5 Noise Impact Assessment

5.1 Introduction

This chapter is compiled based on Annex 5, *Guidelines for Evaluating Noise Impact and Annex* 13, *Guidelines for Noise Assessment of the Technique Memorandum on Environmental Impact Assessment Procedure.* The main contents include assessment of the current noise quality in the Study Area, the potential impacts of the Project on local noise, propose measures to mitigate the various impacts, and evaluating the residual noise impact and its acceptability.

Noise impact mainly arises from the operation of construction equipment, borrowing, vehicle and ship transportation in the process of the construction preparation, bridge enforcement and reconstruction; straightening, widening and deepening of river channels; dyke construction, borrowing, etc.

According to the construction programme, construction method and the list of equipment to be used, noise sensitive receivers (NSRs) under different conditions or ANL on the site boundary is determined first. Then the allowable total construction noise level and traffic noise level of the imaginary noise sources that produce ANL at the NSRs are calculated in this EIA report. ,and finally the modified noise level for NSRS can be obtained with consideration of distance attenuation effect ,modification coefficients of noise barriers and noise reflection. Construction equipment used in previous projects suggests that these types of equipment for the Project construction will not exceed the noise criteria as concerned. For new equipment, a noise impact assessment should be done. Finally, according to the predicted noise level, mitigation measures to further minimize the noise impacts, especially for the construction in restricted hours, are proposed.

5.2 Laws, Regulations and Standards

The standards of the nation and Hong Kong Special Administrative Region (hereafter Hong Kong) are adopted to assess the noise impacts in this chapter. The assessment of the construction site boundary is based on the nation's standard, while the impact assessment of NSRs is based on the standard of Hong Kong.

5.2.1 *Laws, Regulations and Standards of the Nation*

Environmental Noise Standard for Urban Area (*GB*3096—93) (see Table 5.1) is followed on the Shenzhen side, and the grade to be implemented for the assessment refers to *The Zoning of Applying Environmental Noise Standard for Urban Area in Shenzhen City*. *The Standard for Noise on the Border of Construction Site* (*GB*12523—90) (see Table 5.2) is implemented for noise control on the construction site boundary.

Table 5.1 Environmental Noise Standard for Urban Area (GB3096-93) [Leq,dB(A)]

Grade	Applied Area	Daytime	Nighttime
0	Sanitaria,high-class villa zone,high-class hotel zone	50	40
1	Mainly for residential area,culture and educational institutions, rural residential area could be referred	55	45
2	Area intermixed with living,commence and industry	60	50
3	Industrial area	65	55
4	Area on both sides of the main roads in the city	70	55

Table 5.2 Areal Noise Control Standards for Construction Project of China [Leq,dB(A)]

Construction Period	Major Noise Source	Noise Criteria	
		Daytime	Nighttime
Earth rock excavation	Bulldozer,grab,transportation machinery	75	55
Structure construction	Concrete mixer,concrete vibrator	70	55

5.2.2 *Laws, Regulations and Standards of Hong Kong*

The relevant document in Hong Kong is *Noise Control Ordinance* (*NCO*), and the standard concerned in noise control (Acceptable Noise Level) are listed in *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (see Table 5.3). The *Acceptable Noise Level* (*ANL*) is determined by the Areal Sensitive Rank (ASR) of the region, where the NSRs are situated. A rank "A" is applied to the surrounding area of construction site (village and low-density residential zone). A rank "B" is applied to area that is affected by industries and traffic on main roads (it is not the major impact). During the noise impact assessment, factors such as the lo-

cations of the construction site and sensitive receiver, the soundproof effectiveness and topographic characteristics, must be considered in determination of ASR. The noise control authority will evaluate and determine the ASR according to the condition when applying noise permit for the Project construction.

The construction activities in evening and at night will be restricted according to *the Noise Control Ordinance (NCO)*. The future construction activities in evening and at night on the Hong Kong side can be carried out only after the Construction Noise Permit is obtained from the authority and the detailed requirements are followed.

The ASR determined in the EIA report is to be taken only for reference evaluation. Although the detailed description and evaluation aims at the construction noise given in this EIA report, it does not mean that the Construction Noise Permit (CNP) will surely be issued to the Project. The noise control authority will consider more reasonable application for CNP. Once the application is registered, the construction in the restricted time would have to be followed according to the relevant technical memorandum stipulated in NCO. The noise control authority would comprehensively consider the condition (situation) of the region near the construction site and any previous complaints to the construction activity in this area before issuing the CNP. Noise control authority will not be affected by the contents in this report in its decision making. When the CNP is issued, the authority will include all the necessary requirements in it as the items must be followed. Any violation of the requirements would lead cancellation of the CNP and might be prosecuted according to NCO.

Since this Project is a designated project, the noise impact assessment must follow the specifications in the *Technique Memorandum for Environmental Impact Assessment Procedure (EIAO-TM) (Environmental Impact Assessment Ordinance, cap.* 499, *s.* 16), especially the Annex 5 and Annex 13. The criteria in Table1B of Annex 5 must be obeyed in noise control for daytime construction activity. The noise standard for daytime construction activity is shown in Table 5.4.

Table 5.3 **Acceptable Noise Level** **[Leq,dB(A)]**

Time	Grades of Sensitivity to Noise		
	A	B	C
Night(19:00—23:00), daytime and nighttime on holidays including Sunday(07:00—23:00)	60	65	70
Late at Night(23:00—07:00)	45	50	55

Notes:1) quoted from noise ocntrol ordinance in the Technical Menorandum on Noise form Construction Work

other than Percussive Piling

2) it is not applied in percussive piling

Table 5.4 Noise Standards for Daytime Construction Activities [Leq(30mins)dB(A)]

Applied to	07:00 to 19:00 on any day other than sunday or Public Holiday	19:00 to 07:00 or any Time on Sundays or Public Holiday
All residential area including temporary housing accommodation	75	See note 3
Hotels	75	
Educational institutions including kindergartens, nurseries and all other places, where voice communication facility is not required	70 65(during examinations)	

Notes: 1) the above standard apply to the places , where ventilation relying on opened windows .

2) the above standard should be viewed as the maximum pernissible noise levels at the place 1 m from the external walls

3) the criteria in the relevant technical memoranda under the *Noise Control Ordiance* for designated areas and construction works other than percussive piling may be used for planning purpose. *Construction Noise Permit* (CNP) should be required for construction work during the period .

5.2.3 *Coordination of the Standards*

The noise standard of Shenzhen is quite different from that of Hong Kong. The difference between them is not only in the stipulated noise levels, but also in the location of receivers. In the process of assessment, attention should be paid to the following difference between the two standards:

- The standard of Shenzhen is applied to assess the noise impact for boundary of the construction site, and the standard of Hong Kong is applied for assessing the noise at the front side of the nearest sensitive receiver.

- Noise in daytime on the Shenzhen side is assessed based on the specific maximum values; while different standard is applied to assess noise impact in Hong Kong.

- The feature of the Project construction (earth-rock work and structure) is included in the standard of Shenzhen, but not in the standard of Hong Kong.

5.3 Current Status of Noise

5.3.1 *Noise Baseline Monitoring*

The division of the noise sensitive region, acceptable noise level, machinery equipment noise and total noise level etc. have been described in detail in the *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling of Hong Kong*. In addition, the values for modifying the calculation of noise level at a certain distance (forecasted noise level)by sound level have also been given. Therefore, it is not necessary to carry out noise baseline monitoring on the Hong Kong side, and the assessment of noise impacts is conducted based on the (Hong Kong) *Noise Control Ordinance* and associated Technical Memorandum.

For the Shenzhen side, two representative monitoring sites are established according to the situation of the Project site and on site traffic condition. Sound level meter is used for measurement of L_{10}, L_{50}, L_{90} and Leq to obtain the baseline level values. Locations of the monitoring sites are shown in Figure 5.1.

The monitoring was carried out in January 1999 for a period of 24 hours, during which a short period of time is selected for each hour to record 100 Leq data, one measurement for every 5 seconds, to represent the noise level distribution of the hour. When the noise levels fluctuation is more than 10 dB(A), 200 successive Leq data is required. The interval between two measurements is one hour and the sound characteristics of the surrounding environment is recorded at the same time.

For details of noise baseline investigation see Annex 5, and see Figure 5.2 for the results.

5.3.2 *Assessment of Existing Noise Status*

The result of noise baseline monitoring indicates that all the monitored equivalent noise levels exceed the Grade Ⅱ values specified in *Standard of Environmental Noise in Urban Area* (*GB*3096－93), and it is more serious in nighttime in Qiaoshe, due to heavy traffic on Heping Road. The traffic noise in Xinxiu village near the Shenzhen River is less significant, and the monitored equivalent noise levels in daytime reach the Grade Ⅰ of the standard (GB3096－93); while the equivalent noise level in nighttime slightly exceeds the standard due to the noise produced by vehicles in the area.

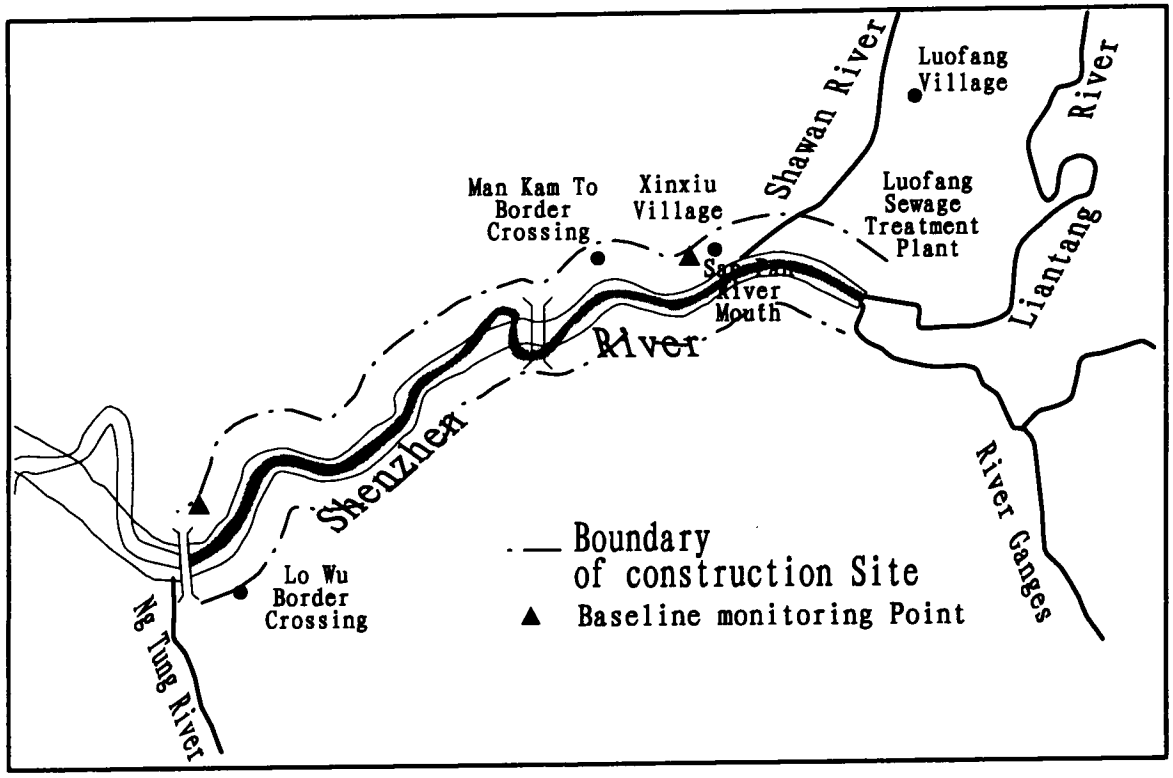


Figure 5. 1 **Location of the Noise Baseline Monitoring Sites**

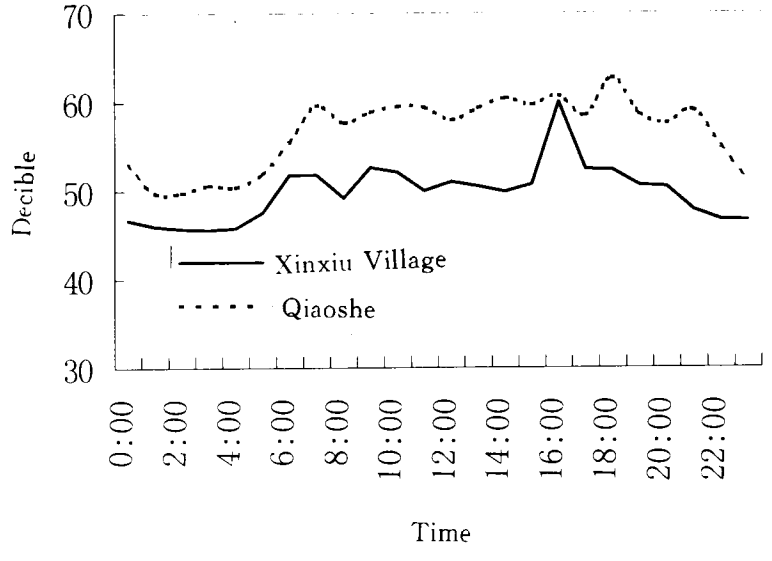


Figure 5. 2 **Daily Variation of the Equivalent Noise Level along the Shenzhen River**

5. 4 Noise Sensitive Receivers

According to the field investigation on Stage Ⅲ Project Area on both Shenzhen and Hong Kong sides, the main noise sensitive receivers during the construction of Stage Ⅲ Project on the Shenzhen side include: the dormitory of the border inspection station, Lo Wu No. 4 Village, Xiangxi Middle School, Huaqiao New Village and Xin xiu

Village; and the noise sensitive receivers on the Hong Kong side include: Lo Wu Tsuen, Lo Wu Public School, Muk Wu Tsuen and Nga Yiu Tsuen. The distribution of the noise sensitive receivers refers to Figure 5.3.

NSRs on the Shenzhen side and Hong Kong side of Stage Ⅲ Project and the minimum distances to the boundary of the construction site are listed below:

The NSRs on the Shenzhen side and their minimum distances to the boundary of the construction site:

1) 1# on the Shenzhen side Dormitory of the inspection station (28 m), see Figure 5.4.

2) 2# on the Shenzhen side Lo Wu No. 4 Village (68 m), see Figure 5.5.

3) 3# on the Shenzhen side Xiangxi Middle School (180 m), see Figure 5.6.

4) 4# on the Shenzhen side Huaqiao New Village (113 m), see Figure 5.7.

5) 5# on the Shenzhen side Xingxiu Village (188 m), see Figure 5.8.

NSRs on the Hong Kong side and their minimum distances to the boundary of the construction site:

1) 1# on the Hong Kong side Lo Wu Tsuen (66 m), see Figure 5.9.

2) 2# on the Hong Kong side Lo Wu Public School (40 m), see Figure 5.9 and Figure 5.9A.

3) 3# on the Hong Kong side Muk Wu Tsuen (140 m), see Figure 5.10.

4) 4# on the Hong Kong side Nga Yiu Tsuen (78 m), , see Figure 5.11.

The nearest distances (m) between NSRs and bridge construction area boundaries:

The nearest distances (m) between NSRs of the both sides and bridge construction area boundaries are listed in Table 5.5.

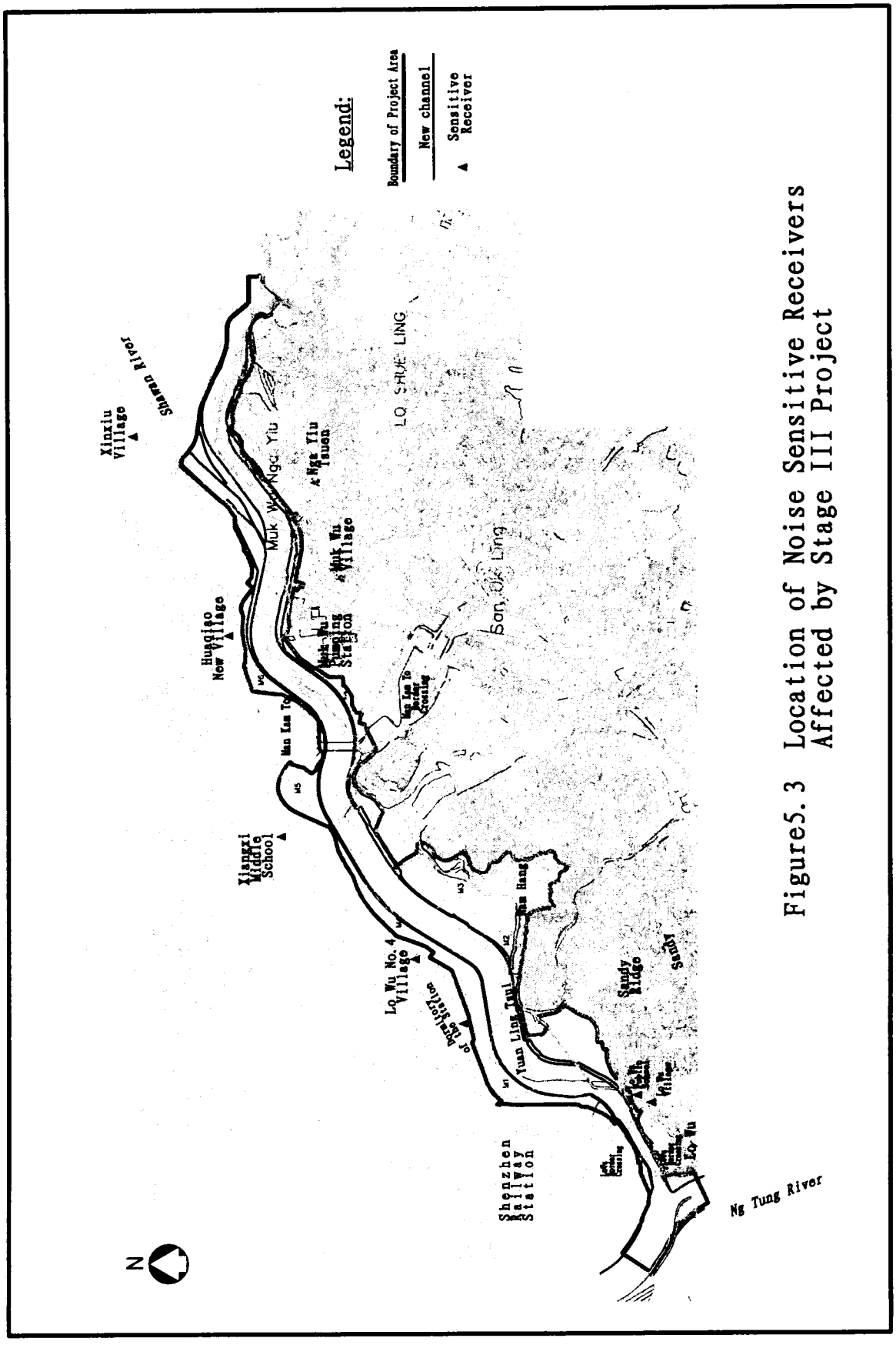


Figure5.3 Location of Noise Sensitive Receivers Affected by Stage III Project

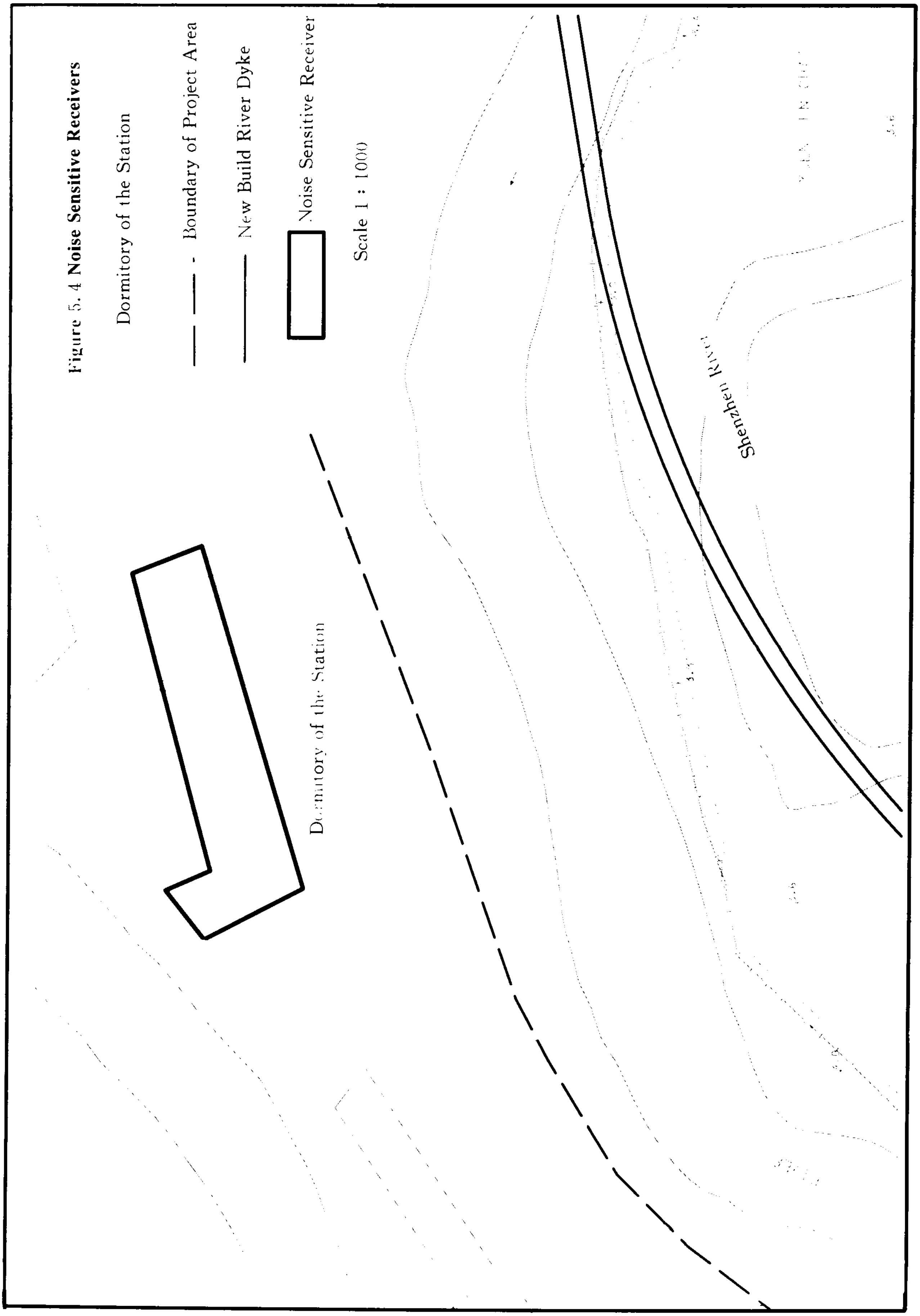


Figure 5. 4 Noise Sensitive Receivers
Dormitory of the Station
Boundary of Project Area
New Build River Dyke
Noise Sensitive Receiver
Scale 1 : 1000
Dormitory of the Station
Shenzhen River

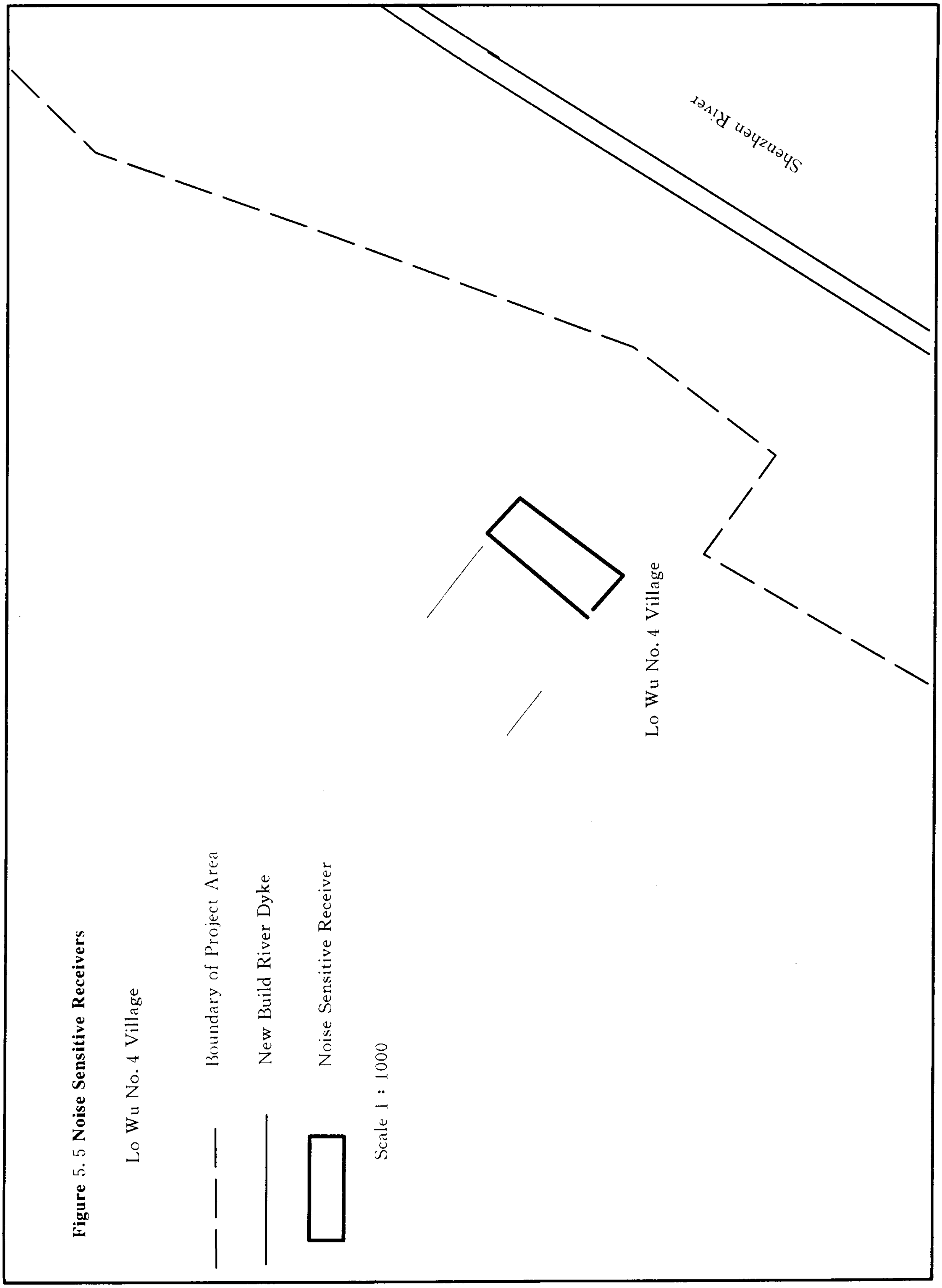


Figure 5. 5 **Noise Sensitive Receivers**

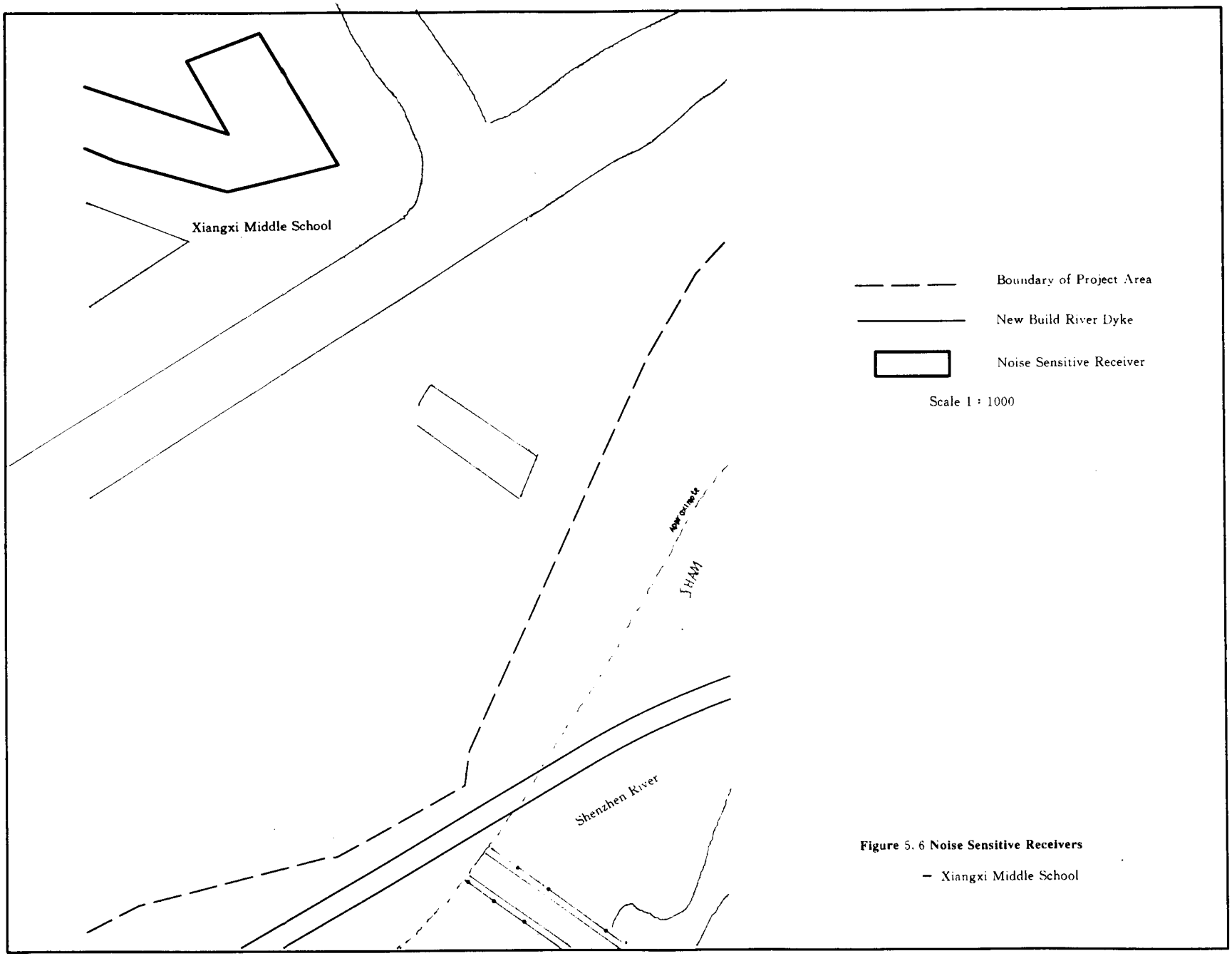


Figure 5. 6 **Noise Sensitive Receivers**

– Xiangxi Middle School

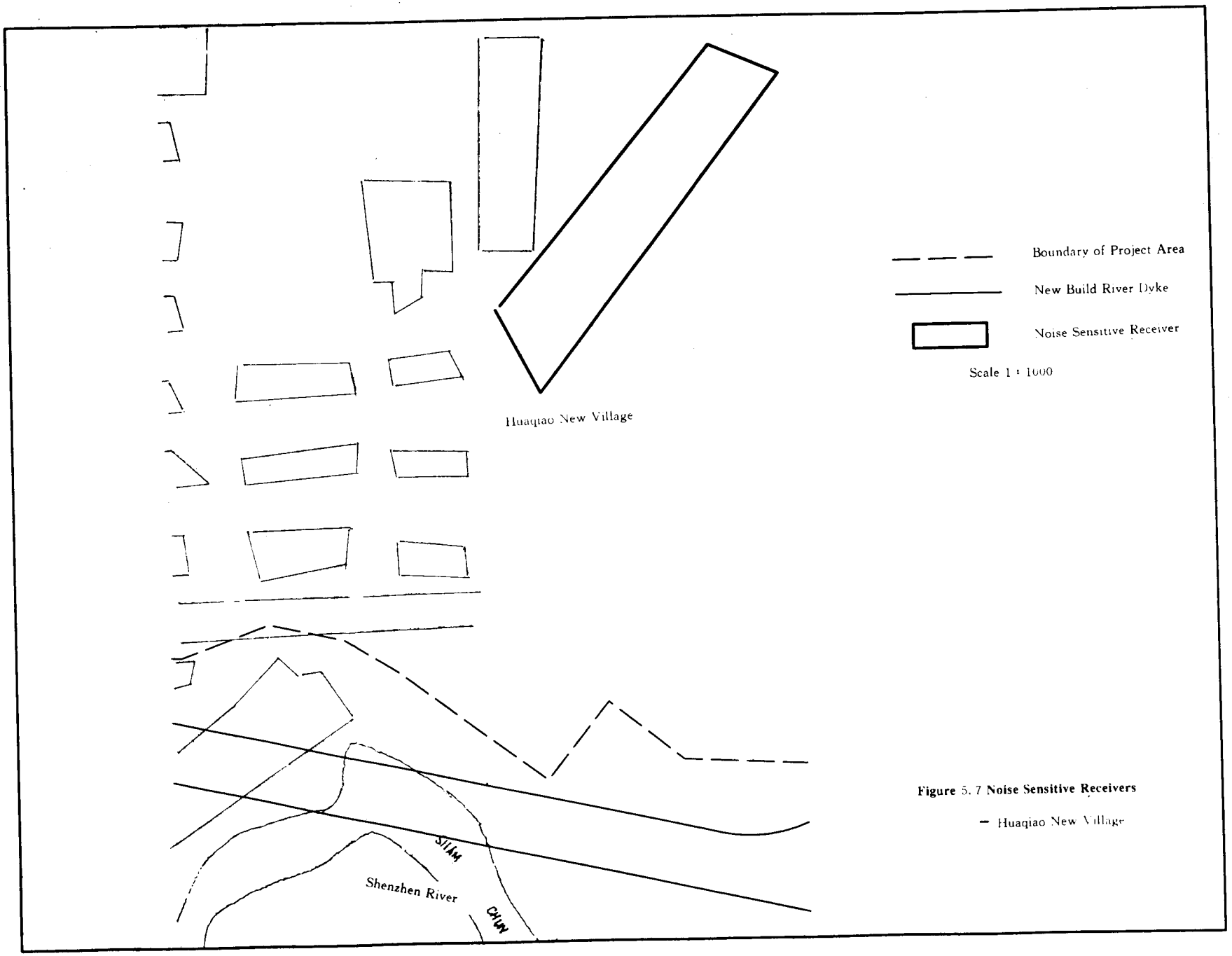


Figure 5. 7 Noise Sensitive Receivers

– Huaqiao New Village

Figure 5. 8 Noise Sensitive Receivers – Xinxiu Village

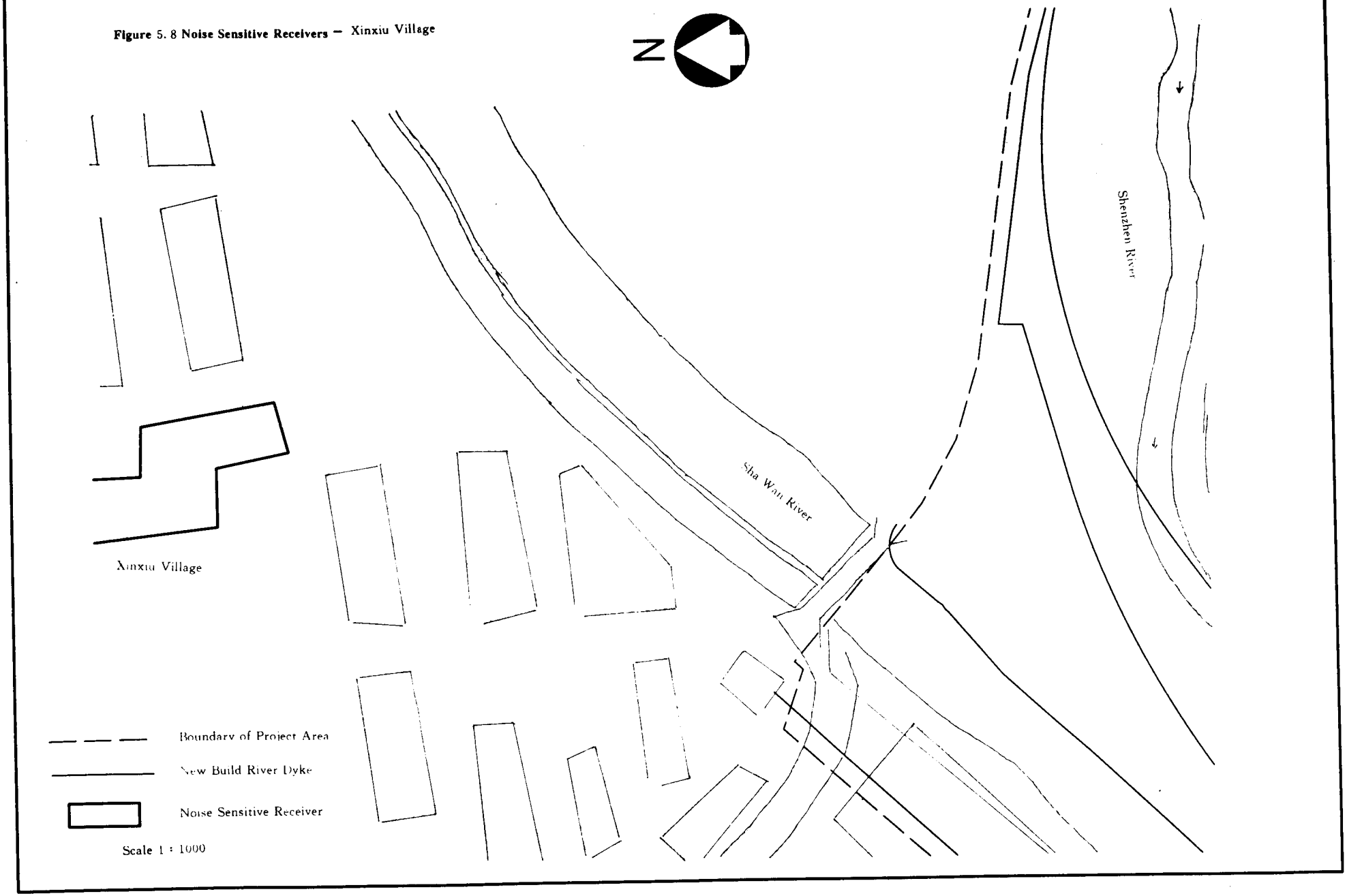
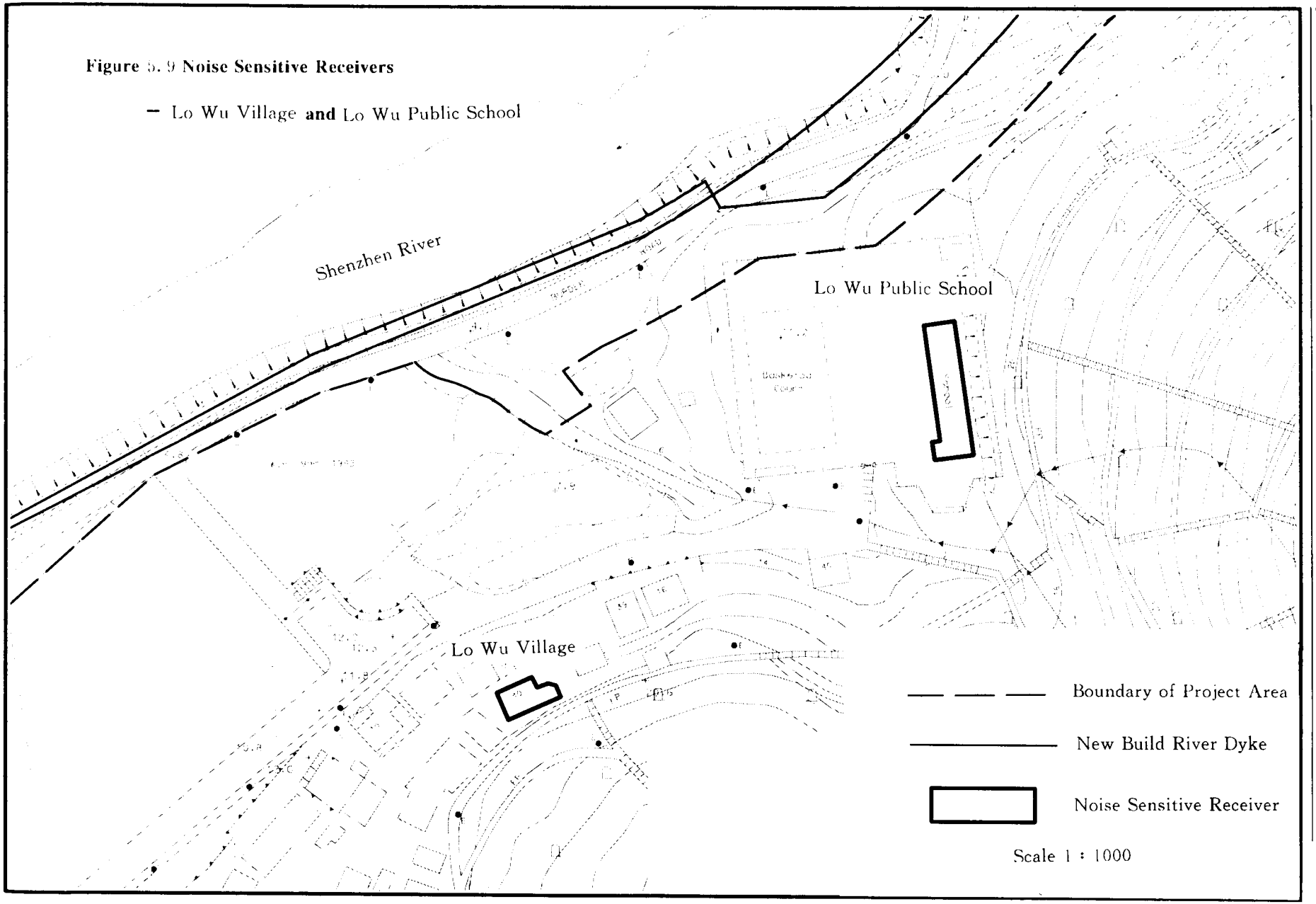


Figure 5.9 Noise Sensitive Receivers

– Lo Wu Village **and** Lo Wu Public School



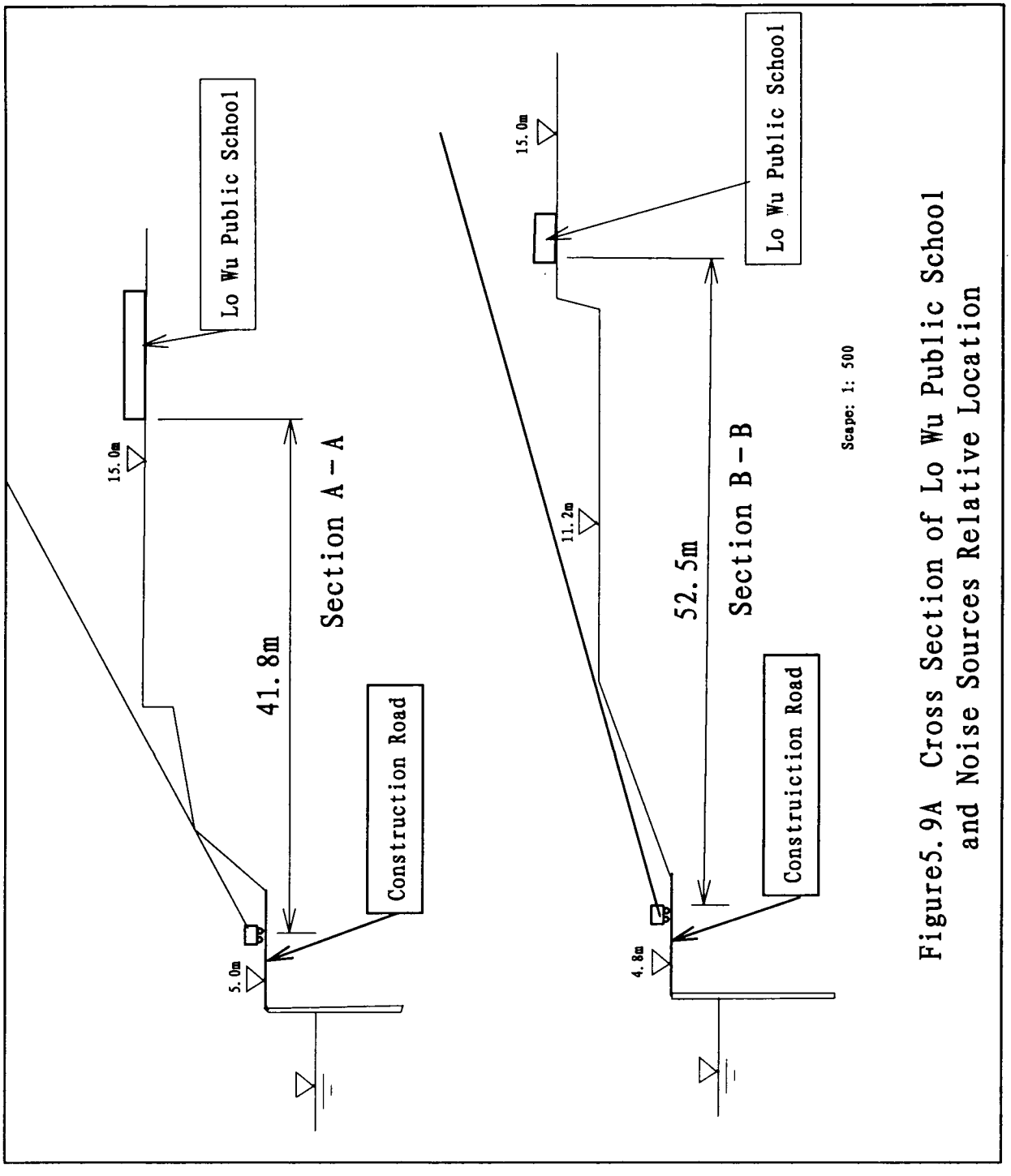


Figure5.9A Cross Section of Lo Wu Public School and Noise Sources Relative Location

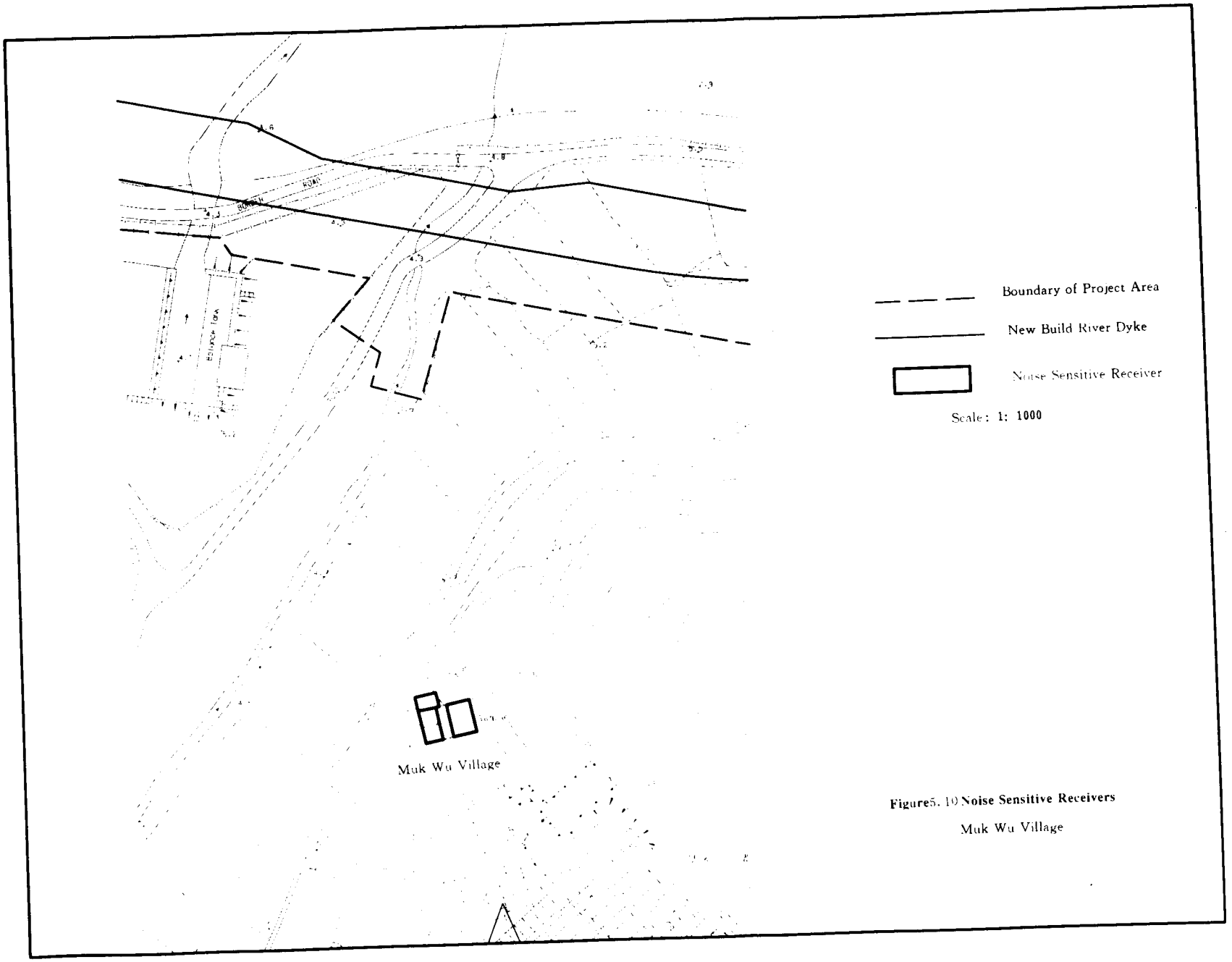


Figure5. 10 Noise Sensitive Receivers

Muk Wu Village

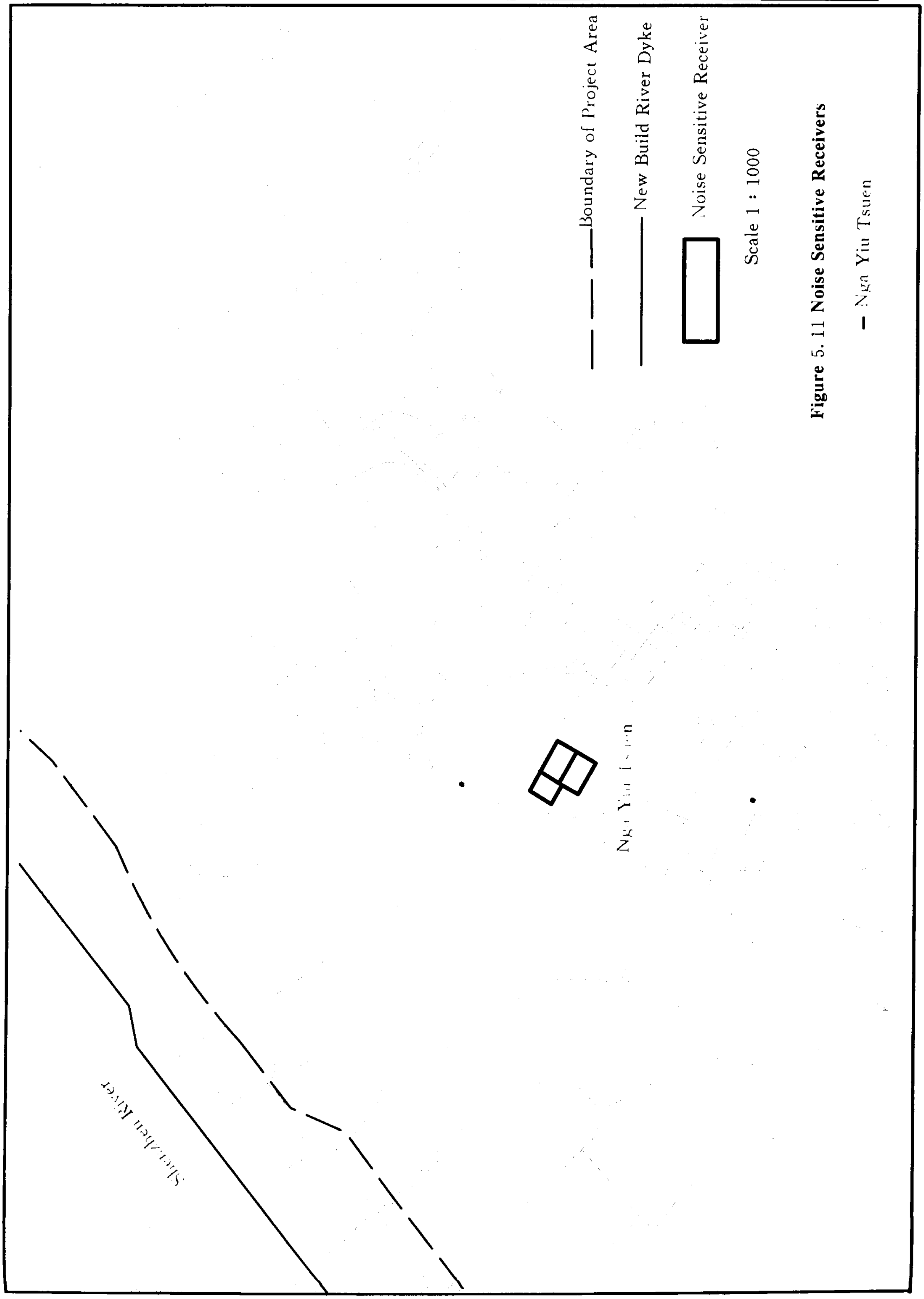


Figure 5. 11 **Noise Sensitive Receivers**

— Nga Yiu Tsuen

Table 5.5 The Nearest Distances between NSRs and Bridge Construction Area Boundaries

Construciton Area Boundary	NSRs on Shenzhen Side					NSRs on Hong Kong Side			
	SZ1#	SZ2#	SZ3#	SZ4#	SZ5#	HK1#	HK2#	HK3#	HK4#
Lo Wu Bridge	650	830	1300	1730	2300	180	260	1700	1930
Man Kam To Bridge	950	700	350	500	3200	1350	1300	600	850

NSRs and the minimum distance to barges:

1) 1# on the Shenzhen side Yumin Village (15 m)

2) 2# on the Shenzhen side Ludan Village (65 m)

3) 3# on the Shenzhen side Xiabumiao Domestic Premises Zone (50 m)

4) 4# on the Shenzhen side Shenzhen City Kou'An Hosipital (110 m)

5) 5# on the Shenzhen side Yunong Village (63 m)

6) 1# on the Hong Kong side Tai Sha Lok(220 m)

7) 2# on the Hong Kong side Ha Wan Tsuen (137 m)

Distribution of the navigation NSRs is shown in Figure 5.12.

5.5 Noise Model

5.5.1 *Assessment Method*

The method for assessing the noise from the construction site are summarized in *Technical Memorandum on Noise from Construction Work other than Percussive Piling of Hong Kong*. This method is also adopted in this EIA to predict noise levels on both the Shenzhen and the Hong Kong sides. The typical points are considered according to the overall layout of the Project.

According to the technical memorandum, the location of a hypothetical noise source, in which all the mechanical equipment is concentrated, must be ascertained before noise forecasting is conducted. According to construction schedule, method and the equipment for the construction recommended by the Project Design Consultant (the equipment recommended has been confirmed by the Empoyer and the Engineer that it is practical and feasible for construction of the Project). The impact on the NSRs in

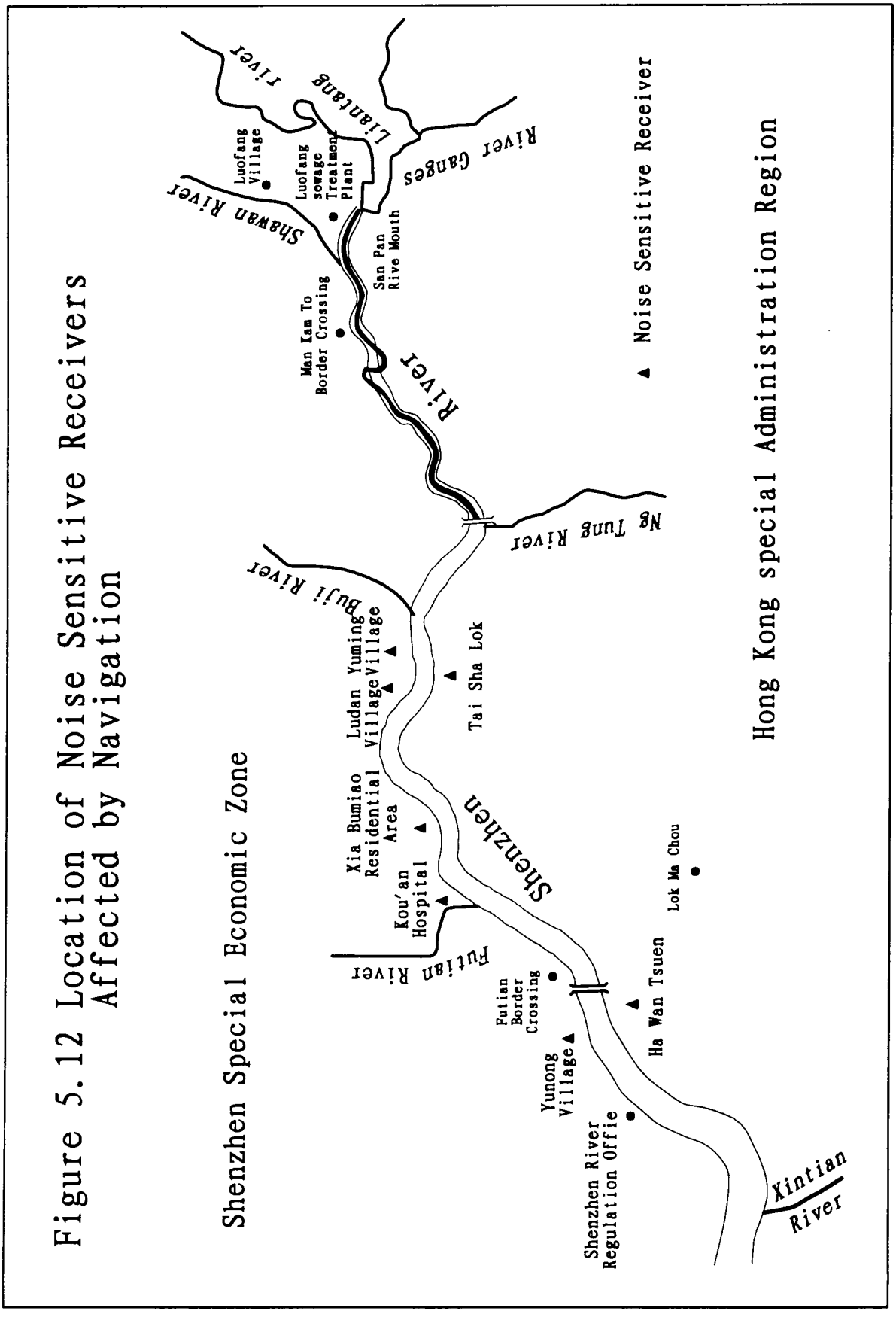


Figure 5.12 Location of Noise Sensitive Receivers Affected by Navigation
Shenzhen Special Economic Zone
Hong Kong special Administration Region
Noise Sensitive Receiver
Shawan River
Liantang River
River Ganges
Luofang Village
Luofang sewage Treatment Plant
San Pan Rive Mouth
Man Kam To Border Crossing
Ng Tung River
Buji River
Ludan Yuming Village
Tai Sha Lok
Xia Bumiao Residential Area
Kou'an Hospital
Futian River
Futian Border Crossing
Shenzhen
Lok Ma Chou
Ha Wan Tsuen
Yunong Village
Shenzhen River Regulation Offie
Xintian River

the different conditions or the ANL on the boundary of construction site is determined first. Then the allowable total construction noise level and traffic noise level of the hypothetical noise source are calculated. At last, the revised noise levels are calculated for all NSRs in consideration of attenuation, shielding and reflection of noise, meanwhile, the potential noise impact on the NSRs under the adverse condition will also be calculated. The issue of construction noise permit will depend on the comparison of the revised noise levels at NSRs with the ANL. If the revised noise levels are higher than the ANL, further mitigation measures, such as setting up noise barriers and/or adopting equipment with low-noise , must be taken, or, the permit should not be issued.

The traffic noise can be divided into two types, one is the noise from the construction site, and the other is the noise other than the construction site. For noise from construction site, the method specified in Section D. 3. 5. 2 in Part 1 (1997) of BS5288 is adopted. The method can calculate the equivalent noise level (Leq) according to parameters such as noise level of the mechanical equipment, traffic flow, average vehicle speed, and the distance between the sensitive receiver and the main roads. The *Calculation Method for Road Traffic Noise* given by the UK Department of Transport is adopted in calculating the traffic noise from other than the construction site.

For calculation of shipping noise impact on surrounding area, the assessment method described in *Technical Memorandum on Noise from the Construction Work other than Percussive Piling* is applied.

5. 5. 2 *Major Task of the Project Construction*

Task 1: Construction site clearing

It includes construction of new border fence and border roads, demolishing existing border roads and fence, leveling the construction site, water and electricity supply, and communication facilities. Meanwhile, office in the construction site, temporary camp and warehouses are also needed.

Task 2: Access road construction

The access road construction includes: (1) 9,470 m fences for construction site, of which 4,800 m is on the Shenzhen side, 4,670 m is on the Hong Kong side; (2) five construction access points; (3) 8600 m road, of which 4,650 m is on the Shenzhen

side, 3,950 m is on the Hong Kong side, and 500 m road on the Shenzhen side needs to be rebuilt or improved; (4) five steel truss bridges, which are mainly used for construction and for the convenience of installing and demolishing, with a total length of 310 m; (5) two floating pontoons.

Task 3: River course excavation

According to the feature of Stage III Project, excavation mainly includes river widening, deepening (dredging) and straightening.

Construction will be implemented in both wet excavation and dry excavation. For wet excavation, grab bucket dredger or long arm backhoe are adopted with mud scow or trippers for spoil transportation. For dry excavation, backhoe or long-arm backhoe are used with trippers for spoil transportation.

The contaminated spoil from wet excavation will be sent to East Sha Chau directly by double-open-bottom mud scow with capacity of 280 m^3(the distance is 45 km). The uncontaminated spoil is transported in the mud scow with capacity of 280 m^3(the distance is 40 km) and dumped into the marine dumping places near the Neilingding Island.

The spoil from dry excavation is dumped in the spoil ground directly by trippers with backhoe (the distance is 3 km); for dumping outside project area, the spoil will be barged to the dumping area near Neilingding Island (the distance is 40 km).

Task 4: Earth dyke filling and building

In the Stage III Project Area, the clean earth excavated from the river will be used for filling earth dykes. Wheel loaders, trippers, bulldozers with 120 hp, 10 t vibrating compactors will be used for earth taking, transportation, leveling and compacting respectively.

Task 5: Protection works for slop and bottom

For protecting the dykes from erosion and reduce the coarseness of the river course, concrete blocks are to be paved on floodplain terrace of the river channel. The protection works of slope and bottom includes: (1) placing consecutive concrete blocks for protecting the slopes above water surface; (2) riprap for protecting the slopes underwater; (3) bag-concrete for riverbed protection around Lo Wu Bridge base; (4) riprap for bottom protection in river mouth of the tributaries (including Ng Tung Ri-

ver Mouth, Sha Wan River Mouth, and the mouth of Ganges River).

The arrangement for the bank protection and bottom protection works includes: the precast concrete will be placed in the upper layer (layer of bag-concrete or riprap), then the gravel layer, the lowest layer will be the geotextile filter.

Task 6: Strengthening and reconstruction of cross border bridges

Five border-crossing bridges need to be strenghtened and rebuilt in Lo Wu and Man Kam To Border Crossings. The scheme for temporary bridge diversion is adopted for Lo Wu Railway Bridge. In addition, scheme of rebuilding Lo Wo Old Footbridge, strengthening bridge pier and bridge abutment for the New Lo Wu Bridge, and scheme of building New Two-way Vehicle Bridge for Man Kam To New and Old Vehicle Bridges have been recommended.

Task 7: Reprovisioning works on both Shenzhen and Hong Kong

The reprovisioning works on the Shenzhen side include: the existing drainage culverts and pipes (e.g. drainpipe of Luofang Wastewater Treatment Plant, drainage culvert in Luofang, flood discharge pipe in Huangbeiling, drainage pipe of the pumping stations and gate drainage culvert in Man Kam To, drainage pipes of the pumping stations and drainage pipes of the gate switching wells in Dongguangchang), conveyor belt, 110 kv No. 10 Power Supply Tower in Huangluoxian, Shan Cha River Gauging Station, frontier communication cable, the reinstallation of Shenzhen Border Crossing, border fences, border roads and new drainage pipe along the Shenzhen side,.

Reprovisioning works on the Hong Kong side include: nine outfalls, Dongjiang Water Mains (especially the reinstallation at Muk Wu Pumping Station), frontier communication cable, electric power cable passing through the border, the reinstallation of Border Crossing and 6 drainage culverts on the Hong Kong side.

5.5.3 *Potential Noise Sources*

(1) Machinery and equipment for Construction

According to the mechanical equipment recommended for Stage Ⅲ, in comparison with the actual conditions in Stage I and Stage II of the Project, the corresponding sound work level (SWLs) and the quantity of the main construction equipment recommended for Stage Ⅲ Project are shown in Table 5.6. It has been confirmed that the

mechanical equipment recommended is commercially available, and shall fullfill the need for construction .

Table 5.6 Major Mechanical Equipment and Corresponding Sound Power Level

Construction Activity	Mechanical Equipment Used in the Construction	Sound Power Level of Each Equipment (dB(A))	Combination of the Mechanical Equipment	Total Sound PowerLevel (dB(A))
Haul road	Bulldozer (CNP030) Trippers (BS5228) Roller (CNP185) Grab/loader (CNP081)	115 105 108 112	1 Grab/loader and 2 Trippers; or 1 Bulldozer; or 1 Roller.	113 115 108
River excavation	Grab dredger(CNP063) Trippers (BS5228) Self-navigating mud barge Grab/loader (CNP081)	112 105 110 112	1 Grab bucket dredger and 1 Self-navigating mud barge (wet excavation); or 1 Grab/loader and 2 Trippers	114 113
Embankment construction	Bulldozer (CNP030) Grab/loader (CNP081) Trippers (BS5228) Vibratory roller (CNP184)	115 112 105 111	1 Grab/loader and 2 Trippers; or 1 Bulldozer; or 1 Roller.	113 115 108
Bank protection and slope protection	Fluid pressure grab bucket (BS5228) Mechanism grab bucket (BS5228) Self-navigation stone barge Concrete agitator truck (CNP044) Crane carried by vehicle (BS5228) (5—10t) Spiral drill machine (CNP167)	102 105 110 109 112 114	1 Mechanism grab bucket, 1 Self-navigation stone barge and 1 Concrete agitator truck; or 1 Fluid pressure grab bucket and 1 Crane carried by lony; or 1 Spiral drill machine and 1 Crane carried by vehicle	113 112.5 116
Strengthen and rebuild the bridges	Rail crane Crane carried by lorry (BS5228)(40t) Spiral drill machine (CNP167) Concrete agitator truck (CNP044) Jack	108 116 109 107	2 Crane carried by vehicles, 1 Concrete agitator truck and 2 Jacks; Or 2 Rail Cranes, 1 Concrete agitator truck and 2 Jacks	118 114.5
Reprovisioning Works	Concrete truck (CNP044) Plate trailer (BS5228) Crane carried by lorry (BS5228)(5—10t)	109 112 112	1 Concrete truck, a Plate trailer and 1 Crane carried by lorry	116

Notes: [1] the above sound power level is assessed in the condition of no natural and man-made noise barrier.

[2] all the combinations of mechanical equipment for each construction activity listed in the above Table are not in operation at the same time, and only one combination of mechanical equipment produces noise during construction operation.

All the combinations of mechanical equipment for each construction activity listed in Table 5.6 are not in operation at the same time, and there is only one combination to produce noise. For example, there are three kinds of combination for embankment construction: 1 grab/loader and 2 trippers; or 1 bulldozer; or 1 roller. During the ex-

cavation and loading operation, the 1 Grab/loader and 2 Trippers are in operation, while the Bulldozer and Roller are not in operation; likewise, when the Bulldozer is in operation, the 1 Grab/loader , 2 Trippers and the Roller are not in operation. The major mechanical equipment needed for all the construction activities listed in Table 5. 6 are not in operation at the same time.

In the following prediction of each kind of construction noise, the total sound power level of the mechanical equipment used in each construction activity is calculated according to the maximum sound power level of all kinds of combination of associated equipment. For example, there are three kinds of combination of mechanical equipment in the embankment construction, i. e. , 1 grab/loader and 2 trippers, or 1 bulldozer, or 1 roller, with the total sound power levels being 113, 115 and 108 dB (A), respectively. During the construction, the bulldozer will produce a sound power level of 115 dB (A) when it is in operation, while the grab/loader, the roller and the tripper are idle, thus, the total sound power level for embankment construction is 115 dB (A). Likewise, the 1 grab/loader and 2 trippers will produce a total sound power level of 113 dB (A) when they are in operation, while the bulldozer and the roller are not in use, thus the total sound power level for the embankment construction is 113 dB (A). However, the 115 dB (A) is adopted in the prediction of the construction noise in this EIA, for the sake of greater reliability.

(2) Tripper noise (transportation on land)

It is assumed that the road for carrying material is used 12 hours per day with a traffic volume of 138, and the peak hour factor is 1. 5, so the traffic volume for the noise assessment is taken as $138\times2\times1.5/12=34.5$ times/h. If taking 30 km/h as the mean speed, the sound level for 10 t truck will be 105 dB(A) according to the method given in BS5228(1997) (Part1. D. 3. 7).

According to the Project plan, the earth-borrowing site is situated in the northwest Shuijin Daliang Village in Buji Town. The former rock transportation route is used for this purpose, which is from Daliang Village to Xiaoguan—Honggang Road, then East Nigang Road—Buxin Road—Aiguo Road—North Yanhe Road—Yanfang Road—Construction site, with a total length of about 17—19 km and two-way traffic volume of 18 vehicles per hour. The assessment is divided into two parts according to the location of the transportation route. The first part is the section from Daliang Village to Honggang Road, which is almost a rural path with few noise sensitive spots. The other part is the section from Honggang Road to the construction site, which pass through Lo Wu District with large traffic volume, and a lot of noise sensitive spots

such as residential zones and schools. For the first part, the method described in D. 3. 5. 2 of BS5228 (1997) is adopted, as it is similar to the haul road. It is supposed that the road is used for 12 hours everyday for carrying material with traffic volume of 18 vehicles per hour, which is applied in traffic noise assessment. Given the mean speed is 30 km/h, the sound level for 10 t truck will be 105 dB(A), based on the method from BS5228(1997) (part1. D. 3. 7). For the other section, the method described in *Computation Method for Traffic Noise* from UK Department of Transport is applied.

(3) Shipping noise

According to the layout scheme of spoil disposal grounds, and corresponding schemes on river excavation and transportation for Stage III Project, East Sha Chau is used as the dumping area for contaminated soil, while some non-contaminated soil will be discarded on both sides of the river section of Stage III Project, and the rest will be dumped in the marine dumping places near the Neilingdin Island. When soil is discarded out of the Project Area, the shipping distance to East Sha Chau is 40 km, and 45 km for the distance to the Neilingding Island. Self-power mud barges (120 t) are used for transportation. According to the monitoring on the same kind of ship, shipping noise mainly come from the noise of the engine and whistling. The sound power level of the shipping noise will reach 124 dB(A) when ship is whistling, and 110 dB (A) when ship is not whistling.

(4) Traffic noise

According to the design, a Two-way Vehicle Bridge will be newly built to replace the former two single-direction bridges in Man Kam To Border Crossing. The designed maximum traffic volume is 8000 vehicles/day. In view of assuring the noise impact, given the average vehicle speed is 35 km/h after the completion of the Man Kam To, the maximum theoretical traffic volume is 4000 vehicle/hour. However, this assumption did not consider the safety of the bridge and the inspection facitilies of the Border Crossing, thus it is impossible.

5. 6 Assessment of Potential Noise Impacts

5. 6. 1 *Daytime Noise on Boundary of Construction Site*

(1) Hong Kong Side

● **Noise impacts of single set of construction activity**

The potential impacts of each single set of construction activity on NSRs are calculated by means of the method summarized in *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, with consideration of attenuation, shielding and reflection of noise. The revised sound level at each NSR and its comparison with associated standard are given in Table 5.7.

Table 5.7 Potential Impacts of Each Single Set of Construction Activity

Construction Activity	Total Sound Power Level (dB (A))[1]	NSRs[2,4]			
		Lo Wu Tsuen	Lo Wu Public School[3]	Muk Wu Tsuen	Nag Yiu Ysuen
Access road	115	74 (0)	68 (0) [3]	67 (0)	72 (0)
River channel excavation	114	73 (0)	67 (0) [2]	66 (0)	71 (0)
Earth-dyke filling	115	74 (0)	68 (0) [3]	67 (0)	72 (0)
Bank slope and bed protection	116	75 (0)	69 (0) [4]	68 (0)	73 (0)
Reprovisioning works	116	75 (0)	69 (0) [4]	68 (0)	73 (0)
Rebuilding of Man Kam To Bridge	118	50 (0)	51 (0) [0]	57 (0)	55 (0)
Rebuilding of Lo Wu Bridge	118	63 (0)	60 (0) [0]	43 (0)	42 (0)

Note: [1] the total sound power levels in the Table are the maximum ones of all kinds of combination in respective construction activities.

[2] the values in parentheses indicate the degrees of the sound power levels at NSRs exceeding the associated standards. The standards are given in Table 5.4.

[3] the values in parentheses indicate the degrees of exceedance over 70 dB (A), the values in square brackets indicate the degrees of exceedance above 65 dB (A).

[4] there are natural barriers between the Lo Wu Public School the Noise Sources (see Figure 5.9A), for this reason, the predicted noise levels are revised by cutting off by 10 dB (A); during the rebuilding of the Lo Wu Bridge, there is a huge buildings (Lo Wu Station Terminal Building) between the Noise Source and the NSRs, therefore, the predicted values are revised by cutting off by 5 dB (A); noise sound reflection is also taken into consideration in the calculation by plus 3 dB (A) of modification coefficient .

The noise levels at NSRs produced by each single set of construction activity have been calculated by means of the method summarized in *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, and the results are given in Table 5.7. It is shown from the Table that the daytime standard 75 dB (A) will not be exceeded at NSRs such as Lo Wu Tsuen, Muk Wu Tsuen and Nga Yiu Tsuen, and the daytime standard 70 dB (A) will not be exceeded at Lo Wu Public School, on

the Hong Kong side when each construction activity is conducted separately (such as dyke construction ,bank slope and bed protection ,river channel excavation , reprovisioning works ,access road construction ,and bridge strengthening works). During examination period, however, the noise level produced by each construction activity excluding bridge rebuilding will exceed the 65 dB (A) standard by 2—4 dB (A).

As the construction area is in a narrow and long shape along the Shenzhen river and the NSRs are scattered on the Hong Kong side, the NSRs will be affected only when construction activity takes place in the river section nearest to them. The farther the construction river section is away from the NSRs, the less significant the noise impact is on the NSRs. For example, when the Man Kam To river section is under construction, Muk Wu Tsuen (on Hong Kong side) will be affected by the construction noise. Because the distances from Man Kam To river section to Lo Wu Public School, Lo Wu Tsuen, and Nga Yiu Ysuen are all over 1,000 m, which is greater than the 600 m distance from the river section to Muk Wu Tsuen, Man Kam To river section construction will not affect the NSRs of the Hong Kong side.

● The cumulative impact of different construction activities

The whole construction area of the Stage III project is divided into four relatively separate sub-areas according to the site conditions such as the layout and structural type of the river channel, and the location of the Border-Crossing. Construction activities will be carried out simultaneously in the four sub-areas. The main project construction period of the Stage III is from July, 2001 to September, 2004, totaling 39 months. According to the construction schedule, quite a few construction activities will be carried out simultaneously. The cumulative construction noise impacts on Hong Kong NSRs are assessed as follows.

Table 5.8 Cumulative Construction Noise Impacts on Hong Kong NSRs

Simultaneous Construction Activities	Total Sound Power Level dB(A)	NSRs[1,3]			
		Lo Wu Tsuen	Lo Wu Public School[2]	Muk Wu Tsuen	Nag Yiu Ysuen
Channel excavation, dyke filling	117.5	76.5 (1.5)	70.5 (0.5) [5.5]	69.5(0)	74.5(0)
Bank and bed protection, dyke filling	118.5	77.5 (2.5)	71.5 (1.5) [6.5]	70.5(0)	75.5(0.5)

Note:[1] the values in parentheses indicate the degrees of the sound power levels at NSRs exceeding the associated standards. The standards are given in Table 5.4.

[2] the values in parentheses indicate the degrees of exceedance over 70 dB (A), the values in square brack-

ets indicate the degrees of exceedance over 65 dB (A).

[3] there are natural barriers between the Lo Wu Public School the Noise Sources (see Figure 5. 9A), for this reason, the predicted noise levels are revised by cutting off by 10 dB (A); during the rebuilding of the Lo Wu Bridge, there is a huge buildings (Lo Wu Station Terminal Building) between the Noise Source and the NSRs, therefore, the predicted values are revised by cutting off by 5 dB (A); noise sound reflection is also taken into consideration in the calculation by plus 3 dB (A) of modification coefficient .

It can be seen from Table 5. 8 that noise levels at Muk Wu Tsuen and Nga Yiu Tsuen will not exceed the daytime standard of 75 dB (A), but, at Lo Wu Tsuen the noise level exceeds the daytime standard of 75 dB (A) and at Lo Wu Public School the noise level exceeds the standard of 70 dB (A), with an excess of 0. 5—1. 5 dB (A) when channel excavation and dyke filling are carried out simultaneously. Noise levels at Lo Wu Tsuen and Nga Yiu Tsuen will both exceed the daytime standard of 75 dB (A), and at Lo Wu Public School the noise level will exceed the standard of 70 dB (A), with an excess of 0. 5—2. 5 dB (A). During examination period, the noise level at Lo Wu Public School will exceed the standard of 65 dB (A), with an notable excess of 5. 5—6. 5 dB (A).

The above-mentioned results are based on the assumption that the construction is carried out in the river section nearest to NSRs when the impacts on NSRs are the most significant. As the construction area is in a narrow and long shape along the Shenzhen River and the NSRs are scattered on the Hong Kong side, the construction operation in the river section nearest to NSRs will last only a short period. When the construction operation is away from the river section nearest to NSRs, the noise impacts on NSRs will become less significant.

The minimum distances required between construction Area Boundary and NSRs when several sets of construction activities are simultaneously carried out are calculated according to the assessment results listed in Table 5. 8 and according to the distance modification coefficient specified in Table 5 of Hong Kong *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, as shown in Table 5. 9.

It can be seen from Table 5. 9 that the minimum distance between construction area boundary and NSRs is over 75 m when channel excavation and dyke filling are carried out simultaneously. The distance must be over 84 m when bank and bed protection and dyke filling are carried out simultaneously. In other words, when the construction operation is carried out 84 m away from any NSRs, the cumulative noise level due

to multiple construction operations at the NSR will not exceed the associated standards. Therefore, in the construction site which is less than 84 m away from NSRs, only one kind of construction operations listed in Table 5. 7 can be carried out at a time, while in the construction site which is greater than 84 m away from NSRs, any of the construction operation combination listed in Table 5. 8 can be carried out at a time.

Table 5. 9 The Minimum Distances (m) Required between Construction Area Boundary and NSRs

Simultaneous Construction Activities	NSRs			
	Lo Wu Tsuen	Lo Wu Public School[1]	Muk Wu Tsuen	Nag Yiu Ysuen
Channel excavation, dyke filling	75	42 (75)	75	75
Bank and bed protection, dyke filling	84	48 (84)	84	84

Note:[1] the values in parentheses indicate the minimum distances required during examination period.

● **The cumulative impact of the Stage III Project with other project (Hong Kong side)**

According to *North District Development Programme* of the Hong Kong Territory Development Department, there is no planned development in the Stage III project area on the Hong Kong side. The nearest one to the Project Area is *Fanling, Sheung Shui Development Program*. Implementation of this programme will involve construction of water supply systems and houses, the latter of which is based on the " *House Ownership Programme*". The minimum distance between the construction areas of the two projects is above 2 km, besides, there is a hill separate them, therefore, there is no need to consider their cumulative noise impacts.

Traffic noise is different from the ordinary stationary noise, and is usually within the acceptable range unless it is in a very near distance. Therefore, the impact of traffic noise can be neglected.

To sum up, the noise cumulative impacts of the project with other project need not be considered in this EIA.

(2) Shenzhen Side

On the Shenzhen side, the noise control is based on the noise level at construction site

boundary, thus, restrictions for activities near the boundary will be quite strict. For example, during road construction, simultaneous operation of 1 grab/loader and 2 trippers will cause violation to the standards for earth-works construction on the construction site boundary near the road. Operation of only one set bulldozer can produce a sound power level of 115 dB (A), thus causing exceedance to the standards on the construction area boundary. The impacts of construction noise on Shenzhen NSRs are predicted as follows:

● Noise impacts of single set of construction activity

The predicted noise level produced by each single set of construction activity at Shenzhen NSRs and its violation to standards are shown in Table 5. 10.

Table 5. 10 Potential Impacts of Each Single Set of Construction Activity

Construction Activity	Total Sound Power Level (dB (A))[1]	NSRs[2,3]				
		Dormitory of the Inspection Station	Lo Wu No. 4 Village	Xiangxi Middle School	Huaqiao New Village	Xinxiu Village
Access road construction	115	71(11)	63(3)	55(0)	59(0)	54(0)
River course excavation	114	70(10)	62(2)	54(0)	58(0)	53(0)
Earth dyke filling	115	71(11)	63(3)	55(0)	59(0)	54(0)
Bank and bed protection	116	72(12)	64(4)	56(0)	60(0)	55(0)
Reprovisioning works	116	72(12)	64(4)	56(0)	60(0)	55(0)
Man Kam To Bridge rebuilding	118	41(0)	46(0)	52(0)	49(0)	33(0)
Lo Wu Bridge rebuilding	118	44(0)	45(0)	41(0)	38(0)	36(0)

Note: [1] the total sound power levels in the Table are the maximum ones of all kinds of combination in respective construction activities.

[2] the values in parentheses indicate the degrees of the sound power levels at NSRs exceeding the associated standards. The standards are given in Table 5. 1.

[3] there are huge buildings between the noise sources and the NSRs such as the dormitory of the inspection station, Lo Wu No. 4 Village, Xiangxi Middle School, Huaqiao New Village, and Xinxiu Village, therefore, the predicted noise levels are revised by cutting off by 10 dB (A); noise sound reflection is also taken into consideration in the calculation by plus 3 dB (A) of modification coefficient .

It can be seen that when each set of construction activities is separately carried out,

the noise levels at Xiangxi Middle School, Huaqiao New Village and Xinxiu Village will not exceed the associated standards. When each set of construction activity, excluding bridge rebuilding, is carried out separately, the noise levels at the dormitory of the inspection station and Lo Wu No. 4 Village will exceed the associated standards, with an exceedance of 2—4 dB (A) at Lo Wu No. 4 Village. As the dormitory is very close to the construction site boundary (28 m), the excess will be very significant, ranging from 10—12 dB (A).

As the construction area is in a narrow and long shape along the Shenzhen river and the NSRs are scattered on the Shenzhen side, the NSRs will be affected only when construction activity takes place in the river section nearest to them. The farther the construction river section is away from the NSRs, the less significant the noise impact is on the NSRs. For example, when the Man Kam To river section is under construction, the most significant affected Xiangxi Middle School is 350 m away, and other NSRs such as the dormitory of the inspection station, Lo Wu No. 4 Village, Huaqiao New Village and Xinxiu Village are all over 500 m away, therefore, when construction is carried out in the Man Kam To river section, the Shenzhen NSRs will not be affected.

● The cumulative impact of different construction activities

According to the construction schedule, quite a few construction activities will be carried out simultaneously. The cumulative construction noise impacts on Shenzhen NSRs are assessed as follows.

Table 5. 11 Superposed Construction Noise Impacts on Shenzhen NSRs

Simultaneous Construction Activities	Total Sound Power Level dB(A)	NSRs[1,2]				
		Dormitoryof the Inspection Station	Lo Wu No. 4 Village	Xiangxi Middle School	Huaqiao New Village	Xinxiu Village
Channel excavation, dyke filling	117. 5	73. 5 (13. 5)	65. 5 (5. 5)	57. 5 (0)	61. 5 (1. 5)	56. 5 (0)
Bank and bed protection, dyke filling	118. 5	74. 5 (14. 5)	66. 5 (6. 5)	58. 5 (0)	62. 5 (2. 5)	57. 5 (0)

Note: [1] the values in parentheses indicate the degrees of the sound power levels at NSRs exceeding the associated standards. The standards are given in Table 5. 1.

[2] there are huge buildings between the noise sources and the NSRs such as the dormitory of the inspection station, Lo Wu No. 4 Village, Xiangxi Middle School, Huaqiao New Village, and Xinxiu Village, therefore, the predicted noise levels are revised by cutting off by 10 dB (A); noise sound reflection is also taken into consideration in the calculation by plus 3 dB (A) of modification coefficient .

It can be seen from Table 5.11 that when several sets of construction activities are simultaneously carried out, the noise levels will not exceed the 60 dB (A) standard for daytime at Xiangxi Middle School and Xinxiu Village, but they will exceed that standard at the dormitory of the inspection station, Lo Wu No. 4 Village and Huaqiao New Village. As it is very close to the construction site boundary (only 28 m away), the dormitory of the inspection station will be seriously affected by the construction noise, with as high an excess as about 14 dB (A). The excess magnitudes at the other two NSRs are about 6 dB (A).

The above-mentioned results are based on the assumption that the construction is carried out in the river section nearest to NSRs when the impacts on NSRs are the most significant. As the construction area is in a narrow and long shape along the Shenzhen River and the NSRs are scattered on the Hong Kong side, the construction operation in the river section nearest to NSRs will last only a short period. When the construction operation is away from the river section nearest to NSRs, the noise impacts on NSRs will become less significant.

The minimum distances required between construction Area Boundary and NSRs when several sets of construction activities are simultaneously carried out are calculated according to the assessment results listed in Table 5.11 and according to the distance modification coefficient specified in Table 5 of Hong Kong *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, as is shown in Table 5.12.

Table 5.12 The Minimum Distances (m) Required between Construction Area Boundary and NSRs

Simultaneous Construction Activities	NSRs				
	Dormitory of the Inspection Station	Lo Wu No. 4 Village	Xiangxi Middle School	Huaqiao New Village	Xinxiu Village
Channel excavation, dyke filling	130	130	130	130	130
Bank and bed protection, dyke filling	145	145	145	145	145

It can be seen from Table 5.12 that the minimum distance between construction area boundary and NSRs must be over 130 m when channel excavation and dyke filling are carried out simultaneously, the distance must be over 145 m when bank and bed pro-

tection and dyke filling are carried out simultaneously. In other words, when the construction operation is carried out 145 m away from any NSRs, the cumulative noise level due to multiple construction operations at the NSR will not exceed the associated standards. Therefore, in the construction site which is less than 145 m away from NSRs, construction operations should not be simultaneously carried out. But in the construction site which is greater than 145 m away from NSRs, any of the construction operation combination can be carried out at the same time.

It should be noted that, in the early preparative phase of the construction (building haul roads and the dyke on the south bank of the River), the distance between the machinery operation in construction activities and the NSR is even closer than that in the main work phase. Thus measures for controlling noise must be implemented. The distance between the equipment used in the main work and construction activities (river dredging, slope protection) and the NSR will be farther than that in preparative phase (access road construction), the receiver will be benefited from the distance attenuation effect.

For receivers close to the noise source, it is infeasible to meet the noise standard in daytime by limiting the quantity of the construction equipment or total sound power level. Because the noise source is too close to the receiver, additional measures must be taken, such as setting up temporary noise barrier or proper scheduling of construction activities and equipment operation.

5.6.2 *Noise on Boundary of the Construction Site in Nighttime and on Public Holidays*

The maximum allowable total sound power level for integration of construction machinery (traffic noise is excluded) is listed in Table 5.13, in the precondition of not exceeding the noise standards for nighttime and public holidays in Shenzhen and Hong Kong. For example, if the total sound power level of the operated equipment does not exceed 99 dB(A), then the noise level at the spot 200 m away from the front side of the sound source will not exceed the noise standard of 45 dB(A) in nighttime of Hong Kong. In the same way, if total sound power level is controlled to be less than 100 dB (A), the noise at the spot 50 m away from the boundary of the construction site will not exceed the nation's noise standard of 50 dB(A) in nighttime It is assumed in the precondition of no natural or artificial barriers.

The stricter noise standard for the evening and the nighttime requires that construction activities should produce less noise. Many kinds of equipment listed in Table 5. 6 are restricted to be operated simultaneously by the associated standards of both Shenzhen and Hong Kong.

Table 5. 13 Maximum Allowable Sound Power Levels for Construction in the Evening and Nighttime [dB(A)]

Distance To Sound Source (m)		10	30	50	100	200	300	500	700	1000	1600	2000	3000
Shenzhen	Earth rock	78	88	92	98	104	108	112	115	118	122	124	128
(night)	Structure	78	88	92	98	104	108	112	115	118	122	124	128
Hong Kong	ASR=A	88	98	102	108	114	118	122	125	128	132	134	138
(evening)	ASR=B	93	103	107	113	119	123	127	130	133	137	139	143
Hong Kong	ASR=A	73	88	87	93	99	103	107	110	113	117	119	123
(night)	ASR=B	78	88	92	98	103	108	112	115	118	122	124	128

(1) Hong Kong side

Usually, if the overall construction activities continue at night and on public holidays, it is very difficult to meet the noise control standards for construction. If construction is conducted near the boundary of construction site, the noise will exceed the standard of NCO, even the machinery is operated in a reasonable combination. It is suggested that the total sound power level of the mechanical equipment should be controlled below 83 dB(A) in the construction near the Lo Wu Tsuen and Lo Wu Public School. The total sound power level of the mechanical equipment should be controlled below 91dB(A) in the construction near the Muk Wu Tsuen and Nga Yiu Tsuen. Since the sound level of a single mechanical equipment exceeds 95 dB(A), remedial measures should be taken to reduce the noise to an acceptable level. For example, the dykes finished in the early phase of Stage III Project might be used as sound barrier, which will reduce the noise impact from channel dredging and embankment construction. Thus if the embankment is completed before dredging, it can play a role of sound barrier later. During the main construction period, the embankment could also provide certain protection from noise impact, if it is high enough. Otherwise, temporary noise barrier should be established above the embankments.

Construction operation must be prohibited both at night and on public holidays because the associated standard for construction noise control is difficult to be satisfied. The constructional activities in the evening and at night must be under the restriction

from *Noise Control Ordnance (NCO)*. Construction can be carried out by construction contractors in the evening, at night and on public holidays in Hong Kong only after a Construction Noise Permit is acquired, and the permit conditions must be seriously followed.

(2) Shenzhen side

The noise limit in Shenzhen is based on the noise level on the boundary of the construction site, the standard strictly restrict the construction activities near the boundary of the construction site. For example, at any place within 35 m to the construction equipment, the noise standard for earth work construction is sure to be violated if dredger and mud barge are operated simultaneously during river dredging period, no matter there is any natural or artificial barrier or not. Likewise, in the bank slope and channel bed protection construction, if a crane truck, a stone barge and a concrete agitator truck operate simultaneously, the noise level at receiver sites within 100 m to the equipment will exceed the construction noise standard of Shenzhen.

The NSRs on the Shenzhen side such as Xiangxi Middle School and Xinxiu Village are all over 180 m away from the boundary of the construction site. During the earth work and structure construction, if the noise levels at these two NSRs should meet the 50 dB(A) standard for nighttime, the total sound power level of the mechanical equipment combination must be controlled below 103 dB(A). During the construction near the Lo Wu No. 4 Village, if the noise level of these NSRs should reach Grade Ⅱ of the standard of Shenzhen (50 dB(A)), the total sound power level of the mechanical equipment combination must be controlled below 95 dB(A). For the construction near the Huaqiao New Village, if the noise level of the NSR should keep at Grade II of the standard of Shenzhen (50 dB(A)), the total sound power level of the mechanical equipment combination must be controlled less than 99 dB(A). Because the dormitory of the inspection station is the nearest NSR to the boundary of the construction site (28 m), the total sound power level of the mechanical equipment should be strictly controlled. For the construction in this area, if the noise level of the NSR should be kept at Grade Ⅱ of the standard of Shenzhen (50 dB(A)), the total sound power level of the mechanical equipment combination must be controlled below 87 dB (A). As the sound power level produced by a single operated equipment in the construction might lead the noise level of the NSR to exceed the standard, construction during the night is prohibited. If it is necessary to conduct construction in nighttime due to the Project plan, specific measures must be adopted to decrease the noise level

to an acceptable level.

5.6.3 *Noise from Traffic and Transportation*

(1) Traffic noise impact in the construction site (transportation on land)

According to the traffic and the sound power level of the truck for transporting material indicated in Section 5.5.3, the noise levels at different distance to the road are calculated, the result is shown in Table 5.14.

Table 5.14 Forecasted Traffic Noise during Construction Period [dB(A)]

Distance (m)	5	10	20	30	40	50	75	100	150	200	300
Face	65.5	62.5	59.5	57.8	56.5	55.5	53.8	52.5	50.8	48.5	47.8
Open space	62.5	59.5	56.5	54.8	53.5	52.5	50.8	49.5	47.8	45.5	44.8

Different from noise produced by fixed source, the traffic noise is usually below the acceptable level except in very close distance. Some restrictive measures might be needed in nighttime in order to satisfy the standard of Shenzhen. The noise impact must be fully taken into consideration in the detailed design of haul roads for Stage III Project. The haul road should be far away from the NSR as much as possible.

(2) Noise impact of shipping

According to the recommended schemes of spoil disposal and the scheme for excavation and transportation, the contaminated spoil will be carried to and discarded in East Sha Chau (40 km for shipping), and part of uncontaminated spoil will be discarded in the sea near Neilingding Island (45 km for shipping). Self-power mud barges (120 t) are used for transportation. According to the survey on ships, shipping noise mainly come from the engine and whistling. Sound level of the shipping noise will reach 124 dB(A) when the ship is whistling, and 110 dB(A) when not whistling. The forecasted values of noise level at different distances are listed in Table 5.15.

Table 5.15 Forecasted Noise Level of Shipping [dB(A)]

Distance(m)	5	10	20	30	40	50	75	100	150	200	250	300	500	700
Whistling	102	96	90	86	84	82	78	76	72	70	68	67	62	59
Not whistling	88	82	76	72	70	68	64	62	58	56	54	53	48	45

According to the results listed in Table 5.15, the receivers on both sides of the Shenzhen River will be seriously affected by whistling. Only at the distance of 700 m away from the ship, noise levels could satisfy Grade Ⅱ of the standard (60 dB(A)) on the Shenzhen side. As most of the NSRs on both sides of the Shenzhen River are within 700 m to the transportation ship, therefore all noise levels of the NSRs will exceed the standard of both Shenzhen and Hong Kong.

During navigation (no whistling), only at the point 120 m away from the ship, noise could satisfy Grade Ⅱ of the standard (60 dB(A)) on the Shenzhen side. Because the NSR on the Hong Kong side, such as Ha Wan Tsuen and Tai Sha Lok are over 120 m away from the ship, navigation (no whistling) will not affect the NSRs on the Hong Kong side. The NSRs on the Shenzhen side are within 120 m to the transportation ship, especially the Yumin Village with a distance of only 15 m, will exert serious impact of noise from ship transportation (the affected noise level is 78 dB(A)). Because the NSR on the Shenzhen side will be affected to different extents, additional measures should be adopted to reduce the noise level to an acceptable level.

(3) Traffic noise from transportation of earth

The prediction for noise impact from earth transportation is computed in two parts.

1) The section from Daliang Village to Honggang Road: Based on the traffic volume on the road and the noise level from the truck for material transportation specified in Section 5.5.3, the noise levels are calculated for the sports with different distances to the road. The result is given in Table 5.16.

As this section is almost undeveloped with few noise sensitive receivers, the noise level at the sports 5 m away from the road can meet Grade IV of the *Standard for Noise in Urban Environment* (*GB*3096—93). Therefore, little impact will be resulted from the surrounding areas.

Table 5.16 Forecasted Traffic Noise in the Operation Period [dB(A)]

Distance(m)	5	10	20	30	40	50	75	100	150	200	300
Front side	65.9	62.9	59.9	58.2	56.9	54.8	53.1	51.8	50.1	48.8	47.1
Open space	62.9	59.9	56.9	55.2	53.9	51.8	50.1	49.8	47.1	45.8	44.1

2) The section from Honggang Road to the construction site: Because the traffic vo-

lume (2,800—4,500 vehicles per hour) in Honggang Road, Nigang Road and Yanho Road is greater than the access road in construction site (18 vehicles per hour), the noise impact on the surrounding area from the trucks for earth transportation is negligible.

(4) Noise from New Man Kam To Bridge

According to the design program, the New Two-way Vehicle Bridge will be built to replace the previous two vehicle bridges in Man Kam To Border Crossing, the design traffic volume is 8,000 vehicles per day, equal to 800 vehicles per hour. In light with the relevant regulations of Hong Kong, noise prediction is normally based on the maximum traffic volume within 15 years after the bridge is put into operation. Considering the extreme condition, namely assuming the mean vehicle speed is 40 km/h after completion of the bridge, and the maximum theoretical traffic volume would reach 4,000 vehicles per hour. This assumption does not consider the safety requirement of the bridge, nor inspection facitilies of the Border Crossing. It is expected that the maximum traffic volume within 15 years upon operation of the New Man Kam To Bridge will not exceed this volume.

The NSRs near Man Kam To Bridge includes Xiangxi Middle School on the Shenzhen side (310 m to the Bridge), Muk Wu Tsuen on the Hong Kong side (600 m to the Bridge), and Nga Yiu Tsuen (1,089 m to the new Bridge) respectively. As all the NSRs around the Man Kam To New Bridge are greater than 300 m away from the bridge (310 m on Shenzhen side, and 600 m on Hong Kong side), the traffic noise will not affect the NSRs of both sides after the New Bridge is open to traffic.

5.6.4 *Noise in Maintenance Period*

Because river course dredging is the sole operation in the maintenance period and will not be carried out in nighttime, the noise impact during this period will be the same as described in Section 5.5.1 and 5.5.3. Namely:

During the dredging operation, the noise level on the Hong Kong side at NSRs such as Lo Wu Tsuen (1# on the Hong Kong side), Muk Wu Tsuen (3# on the Hong Kong side), and Nga Yiu Tsuen (4# on the Hong Kong side) will not exceed the noise standard of 75 dB(A) in daytime. The noise level at Lo Wu Public School (2# on the Hong Kong side) will also not exceed the standard of 70 dB (A) in daytime, but will exceed the standard of 65 dB (A) during examination period. The NSRs on

the Shenzhen side, such as Xiangxi Middle School and Xinxiu Village, are all over 180 m away to the boundary of the construction site. During construction, if the noise level of these NSRs meet the Grade Ⅱ of the standard of Shenzhen (60 dB(A)), the total sound level of the mechanical equipment combination must be controlled below 113 dB(A). For the construction near the Lo Wu No. 4 Village, in order to keep the noise level of these NSRs at Grade Ⅱ of the standard of Shenzhen (60 dB(A)), the total sound level of the mechanical equipment combination must be controlled below 105 dB(A), while 109 dB(A) for the construction near the Huaqiao New Village. As the border inspection station dormitory is the nearest to the boundary of the construction site (28 m), the total sound power level of the mechanical equipment should be strictly controlled in the construction. For keeping the noise level of these NSRs in Grade Ⅱ of the standard of Shenzhen (60 dB(A)), the total sound level of the mechanical equipment combination must be controlled below 97 dB(A). Additional measures should be adopted to reduce the noise level to an acceptable level because the sound level produced by a single equipment operating might lead the noise level of the NSR to exceed the standard.

During operation of marine dumping places, the receivers on both sides of the Shenzhen River will be seriously affected by whistling. Only at the distance of 700 m away from the ship, the noise levels satisfy Grade Ⅱ of the standard (60 dB(A)) on the Shenzhen side. The NSRs on both sides of the Shenzhen River are basically within 700 m to the transportation ship, therefore noise level of all NSRs exceed the standard of Shenzhen and Hong Kong. During shipping (no whistling), only at the point 120 m away from ship, noise on the Shenzhen side could satisfy Grade Ⅱ of the standard (60 dB(A)). As Ha Wan Tsuen and Tai Sha Lok, are over 120 m away from the ship, navigation (no whistling) will cause no effect on the NSR on the Hong Kong side. The NSR on the Shenzhen side are within 120 m to the ship, especially Yumin Village being the closest (15 m), therefore, significant impact of the noise from the ship navigation (affected noise level is 78 dB(A)) will be resulted. As the NSR on the Shenzhen side will be affected to different extent, additional measures should be adopted to reduce the noise impact reduce to an acceptable level.

5.7 Mitigation Measures

According to the above assessment results, noise control measures should be taken in order to make construction noise and traffic noise to an acceptable level.

5.7.1 *Construction Period*

(1) Proper scheduling the construction

When arranging the construction, a great deal of mechanical equipment at the same site must be avoided. A rational construction plan might reduce the quantity of machinery for the construction, in addition, more evenly distribute the machinery in whole construction area, but not concentrated at a spot that might disturb the sensitive area nearby. In addition, it must be avoided that several sets of the construction equipment are used at the same time near sensitive sites or on the boundary of the construction site. Mechanical equipment operation and construction activities should be arranged in areas far away from the sensitive areas. Construction at night must be prohibited except for emergency.

Meanwhile, rational arrangement might produce self-mitigation effect to certain extent, especially for this Project. Material with high density stockpiled in construction site can be used as sound barrier. Operation of taking material from stocking yard must begin with the backside of the area to make full use of the stocking yard as natural sound barrier, when possible. Containers or office buildings in the construction site can also be arranged as sound barrier. Dyke built in the early phases of Stage III Project might be used as sound barrier. Proper arranging river dredging and dyke construction may create some natural sound barrier. Receivers outside the dyke can be protected from noise impact by dykes. Therefore, if dyke is built before river dredging according to the construction plan, it might be used as sound barrier earlier.

(2) Reducing noise from equipment

Another effective method mitigating construction noise is to control noise through choosing equipment with low noise output or use silencer, noise abatement pipe or sound barrier. The specific measures include:

● For fixed equipment such as compressor, concrete mixer, bulldozer, grab, and tip lorry, etc., noise can be reduced through installing silencer, or isolating the vibrating parts of the engine (it could reduce noise by 5—15 dB(A)). Besides, the parts that produce noise can be partially or entirely enclosed, and vibration-absorption cushion, vibration-proof base can be used to decrease vibration of faceplate (it could reduce noise by 5—15 dB(A)).

● Try best to choose equipment with low noise.

● Idle equipment should be switched off or decelerated.

● All mechanical machine must be maintained periodically, poorly maintained equipment usually cause strong noise because of vibration of the loosed parts or damage of noise abatement part (such as noise snubber).

● Temporary noise barrier should be set up near the boundary of the construction site or the fixed machinery (it could reduce noise by 5—15 dB(A)). The material of the noise barrier could use architectural material (such as concrete, block, etc.), metal material (such as plate steel, plate aluminum alloy etc.), nonmetal material (such as transparent organic glass, plastic, polyester glassfiber, polycarbonicthane and compound material, etc.) etc.. If noise barrier uses inner acoustic liner, it will reduce noise reflection. In certain case, sandbag can also be used as noise barrier.

According to the effectiveness of noise barrier described in Section 2.10 of *Technical Memorandum on Noise from Construction Work other than Percussive Piling* , when the mechanical equipment and NSRs are isolated by the object with effective noise barrier function during construction, the noise from the mechanical equipment could be reduced by 10 dB(A). If the mechanical equipment (except for the "tranquil" ones) and NSRs are enclosed by the noise barrier by the contractor, the noise level from the mechanical equipment could be reduced by 5 dB(A). According to the character of Stage III of the Shenzhen River Regulation Project, the former is recommended. The material and size recommended for the noise barrier, and its potential effect of reducing noise from machinery during construction in the most unfavorable condition construction near the Lo Wu Public School on the Hong Kong side, the border inspection station dormitory and Lo Wu No. 4 Village on the Shenzhen side are listed in Table 5.17.

●Although its impact on receivers lasts for only a short period of time, the noise pollution caused by ship whistling is very serious. Therefore, it must be under control. Horns with low sound level and good orientation are recommended to use for transportation ships, because it can not only give alarm, but also reduce noise significantly (by 10—15 dB). If condition permits, it is recommended to use lamplight to replace horn. Though noise produced by shipping (no whistling) is much lower than whistling, but its duration is much longer, therefore, installation of silencer is suggested to decrease the noise produced by engine (by10—15 dB(A)). Besides, engine

enclosure should be used at the same time (it could reduce noise by more than 15 dB (A)). Engine without enclosing device must be prohibited for use.

Table 5. 17 Technique Parameters of the Sound Barrier Available in Construction Activities

Protected Object	Material of Sound Barrier	Length of Sound Barrier(m)	Height of Sound Barrier(m)	Thickness of Sound Barrier(m)	Effect of Reducing Noise dB(A)
Lo Wu Public School (Hong Kong)	Brick wall (double face brushing)	210	3. 5	0. 25	10
	Glued board (hollow in double layers)	230	3. 5	0. 002+0. 025	12
Dormitory of the Border Inspection Station (Hong Kong)	Brick wall(double face brushing)	160	3. 5	0. 25	10
	Glued board (hollow in double layer)	220	3. 5	0. 002+0. 025	12
	Baisheng glued board (made in Germany)	300	3. 5	0. 016	15
	Lixing XL resistance board	300	3. 5	0. 006	15
Lo Wu No. 4 Village (Shenzhen)	Brick wall(double face brushing)	400	3. 5	0. 25	10
	Glued board (hollow in double layer)	500	3. 5	0. 002+0. 025	12
	Baisheng glued board (made in Germany)	780	3. 5	0. 016	15
	Lixing XL resistance board	780	3. 5	0. 006	15

Ship whistling should be prohibited during operation period. Besides, silencer should be installed to decrease the operation noise (by 10—15 dB (A)). In addition, engine enclosure should be used (noise level can be cut down by more than 10 dB (A)) and engine without enclosing device must be prohibited for use. The noise level can be cut down by more than 20 dB (A) after the above-mentioned measures are taken. The residual impact of shipping noise is as shown in Table 5. 18.

It can be seen from Table 5. 18 that the noise levels at NSRs of both sides can be controlled under the acceptable levels after noise limitation measures are taken..

Table 5.18 Residual Impact of Shipping Noise after Mitigation Measures are taken **dB(A)**

NSRs	Distance (m)	Noise Level dB(A)	Status of Standard Attainment
Yumin Village (Shenzhen1#)	15m	58 (0)	Attended
Ludan Village(Shenzhen2#)	65m	46 (0)	Attended
Xiabumiao Dwelling Area (Shenzhen3#)	50m	48 (0)	Attended
Hospital of Shenzhen Border Crossing Port (Shenzhen4#)	110m	42 (0)	Attended
Yunong Village (Shenzhen5#)	63m	46 (0)	Attended
Tai Sha Lok (Hong Kong1#)	220m	35 (0)	Attended
Ha Wan Tsuen (Hong Kong1#)	137m	39 (0)	Attended

In order to keep the noise levels at all NSRs under acceptable levels, i. e., 75 dB (A) for daytime at Lo Wu Village (Hong Kong side 1#), Muk Wu Tsuen (Hong Kong side 3#) and Nga Yiu Tsuen (Hong Kong side 4#), 70 dB (A) for daytime and 65 dB (A) for examination time at Lo Wu Public School (Hong Kong side 2#), and Grade II standards (60 dB (A)) specified in Standard for Noise in Urban Environment on Shenzhen side, some mitigation measures, such as setting up temporary sound barrier, must be taken.

The residual impacts on NSRs after mitigation measures are taken are given in Table 5.19.

It can be seen from Table 5.19 that during construction period the residual impact of construction noise on all NSRs is below the acceptable levels by means of anechoic tube, muffler (M1) and temporary noise barrier (M2).

Because noise limitation is stricter for the evening and night, construction operation should be prohibited during that period.

In construction period, NSRs on both Shenzhen and Hongkong sides will reach acceptable level after adopting mitigation measures. It has not residual impact.

Table 5. 19 Residual Impacts on NSRs after Mitigation Measures are taken **dB(A)**

Construction Activity	Total Sound Power Level	NSRs[1,2]								
		Shen-zhen 1#	Shen-zhen 2#	Shen-zhen 3#	Shen-zhen 4#	Shen-zhen 5#	Hong Kong1#	Hong Kong2#	Hong Kong3#	Hong Kong4#
Access road construction	115	58 (0) M1+M2	58 (0) M2	55 (0) M0	59 (0) M0	54 (0) M0	74 (0) M0	63 (0) M2	67 (0) M0	72 (0) M0
River course excavation	114	57 (0) M1+M2	57 (0) M2	54 (0) M0	58 (0) M0	53 (0) M0	73 (0) M0	62 (0) M2	66 (0) M0	71 (0) M0
Earth dyke filling	115	58 (0) M1+M2	58 (0) M2	55 (0) M0	59 (0) M0	54 (0) M0	74 (0) M0	63 (0) M2	67 (0) M0	72 (0) M0
Bank and bed protection	116	59 (0) M1+M2	59 (0) M2	56 (0) M0	60 (0) M0	55 (0) M0	73 (0) M0	64 (0) M2	68 (0) M0	73 (0) M0
Reprovision-ing works	116	59 (0) M1+M2	59 (0) M2	56 (0) M0	60 (0) M0	55 (0) M0	73 (0) M0	64 (0) M2	68 (0) M0	73 (0) M0
Man Kam To Bridge re-building	118	41 (0) M0	46 (0) M0	52 (0) M0	49 (0) M0	33 (0) M0	50 (0) M0	51 (0) M0	57 (0) M0	55 (0) M0
Lo Wu Bridge re-building	118	44 (0) M0	45 (0) M0	41 (0) M0	38 (0) M0	36 (0) M0	63 (0) M0	60 (0) M0	43 (0) M0	42 (0) M0

Note:[1] M0 means no mitigation measure is taken; M1 means anechoic tube (or muffler) is applied (noise level can be cut down by 8 dB (A)); M2 means temporary noise barrier is used (noise level can be cut down by 5 dB (A)); M1+M2 means both anechoic tube (or muffler) and temporary noise barrier are applied (noise level can be cut down by 13 dB (A)).

[2] the values in parentheses indicate the degrees of the sound power levels at NSRs exceeding the associated standards. The standards are given in Table 5. 1 and Table 5. 3.

5. 7. 2 *Maintenance Period*

Decreasing equipment noise

●For fixed equipment such as grab, etc., noise can be decreased through installing silencer, noise abatement pipe or isolating the vibrating parts of the engine properly.

●Choose equipment with low noise.

●Idle equipment should be switched off or decelerated.

●All mechanical machines must be periodically maintained, poorly maintained equipment usually cause strong noise because of vibration of the loosed parts or damage of noise abatement parts (such as silencer).

●Horns with low sound level and good orientation are recommended to use on mud

barges. If condition permits, lamplight can be used to replace horn. Silencer is suggested to decrease the noise produced by engine, besides, engine enclosure should also be used at the same time. Engine without covering device must be prohibited for use.

5.8 Residual Impacts

The residual impacts described in this section are the residual environmental impact that remains after taking all mitigation measures recommended.

5.8.1 *Residual Construction Noise Impact*

During construction period, the construction noise levels at all NSRs of both sides can be kept below the acceptable level after the mitigation measures are taken, therefore, there is no residual construction noise impact.

5.8.2 *Residual Traffic Noise Impact*

(1) Traffic noise during the construction period (transportation on land)

1) Traffic noise from the construction site

Different from noise produced by fixed source, the traffic noise is usually within the acceptable level except for very close distance. No significant impact is expected on the surrounding NSRs caused by the construction activity inside the construction site.

2) Traffic noise from other than the construction site

The traffic volume (18 vehicles per hour) is rather small in the section from Daliang Village via Honggang Road to the construction site. This section is almost undeveloped with few noise sensitive receivers, the sound level at the point 5 m away from the road can meet Grade IV of the *Standard for Noise in Urban Environment* (*GB*3096—93). It has little impact on the surrounding area. As the traffic volume (2,800—4,500 vehicles per hour) in Honggang Road, Nigang Road and Yanho Road is much larger than 18 vehicles per hour, the impact on the surrounding area from the trucks for earth transportation is much smaller than the original one, therefore is negligible. So the traffic noise from other than the construction site has no impact on the NSR in the surrounding area.

3) Noise from the New Man Kam To Bridge

Since the NSRs around the new Man Kam To Bridge are over 300 m away from the

bridge, no significant noise impact on the NSRs of both sides is expected to be caused by the traffic at the designed volume (8,000 vehicles per day) or the extreme traffic volume (4,000 vehicles per hour at speed of 40 km/h, and the capacity of the inspection facilities in the border crossing is not considered).

(2) Noise from shipping

The shipping-produced noise levels at all NSRs of both sides can be kept below the acceptable level after the mitigation measures are taken.

5.9 Conclusion

The impacts of noise from construction activities and traffic have been assessed according to the nation's relevant standard and the standard of Shenzhen and Hong Kong on construction noise. The calculation procedure specified in *Technical Memorandum on Noise from Construction Work other than Percussive Piling* of Hong Kong has been strictly followed. With some modification to suit the lack of detailed information concerning the Project. Conclusion of the assessment are summarized as follows:

1) During construction, on the Hong Kong side of the Shenzhen River, it is not difficult to meet the standard of Hong Kong for construction noise in daytime. When each set of construction activities is separately carried out, the noise levels at the NSR on the Hong Kong side such as Lo Wu Tsuen (1# on the Hong Kong side), Muk Wu Tsuen (3# on the Hong Kong side), and Nga Yiu Tsuen (4# on the Hong Kong side) will meet the noise standard of 75 dB (A) in daytime, and the noise level at Lo Wu Public School (2# on the Hong Kong side) will also meet the noise standard of 70 dB (A). During examination period, however, the noise level at Lo Wu Public School will exceed the standard of 65 dB (A), by 2—4 dB (A). But, the noise level at Lo Wu Public School can be cut down to an acceptable level of 63 dB (A) after adopting appropriate mitigation measures .

2) On the Shenzhen side, it is difficult to satisfy the standard of construction noise during the daytime as the standard is based on the boundary of construction site. Even a single set of machinery equipment in operation may cause exceedance of the standard on the construction site boundary during construction period. When each set of construction activities is separately carried out, the noise levels at Xiangxi Middle School, Huaqiao New Village and Xinxiu Village will not exceed the associated standards. When each set of construction activity, excluding bridge reconstruction is carried out separately, the noise levels at the dormitory of the inspection station and Lo

Wu No. 4 Village will exceed the associated standards, with an excess of 2—4 dB (A) at Lo Wu No. 4 Village. As the dormitory is very close to the construction site boundary (28 m), the exceedance will be very significant, ranging from 10—12 dB (A). Therefore, additional measures should be adopted to reduce the noise level to acceptable range.

3) Since the standard of noise in nighttime is much stricter, operation of a single set of mechanical equipment might make the noise of the NSR on both sides of the Shenzhen River exceed the standard concerned. Therefore, construction should be prohibited during nighttime except that an emergency occurs.

4) On the Shenzhen side , only one set of construction activity can be carried out within the site that is less than 145 m away from NSRs. On the Hong Kong side, only one set of construction activity can be carried out within the site that is less than 84 m away from NSRs.

5) As traffic noise is different from noise produced by fixed source, it usually is within acceptable level except in very close distance. In the construction period, the traffic noise impact on NSRs within the construction site is acceptable.

6) In the case of normal operation of bridge, the traffic noise impact on NSRs is acceptable because the NSRs around the new Man Kam To Bridge are over 300 m away from the Bridge.

7) The NSRs on the Shenzhen side will be affected by the noise from shipping during both construction period and maintenance period, and the noise levels will exceed the standard of Shenzhen side. The impact on the Hong Kong side caused by shipping is acceptable, as the NSR is far away from the River. The shipping-produced noise levels at all NSRs of both sides can be kept below the acceptable level after the mitigation measures are taken.