m	60	61	58	51	60
ST10	280 m	60	61	58	51	60
ST11	250 m	61	62	59	52	61
ST12	282 m	60	61	58	51	60
ST13	300 m	60	60	57	50	59
ST14	300 m	60	60	57	50	59
ST15	300 m	60	60	57	50	59
ST16	300 m	60	60	57	50	59
ST17	300 m	60	60	57	50	59
ST18	20 m	83	84	81	74	83
SS1	300 m	60	60	57	50	59
SS2	300 m	60	60	57	50	59
SS3	300 m	60	60	57	50	59
SS4	300 m	60	60	57	50	59
SS5	300 m	60	60	57	50	59

Notes: (1): Represents school
(2): Represents kindergarten
Denotes exceedance of Noise Criteria

5.5.3 The above results show that village properties greater than 50m away from the works will not be subject to noise levels above the standards during the pumping station construction. No exceedances are predicted during the use of the compactor either, with the exception of the kindergarten (LT2) where the 70 dB(A) standard is marginally exceeded. In total, construction of the pumping stations have the potential to create adverse daytime noise impacts at 13 representative NSRs, as follows:

- C1 as a result of works for the Tai Lam Correctional Institution Pumping Station;
- TC1, TC2, TC15 which are closest to the Tai Lam Chung Pumping Station;
- TC21 which is adjacent to the proposed Tai Lam Valley Pumping Station site;
- LC6, LC7 and LC8, residential properties of Tsing Lai Wan Villas which are adjacent to the Castle Peak Villas Pumping Station;
- LT1, LT2, LT4 and C2 in Luen On San Tsuen, the first two representing the school and kindergarten; and
- ST18, a residential property adjacent to the proposed So Kwun Wat Tsuen Pumping Station.

5.5.4 Thus, mitigation measures will be required for these closer NSRs during concrete breaking, excavation, building fabrication and concrete laying and also at the kindergarten for earth compaction where the noise criteria will be exceeded, as indicated by the shaded boxes in

Table 5.4. Recommended mitigation measures include the use of temporary noise barriers, silencers on equipment and the use of mufflers, as detailed in Section 5.7 below.

5.6 Sewer Alignment Construction Noise Impacts

5.6.1 Construction of the main sewers will involve similar works as for the pumping stations, along with additional equipment for paving works. Work in the villages, however, will be largely completed by hand but with some equipment required to break the concrete and compact the soil after infilling of the trenches. The sound power levels of the equipment expected to be used for the main sewers and village sewers construction are provided in Table 5.5 below.

Table 5.5: Sound Power Level (SWL) of Equipment Assumed for Main Sewer and Village Sewer Construction

Scenario	Equipment	Technical Memorandum ID	No. of Equipment	SWL per item	Total SWL (by scenario)
Main Sewer Construction					
Concrete / Asphalt Breaking	Hand held Breaker	CNP025	2	111	114
	Air Compressor	n/a(1)	1	95	
Sewer Trench Excavation	Excavator	CNP081	1	112	115
	Lorry	CNP141	1	112	
Earth Compaction	Compactor	CNP050	1	105	105
Sewer Pipe Installation	Crane	CNP048	1	112	112
Concrete Laying	Concrete Lorry Mixer	CNP044	1	109	109
Paving	Asphalt paver	CNP004	1	109	109
Village Sewer Construction					
Concrete / Asphalt Breaking	Hand held Breaker	CNP025	1	111	111
	Air Compressor	n/a(1)	1	95	
Earth Compaction	Compactor	CNP050	1	105	105

Note: (1): BS 5228 (1997) Part 1, Table C.7, Item 24

5.6.2 A summary of the distance of the representative NSRs from the sewer works and which NSRs are relevant to the main and village sewer laying works is provided in Table 5.6 below.

Table 5.6 Summary of Representative NSRs Potentially Affected by Main and Village Sewer Alignment Construction

Noise Sensitive Receiver	Distance of NSR to Main Sewer Alignment Works (m)	Distance of NSR to Village Sewer Alignment Works (m)
C1	26 m	-
C2	28 m	-
C3	43 m	-
TC1	22 m	3 m
TC2	35 m	3 m
TC3	-	5 m
TC4	-	1 m
TC5	-	1 m
TC6	-	1 m
TC7	-	1 m
TC8	-	4 m
TC9	-	1 m
TC10	-	1 m
TC11	-	6 m
TC12	-	1 m
TC13	-	4 m
TC14	-	4 m
TC15	20 m	-
TC16	-	3 m
TC17	12 m	1 m
TC18	26 m	-
TC19	12 m	-
TC20	12 m	-
TC21	14 m	-
LC1	8 m	-
LC2	12 m	-
LC3	13 m	-
LC4	8 m	-
LC5	15 m	-
LC6	15 m	-
LC7	20 m	-
LC8	5 m	-
LC9	48 m	-
LC10	29 m	-
LC11	28 m	-
LC12	28 m	-
LC13	5 m	-
LT1[(1)]	5 m	-
LT2[(2)]	6 m	-
LT3	5 m	-
LT4	10 m	-

Table 5.6 Cont'd.....

Noise Sensitive Receiver	Distance of NSR to Main Sewer Alignment Works (m)	Distance of NSR to Village Sewer Alignment Works (m)
LT5	-	5 m
LT6	-	4 m
LT7	-	3 m
LT8	-	10 m
WU1	-	1 m
WU2	-	1 m
WU3	-	4 m
WK1	-	3 m
WK2	-	1 m
WK3	-	7 m
WK4	-	3 m
P1	117 m	-
P2	112 m	-
P3	140 m	-
ST1	-	2 m
ST2	-	1 m
ST3	-	4 m
ST4	-	4 m
ST5	-	1 m
ST6	-	4 m
ST7	-	1 m
ST8	-	1 m
ST9	-	4 m
ST10	-	2 m
ST11	-	2 m
ST12	-	2 m
ST13	-	2 m
ST14	-	2 m
ST15	-	2 m
ST16	-	4 m
ST17	-	3 m
ST18	-	10 m
SS1	-	2 m
SS2	-	1 m
SS3	-	1 m
SS4	-	4 m
SS5	-	3 m

Notes: (1): Represents school
(2): Represents kindergarten

5.6.3 The potential unmitigated noise impacts at the representative NSRs, based upon the use of the equipment in Table 5.5 above, are given in Tables 5.7 and 5.8 for the main and village sewers respectively.

Table 5.7: Predicted Unmitigated Noise Levels from Main Sewer Construction

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	114.1	115.0	105.0	112.0	109.0	109.0
C1	26 m	81	82	72	79	76	76
C2	28 m	80	81	71	78	75	75
C3	43 m	76	77	67	74	71	71
TC1	22 m	82	83	73	80	77	77
TC2	35 m	78	79	69	76	73	73
TC3	-	-	-	-	-	-	-
TC4	-	-	-	-	-	-	-
TC5	-	-	-	-	-	-	-
TC6	-	-	-	-	-	-	-
TC7	-	-	-	-	-	-	-
TC8	-	-	-	-	-	-	-
TC9	-	-	-	-	-	-	-
TC10	-	-	-	-	-	-	-
TC11	-	-	-	-	-	-	-
TC12	-	-	-	-	-	-	-
TC13	-	-	-	-	-	-	-
TC14	-	-	-	-	-	-	-
TC15	20 m	83	84	74	81	78	78
TC16	-	-	-	-	-	-	-
TC17	12 m	88	88	78	85	82	82
TC18	26 m	81	82	72	79	76	76
TC19	12 m	88	88	78	85	82	82
TC20	12 m	88	88	78	85	82	82
TC21	14 m	86	87	77	84	81	81
LC1	8 m	91	92	82	89	86	86
LC2	12 m	88	88	78	85	82	82
LC3	13 m	87	88	78	85	82	82
LC4	8 m	91	92	82	89	86	86
LC5	15 m	86	86	76	83	80	80
LC6	15 m	86	86	76	83	80	80
LC7	20 m	83	84	74	81	78	78
LC8	5 m	95	96	86	93	90	90
LC9	48 m	75	76	66	73	70	70
LC10	29 m	80	81	71	78	75	75
LC11	28 m	80	81	71	78	75	75
LC12	28 m	80	81	71	78	75	75
LC13	5 m	95	96	86	93	90	90

Table 5.7 Cont'd...

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	114.1	115.0	105.0	112.0	109.0	109.0
LT1(1)	5 m	95	96	86	93	90	90
LT2(2)	6 m	94	94	84	91	88	88
LT3	5 m	95	96	86	93	90	90
LT4	10 m	89	90	80	87	84	84
LT5	-	-	-	-	-	-	-
LT6	-	-	-	-	-	-	-
LT7	-	-	-	-	-	-	-
LT8	-	-	-	-	-	-	-
WU1	-	-	-	-	-	-	-
WU2	-	-	-	-	-	-	-
WU3	-	-	-	-	-	-	-
WK1	-	-	-	-	-	-	-
WK2	-	-	-	-	-	-	-
WK3	-	-	-	-	-	-	-
WK4	-	-	-	-	-	-	-
P1	117 m	68	69	59	66	63	63
P2	112 m	68	69	59	66	63	63
P3	140 m	66	67	57	64	61	61
ST1	-	-	-	-	-	-	-
ST2	-	-	-	-	-	-	-
ST3	-	-	-	-	-	-	-
ST4	-	-	-	-	-	-	-
ST5	-	-	-	-	-	-	-
ST6	-	-	-	-	-	-	-
ST7	-	-	-	-	-	-	-
ST8	-	-	-	-	-	-	-
ST9	-	-	-	-	-	-	-
ST10	-	-	-	-	-	-	-
ST11	-	-	-	-	-	-	-
ST12	-	-	-	-	-	-	-
ST13	-	-	-	-	-	-	-
ST14	-	-	-	-	-	-	-
ST15	-	-	-	-	-	-	-
ST16	-	-	-	-	-	-	-
ST17	-	-	-	-	-	-	-
ST18	-	-	-	-	-	-	-
SS1	-	-	-	-	-	-	-

Table 5.7 Cont'd...

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	114.1	115.0	105.0	112.0	109.0	109.0
SS2	-	-	-	-	-	-	-
SS3	-	-	-	-	-	-	-
SS4	-	-	-	-	-	-	-
SS5	-	-	-	-	-	-	-

Note (1): Represents school
(2): Represents kindergarten
'-' not applicable - see Table 5.6
Denotes exceedance of Noise Criteria

Table 5.8: Predicted Unmitigated Noise Levels from Village Sewer Construction

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)	
		Concrete Breaking	Earth Compaction
	SWL	111.1	105.0
C1	-	-	-
C2	-	-	-
C3	-	-	-
TC1	3 m	97	90
TC2	3 m	97	90
TC3	5 m	92	86
TC4	1 m	106	100
TC5	1 m	106	100
TC6	1 m	106	100
TC7	1 m	106	100
TC8	4 m	94	88
TC9	1 m	106	100
TC10	1 m	106	100
TC11	6 m	91	84
TC12	1 m	106	100
TC13	4 m	94	88
TC14	4 m	94	88
TC15	-	-	-
TC16	3 m	97	90
TC17	1 m	106	100

Table 5.8 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)	
		Concrete Breaking	Earth Compaction
	SWL	111.1	105.0
TC18	-	-	-
TC19	-	-	-
TC20	-	-	-
TC21	-	-	-
LC1	-	-	-
LC2	-	-	-
LC3	-	-	-
LC4	-	-	-
LC5	-	-	-
LC6	-	-	-
LC7	-	-	-
LC8	-	-	-
LC9	-	-	-
LC10	-	-	-
LC11	-	-	-
LC12	-	-	-
LC13	-	-	-
LT1	-	-	-
LT2	-	-	-
LT3	-	-	-
LT4	-	-	-
LT5	5 m	92	86
LT6	4 m	94	88
LT7	3 m	97	90
LT8	10 m	86	80
WU1	1 m	106	100
WU2	1 m	106	100
WU3	4 m	94	88
WK1	3 m	97	90
WK2	1 m	106	100
WK3	7 m	89	83
WK4	3 m	97	90
P1	-	-	-
P2	-	-	-
P3	-	-	-
ST1	2 m	100	94
ST2	1 m	106	100
ST3	4 m	94	88
ST4	4 m	94	88

Table 5.8 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Unmitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)	
		Concrete Breaking	Earth Compaction
	SWL	111.1	105.0
ST5	1 m	106	100
ST6	4 m	94	88
ST7	1 m	106	100
ST8	1 m	106	100
ST9	4 m	94	88
ST10	2 m	100	94
ST11	2 m	100	94
ST12	2 m	100	94
ST13	2 m	100	94
ST14	2 m	100	94
ST15	2 m	100	94
ST16	4 m	94	88
ST17	3 m	97	90
ST18	10 m	86	80
SS1	2 m	100	94
SS2	1 m	106	100
SS3	1 m	106	100
SS4	4 m	94	88
SS5	3 m	97	90

Note '-' not applicable - see Table 5.6

Denotes exceedance of Noise Criteria

5.6.4 Based upon the above predictions, due to the proximity of the NSRs to the proposed works, the majority of sensitive receivers would be exposed to noise levels in excess of the 75 dB(A) standard for the residential properties and 70 dB(A) for the school and kindergarten, with some minor exceptions for NSRs further away. All the NSRs affected by the sewer laying works in the villages are very close, being generally within about 5m of the proposed works and thus, exceedances occur in all cases. Thus, mitigation measures will be required during the laying of both the main and village sewer alignments.

5.7 Pumping Stations Construction Mitigation Measures

5.7.1 As detailed in Table 5.5, most activities for the construction of the pumping stations have the potential to create adverse daytime noise impacts at 13 representative NSRs and, therefore, mitigation measures in these locations will be required during the construction phase. The following forms of mitigation are assumed during the calculation of residual noise levels and are recommended for incorporation into the Contract Specifications.

(i) ensure that silencers are installed on the exhaust pipes of the trucks, excavators,

compactors, concrete lorry mixers and cranes to reduce the noise levels during site formation, foundation excavation, building fabrication, compaction and concrete laying by 5dB(A);

(ii) the sound power of the breaker should be restricted to 109dB(A). The Contractor can achieve this by checking the Noise Emission Label of the breaker, issued by the Hong Kong Environmental Protection Department. Models available in Hong Kong have been checked and it has been confirmed that some breakers can meet this standard. For example the, 'Atlas Copco' model 'TEX22PS' can achieve such restriction and dealers are available in Hong Kong; and

(iii) temporary noise barriers should be constructed around the site boundary of the proposed pumping stations such that the equipment for all construction scenarios will be totally screened from the NSRs. With the exception of a small gap for access purposes, the barriers should have no openings or gaps. The access should be positioned to face away from NSRs as far as possible but if this is not possible additional smaller barriers should be used to screen individual pieces of equipment. Based upon this, attenuation of 10dB(A) can be achieved.

5.7.2 The maximum noise levels at each of the NSRs during the construction phase of the pumping stations with the above noise mitigation measures applied are shown in Table 5.9 below. It should be noted that while the majority of NSRs are some distance away and do not require mitigation, the mitigation applied for the protection of the closer properties will also benefit the other NSRs and as such the mitigated levels for all NSRs have been provided in the following table.

Table 5.9: Predicted Noise Level from Pumping Station Construction at Representative NSRs after Mitigation

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	112.1	110.0	107.0	100.0	112.6
C1	27 m	68	66	63	56	69
C2	38 m	65	63	60	53	66
C3	300 m	47	45	42	35	49
TC1	26 m	69	67	64	57	70
TC2	40 m	65	63	60	53	66
TC3	54 m	62	60	57	50	63
TC4	62 m	61	59	56	49	62
TC5	81 m	59	57	54	47	60
TC6	87 m	58	56	53	46	59
TC7	124 m	55	53	50	43	56
TC8	148 m	54	52	49	42	55

Table 5.9 Cont'd....

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	112.1	110.0	107.0	100.0	112.6
TC9	102 m	57	55	52	45	58
TC10	83 m	59	57	54	47	60
TC11	135 m	54	52	49	42	55
TC12	200 m	51	49	46	39	52
TC13	114 m	56	54	51	44	57
TC14	123 m	55	53	50	43	56
TC15	32 m	67	65	62	55	68
TC16	87 m	58	56	53	46	59
TC17	57 m	62	60	57	50	63
TC18	120 m	55	53	50	43	56
TC19	172 m	52	50	47	40	53
TC20	200 m	51	49	46	39	52
TC21	18 m	72	70	67	60	73
LC1	140 m	54	52	49	42	55
LC2	120 m	55	53	50	43	56
LC3	105 m	57	55	52	45	58
LC4	125 m	55	53	50	43	56
LC5	65 m	61	59	56	49	62
LC6	20 m	71	69	66	59	72
LC7	23 m	70	68	65	58	71
LC8	48 m	63	61	58	51	63
LC9	58 m	62	60	57	50	63
LC10	113 m	56	54	51	44	57
LC11	150 m	53	51	48	41	54
LC12	152 m	53	51	48	41	54
LC13	125 m	55	53	50	43	56
LT1[(1)]	42 m	65	63	60	53	66
LT2[(2)]	22 m	70	68	65	58	71
LT3	72 m	60	58	55	48	61
LT4	47 m	64	62	59	52	65
LT5	60 m	61	59	56	49	62
LT6	73 m	60	58	55	48	61
LT7	133 m	55	53	50	43	56
LT8	153 m	53	51	48	41	54
WU1	234 m	50	48	49	38	51
WU2	214 m	50	48	49	38	51
WU3	184 m	52	50	47	40	53
WK1	183 m	52	50	47	40	53

Noise Sensitive Receiver	Distance from Pumping Station to NSR	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)				
		Concrete Breaking	Excavation	Building Fabrication	Earth Compaction	Concrete Laying
	SWL	112.1	110.0	107.0	100.0	112.6
WK2	172 m	52	50	47	40	53
WK3	200 m	51	49	46	39	52
WK4	154 m	53	51	48	41	54
P1	300 m	47	45	42	35	48
P2	300 m	47	45	42	35	48
P3	300 m	47	45	42	35	48
ST1	155 m	53	51	48	41	54
ST2	175 m	52	50	47	40	53
ST3	175 m	52	50	47	40	53
ST4	145 m	54	52	49	42	55
ST5	172 m	52	50	47	40	53
ST6	165 m	53	51	48	41	54
ST7	202 m	51	49	46	39	52
ST8	250 m	49	47	44	37	50
ST9	270 m	48	46	43	36	49
ST10	280 m	48	46	43	36	49
ST11	250 m	49	47	44	37	50
ST12	282 m	48	46	43	36	49
ST13	300 m	47	45	42	35	49
ST14	300 m	47	45	42	35	49
ST15	300 m	47	45	42	35	49
ST16	300 m	47	45	42	35	49
ST17	300 m	47	45	42	35	49
ST18	20 m	71	69	66	59	72
SS1	300 m	47	45	42	35	49
SS2	300 m	47	45	42	35	49
SS3	300 m	47	45	42	35	49
SS4	300 m	47	45	42	35	49
SS5	300 m	47	45	42	35	49

Note (1): Represents school
(2): Represents kindergarten
Denotes exceedance of Noise Criteria

5.7.3 With the mitigation applied, the noise levels at all residential NSRs would meet the 75 dB(A) limit during the construction of the pumping stations. The mitigated levels in Luen On San Tsuen would also be sufficient to meet the 70dB(A) criteria for both the kindergarten and the school, with the exception of the use of the vibratory pokers and the concrete mixer during concrete laying which would exceed this limit for the kindergarten. While, the use of this equipment will be short term, in order to avoid residual impacts, it is recommended that this

activity be scheduled to be undertaken outside normal kindergarten hours.

5.7.4 The noise criteria for exam periods at these educational premises is 65 dB(A) and the mitigated results in Table 5.9 show that Scenarios 1, 2 and 5 will exceed this level for the kindergarten, as indicated by the shaded boxes for LT2. Use of the vibratory pokers and the concrete lorry mixer during exam periods at the school (LT1) would also result in an exceedance of the 65dB(A) standard. Therefore, it is recommended that these construction activities are scheduled outside any exam periods at the kindergarten or school in Luen On San Tsuen.

5.7.5 Based upon the implementation of the recommended mitigation measures, all noise levels can be reduced to acceptable levels during pumping station construction and residual impacts are not predicted.

5.8 Main Sewer Alignment Construction Mitigation Measures

5.8.1 The potential noise impacts from the construction of the main sewer alignments can be reduced by the use of the following mitigation measures:

(i) ensure that silencers are installed on the exhaust pipes of the trucks, excavators, compactors, concrete lorry mixers and cranes to reduce the noise levels during site formation, foundation excavation, building fabrication, compaction and concrete laying by 5dB(A);

(ii) the sound power of the breaker should be restricted to 109dB(A). The Contractor can achieve this by checking the Noise Emission Label of the breaker, issued by the Hong Kong Environmental Protection Department. Models available in Hong Kong have been checked and it has been confirmed that some breakers can meet this standard. For example, the 'Atlas Copco' model 'TEX22PS' can achieve such restriction and dealers are available in Hong Kong; and

(iii) temporary noise barriers, where a clearance of at least 5m, including pedestrian access, is available, for an attenuation of 10dB(A).

5.8.2 The use of temporary noise barriers in this case, where the designated space permits, would have to be of sufficient length to screen 'mobile' equipment, such as the excavator and the lorry. It is anticipated that this equipment would either be stationary or the normal movements required during excavation and loading operations would be relatively confined and could be adequately screened. Mitigated noise levels from main sewer construction at representative NSRs are given in Table 5.10 and the noise modelling results provided in full in Appendix B. It should be noted that while some of NSRs are some distance away and do not require mitigation, the mitigation applied for the protection of the closer properties will also benefit the other NSRs and as such the mitigated levels for all NSRs have been provided in the following table.

Table 5.10: Mitigated Noise Levels at Representative NSRs during Main Sewer Construction

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	112.1	110.0	105.0	107.0	104.0	109.0
C1	26 m	69	67	62	64	61	66
C2	28 m	68	66	61	63	60	65
C3	43 m	64	62	57	59	56	61
TC1	22 m	70	68	63	65	62	67
TC2	35 m	66	64	59	61	58	63
TC3	-	-	-	-	-	-	-
TC4	-	-	-	-	-	-	-
TC5	-	-	-	-	-	-	-
TC6	-	-	-	-	-	-	-
TC7	-	-	-	-	-	-	-
TC8	-	-	-	-	-	-	-
TC9	-	-	-	-	-	-	-
TC10	-	-	-	-	-	-	-
TC11	-	-	-	-	-	-	-
TC12	-	-	-	-	-	-	-
TC13	-	-	-	-	-	-	-
TC14	-	-	-	-	-	-	-
TC15	20 m	71	69	64	66	63	68
TC16	-	-	-	-	-	-	-
TC17	12 m	75	73	68	70	67	72
TC18	26 m	69	67	62	64	61	66
TC19	12 m	75	73	68	70	67	72
TC20	12 m	75	73	68	70	67	72
TC21	14 m	74	72	67	69	66	71
LC1	8 m	79	77	72	74	71	76
LC2	12 m	75	73	68	70	67	72
LC3	13 m	75	73	68	70	67	72
LC4	8 m	79	77	72	74	71	76
LC5	15 m	73	71	66	68	65	70
LC6	15 m	73	71	66	68	65	70
LC7	20 m	71	69	64	66	63	68
LC8	5 m	83	81	76	78	75	80
LC9	48 m	63	61	56	58	55	60
LC10	29 m	68	66	61	63	60	65
LC11	28 m	68	66	61	63	60	65
LC12	28 m	68	66	61	63	60	65

Table 5.10 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	112.1	110.0	105.0	107.0	104.0	109.0
LC13	5 m	83	81	76	78	75	80
LT1(1)	5 m	83	81	76	78	75	80
LT2(2)	6 m	81	79	74	76	73	78
LT3	5 m	83	81	76	78	75	80
LT4	10 m	77	75	70	72	69	74
LT5	-	-	-	-	-	-	-
LT6	-	-	-	-	-	-	-
LT7	-	-	-	-	-	-	-
LT8	-	-	-	-	-	-	-
WU1	-	-	-	-	-	-	-
WU2	-	-	-	-	-	-	-
WU3	-	-	-	-	-	-	-
WK1	-	-	-	-	-	-	-
WK2	-	-	-	-	-	-	-
WK3	-	-	-	-	-	-	-
WK4	-	-	-	-	-	-	-
P1	117 m	56	54	49	51	48	53
P2	112 m	56	54	49	51	48	53
P3	140 m	54	52	47	49	46	51
ST1	-	-	-	-	-	-	-
ST2	-	-	-	-	-	-	-
ST3	-	-	-	-	-	-	-
ST4	-	-	-	-	-	-	-
ST5	-	-	-	-	-	-	-
ST6	-	-	-	-	-	-	-
ST7	-	-	-	-	-	-	-
ST8	-	-	-	-	-	-	-
ST9	-	-	-	-	-	-	-
ST10	-	-	-	-	-	-	-
ST11	-	-	-	-	-	-	-
ST12	-	-	-	-	-	-	-
ST13	-	-	-	-	-	-	-
ST14	-	-	-	-	-	-	-
ST15	-	-	-	-	-	-	-
ST16	-	-	-	-	-	-	-
ST17	-	-	-	-	-	-	-
ST18	-	-	-	-	-	-	-
SS1	-	-	-	-	-	-	-

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
	SWL	112.1	110.0	105.0	107.0	104.0	109.0
SS2	-	-	-	-	-	-	-
SS3	-	-	-	-	-	-	-
SS4	-	-	-	-	-	-	-
SS5	-	-	-	-	-	-	-

Note (1): Represents school
(2): Represents kindergarten
'-' not applicable - see Table 5.6
Denotes exceedance of Noise Criteria

5.8.3 The result for the main sewer alignments show that, with the mitigation specified in Section 5.8.1 applied, the noise levels at the majority of NSRs can be reduced to acceptable levels. However, some of the sensitive receivers, which are particularly close to the proposed works in Lok Chui Street and in Luen On San Tsuen, will remain above the criteria. The eight representative properties where exceedances remain are detailed below and comprise largely residential properties but also include the school and kindergarten in Luen On San Tsuen.

Lok Chui Street

- LC1 : exceedances of 1-4 dB(A) during all activities except during compaction, concrete laying and sewer pipe installation;
- LC4 : all activities except during compaction, concrete laying and sewer pipe installation with 1-4 dB(A) exceedances;
- LC8 : all activities except concrete laying with 1-5 dB(A) exceedances; and
- LC13: all activities except concrete laying with 1-5 dB(A) exceedances.

Luen On San Tsuen

- LT1 : all activities at the school with 6-11 dB(A) exceedances above the 70 dB(A) standard;
- LT2 : all activities at the kindergarten with 6-11 dB(A) exceedances above the 70 dB(A) standard;
- LT3 : all activities except concrete laying with 1-8 dB(A) exceedances; and
- LT4 : marginal 2 dB(A) exceedance during breaker use only.

5.8.4 Thus, additional mitigation measures to further reduce the noise levels at these locations and during these activities will be required.

5.8.5 It will be the responsibility of the Contractor, in agreement with the Engineer's Representative, the Independent Checker (Environmental) and the Environmental Specialist as the leader of the Environmental Team, to determine the means by which the noise levels are further reduced,

taking into account the on-site conditions and programming and to demonstrate that noise levels are within acceptable levels. However, further mitigation options and the attenuation afforded by their implementation are investigated below.

5.8.6 The possible mitigation measures to further reduce noise levels could include:

(i) manual working for concrete breaking and excavation works, relevant to concrete breaking and sewer trench excavation only;

(ii) use of alternative pavement removal methods/equipment to replace the use of the breaker only;

(iii) use of an acoustic enclosure in place of a barrier, where practicable, to screen the breaker and the compactor, with other equipment being too large to use within an enclosure; and

(iv) scheduling the operating times of equipment, relevant to all activities.

5.8.7 The most effective method that may be used to reduce noise is the manual breaking of concrete and manual excavation which will negate the need for any mechanical equipment during these activities with the exception of a lorry for the collection and transportation of excavated material. In the case of manual concrete breaking, all noise levels would be reduced to well within the noise criteria for both residential properties and educational facilities alike. However, this method is only possible where the concrete is less than 50mm and also has programming and manpower constraints. In addition, breaking concrete by hand would mean that the work would take several times longer than with the breaker which could prolong any disruption to local residents.

5.8.8 Manual excavation would reduce the overall noise levels by 3 dB(A) but will be subject to the same programming and manpower constraints. Notwithstanding, it is recommended that manual breaking and excavation should be used wherever practicable in areas where noise exceedances have been predicted.

5.8.9 Where manual methods cannot be used, alternative mitigation measures may include:

C use of alternative pavement removal methods/equipment. The kick ripper (saw and lift) method of pavement removal can reduce the noise level by in the region of 7-9 dB(A) in comparison to the breaker but could be slightly slower and is only applicable where the pavement to be removed is less than 100mm thick.

The use of controlled explosives and the use of chemical agents for pavement removal have been considered. However, the use of explosives has disadvantages in terms of safety, damage to foundations and utilities and the use of chemical agents also has limitations in respect of the integrity of foundations and possible soil contamination. In light of the proximity of structures and residents, neither of these methods are recommended and are not considered further;

- use of an acoustic enclosure in place of a barrier where there is at least a 6m clearance. Enclosures can give a noise attenuation of up to 15-25 dB(A) in accordance with Part (iv) of EPD's Summary on Quiet Equipment. A typical noise enclosure can be seen in Drawing 5.1. Any enclosure used should have a mass per unit of surface area of at least 7kg/m^2 and an acoustic lining. For the purposes of assessing the benefit of this method, an attenuation of 20 dB(A) is assumed; and

- scheduling the operating times of equipment. It may be possible through the Contractor's working practices to limit the operational time of certain activities and equipment. In order to provide an evaluation of the potential noise attenuation benefits of this approach, a reduction of the operating time of the breaker by 15 minutes in any 30 minutes period, providing a noise reduction of 3 dB(A), has been assumed.

5.8.10 The noise levels at each of the NSRs subject to residual impacts from the main sewer construction for each of these additional mitigation options are given below in Table 5.11. The additional attenuation from these further mitigation scenarios have been taken from the mitigated levels detailed in Table 5.10 in order to provide the results provided below.

Table 5.11 Predicted Noise Levels for Different Mitigation Scenarios during Main Sewer Construction

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
Manual Breaking and Excavation (Concrete Breaking and Trench Excavation only)							
LC1	8 m	-	74	*72*	*74*	*71*	*76*
LC4	8 m	-	74	*72*	*74*	*71*	*76*
LC8	5 m	-	78	*76*	*78*	*75*	*80*
LC13	5 m	-	78	*76*	*78*	*75*	*80*
LT1	5 m	-	78	*76*	*78*	*75*	*80*
LT2	6 m	-	76	*74*	*76*	*73*	*78*
LT3	5 m	-	78	*76*	*78*	*75*	*80*
LT4	10 m	-	75	*70*	*72*	*69*	*74*

Table 5.11 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Main Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)					
		Concrete Breaking	Sewer Trench Excavation	Compaction	Sewer Pipe Installation	Concrete Laying	Paving
Use of Kick Ripper in place of Breaker							
LC1	8 m	72	*77*	*72*	*74*	*71*	*76*
LC4	8 m	72	*77*	*72*	*74*	*71*	*76*
LC8	5 m	76	*81*	*76*	*78*	*75*	*80*
LC13	5 m	76	*81*	*76*	*78*	*75*	*80*
LT1	5 m	76	*81*	*76*	*78*	*75*	*80*
LT2	6 m	75	*79*	*74*	*76*	*73*	*78*
LT3	5 m	76	*81*	*76*	*78*	*75*	*80*
LT4	10 m	73	*75*	*70*	*72*	*69*	*74*
Use of Acoustic Enclosure (for Concrete Breaking and Compaction only)							
LC1	8 m	66	*77*	72	*74*	*71*	*76*
LC4	8 m	66	*77*	72	*74*	*71*	*76*
LC8	5 m	70	*81*	66	*78*	*75*	*80*
LC13	5 m	70	*81*	66	*78*	*75*	*80*
LT1	5 m	70	*81*	66	*78*	*75*	*80*
LT2	6 m	69	*79*	64	*76*	*73*	*78*
LT3	5 m	70	*81*	66	*78*	*75*	*80*
LT4	10 m	67	*75*	70	*72*	*69*	*74*
Scheduling of Operating Times (All activities)							
LC1	8 m	76	74	72	74(2)	71(2)	73
LC4	8 m	76	74	72	74(2)	71(2)	73
LC8	5 m	80	78	73	75	75	77
LC13	5 m	80	78	73	75	75	77
LT1	5 m	80	78	73	75	75	77
LT2	6 m	80	79	74	76	73	78
LT3	5 m	80	78	73	75	75	77
LT4	10 m	74	75(1)	70(1)	72(2)	69	74

Note: Values in *italics* indicate noise levels have not changed and no additional attenuation has been provided by the mitigation scenario.

(1) mitigation provided by noise barrier and/or silenced breaker and no further mitigation required.

(2) mitigation provided by use of silencer on crane and no further mitigation required.

5.8.11 In addition, noise levels can be further controlled by the following methods:

- the construction activities should be carried out in the daytime period (08.00-18.00) only and shall exclude Sundays and public holidays;
- powered mechanical equipment shall not be used within 5m of an NSR without the

permission of the Engineer's Representative;

- good site practice to limit noise emission at source; and
- avoidance of simultaneous noisy activities.

5.8.12 Based upon the examples provided above, it can be seen that noise levels can be reduced further and based upon a combination of mitigation measures, compliance with the noise standards should be achievable in most cases. The acoustic enclosure provides the most effective single measure for two of the construction scenarios and thus, it is recommended that this method be used where space permits. Notwithstanding, the Contractor shall use all practicable means to minimise noise levels. However, it is possible that, in the worst case, residual impacts could occur during any of the activities, particularly at the school and kindergarten in Luen On San Tsuen.

5.8.13 All the construction activities will be of short duration at any one location. The concrete breaking activities are expected to influence any one sensitive receiver for a period of approximately 1-2 hours only before the activity is far enough away for sufficient distance attenuation to reduce the noise to within the acceptable levels. Excavation works could continue intermittently over the period of one day but would also be on-going for only 1-2 hours at one go. Compaction is applied to relatively thin layer of material in the region of 300mm thick, and as such the use of the compactor would be intermittent, stopping frequently as a fresh layer of material is added to the trench. The works, however, would go on for less than a day with continuous operation for less than an hour at any one time. Crane and lorry operation will be short and infrequent and anticipated to last no longer then half and hour. In respect of the asphalt paver, a long stretch of road or pavement can be treated in a short space of time and it is anticipated that works in any one location could be completed in 1-2 hours.

5.8.14 The construction of the sewer alignment is an integral element of the works and cannot be avoided. However, based upon the limited number of properties potentially affected by residual impacts for the main sewer works and the short duration of these impacts should they occur, it is considered that the residual impacts would be acceptable within the overall environmental benefits of the scheme as discussed in Section 2 of this report.

5.8.15 Notwithstanding, it is recommended that works adjacent to the Luen On San Tsuen school and kindergarten (LT1 and LT2) should be scheduled outside the normal school hours when noise levels cannot be reduced to within the standards by other means and not within exam periods.

5.9 Village Sewer Alignment Construction Mitigation Measures

5.9.1 Within the villages, works using mechanical equipment are limited to concrete breaking and compacting and only properties facing these will be affected by the elevated noise levels, with residents behind being largely screened. A large proportion of the village houses, however, will be within 5 m of the trenches that will have to be constructed. The application of the alternative breaker with lower noise level, as detailed in Section 5.8.1 for the main sewers, is recommended but this will only reduce the noise during concrete breaking by 2 dB(A). The silenced compactor is also recommended but this will reduce levels by 5dB(A).

5.9.2 While the use of a temporary barrier is recommended, due to space constraints in some locations posed by the width of the lanes and protruding structures such as air conditioners, the use of a barrier within the alleyways of the villages may not be possible and this will need to be determined by the Contractor when on site. However, in most cases, the barrier can be introduced between the construction site and the facade of the house since the breaking would not be immediately adjacent to or on the front facade. Therefore, the use of a barrier is possible during the breaking process. Thus, the worst case predicted noise levels at the NSRs potentially affected by the village sewer laying works are detailed in Table 5.12 below. Two scenarios have been considered, the first where only the alternative breaker, as stated in Section 5.8.1, has been applied and the second where both the alternative silenced breaker and barrier are implemented.

Table 5.12: Mitigated Noise Levels at Representative NSRs for Village Sewer Construction

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)			
		With Breaker of Sound Power Restriction of 109dB(A) and Silenced Compactor		With Breaker of Sound Power Restriction of 109dB(A), Silenced Compactor plus Barrier	
		Concrete Breaking	Compaction	Concrete Breaking	Compaction
SWL		109.2	100.0	109.2	100.0
C1	-	-	-	-	-
C2	-	-	-	-	-
C3	-	-	-	-	-
TC1	3 m	95	85	85	75
TC2	3 m	95	85	85	75
TC3	5 m	90	81	80	71
TC4	1 m	104	95	94	85
TC5	1 m	104	95	94	85
TC6	1 m	104	95	94	85
TC7	1 m	104	95	94	85
TC8	4 m	92	83	82	73
TC9	1 m	104	95	94	85
TC10	1 m	104	95	94	85
TC11	6 m	89	79	79	69
TC12	1 m	104	95	94	85
TC13	4 m	92	83	82	73
TC14	4 m	92	83	82	73
TC15	-	-	-	-	-
TC16	3 m	95	85	85	75
TC17	1 m	104	95	97	85
TC18	-	-	-	-	-

Table 5.12 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)			
		With Breaker of Sound Power Restriction of 109dB(A) and Silenced Compactor		With Breaker of Sound Power Restriction of 109dB(A), Silenced Compactor plus Barrier	
		Concrete Breaking	Compaction	Concrete Breaking	Compaction
	SWL	109.2	100.0	109.2	100.0
TC19	-	-	-	-	-
TC20	-	-	-	-	-
TC21	-	-	-	-	-
LC1	-	-	-	-	-
LC2	-	-	-	-	-
LC3	-	-	-	-	-
LC4	-	-	-	-	-
LC5	-	-	-	-	-
LC6	-	-	-	-	-
LC7	-	-	-	-	-
LC8	-	-	-	-	-
LC9	-	-	-	-	-
LC10	-	-	-	-	-
LC11	-	-	-	-	-
LC12	-	-	-	-	-
LC13	-	-	-	-	-
LT1	-	-	-	-	-
LT2	-	-	-	-	-
LT3	-	-	-	-	-
LT4	-	-	-	-	-
LT5	5 m	90	81	80	71
LT6	4 m	92	83	82	73
LT7	3 m	95	85	85	75
LT8	10 m	84	75	74	65
WU1	1 m	104	95	94	85
WU2	1 m	104	95	94	85
WU3	4 m	92	83	82	73
WK1	3 m	95	85	85	75
WK2	1 m	104	95	94	85
WK3	7 m	87	78	77	68
WK4	3 m	95	88	85	75
P1	-	-	-	-	-
P2	-	-	-	-	-
P3	-	-	-	-	-
ST1	2 m	98	89	88	79

Table 5.12 Cont'd.....

Noise Sensitive Receiver	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)			
		With Breaker of Sound Power Restriction of 109dB(A) and Silenced Compactor		With Breaker of Sound Power Restriction of 109dB(A), Silenced Compactor plus Barrier	
		Concrete Breaking	Compaction	Concrete Breaking	Compaction
	SWL	109.2	100.0	109.2	100.0
ST2	1 m	104	95	94	85
ST3	4 m	92	83	82	73
ST4	4 m	92	83	82	73
ST5	1 m	104	95	94	85
ST6	4 m	92	83	82	73
ST7	1 m	104	95	94	85
ST8	1 m	104	95	94	85
ST9	4 m	92	83	82	73
ST10	2 m	98	89	88	79
ST11	2 m	98	89	88	79
ST12	2 m	98	89	88	79
ST13	2 m	98	89	88	79
ST14	2 m	98	89	88	79
ST15	2 m	98	89	88	79
ST16	4 m	92	83	82	73
ST17	3 m	95	85	85	85
ST18	10 m	84	75	74	65
SS1	2 m	98	89	88	79
SS2	1 m	104	95	94	85
SS3	1 m	104	95	94	85
SS4	4 m	92	83	82	73
SS5	3 m	95	85	85	85

Note. '-' not applicable - see Table 5.6

5.9.3 The results show that the additional 10 dB(A) attenuation afforded by the use of the barrier would enable the residential properties more than 9m away to be protected to within the 75 dB(A) standard during both breaker activities and within 3m during compactor activities. However, all properties within 9m for the breaker and 3m for the compactor would still experience residual impacts of between 1-19dB(A) with the barrier in place. The worst affected properties are 1-2m away.

5.9.4 Thus, additional mitigation measures would be required. Again, it will be the responsibility of the Contractor, in agreement with the Engineer's Representative, the Independent Checker (Environmental) and the Environmental Specialist as the leader of the Environmental Team, to determine the means by which the noise levels are further reduced taking into account the on-

site conditions and programming and to demonstrate that noise levels are within acceptable levels.

5.9.5 As noted above, properties which are more than 9m away from the works can be protected by the use of the alternative breaker and a temporary barrier and more than 3m away by a silenced compactor and barrier. However, as detailed in Table 5.12, if it is not possible to use the barrier due to site conditions and the need to have a clearance of 5m, further methods of mitigation will need to be considered to protect these properties.

5.9.6 Measures could include any one or more of the following:

(i) manual working for concrete breaking;

(ii) use of alternative pavement removal methods/equipment in place of the breaker (concrete breaking only);

(iii) use of an acoustic enclosure; and

(iv) scheduling the operating times of equipment.

5.9.7 The noise levels at each of the NSRs subject to residual impacts from the village sewer construction for each of these additional mitigation scenarios are given below in Table 5.13 below. The additional attenuation from these further mitigation options have been taken from the mitigated levels detailed in Table 5.12 in order to obtain the results provided below.

Table 5.13 Predicted Noise Levels for Different Mitigation Scenarios during Village Sewer Construction

NSR	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)							
		Manual Breaking of Concrete (concrete breaking only)		Use of Kick Ripper to Replace Breaker (concrete breaking only)		Acoustic Enclosure (both activities)		Scheduling of Operating Times (both activities)	
		CB	C[(1)]	CB[(2)]	C[(1)]	CB	C	CB[(4)]	C[(4)]
TC1	3 m	-	*85*	88	*85*	74	65	89	82
TC2	3 m	-	*85*	78	*85*	74	65	79	82
TC3	5 m	-	*81*	83	*81*	70	61	84	78
TC4	1 m	-	*95*	97	*95*	84	75	98	92
TC5	1 m	-	*95*	97	*95*	84	75	98	92
TC6	1 m	-	*95*	97	*95*	84	75	98	92
TC7	1 m	-	*95*	97	*95*	84	75	98	92
TC8	4 m	-	*83*	85	*83*	72	63	86	80
TC9	1 m	-	*95*	97	*95*	84	75	98	92

Table 5.13 Cont'd.....

NSR	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)							
		Manual Breaking of Concrete (concrete breaking only)		Use of Kick Ripper to Replace Breaker (concrete breaking only)		Acoustic Enclosure (both activities)		Scheduling of Operating Times (both activities)	
		CB	C[(1)]	CB[(2)]	C[(1)]	CB	C	CB[(4)]	C[(4)]
TC10	1 m	-	*95*	97	*95*	84	75	98	92
TC11	6 m	-	*79*	82	*79*	69	69	83	76
TC12	1 m	-	*95*	97	*95*	84	75	98	92
TC13	4 m	-	*83*	85	*83*	72	63	86	82
TC14	4 m	-	*83*	85	*83*	72	63	86	80
TC16	3 m	-	*85*	88	*85*	74	65	89	82
TC17	1 m	-	*95*	97	*95*	84	75	98	92
LT5	5 m	-	*81*	83	*81*	70	71	84	78
LT6	4 m	-	*83*	85	*83*	72	63	86	80
LT7	3 m	-	*85*	88	*85*	74	65	89	82
LT8	10 m	-	*75*	77	*75*	74[(3)]	75[(3)]	78	72
WU1	1 m	-	*95*	97	*95*	84	75	98	92
WU2	1 m	-	*95*	97	*95*	84	75	98	92
WU3	4 m	-	*83*	87	*83*	72	63	88	80
WK1	3 m	-	*85*	88	*85*	74	65	89	82
WK2	1 m	-	*95*	97	*95*	84	75	98	92
WK3	7 m	-	*78*	80	*78*	67	68	81	75
WK4	3 m	-	*85*	88	*85*	74	65	89	85
ST1	2 m	-	*89*	91	*89*	78	69	92	86
ST2	1 m	-	*95*	97	*95*	84	75	98	92
ST3	4 m	-	*83*	85	*83*	72	63	86	80
ST4	4 m	-	*83*	85	*83*	72	63	86	80
ST5	1 m	-	*95*	97	*95*	84	75	98	92
ST6	4 m	-	*83*	85	*83*	72	63	86	80
ST7	1 m	-	*95*	97	*95*	84	75	98	82
ST8	1 m	-	*85*	97	*85*	84	75	98	82
ST9	4 m	-	*83*	85	*83*	72	63	86	80
ST10	2 m	-	*89*	91	*89*	78	69	92	86
ST11	2 m	-	*89*	91	*89*	78	69	92	86
ST12	2 m	-	*89*	91	*89*	78	69	92	86
ST13	2 m	-	*89*	91	*89*	78	69	92	86
ST14	2 m	-	*89*	91	*89*	78	69	92	86
ST15	2 m	-	*89*	91	*89*	78	69	92	86
ST16	4 m	-	*83*	85	*83*	72	63	86	80
ST17	3 m	-	*85*	88	*85*	74	65	89	82

Table 5.13 Cont'd.....

NSR	Distance from NSR to Village Sewer Alignment Works	Mitigated Noise Levels for Each Construction Scenario L_{eq}, dB(A) (Standard 75dB(A), 70 dB(A) for schools)							
		Manual Breaking of Concrete (concrete breaking only)		Use of Kick Ripper to Replace Breaker (concrete breaking only)		Acoustic Enclosure (both activities)		Scheduling of Operating Times (both activities)	
		CB	C[(1)]	CB[(2)]	C[(1)]	CB	C	CB[(4)]	C[(4)]
ST18	10 m	-	*75*	77	*75*	74[(3)]	75[(3)]	78	72
SS1	2 m	-	*89*	91	*89*	78	69	92	86
SS2	1 m	-	*95*	97	*95*	84	75	98	92
SS3	1 m	-	*95*	97	*95*	84	75	98	92
SS4	4 m	-	*83*	85	*83*	72	63	86	80
SS5	3 m	-	*85*	88	*85*	74	65	89	82

Note: Values in *italics* indicate noise levels have not changed and no additional attenuation has been provided by the mitigation scenario.

(1) - silencer on compactor assumed. Take off 10 dB(A) for use of noise barrier during compactor activities.

(2) - no noise barrier attenuation assumed in the figures. Take off 10 dB(A) for use of noise barrier during activities.

(3) - mitigation provided by noise barrier and silenced breaker/compactor as appropriate, no further mitigation required.

(4) - no noise barrier attenuation assumed in the figures. Take off 10 dB(A) for use of noise barrier during activities.

'-' no mechanical equipment required.

CB Concrete Breaking

C Compaction

5.9.8 All measures can provide some additional noise reduction but only the noise enclosure used in combination with the alternative silenced breaker/compacter can reduce noise levels at properties greater than 3m away to within the standard and it is recommended that the enclosure, a typical example of which is detailed in Drawing 5.1, is used wherever the designated space constraints permit. However, further reductions could be achieved if a combination of measures were applied. Notwithstanding, residual impacts will occur at the closest receivers, 1-2m from the proposed works during concrete breaking.

5.9.9 As detailed in Section 5.8.13 above, the duration of the proposed works will be very short, lasting in general 1-2 hours for concrete breaking before the activity is far enough away for the distance to reduce the noise to within the acceptable levels and less than 1 hour at any one time for compactor activities.

5.9.10 The construction of the village sewer alignment is an integral element of the works and cannot be avoided. However, based upon the short duration of the residual impacts, it is considered that they would be acceptable.

5.10 Operational Noise Impacts

5.10.1 Operational noise will be restricted to noise from the pumping stations, specifically the pump. Each pumping station will have submersible pumps situated below ground level in a wet well and under a metal cover. The noise generated by the electric pump at source will have a sound power level in the region of 88 dB(A). The walls of the pumping station have been designed to be approximately 150m thick as shown in in Drawings 5.2a and 5.2b. However, for the purposes of this assessment, 100mm thick concrete, and therefore a transmission loss between 125Hz and 8000Hz has been assumed. This would equate to at least a 29 dB(A) attenuation in accordance with 'Sound Analysis and Noise Control, John Foreman, 1990, Van Nostrand Reinhold, Table 5.5, pp154' but due to the louvres and doors in the structure the attenuation would be in the region of 20 dB(A).

5.10.2 The preliminary layout and sections of the proposed Castle Peak Villas pumping station are shown in Drawings 5.2a and 5.2b. This layout is typical of all the proposed pumping stations. It can be seen in the Sectional Plan in Drawing 5.2a that, in this case, the two pumps and one standby pump, will be located towards the centre of the structure. In addition, as shown in Section 1-1 of Drawing 5.2b the pumps will be located some 4m below ground in the wet well and enclosed using a 1/8" aluminum sheet. This would provide a transmission loss of 13dB(A) at 125HZ. Thus, based upon the protection of both the pump enclosure and the pumping station building, a total attenuation of 33 dB(A) can be assumed. However, in order to be conservative a value of 29 dB(A) has been adopted for the purposes of this assessment.

5.10.3 The noise prediction results at the closest sensitive receivers based upon these worst case assumptions are shown in Table 5.14 below, with the daytime and nighttime noise standards included for reference. A full set of modelling results are provided in Appendix B.

Table 5.14: Predicted Operational Noise Levels

Pumping Station	NSR ID	Noise Level at NSR, Leq, dB(A)	Nighttime Noise Standard, Leq, dB(A)	Daytime Noise Standard, Leq, dB(A)
Tai Lam Correctional Institution	C1	31	45	55
Tai Lam Chung Tsuen	TC1	32	45	55
	TC2	27	45	55
Luen On San Tsuen	LT2	33	45	55
	N1	34	45	55
Tai Lam Valley (2 pumps)	TC21	38	45	55
Castle Peak Villas (2 pumps)	LC6	37	45	55
	LC7	36	45	55
So Kwun Wat Tsuen	ST18	34	45	55
So Kwun Wat Tsuen	N3	10	45	55

Note : Tonality has not been used as the full spectrum of noise is not available. However, the noise of pump will be continuous and so impulsive and intermittent noise is not included.

5.10.4 The Area Sensitivity Rating assumed in this EIA Report is for indicative assessment only. It should be noted that fixed noise sources are controlled under Section 13 of the NCO and, 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 in force and taking into account of contemporary conditions/situations of adjoining land uses. Nothing in this EIA Report shall bind the Noise Control Authority in the context of law enforcement against all the fixed noise sources being assessed.

5.10.5 Based upon the above determination, it is predicted that the noise levels during the operational phase will be within the acceptable nighttime and daytime noise levels .

5.11 Residual Impacts

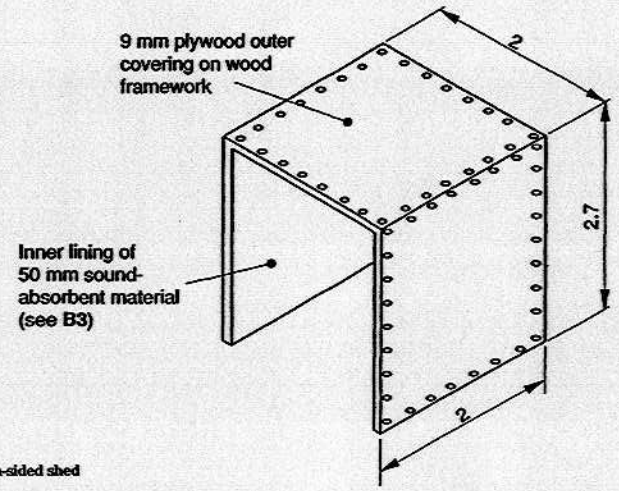
5.11.1 Temporary residual noise impacts may occur during main and village sewer construction. However, it is expected that individual village units will be affected by elevated noise levels for a very short period, generally of no more than 1-2 hours, for each activity. The impact is considered to be unavoidable as the construction of the sewer alignments in the villages is an integral element of the implementation of the scheme. As the duration of the works are so minimal, the residual impacts are considered acceptable.

5.11.2 No residual noise impacts will occur from the operation of the project.

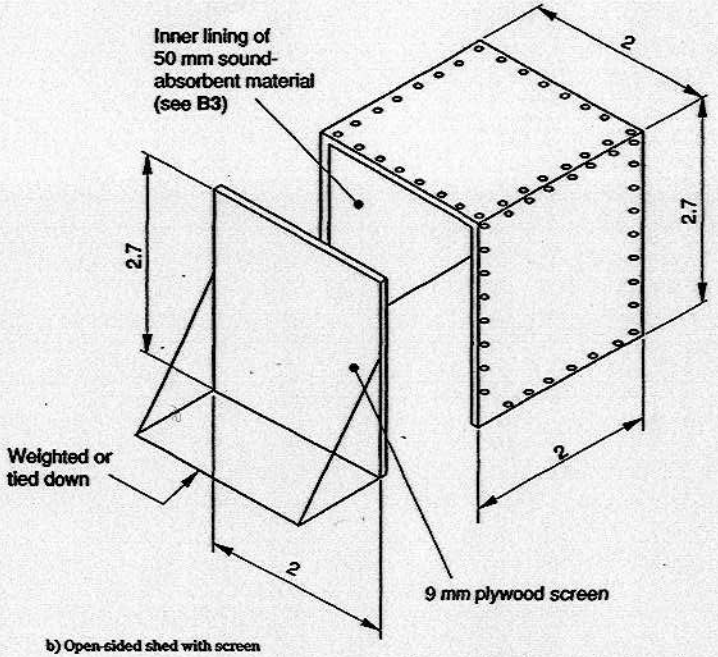
5.12 Environmental Monitoring and Audit

5.12.1 The assessment has concluded that while on the whole construction noise impacts can be mitigated to acceptable levels, some residual impacts are likely to occur within the villages environs. Thus, it is recommended that construction phase environmental monitoring and audit is undertaken to ensure that the recommended mitigation measures are being implemented and are effective. EM&A for noise during the operational phase is not required. Further details of the specific EM&A requirements are detailed in Section 11 of this report and in the EM&A Manual.

3 dimension view

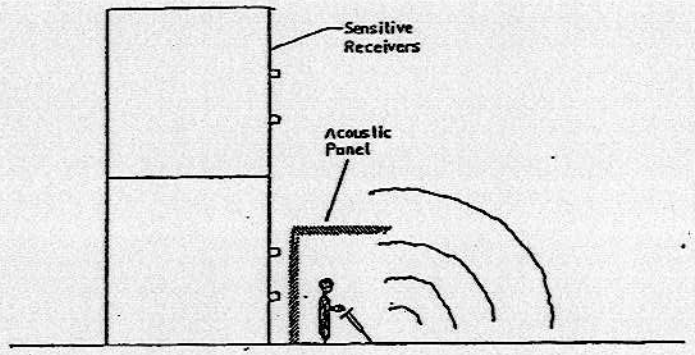


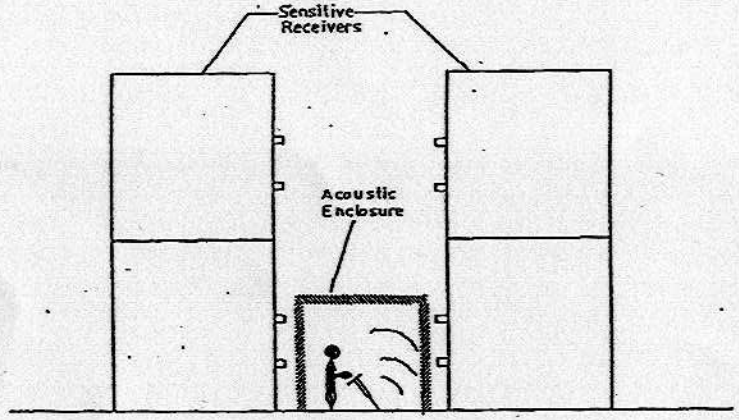
a) Open-sided shed



b) Open-sided shed with screen

Cross Section





Unless otherwise stated, dimensions are in metres

Typical Noise Enclosure

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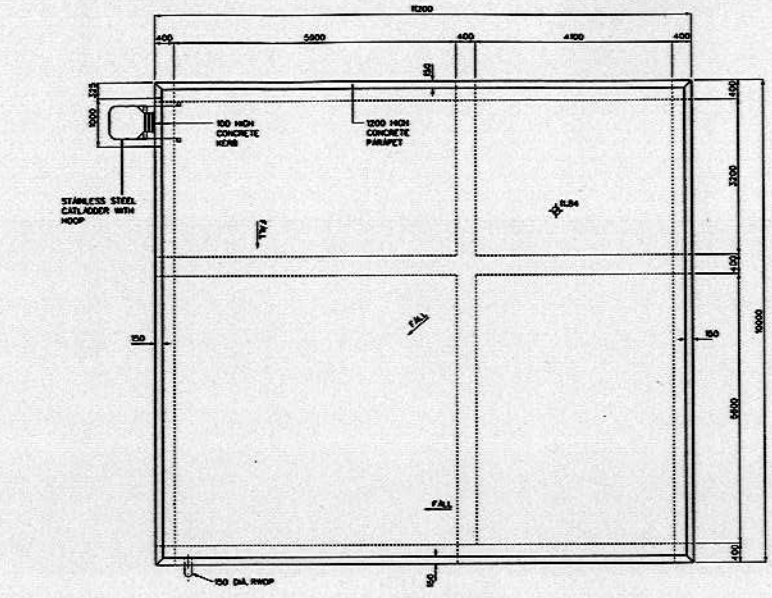
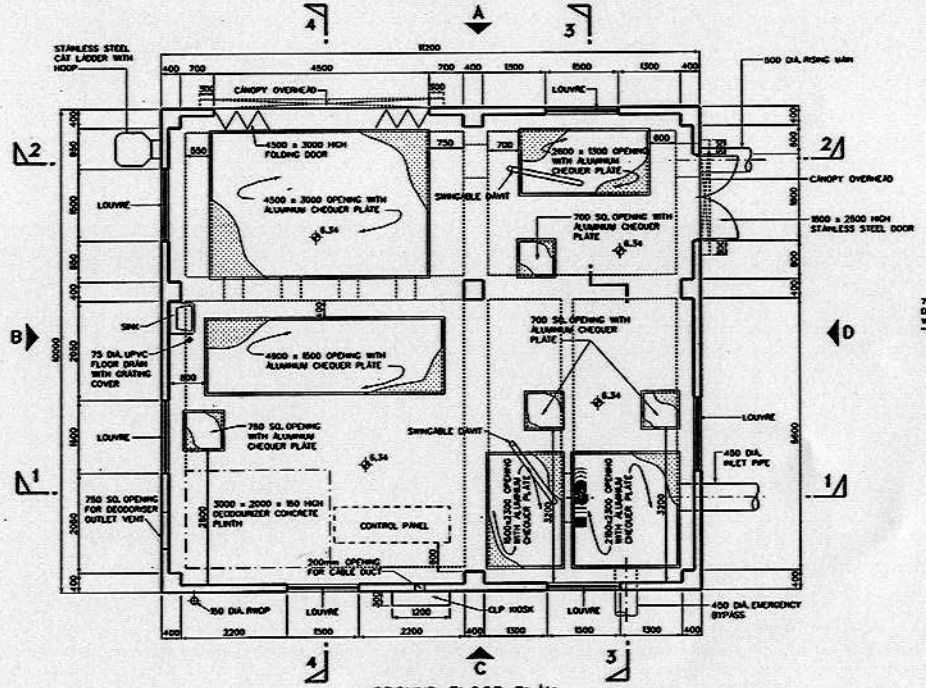
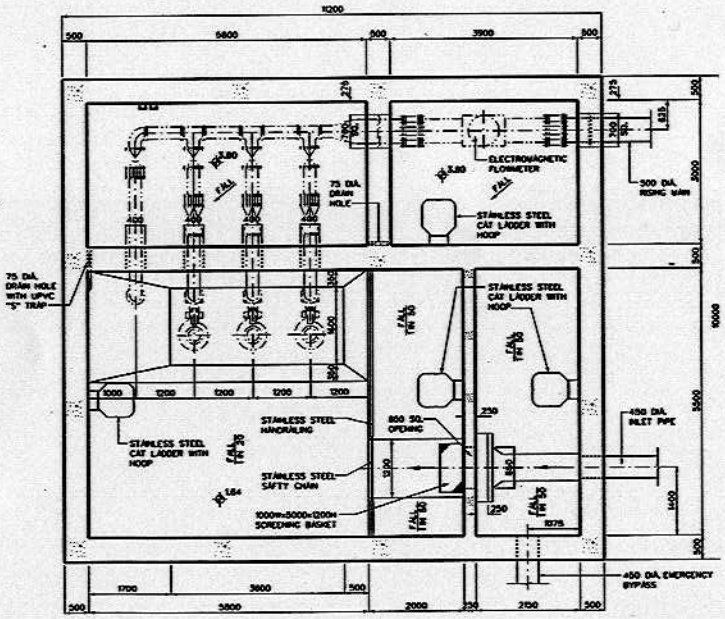
Drawing No. 5.1



ROOF PLAN



GROUND FLOOR PLAN



SECTIONAL PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL LEVEL ARE IN METERS REFERRED TO P.D.M.D.
3. CONCRETE STRUCTURES BELOW GROUND FLOOR LEVEL SHALL BE WATER-RETAINING TO DESIGNATION.
4. PENSTOCKS, VALVES, CRANE GEARS, FITTINGS, PUMPS AND OTHER E&M INSTALLATIONS WHERE THE PUMPING STATION SHALL BE SUPPLIED AND INSTALLED BY THE E&M CONTRACTOR UNLESS OTHERWISE SPECIFIED.
5. EXACT LOCATIONS OF RECESS & OPENINGS FOR INSTALLATION OF E&M EQUIPMENT SHALL BE DETERMINED ON SITE BY THE ENGINEER.
6. UNLESS OTHERWISE STATED, CONCRETE GRADE SHALL BE:
   SUPERSTRUCTURES = 30/20
   SUBSTRUCTURES = 40/20
   BENCHING = 30/20
   BUILDING LAYER = 30/20
   PLINTH = 30/20
7. ALL STEEL WORKS SHALL BE STAINLESS STEEL UNLESS OTHERWISE STATED.
8. ALL EXPOSED CORNERS OF CONCRETE SURFACES SHALL HAVE 20x20mm CHAMFERS UNLESS OTHERWISE STATED.
9. ABBREVIATIONS :
   S.S. DENOTES STAINLESS STEEL
   E&M DENOTES ELECTRICAL AND MECHANICAL
   RWDP DENOTES RAINWATER DOWN PIPE
   SWL DENOTES SAFE WORKING LOAD
10. ALL EXTERNAL CONCRETE WALL SHALL BE 150 THICK.
11. ALL FALLS SHALL HAVE GRADIENT OF 1:100 UNLESS OTHERWISE STATED.
12. DETAILS OF STAINLESS STEEL CAT LADDER SHALL BE REFERRED TO DRAWING NOS. EDW/BSDS/XXXX AND EDW/BMDS/XXXX.
13. DETAILS OF STAINLESS STEEL HANDRAILING SHALL BE REFERRED TO DRAWING NO. EDW/BMDS/XXXX.

PROVISIONAL
SUBJECT TO AMENDMENT

Castle Peak Villas Pumping Station (Sheet 1 of 2)

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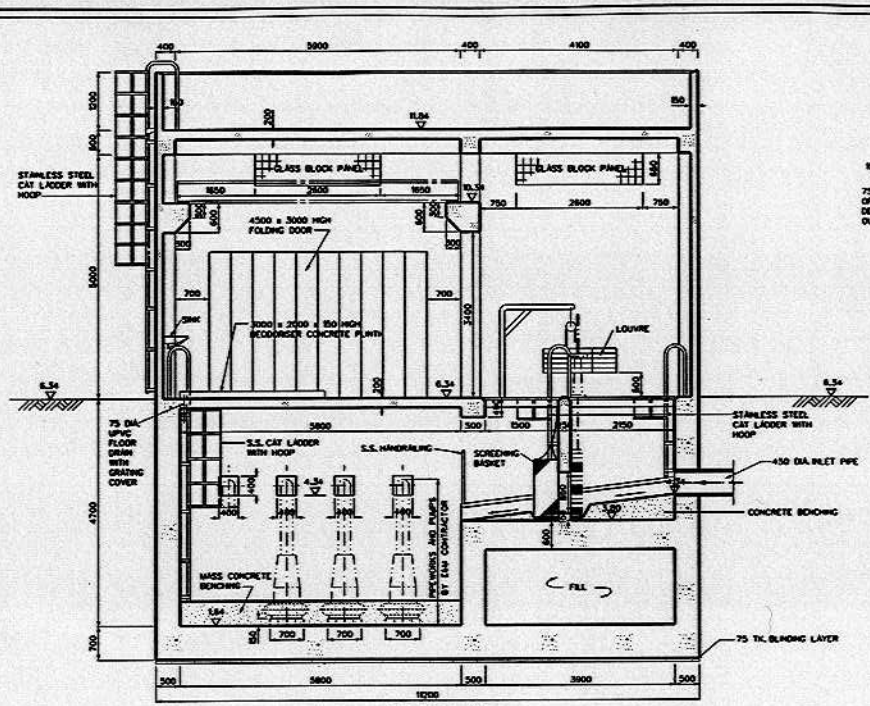
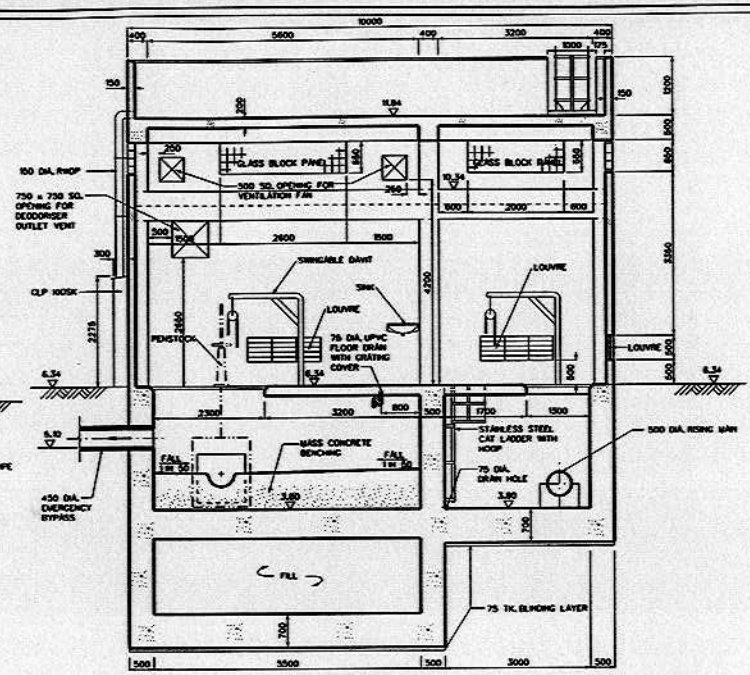
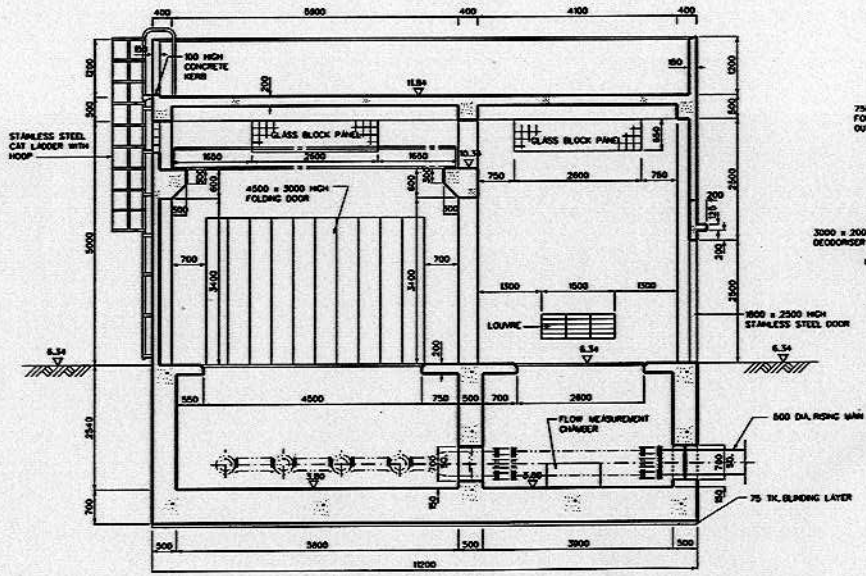
Figure No. 5.2a



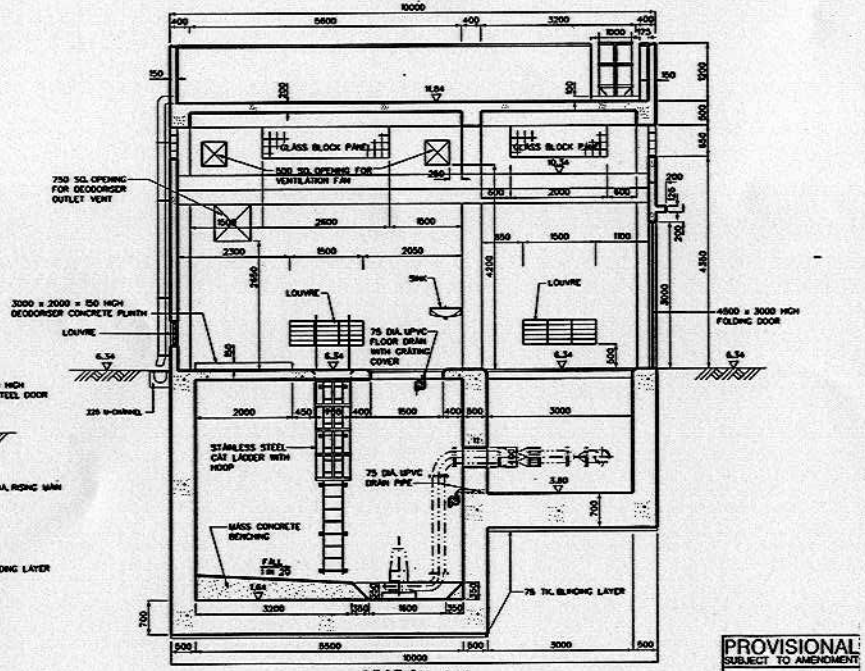
SECTION 1-1



SECTION 3-3



SECTION 2-2



SECTION 4-4

NOTES:

1. FOR NOTES REFER TO DRAWING No. DDM/WDDS/4808

PROVISIONAL
SUBJECT TO AMENDMENT

Castle Peak Villas Pumping Station (Sheet 2 of 2)

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Figure No. 5.2b