7 Spoil Impact Assessment

7.1 Introduction

This Chapter discusses evaluation of spoil quality, various spoil dumping schemes and impacts of spoil storage, transportation and dumping on the environment . In addition, mitigation measures, residual impacts and their acceptability will also be discussed. Spoil arises from the construction activities of the Regulation of Shenzhen River Stage III project including river channel dredging, dyke construction, re-alignment of border roads, re-provisioning work and re-construction of Man Kam To vehicular bridge.

7.1.1 *Construction and Demolition Material from Stage Ⅲ Phase Ⅰ Works*

Regulation of Shenzhen River Stage III Phase I worked involve re-alignment of the existing border road on the Hong Kong side, which will be affected by the Stage III drainage channel. Excavation for the Phase I works will be carried out on the land on the southern side of the existing border road under dry conditions. About 21,000 cum of public fill, being soil not suitable for re-use for forming the road embankment and building debris, and about 9,000 cum of constructioin and demolition (C&D) waste, being superficial soil with vegetation, timber and household refuse from site clearance, will be disposed of off site.

In the planning and design stage, effort has been made to maintain a balance between the filling and excavation quantities as far as possible . The design has fully allowed for re-use of suitable excavated material for forming the road embankment with a view to minimizing diposal of public fill.

The Drainage Services Department will apply to the Public Filling Sub-committee and the Environmental Protection Department for public filling facilities and landfills for the public fill and C&D waste generated respectively.

In the construction stage, the contractor shall submit a waste management plan to the Engineer for approval with appropriate mitigation measures, including the allocation of an area for waste segregation. The Engineer ahall ensure that the day-to-day ope-

rations on site comply with the approved waste management plan.

In addition, to minimize the generation of construction and demolition (C&D) material, the Engineer shall closely monitor the excavation process to ensure that all suitable excavated material be re-used for forming the road embankment. The Engineer shall also encourage the contractor to use non-timber formwork and temporary work.

The contractor shall separate public fill from C&D waste for disposal at appropriate locations and shall sort C&D waste by category on site to facilitate re-use/re-cycling in order to reduce the generation of such waste. The contractor shall break down any oversized public fill/C&D material to less than 250mm in size so as to facilitate its re-use by other reclamation or earth filling projects.

The contractor shall dispose of the public fill and C&D waste at the designated public filling facilities and land fills respectively by trucks. This will be controlled by the trip-ticket system in accordance with the requirements of Works Bureau Technical Circular No. 5/99. The contractor shall submit to the Engineer receipts issued by the public filling facilities and land fills. The Engineer shall carry out random checks on the receipts to ensure compliance.

The contractor shall submit records on the disposal, re-use and re-cycling of C&D material to the Engineer for monitoring purposes.

Assessments of Stage Ⅲ Phase I works on the environmental impacts related to the disposal of C&D material at the designated public filling facilities and land fills should have been carried out by the relevant authorities and will not re-assessed in this report. The remaining chapter discusses the disposal of spoil generated from the Stage III Phase II works.

7.1.2 *Material from Stage Ⅲ Phase Ⅱ Works*

According to the project design, the total amount of spoil produced in Phase Ⅱ of Stage III Project will be 1,603,600 m^3, of which about 201,800 m^3 are contaminated and 1,401,800 m^3 are uncontaminated. In this report, the contaminated spoil refers to materials clossified as Class C in Hong Kong Classification of Dredged Mud for Marine Disposal (Environmental Protection Department Technical Circular (TC) No. 1-1-92); others are uncontaminated spoil.

7.2 Regulations and Standards

7.2.1 *National Regulations and Standards*

Soil environment quality is classified into three grades in *Environmental Quality Standard for Soil*(*GB*15618-1995) as shown in Table 7.1.

Table 7.1 **Environment Quality Standard for Soil** **mg/kg**

Parameters \ Classes / Soil's pH		Class I	Class II			Class III
		Background	<6.5	6.5~7.5	>7.5	>6.5
Cd	≤	0.20	0.30	0.30	0.60	1.0
Hg	≤	0.15	0.30	0.50	1.0	1.5
As Paddy field	≤	15	30	25	20	30
Dry land	≤	15	40	30	25	40
Cu Farm land, etc.	≤	35	50	100	100	400
Orchard	≤	—	150	200	200	400
Pb	≤	35	250	300	350	500
Cr Paddy field	≤	90	250	300	350	400
Dry land	≤	90	150	200	250	300
Zn	≤	100	200	250	300	500
Ni	≤	40	40	50	60	200
BHCs	≤	0.05	0.50			1.0
DDD	≤	0.05	0.50			1.0

In this table, Class I is the limited value of soil environment quality for protecting and maintaining regional ecosystems in natural background; Class II is the limited value of soil for ensuring agricultural activities and human health; Class III is the critical value for ensuring agriculture and forest production, and normal growth of plants.

According to the *Marine Waste Disposal Management Regulation* issued by State Council, waste disposal into marine area must be approved by the relevant authority. The temporary regulation on the waste dumped into sea issued by State Ocean Bureau has stipulated some requirements for waste disposal into sea, while no concentration standard limit for pollutants has been issued yet.

7.2.2 *Regulation and Standard in Hong Kong*

Contaminated spoil disposal in Hong Kong marine areas must be approved by Environmental Protection Department. The spoil contaminated by hazardous metals is divided into three classes according to the standard given out in Table 7.2 (*Technique Circular No.* (*TC*) *No.* 1-1-92).

Table 7.2 Classification of Standard for Heavy Metal Pollution in Dredged Silt in Hong Kong (Dry weight, mg/kg)

Class	Cd	Cr	Cu	Hg	Ni	Pb	Zn
A	0.0—0.9	0—49	0—54	0—0.07	0—34	0—64	0—140
B	1.0—1.4	50—79	54—64	0.7—0.9	34—39	64—74	150—190
C	>1.5	>80	>65	>1.0	>40	>75	>200

The treatment demands for various types of spoil are as follows:

Class A: Contaminated, no special measure is needed in dredging, transporting and discarding.

Class B: Medium contaminated, special notice needs to be made during its dredging and transportation, and special attention should also be paid to potential pollutant releasing through dissolving and re-suspension in discarding process.

Class C: Heavy contaminated, it must be effectively isolated before disposal.

No assessment standard for PAHs and PCBs has been stipulated in either Shenzhen or Hong Kong.

7.2.3 *Criteria Coordination*

Because spoil will come from both Shenzhen and Hong Kong at the same time and will be disposed in the areas of Shenzhen and Hong Kong, respectively, *Environmental Quality Standard for Soil* (*GB*15617-1995) and Hong Kong *Classification Standard for Heavy Metal Pollution in Dredged Silt* (*Technique Circular No.* (*TC*) *No.* 1-1-92) are applied in assessment of spoil. The regulation of Hong Kong must be executed for spoil disposal in Hong Kong marine areas, while the *Disposal Management Regulation of P. R. China* and the temporary regulation on the waste dumping at sea issued by State Ocean Bureau must be implemented for dumping in Shenzhen marine

area. In addition, Hakanson potential ecological risk index is used to assess the potential impact of terrestrial dumping.

7.3 Pollution of Bottom Material and Bank Soil

7.3.1 *Sampling and Monitoring*

According to *Works Branch Technical Circular No.* 22/92, *Marine Disposal of Dredged Mud* of Hong Kong, and State Ocean Bureau's requirement for waste dumping into marine, considering the practical situation of Stage III Project, totally fifty-seven sampling holes for bed sediment and bank soil were taken. There is 7 sampling holes for bank soil monitoring, the series numbers are szk403, szk404, szk413, szk414, szk415, szk416 and szk417, respectively. Though the sampling holes of szk425,szk426,szk427 and szk428 are not in river-course, all of them are located between Liantang River and River Ganges and near Sancha river mouth. The four soil samples are heavy polluted because the long-term deposition of pollutants from serious polluted Liantang River and River Ganges. Therefore, they can not represent the bank soil but rather the river sediment, and are regarded as sediment sampling holes. From each borehole, 10 cm long of borehole samples are collected in river bottom at depth of 0.9, 1.9, 2.9 m and afterwards at an interval of 3 m, respectively. As the dredging depth usually excesses 3 m and reaches 6 m, it was estimated that five samples were to be taken from every borehole, thus, totally $57 \times 5 = 285$ sediment samples were collected. As the bottom of some sampling holes are rock, thus the actual samples taken are 272 groups, among which, the bank soil samples are 35 groups and the sediment samples are 237 groups. The location of sampling holes is shown in Figure 7.1.

The sediment and bank soil monitoring was carried out from November to December 1998.

The analyzed items included: pH, total Cu, total Pb, total Zn, total Cd, total Cr, total Ni, total Hg, total As, sulfide, mineral oil, organic material, BHCs, DDT, PAHs(16 items), PCBs(7 types)and moisture content. The sampling and analysis method from USEPA is applied in the monitoring. For some items having no special requirement in Hong Kong, the relevant state recommendation methods shown in Table 7.3 were applied.

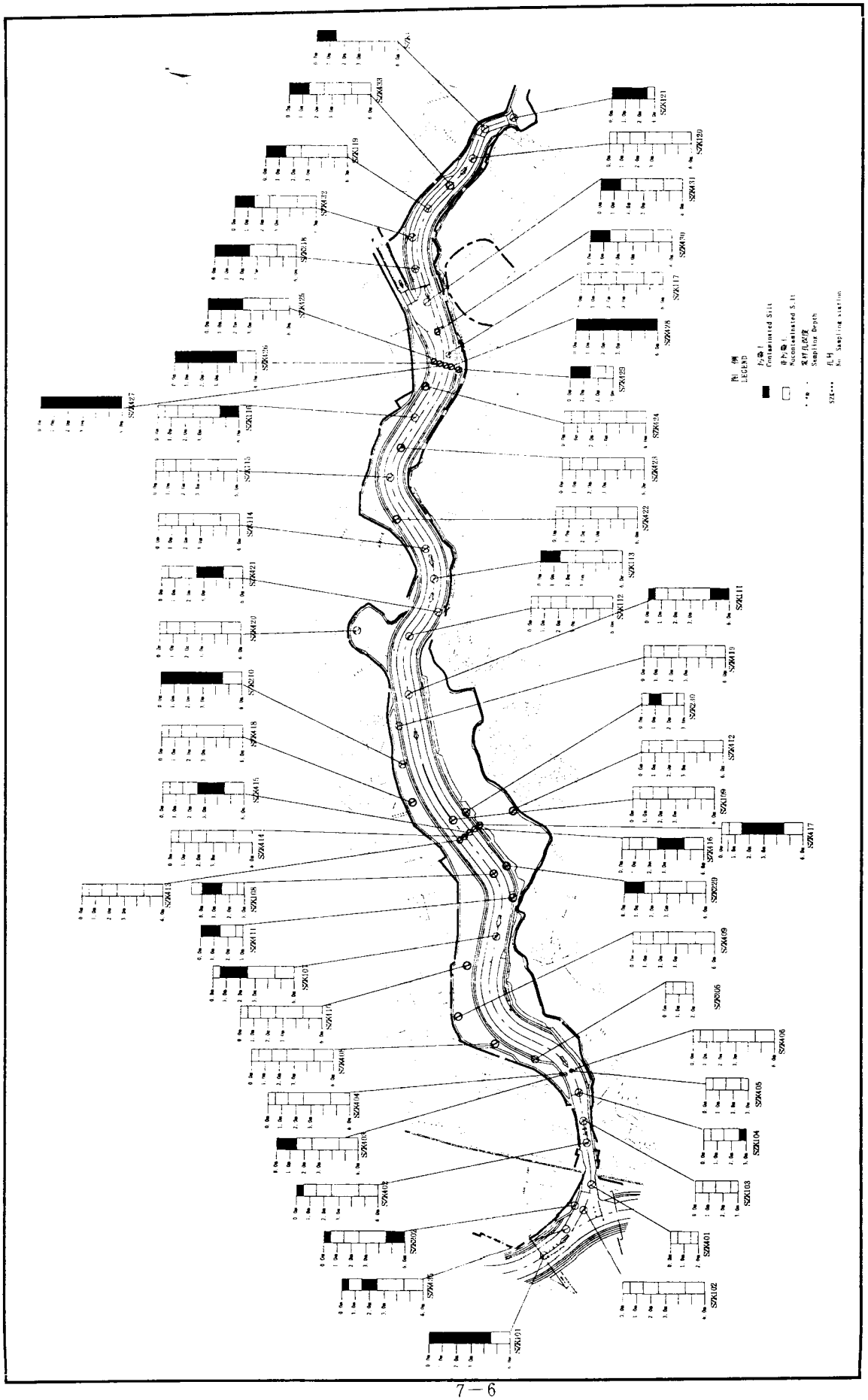

Fig. 7.1 Sampling Location and Analysis Result for Bank Soil and Bottom Material

Sediment and bank soil monitoring results are shown in Annex 7, Table A7.1.

Table 7.3 Analysis Method for Bottom Material and Bank Soil Monitoring

Items		Analysis Method	Items		Analysis Method
Dry Weight		Weighting Method	Total Ni		AAS
pH		Electrode	Total Hg		Cold Vapour AAS
Total Cu		AAS	Total As		AAS
Total Pb		AAS	Sulfide		Volumetric Method
Total Zn		AAS	Oily		Weighting Method
Total Cd		AAS	Organic Material		Volumetric Method
Total Cr		AAS			
Organic Chloride	α−BHC	GC	PAHs	Naphthalene	HPLC
	β−BHC	GC		Acenaphthylene	HPLC
	γ−BHC	GC		Acecaphthene	HPLC
	δ−BHC	GC		Fluorene	HPLC
	4,4′−DDE	GC		Phenanthrene	HPLC
	4,4′−DDD	GC		Anthracene	HPLC
	o,p′−DDT	GC		Fluoranthene	HPLC
	4,4′−DDT	GC		Pyrene	HPLC
PCBs	PCB−1016	GC		Benzo(a) Anthrancene	HPLC
	PCB−1221	GC		Chrysene	HPLC
	PCB−1232	GC		Benzo(b) Fluoranthene	HPLC
	PCB−1242	GC		Benzo(k) Fluoranthene	HPLC
	PCB−1248	GC		Benzo(a)Pyrene	HPLC
	PCB−1254	GC		Dibenzo(a,h) Anthracene	HPLC
	PCB−1260	GC		Benzo(g,h,i) Pyrene	HPLC
				Indeno(1,2,3-cd) Pyrene	HPLC

7.3.2 *Bank Soil Quality*

According to the *Environmental Quality Standard for Soil* (*GB*15618-1995), all 35 groups of bank soil sample satisfy the relevant standard. According to Hong Kong *Classification of Heavy Metal pollution in Dredged Silt* (*Technique Circular No.* (*TC*) *No.* 1-192), among the 35 groups of sample, 5 groups meet Class C, 11 groups meet Class B, and the rest conform to Class A. It shows that the bank soil quality is in relatively good condition and has not been seriously polluted.

The potential ecological risk index, established by Swedish scientist Hakanson, provides the standard for assessing the potential damage to ecology caused by sediment.

Potential ecological risk index (RI) is the sum of various heavy metal potential eco-

logical risk coefficients (Ei). The formula is as follows:

$$RI=\sum Ei \tag{7-1}$$

$$Ei=Ti\times Ci \tag{7-2}$$

$$Ci=Cmi/Cri \tag{7-3}$$

Where RI: sediment potential ecological risk index;

Ei: potential ecological risk coefficient of heavy metal i;

Ti: virulence response coefficient of heavy metal i;

Ci: geochemical abundance ratio of heavy metal i;

Cmi: content of element i in sediment

Cri: reference value for calculating.

Reference value is the geochemical background value before industrialization (see Table 7.4), the values recommended by Hakanson based on biological toxic test and geochemical concentration ratio (see Table 7.4) have been taken as the element virulence response coefficients.

Table 7.4 Reference Value and Virulence Response Coefficient

Heavy metal	Cu	Cd	Pb	Zn	Cr	As	Hg
Cri (mg/kg)	50	1.0	70	175	90	15	0.25
Ti	5	30	5	1	2	10	40

RI indicates the potential ecological impact of heavy metal in sediment, and the classification standard of ecological damage degree with different RI is shown in Table 7.5.

Table 7.5 Classification Standard for Potential Ecological Risk Index

Potential ecological risk index	Ecological damage degree
<150	Light ecological damage
150−300	Medium ecological damage
300−600	Strong ecological damage
>600	Extreme ecological damage

Based on the Assessment using Hakanson potential ecological risk index, the potential ecological risk indexes are all less than 150, which indicate that the ecological risk

caused by bank soil terrestrial dumping is insignificant, thus the bank soil can be terrestrially dumped.

The statistical results of bank soil monitoring data are listed in Table 7.6.

Table 7.6 Statistical Result of Bank Soil Monitoring Data

Parameters	Total Cu	Total Pb	Total Zn	Total Cd	Total Ni	Total Cr	Total As	Total Hg	S^{2-}	Mineral oil	Organic material
Unit	mg/kg										%
Average	15.12	48.49	39.32	0.05	11.53	39.95	6.55	0.06	1.74	10.28	1.18
Maximum	36.55	275	93.0	0.30	23.70	75.6	12.52	0.22	18.8	110	5.29
Minimum	1.80	11.30	5.00	0.00	0.50	0.00	0.56	0.00	0.00	0.00	0.31

Parameters	Organic chlorine (mg/kg)								PCBs (mg/kg)
	BHCs				DDT				
	α—BHC	γ—BHC	β—BHC	δ—BHC	4,4′—DDE	4,4′—DDD	o,p′—DDT	4,4′—DDT	
Average	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
Maximum	0.0000	0.0007	0.0007	0.0007	0.0000	0.0001	0.0011	0.0003	0.0068
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Para.	PAHs (mg/kg)							
	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
Aver.	0.0198	0.0111	0.0132	0.0067	0.00508	0.0045	0.0157	0.0168
Max	0.2721	0.1427	0.4541	0.1520	0.1111	0.0862	0.3251	0.4036
Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Para.	PAHs (mg/kg)							
	Benzo[a] anthracene	Chrysene	Bezno[b] Fluoranthene	Bezno[k] Fluoranthene	Benzo[a] pyrene	Dibenzo[a,h] anthracene	Benzo[g,h,I] perylene	Indeno [1,2,3-cd] pyrene
Aver.	0.0025	0.0018	0.0012	0.0007	0.0011	0.0027	0.0005	0.0002
Max	0.0596	0.0406	0.0152	0.009	0.0224	0.0607	0.0128	0.0068
Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

7.3.3 *Bottom Material Quality*

Among the 237 groups of sediment samples monitored, 81 groups exceed class Ⅱ in *Environmental Quality Standard for Soil* (*GB*15618-1995), accounting for 34.2% of the total sediment samples, meanwhile 24 groups exceed class III, accounting for 10.1% of the total. According to the *Classification Standard for Heavy Metal Pollution in Dredged Silt* of Hong Kong (Technique Circular No. (TC) No. 1-1-92), among the 237 groups of sediment samples, 66 reach Class C, accounting for 27.8% of the total sediment samples; 41 meet Class B, accounting for 17.4%; the rest 130 sat-

isfy Class A, accounting for 46.8%.

For vertical distribution, most of the class C contaminated spoil samples are surface layer samples (No. 1 or 2 sample for each sampling hole). It indicates that heavy metals are mainly concentrated in the surface layer. But there are also some class C polluted samples in deep layer.

Based on the method of Hakanson potential ecological risk index, the indexes are calculated as follows: one group sample is more than 600 (extreme ecological damage); 3 group samples range from 300 to 600 (strong ecological damage); 15 group samples range from 150 to 300 (medium ecological damage); and the other 218 group samples are less than 150 (light ecological damage). The results show that the contaminated spoil is not suitable for terrestrial dumping.

The statistical results of sediment monitoring data are listed in Table 7.7.

Table 7.7 Statistical Result of Sediment Monitoring DataPar

Pameters	Total Cu	Total Pb	Total Zn	Total Cd	Total Ni	Total Cr	Total As	Total Hg	S^{2-}	Mineral oil	Organic material
Unit	mg/kg										%
Average	21.92	93.05	99.13	0.35	11.78	21.46	6.07	0.07	15.57	34.30	1.49
Maximum	265	7156	1627	2.36	157.0	150.7	117	1.17	644	1780	6.97
Minimum	2.25	9.48	1.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.19

Parameters	Organic chlorine(mg/kg)								PCBs (mg/kg)
	BHCs				DDT				
	α— BHC	γ— BHC	β— BHC	δ— BHC	4,4′— DDE	4,4′— DDD	o,p′— DDT	4,4′— DDT	
Average	0.0000	0.0001	0.0001	0.0006	0.0000	0.0001	0.0000	0.0000	0.0041
Maximum	0.0000	0.0041	0.0112	0.0395	0.0000	0.0123	0.0041	0.0039	0.3367
Minimum	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Para.	PAHs (mg/kg)							
	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
Aver.	0.0425	0.0380	0.1034	0.0149	0.0174	0.0116	0.0750	0.1310
Max	2.8595	1.8125	14.0800	1.2255	1.0570	0.5880	5.4150	16.9500
Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Para.	PAHs (mg/kg)							
	Benzo(a) Anthracene	Chrysene	Bezno(b) Fluoranthene	Bezno(k) Fluoranthene	Benzo(a) pyrene	Dibenzo(a,h) anthracene	Benzo (g,h,l) perylene	Indeno (1,2,3-cd) pyrene
Aver.	0.0550	0.0303	0.0040	0.0043	0.0021	0.0003	0.0001	0.0001
Max	2.9985	3.3430	0.2452	0.8395	0.2770	0.0372	0.0209	0.0129
Min.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

7.4 Spoil Disposal Scheme for the Project

7.4.1 *Selection of Spoil Disposal Sites (Dumping Area)*

The EIA team and Design Consultant have carried out a through site search in Shenzhen and Hong Kong, which can potentially be used for spoil disposal. The results are given below.

(1) East Sha Chau Marine Disposal Area (CMPs)

The East Sha Chau Marine Disposal Area (CMPs) are situated to the east of the Sha Chau in Hong Kong, between the Sha Chau and the new Chek Lap Kok Airport, and parallel to the Airport with a distance less than 500 m. Because it is close to the Lantau island, the spoil site is also called the *shachau Lantau island spoil site*. It is 45 km from Lo Wu Bridge, the construction site of Stage III Project, (Please see Figure 7.2 and 7.3). The whole CMPs include four areas, i.e., CMP Ⅰ, CMP Ⅱ, CMP Ⅲ and CMP Ⅳ, which are the designated areas for disposal of spoil produced from excavation and dredge operation in Hong Kong.

According to the *Dumping at Sea Act* of Hong Kong, permission must be obtained from Environmental Protection Department before dumping contaminated spoil into the marine area near East Sha Chau.

(2) The dumping area near Neilingding Island

The dumping area is located near the Neilingding Island in the Shenzhen waters, about 40 km away from Lo Wu Railway Bridge of Stage III Project.

The dumping area near Neilingding Island was approved by the State Ocean Bureau in 1988 and managed by the Shenzhen Ocean Management Division of the Bureau. The whole area of the dumping zone is 8.9 km^2, of which 4.2 km^2 have been in use at present. The average depth of the area is about 5 m with a maximum depth of 6.7 m and a minimum depth of 3 m. Coordinates of the controlling points for the dumping area are given in Table 7.8.

The purpose of the dumping area was initially planned for receiving the dredge spoil from the port in western Shenzhen and serving for development of this region. From 1988 to 1998, about 30,000,000 m^3 of spoil have been dumped in the area with an anual average of, about 3000,000 m^3. Due to the implementation of the Shenzhen River

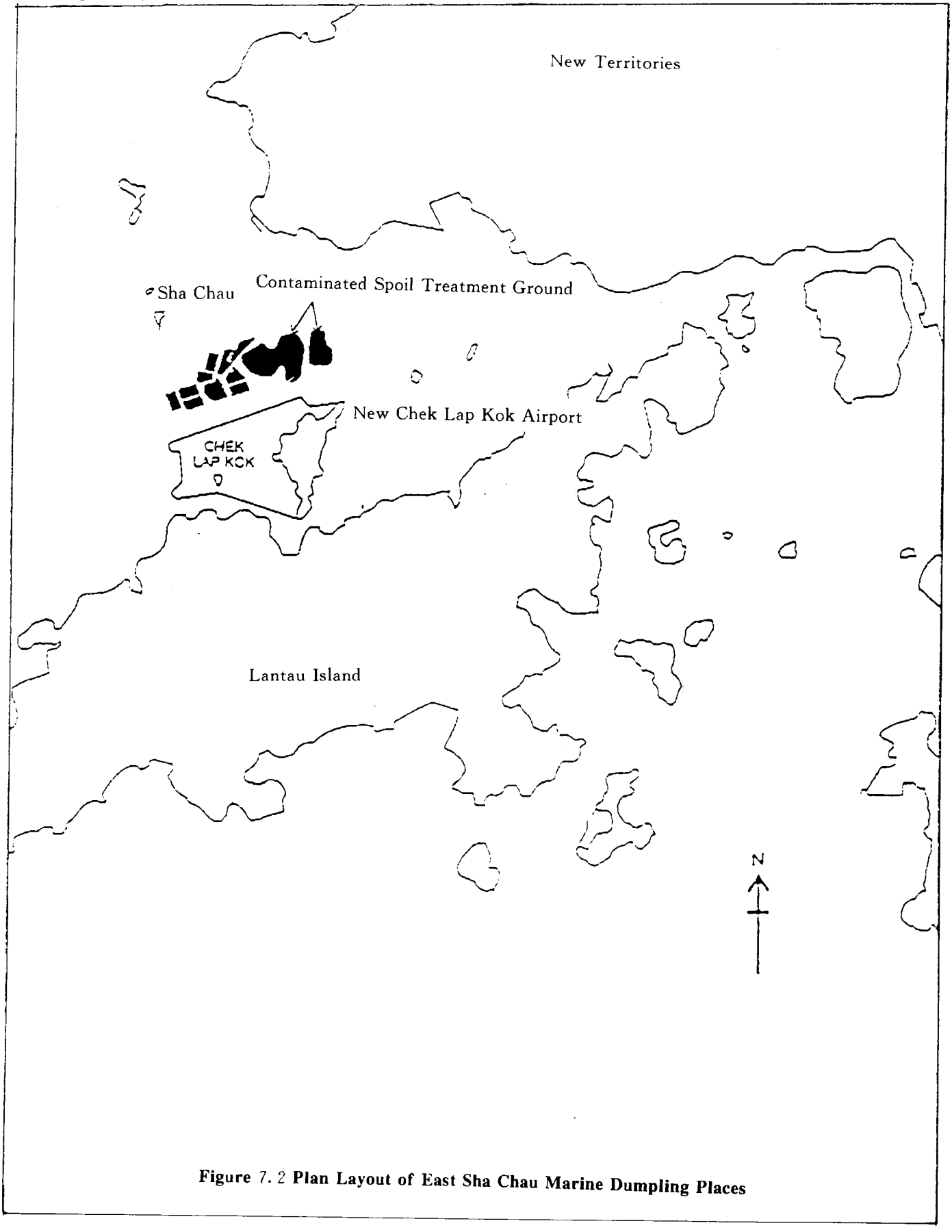

Figure 7.2 Plan Layout of East Sha Chau Marine Dumpling Places

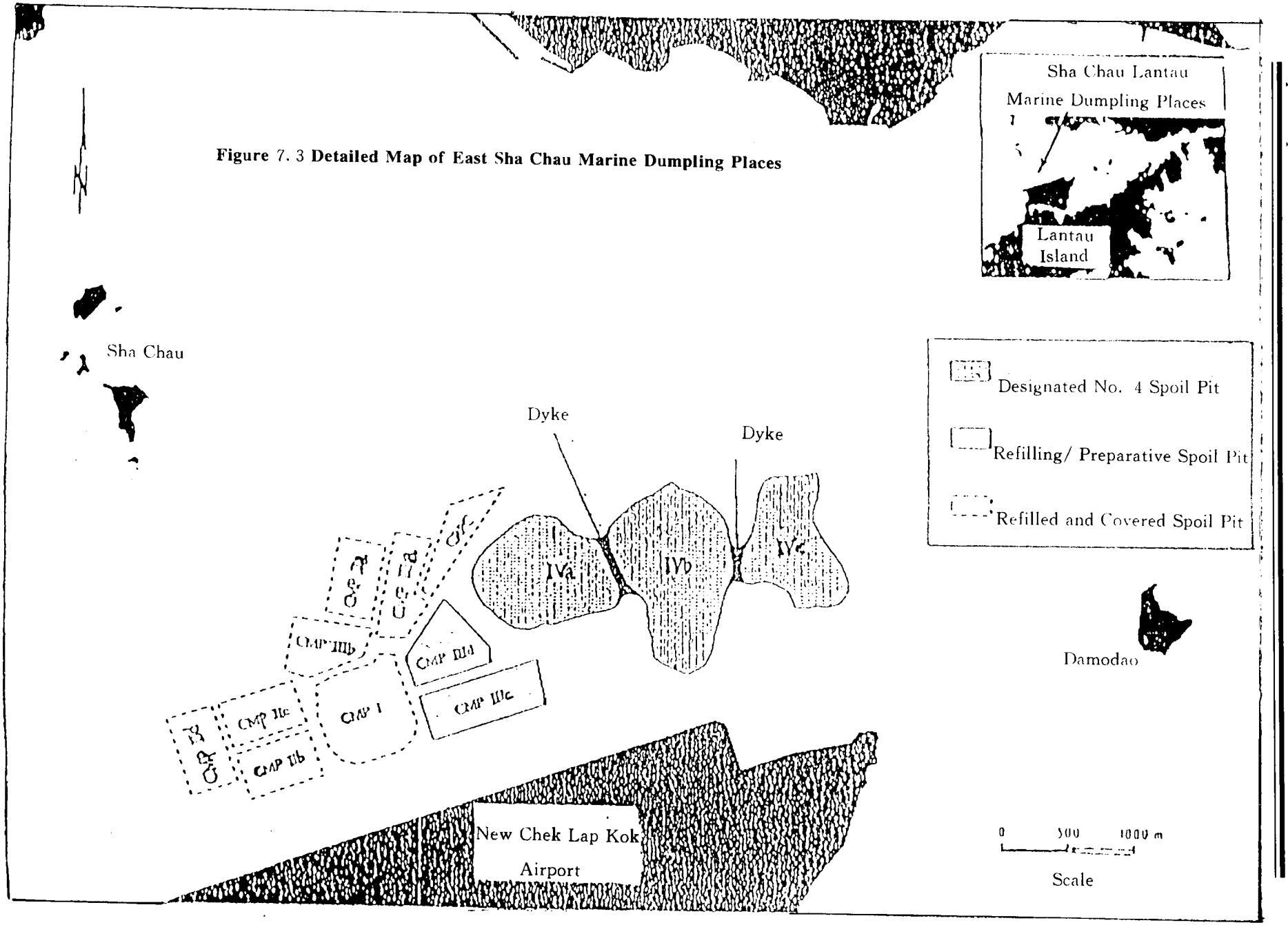

Figure 7. 3 Detailed Map of East Sha Chau Marine Dumpling Places

Table 7.8 Coordinates of Controlling Point at the Dumping Area of Neilingding Island

Controlling point number		Longitude	Latitude
Planned disposal zone	A	113°49″12′	22°25″00′
	B	113°50″00′	22°23″00′
	C	113°50″36′	22°25″00′
	D	113°51″12′	22°23″00′
Disposal zone in use	A	113°49″12′	22°25″00′
	B	113°50″00′	22°23″00′
	E	113°50″36′	22°23″00′
	F	113°49″00′	22°25″00′

regulation project in 1994, an application for dumping the uncontaminated spoil in the area was made and approved by relevant authorities. For further planning and utilization of this dumping area, in 1995 the Shenzhen Ocean Management Division carried out a monitoring study in this area, and more strict dumping requirements and regulations were stipulated.

According to the relevant state regulations, approval must be acquired from the Shenzhen Ocean Management Division of State Ocean Bureau before disposing spoil of Stage III Project near Neilingding Island

(3) Site Formation for San Tin container port backup site

The San Tin container port backup site is located inside the border of the Hong Kong side, downstream from Lok Ma Chau, opposite the Shenzhen Hanggang Port, about 5-6 km from the construction site of Stage III Project. It is a large container site planned by the Government of Hong Kong Special Administration Zone. Its capacity is large enough to accept the disposal of the uncontaminated soil from channel excavation in Stage III Project. However, because it is still in planning stage, there are many uncertain factors. Besides, land resumption will be necessary if it is going to be utilized.

(4) The spoil sites along the reach of Stage III Project

Since there is no suitable spoil site along the River on the Shenzhen side, the Design Consultant has compared several sites on the Hong Kong side, which might potential-

ly be utilized for spoil disposal, including riverine shoals, fishponds, marsh and meanders, agricultural land and cropland, etc., as shown in Figure 7.4.

(5) Reclamation along the Binghai Avenue

The government of Shenzhen city is planning a new mud-waste storage site which can serve for ten years. The storage site is located near the Chegongmiao on the Binghai Avenue of Shenzhen. It is part of the reclamation project along the direction to Nanshan District. Since the project is just under planning stage, and the characteristics and scale need to be further studied, the availability of this disposal is uncertain.

(6) Baishizhou mud-waste storage site

The site is located on the Dasha river mouth of Shenzhen Bay. According to the Shenzhen mud-waste management office, it was originally planned to use for three years with a capacity of more than 1,000,000m^3. The site began to store mud and spoil in June 1997. According to the existing demand, it will be full in July 1998.

(7) Wushigu abandaned quarry

The quarry is located in the northeast of Shenzhen, the foot of Wutong (Nu Tung) Mountains, north of Luosha Road, 12 km from the San Pan River mouth. It has been abandaned for unknown reason several years ago. Its area is estimated to be about 20,000 m^2, which now becomes a round delved with water inside. The maximum depth is about 10 m, and the available height above the water surface is more than 30 m with the capacity of exceeding 400,000 m^3. It was however discovered that the area has been purchased by an estate agent with approval from the Land Planning Bureau of Shenzhen City. So it is impossible to use it as the spoil site now.

(8) Beihuan road mud-waste storage site

Beihuan road mud-waste storage site is located near Shenzhen Agricultural Research Institute on Beihuan Road. Presently, the site has been almost filled up. To meet the current demand,it was proposed to up, it will not be considered as the spoil dumping site for Stage III Project.

The results of the above site reach indicated that, the places available for soil damping are as follows:

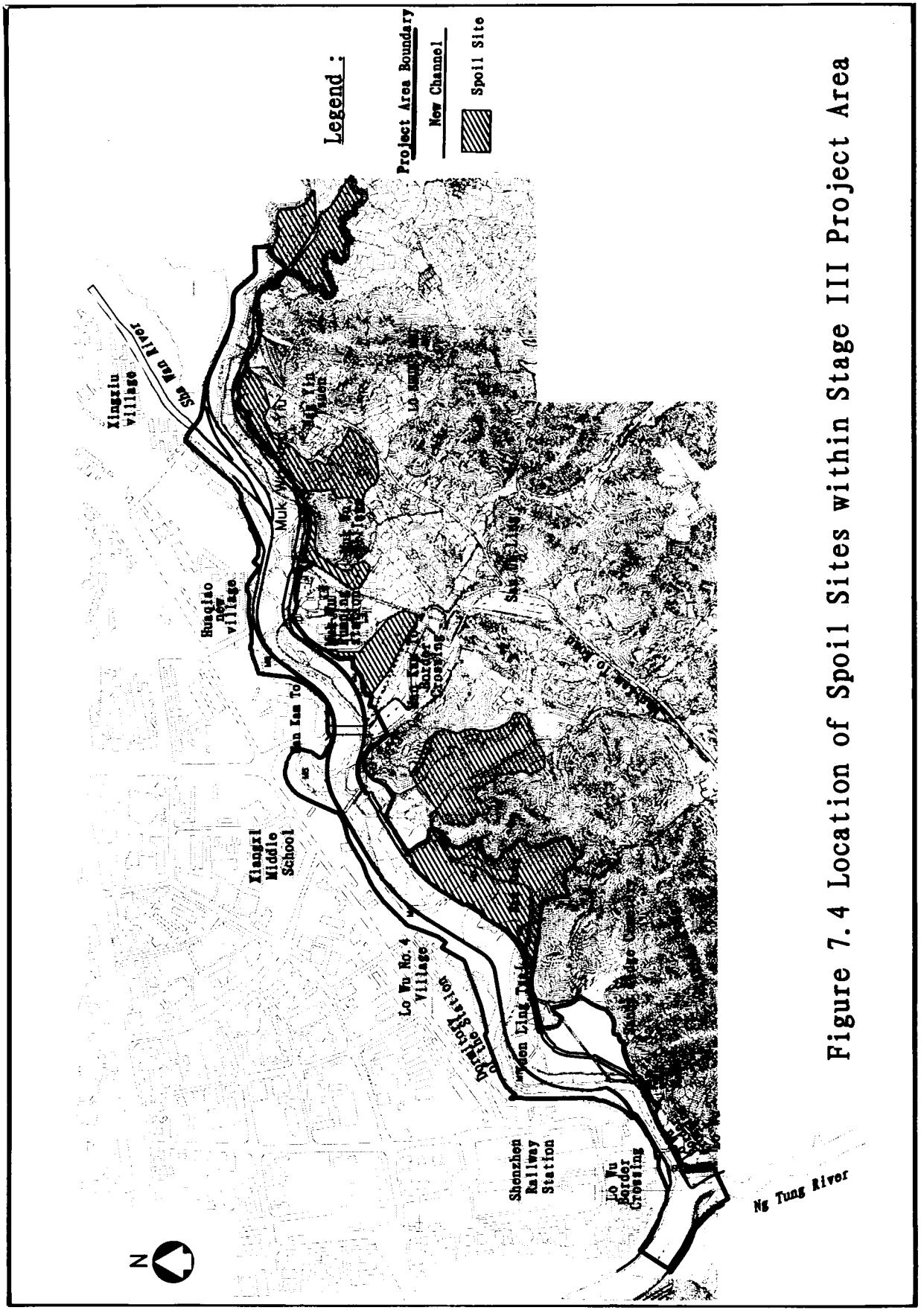

Figure 7.4 Location of Spoil Sites within Stage III Project Area

East Sha Chau (Hong Kong) marine disposal area;

Neilingding Island (Shenzhen) disposal area;

The spoil sites along the reach of Stage III project;

The site formation for San Tin Container port backup site (Hong Kong).

7.4.2 *Spoil Disposal Schemes*

From the above analysis the following possible disposal schemes are availoble for consideration:

Scheme One: terrestrial disposal of all spoil along the riverside of the Stage III Project.

Scheme Two: terrestrial disposal of all contaminated spoil along the riverside of the Stage III Project, and marine disposal of all uncontaminated spoil at the site near Neilingding Island.

Scheme Three: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine disposal area, and terrestrial disposal of all uncontaminated spoil at San Tin Container Port.

Scheme Four: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine disposal area, and terrestrial disposal of part of uncontaminated spoil of dry excavated materials in bloodworm ponds and abandoned fishponds located in east of Nam Hang, while the remainder of the uncontaminated spoil will be dumped near Neilingding Island.

Scheme Five: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine disposal area, and disposal all uncontaminated spoil near Neilingding Island.

Scheme Six: disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine disposal area, and disposal part of uncontaminated spoil of dry excavation at Nam Hang low lands and valley, while disposal of the remainder of the uncontaminated spoil near Neilingding Island.

7.4.3 *Method of Excavation*

The method of excavation involve the following:

Dredging

Grab dregers and long boom backhoe shovels will be used for dredging in combination with barge hopper for transporting spoil.

Excavation in the Dry

Backhoe shovels or long boom backhoe shovels will be used for excavation outside the existing river course for forming new channel with lorries for transporting.

The maximum monthly excavation output is 90,500 m^3. the maximum monthly dry-land excavation quantities are 69,400 m^3, the maximum monthly underwater excavation quantities are 40,400 m^3,

7.5 Environmental Assessment for the Spoil Disposal Schemes

7.5.1 *Environmental Alternatives for Spoil Disposal*

(1) Principles for spoil disposal

1) Based on the assessment of quality for bottom material and bank soil, the contaminated spoil is not suitable to be discarded on land. There is no marine disposal area for contaminated spoil on the Shenzhen side. East Sha Chau is the only marine disposal area for contaminated spoil.

2) According to the waste disposal principle of Hong Kong Environmental Protection Department, the spoil produced from land should be disposed on land as much as possible, if it is restricted by some adverse impact, then other disposal schemes should be considered. In construction of Stage III Project, a large quantity of spoils are produced by channel excavation, so it should be disposed on land as much as possible, except for the mud from river dredging.

(2) Environmental comparison of the spoil disposal schemes

In Table 7.9, the main environmental impacts for each spoil disposal scheme are listed, and their main advantages and disadvantages are listed in Table 7.10.

Table 7.9 Main Environmental Impacts for the Spoil Disposal Schemes

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
Scheme	Terrestrial disposal of all spoil along the riverside within the scope of Stage III Project.	Terrestrial disposal of all contaminated spoil along the riverside within the scope of Stage III Project, and marine disposal of all uncontaminated spoil near NeiLingding Island.	Marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and terrestrial disposal of all uncontaminated spoil at Xintian Container Port.	Marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and terrestrial disposal of part of uncontaminated spoil of dry excavated materials in bloodworm ponds and discarded fishponds located eastern of Nam Hang, while remainder of uncontaminated spoil is dumped near NeiLingding Island.	Marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and disposal all uncontaminated spoil near NeiLingding Island.	Disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and disposal part of uncontaminated spoil of dry excavation in Nam Hang low-lying lands and valley, while the remainder of the uncontaminated spoil near NeiLingding Island.
Water Impact	Leaching from contaminated spoil will possibly affect water quality.	Leaching from contaminated spoil will possibly affect water quality. Ships loading sludge may discharge wastewater into sea, which may affect the water quality. Such impact can be avoided.	Ships loading sludge may discharge wastewater into sea, may affecting water quality, which can be avoided.	Ships loading sludge may discharge wastewater into sea, may affecting water quality, which can be avoided.	Ships loading sludge may discharge wastewater into sea, may affecting water quality, which can be avoided.	Ships loading sludge may discharge wastewater into sea, may affecting water quality, which can be avoided.
Air Quality Impact	Dust will be produced when transporting spoil in construction sites which may affect some residents nearby (like Muk Wu Tsuen).	Dust will be produced during transporting spoil in construction sites but will not affect residents nearby. Gas emission from transport facilities will affect air quality slightly.	The haul road is long from site to Xintian Container Port more dust will be produced. Gas emission from transport facilities will	Dust will be produced during transporting spoil in construction sites but will not affect residents nearby. Gas emission from transport facilities will affect air quality slightly.	Gas emission from transporting facilities will affect air quality slightly. No on site treatment of contaminated spoil, so no odor emission.	Dust will be produced when transporting spoil in construction sites but will not affect residents nearby. Gas emission from transport facilities will affect air quality slightly.

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
	Gas emission from transport facilities will affect air quality slightly. Sludge storage will emit odor.	Sludge storage will emit odor.	affect air quality slightly. No odor emission as contaminated spoil will not be treated on-site	No odor emission as contaminated spoil will not be treated on-site.		No odor emission as contaminated spoil will not be treated on-site
Noise impact	The noise from haul facilities on-site can be controlled at acceptable level.	The noise from transport facilities on-site can be controlled at acceptable level. Ship noise will affect NSR along river.	Transporting noise impact is low, but ship noise will affect NSR along river.	The noise from haul facilities on-site can be controlled at acceptable level. Ship noise will affect NSR along river.	Ship noise will affect NSR along river.	The noise from haul facilities on-site can be controlled at acceptable level. Ship noise will affect NSR along river.
Ecology Impact	More wetland will be occupied, especially for bloodworm, which will cause strong impact on ecology and one rare species be affected. Disturbing wildlife in spoil disposing process. A large area of vegetable and arable land will be occupied. Part contaminated spoil will cause extremely ecology impact on terrestrial system.	Wetlands and fishponds will be occupied which will affect ecosystem. Disturbing wildlife in spoil process. Part contaminated spoil will cause extremely ecology impact on terrestrial system.	Fishponds will be occupied in Xintian spoil site, which will affect ecosystem of Shenzhen Bay and Mai Po Nature Reserve. Disturbing wildlife in spoil process.	There are 3.5 hm^2 of marshes, 3.4 hm^2 of fishponds, and 2.3 hm^2 of woodlands, which will cause significant impact on ecosystem and one rare specie be affected. Habitant fragmentation increases, the largest woodland (18.5 hm^2) will be divided into two parts.	The ecology impact arose from spoil can be ignore.	There are 2.3 hm^2 of marsh, 0.8 hm^2 woodlands, and 1.2 hm^2 of fishponds. Since woodlands are sparse and fragmentary distributed, and the marshes are small in size and have low quality. Fishponds are abandoned and unmanaged. Disturbing wildlife in spoil process, but the species affected are common and not under protection.

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
Fishponds and other Commercial Activities Loss	There are 2.3 hm^2 of fishponds, 1.1 hm^2 of bloodworm ponds loss, and agriculture loss arose from a large area of vegetable and arable lands loss.	There are 1.2 hm^2 of abandoned fishpond loss, and will not cause any commercial activities loss.	There are lots of fishponds lost in Xintian Spoil Site.	There are 2.3 hm^2 of fishponds, 1.1 hm^2 of bloodworm ponds loss.	It will not cause any fishponds and other commercial activities loss.	There are 1.2 hm^2 of abandoned fishpond loss, it will not cause any effect on commercia activities.
Future Development of Spoil disposal Ground	Lots of land occupied in spoil sites will lose their original usage, only suitable for dry land plant.	Land occupied in spoil sites will lose their original usage, only suitable for dry land plant.	Spoil in Xintian spoil site will no longer be used as fishponds.	The occupied wetlands and bloodworm ponds may be only used as dryland.	No future development limitation for spoil site will arise.	The spoil disposal will not change original usage of spoil site, so no future development limitation for spoil site will arise.
Culture Heritage	No cultural heritage affected.	No cultural heritage affected.	No cultural heritage affected.	No cultural heritage affected.	No cultural heritage affected.	No cultural heritage affected.
Landscape and Visual Impact	Landscape will lose for marshes, fishponds, woodlands, low-lying grassland and arable land loss in spoil site. The loss difficult to be restored after project completion. The adverse impact of bare spoil sites can be abated by re-vegetation.	Landscape will lose for marshes, fishponds, woodlands and low-lying grassland loss in spoil site which causes adverse impact on landscape resources. All impact can be restored and compensated on-site. The adverse impact from bare ground in spoil sites can be abated by re-vegetation.	No unacceptable landscape impact be caused.	Landscape resources will lose for marshes, fishponds, woodlands and low-lying grassland loss in spoil site which causes adverse impact on landscape resources. All impact can be restored and compensated on-site. The adverse impact from bare ground in spoil sites can be abated by re-vegetation.	No landscape impact.	Landscape resources will lose for marshes, fishponds, woodlands and low-lying grassland loss in spoil site which causes adverse impact on landscape resources. All impact can be restored and compensated on-site. The adverse impact from bare ground in spoil sites can be abated by re-vegetation.

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
Recommended Mitigation Measures	To discharge the leachate from contaminated spoil, when it meets the government criterion after enough sedimentation. Spraying the transport and field road periodically; keep all vehicles at good condition, equip gas-emission cleaner on them. Seriously polluted sludge need to be sealed and covered. Restoring and compensating the lost wetland. Covering clean soil on contaminated spoil. Re-vegetating spoil site after disposal.	To discharge the leachate from contaminated spoil, when it meets the government criterion after enough sedimentation. Spraying the transport and field road periodically; keep all vehicles at good condition, equip gas-emission cleaner on them. Seriously polluted sludge need to be sealed and covered. Restoring and compensating the lost wetland and fishponds. Covering clean soil on contaminated spoil. Re-vegetating spoil site after disposal.	To restore the same area fishponds lost in Xintain spoil site around the area. Strengthening the barging ships and prohibit discharging oily wastewater into sea. Spraying the transport and field road periodically; vehicle should be watered before leaving the construction site; keep all vehicles at good condition. equip gas-emission cleaner on them. Seriously polluted sludge need to be sealed and covered. Prohibiting shipping from 23:00 to 7:00. Choosing horns with low sound level and good orientation used on transportation ships, and use lamplight in place of horns.	To strengthen the barging ships and prohibit discharging oily wastewater into sea. Spraying the transport and field road periodically; vehicle should be watered before leaving the construction site; keep all vehicles at good condition, equip gas-emission cleaner on them. Seriously polluted sludge need to be sealed and covered. Prohibiting shipping from 23:00 to 7:00. Choosing horns with low sound level and good orientation used on transportation ships, and use lamplight in place of horns. Installing of engine noise snubber to decrease the noise produced by engines. Engine without enclosing device must be prohibited to use. Re-vegetating spoil site after disposal. To restore and compensating the lost wetland.	To strengthen the barging ships and prohibit discharging oily wastewater into sea. Prohibiting shipping from 23:00 to 7:00. To choose horns with low sound level and good orientation used on transportation ships, and use lamplight in place of horns. Installing engine noise snubber to decrease the noise produced by engines. Engine without enclosing device must be prohibited to use.	To strengthen the barging ships and prohibit discharging oily wastewater into sea. Spraying the transport and field road periodically; vehicle should be watered before leaving the construction site; keeping all vehicles at good condition, installing gas-emission cleaner on them. Seriously polluted sludge need to be sealed and covered. Prohibiting shipping from 23:00 to 7:00. Choosing horns with low sound level and good orientation used on transportation ships, and use lamplight in place of horns. Installing of engine noise snubber to decrease the noise produced by engines. Engine without enclosing device must be prohibited to use.

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
			Installing of engine noise snubber to decrease the noise produced by engines. Engine without enclosing device must be prohibited to use.			Re-vegetating spoil site after disposal. To restore and compensating the lost wetland.
Residual Environmental Impact	Heavy metal remained in contaminated spoil has potential impact on terrestrial ecosystem which is difficult to get rid of. Lots of arable and vegetable lands may lose their original usage. Bloodworm loss will lead to impact on ecosystem, which is difficult to get rid of. Other residual impacts are acceptable after other mitigation measures implemented.	Heavy metal remained in contaminated spoil has potential impact on terrestrial ecosystem which is difficult to get rid of. Other residual impacts are acceptable after other mitigation measures implemented.	It is difficult to estimate the fishpond loss. Other residual impacts are acceptable after other mitigation measures implemented.	Though wetland loss can be compensated, it is difficult to compensate the ecology impact caused by bloodworm loss. Other residual impacts are acceptable after other mitigation measures implemented.	All residual impacts are at acceptable level. This scheme will expand construction period 17 months including two flood seasons, which may lead unpredictable impact.	Other residual impacts are acceptable after other mitigation measures implemented.

No.	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6
Environmental Acceptability	It is unacceptable for significant ecology impact and large land occupation.	The ecology impact is too significant to accept.	Due to the special value of Shenzhen Bay and Mai Po Nature Reserve, it is unacceptable.	The ecology impact is too significant to accept.	The residual impacts are acceptable, but it does not follow the principle of terrestrial disposal. From engineering view, the construction period is too long to accept.	Acceptable
Priory Order	6	4	5	3	2	1

Table 7.10 Comparison for Each Scheme

Scheme	Advantage	Disadvantage
No. 1	No spoil barging, which meets the principle of terrestrial disposal. Noise impact from navigation does not occur.	leachate from contaminated spoil will possibly affect water quality; odor will emit from spoil storage; marsh and bloodworm ponds requisition will cause ecological impact; heavy metal in contaminated spoil will possibly affect ecosystem; a large area of land will be required; air emission and noise during spoil disposing process; affecting development of Muk Wu Tsun.
No.2	A large amount of uncontaminated spoil will be transported outside, and the land occupation area within construction site is small.	leachate from contaminated spoil will possibly affect water quality; odor will emit from spoil storage; marsh and bloodworm ponds acquisition will arise ecological impact; heavy metal in contaminated spoil will be possible affect strongly on ecosystem;
No.3	Contaminated spoil will not be disposed on-site, so it can avoid impact of leachate on water quality, impact of heavy metal in contaminated spoil on ecosystem, as well as odor emission. Transporting large amount of uncontaminated spoil to outside will solve the problem of lacking of space for spoil in construction sites.	Fishpond loss in Xintian spoil site will affect the ecosystem of Shenzhen Bay and Mai Po Nature Reserve; Air pollution will affect large area along the transport lines when using truck for outside disposal of spoil. Not meeting the principle of terrestrial disposal as much as possible.

Scheme	Advantage	Disadvantage
No.4	Contanminated spoil will not be disposed on-site so it can prevent leachate from polluting water quality, and heavy metal in contaminated spoil from affecting ecosystem, as well as odor emission. Meeting the principle of terrestrial disposal.	The areas of occupied marshes, fishponds and woodlands are more than that of Scheme 4; The largest woodland will be divided and fragmentary of habitat will be increased; More significant impact will be arisen from bloodworm pond loss, which has great impact on ecological system.
No.5	Contaminated spoil will not be disposed on-site so it can prevent leachate from polluting water quality, and heavy metal in contaminated spoil from affecting ecosystem, as well as odor emission. No land occupation.	Not following the principle of terrestrial disposal as much as possible. This scheme will prolong the construction period by 17 months including two flood seasons, which may occur unpredictable impact.
No.6	Contaminated spoil will not be disposed on-site so it can prevent leachate from polluting water quality, and heavy metal in contaminated spoil from affecting ecosystem, ecological impact caused by bloodworm pond loss, as well as odor emission. Few lands will be occupied. Meeting the principle of terrestrial disposal.	2.3 hm^2 of marsh, 0.8 hm^2 of woodlands, and 1.2 hm^2 of fishponds will be lost, which less than that of Scheme 4. Woodlands are sparse and fragmentary, and the marshes are small in size with low quality. Fishponds have been abandoned and unmanaged.

Scheme One: terrestrial disposal of all spoil along the riverside within the scope of Stage III Project. Because no transporting spoil outside is needed, it meets the land disposal principle of Hong Kong. However, some issues, such as (i) leachate from contaminated spoil will potentially affect water quality; (ii) odor will emit from spoil storage site; (iii) acquisition of marsh and bloodworm ponds will cause ecological impact; (iv) heavy metal in contaminated spoil will potentially affect ecosystem; (v) a large area of land will be resumed; (vi) air pollution and noise will be resulted in during spoil disposal process; (vii) development of Muk Wu Tsuen will be affected, etc., will be resulted in. Except for the first two issues, the other five are difficult to deal with, so this scheme is unacceptable.

Scheme Two: terrestrial disposal of all contaminated spoil along the riverside within the scope of Stage III Project, and marine disposal of all uncontaminated spoil near Neilingding Island. Compared with Scheme One, it can avoid some issues like a large area land resumption, disturbing the residents, and impact on development of Muk Wu Tusen. But it still cannot avoid the impacts of leachate on water quality, the odor emitted from spoil storage, especially the impact of heavy metal leached from contaminated spoil on ecosystem, when treating the contaminated spoil on site. Therefore, this scheme is also unacceptable.

Scheme Three: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and terrestrial disposal of all uncontaminated spoil at San Tin Container Site. Although it can avoid all effects arisen from on-site treatment of spoil, it needs to occupy some fishponds in San Tin spoil area, which is one of the important habitants for aquatic bird species in the adjacent bay area. The loss of Fishpond will reduce the area for bird inhabiting and feeding, and affect the ecosystem in Shenzhen Bay (Deep Bay) and Mai Po Nature Reserve, which are long-term impact. In addition, up to now, it is still uncertain for San Tin as spoil disposal site. Therefore, this scheme is unacceptable as it has significant impact on the local ecosystem.

Scheme Four: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and terrestrial disposal of part of uncontaminated spoil of dry excavated materials in bloodworm ponds and abandoned fishponds located in east of Nam Hang, while the remainder of uncontaminated spoil is to be dumped

near Neilingding Island. It can avoid various impacts for on site treating contaminated spoil and meet the principle of discarding spoil on land as much as possible. But it also need occupy marsh, especially bloodworm ponds, so it is unacceptable for its strong impact on the local ecosystem.

Scheme Five: marine disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and disposal all uncontaminated spoil near Neilingding Island. Among all schemes, the direct impact of this scheme is the minimum, but the construction period will be prolonged for 17 months, including two flood periods. If there are flood occurring during these two periods, it maybe not only affect the public benefits seriously, but also lead to a series of environmental impact. Due to a longer construction period, this scheme will prevent the Project from fully playing its benefits earlier. On the other side, it does not meet the principle of "discarding spoil on land as much as possible". This scheme can be chosen as one of alternatives but not the best one.

Scheme Six: disposal of all contaminated spoil in East Sha Chau (Hong Kong) marine spoil disposal area, and disposal part of uncontaminated spoil of dry excavation at Nam Hang low-lying land and valleys, while the remainder of the uncontaminated spoil near Neilingding Island. This scheme can avoid various environmental impacts and meet the principle of "discarding spoil on land as much as possible". Although it will occupy 2.3 hm^2 of marsh, 1.2 hm^2 of fishponds, and 0.8 hm^2 of woodlands, all these lands are sparsely and fragmentarily distributed and have frequently experienced hill fire, at the same time, the marshes are small in size with low quality and fishponds have been abandoned. So the spoil impact of this scheme on the local ecosystem is very low. As no people live in this area, so no impact on residents is expected. From environmental point of view, this scheme is the best one for spoil disposal.

In sum, the recommended spoil scheme is that using East Sha Chau as the contaminated spoil disposal site (the disposal quantity is 201,800 m^3), 500,000 m^3 uncontaminated spoil of dry excavation will be disposed in the low-lying land and valley near Nam Hang, while the remained 901,800 m^3 will be disposed near Neilingding Island.

The total area of the recommended spoil sites is 83,000 m^2, and the maximum top elevation is 18.0 m. Layout of the spoil-discarding site is shown in Figure 7.5.

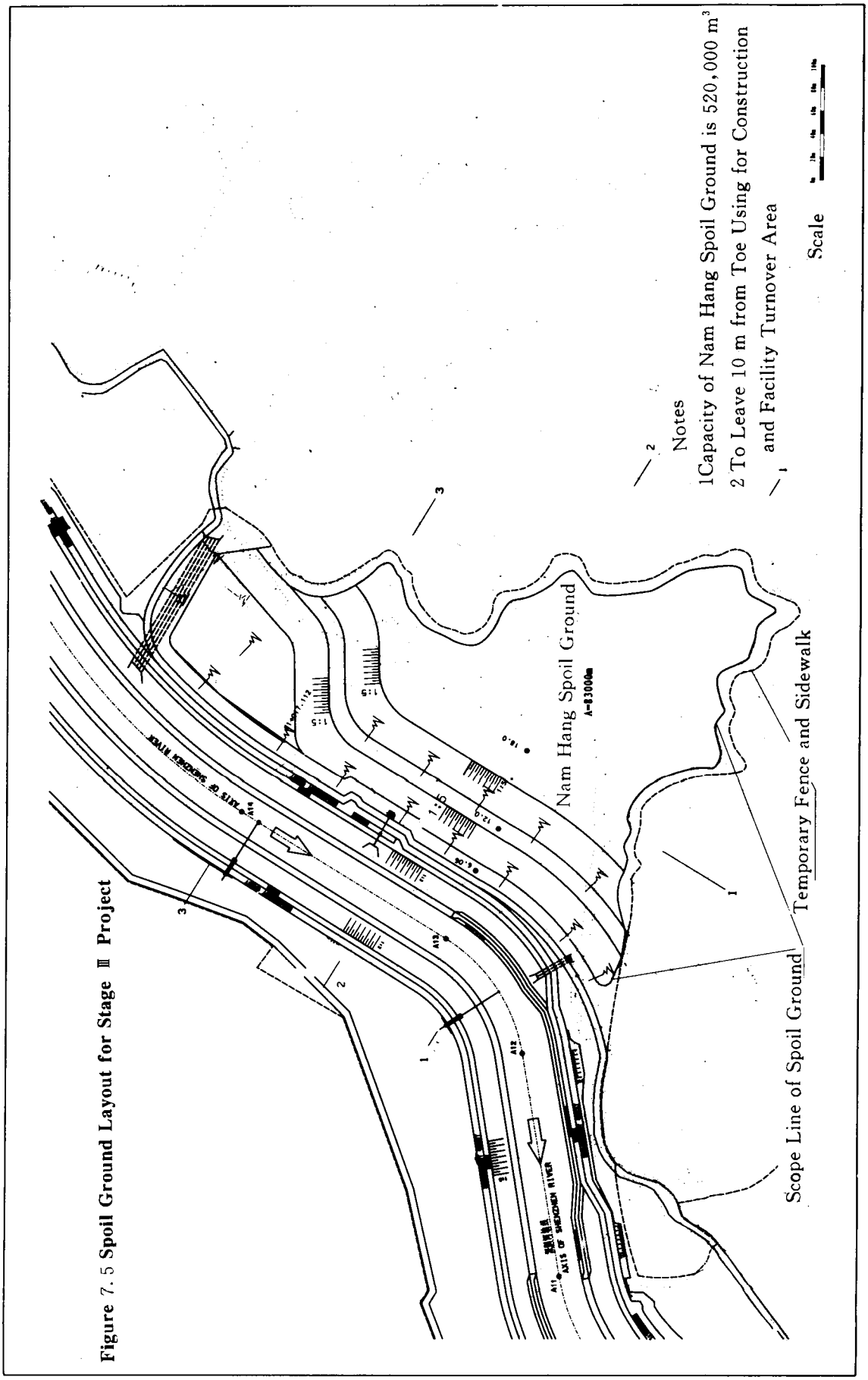

Figure 7.5 Spoil Ground Layout for Stage Ⅲ Project

7.5.2 *Impact Assessment*

In this section, environmental impact of spoil disposal for the recommended schemes will be assessed. Because the marine disposal sites proposed in the schemes are the places designated by State Government/Hong Kong SAR Government, and its EIA has already been done, so the impact of disposal spoil at sea will not be assessed here. Applying for disposal permission from the relevant authority (Shenzhen Ocean Management Division of State Ocean Bureau and Hong Kong Environmental Protection Department) is necessary before disposing the spoil from the Project.

(1) Potential impact on water quality

1) The infiltration impacts of spoil sites

The elutriate test of contaminated soil shows that little of the metal pollutants will be elutriated. In the recommended scheme, there is very low possibility for the pollutants enter the river with leachate. In addition, the amount of contaminated spoil is much less than the uncontaminated spoil. The test of the pollutants in soils shows that the content of organic materials in uncontaminated spoil is less than 3mg/kg with average of 1 mg/kg. So the discarding of uncontaminated spoil will not lead to water pollution due to infiltration. This conclusion is the same as that of the environmental impact assessment for Stage Ⅱ Project. In the environmental impact assessment for Stage Ⅱ Project, it is considered that because the soils (bottom materials or bank soil) are only transferred from the bottom of river channel to the adjacent land, any factors impacting on the hydro-geological environment (such as the underlying material infiltration and affinity to metals, the distance and the hydraulic gradient between the mud and groundwater table) will not change significantly. As a result, the mode transfer of heavy metal from sediment to groundwater will remain unchanged. In other words, no matter what kind of relationship between the heavy metal in bed sediment and groundwater is, construction of the Project will not change its situation. This conclusion is also true and suitable to Stage III Project.

2) The impact of ship wastewater

According to project scheme, some spoil is to be disposed outside by ship. Ships loading sludge may discharge wastewater into sea, which may affect the water quality.

Because the effect is insignificant and can be well controlled by improved management, no shipping pollution event has been reported yet in Shenzhen River and Shenzhen Bay.

Except for the two points above, Nam Hang spoil site will be used for storing uncontaminated dry excavated material. So no water pollution will be caused by leachate.

In sum, the impact of spoil on water quality is slight.

(2) Potential impact on air quality

In process of spoil disposal, trucks will be used for transport inside spoil site, while ships used for transport outside. Dust will be produced during spoil transport process using trucks, but no dust will be arisen in shipping process. The dust effect arisen from truck transportation has been discussed in Chapter 4 "Air Quality Impact Assessment". The assessment shows that construction activities will cause TSP concentration exceeding the criteria at two and four sensitive receivers on the Shenzhen side and the Hong Kong side, respectively, if no mitigation measures are taken. Transporting in spoil site is the main source of dust. After adopting mitigation measures, the concentration of TSP at all SARs will meet the standard.

Emission from the ships and trucks will cause impact on air quality because of fuel combustion, but the impact is insignificant (see Chapter 4).

Odor will be emitted in the process of storage and transport. However, the affected range is small, and it only affects the construction workers on-site. Nam Hang spoil site will store uncontaminated dry excavated material, thus no odor emission will be resulted in.

The impact of spoil disposal on air quality is mainly concentrated in the construction period.

(3) Potential impact of noise

The noise impact is mainly arisen in the process of transport. The noise from trucks will meet associated standard at 20 m away from the transport routes (see Chapter 5). Thus the ship noise is the main noise source in process of spoil disposal.

The noise sensitive receivers (NSR) and the nearest distance between the receiver and

the transport ships are given below:

On the Shenzhen side

Yumin Village (15 m)

Ludan Village (65 m)

Xiabumiao residential area (50 m)

Shenzhen Port Hospital (110 m)

Yunong village (63 m)

On the Hong Kong side:

Tai Sha Lok (220 m)

Ha Wan Tsuen (137 m)

The distribution of the sensitive receivers affected by navigation noise is shown in Figure 5.12.

According to the result of noise impact assessment, the noise level is 124 dB (A) and 110 dB (A) when whistling and not whistling, respectively.

Accordiny to the calculation in Chapter 5, when whistling, the noise level at 700 m away from the ships will be 60dB(A), which meets class II of the state standard and Hong Kong allowable noise level. However, as all the NSR along Shenzhen River are within 700 m from transporting ships, the noise level on NSR will exceed the standards in both Shenzhen and Hong Kong.

When ship is not whistling, the noise level along the River on the Shenzhen side at the distance of 120 m away from the ship will be 60 dB (A). On the Hong Kong side, the two NSR, Tai Sha Lok and Ha Wan Tsuen are more than 120 m away from the transporting ships, so it will not be affected when not whistling. On the Shenzhen side, as the NSR are within 120 m from the ship, especially Yumin Village is only 15 m away, which will be affected seriously (noise level is 78 dB(A)). So it is necessary to adopt mitigation measures to reduce noise level to acceptable level.

The noise impact also belongs to temporary one.

(4) Potential impact on ecology

1) Habitant loss

In the recommended spoil site, there are 2. 3 hm^2 of marsh, 0. 8 hm^2 of woodlands, 1. 2 hm^2 of fishponds, 0. 2 hm^2 of bushes, 5. 1 hm^2 of hillside grass land, and 1. 5 hm^2 of low-lying grassland. Since woodlands are sparsely and fragmentarily distributed, and marshes are small in size with low quality. It is estimated that few animals will be forced to migrant. The fishponds there have been abandoned.

2) Dust impact on plants

Dust arisen from spoil disposal will affect those plants with less ecological significance. But there are frequent hill fires. The impact of spoil disposal in open will continue until re-planting is completed. Spraying water on the roads can reduce the dust arisen from traffic.

3) Fragmentation

The areas of marshes and woodlands in Nam Hang valley are very small. Woodlands are separately distributed and apart from others. There are graves on slope around valley, and plants were destroyed by hillfires sometimes. Spoil disposal will not enhance the impact of fragmentation on relevant important habitats. Thus the impact is insignificant.

4) Disturbance to animals

The disturbance will mainly be restricted on the storage area due to spoil unloading and transportation. It will also affect some animals, mainly grassland insects having insignificant ecology, including *Euploea midamus*, *Eurema hecabe*, *Papolio polytes and Zizeeria maha*. They are very popular in Hong Kong, and not protected by local laws. Thus the impact is rather insignificant.

(5) Potential Impact on Landscape

Along with filling up of the original valley and the low-lying land, ground level of the spoil site will be raised with a maximum value of 6 m. The backside of spoil site is along hillside while its front side facing the River. The slope facing the river is gentle, with a ramp at 12 m elevation. Above the slope is a flat top (for spoil sties scheme

refers to Figure 7.5, and the crossing section after storage see Figure 7.6). It is expected that soil pilling up will not affect the view, and cause no in-consistency with the surroundings either. So it will have no adverse impact on landscape and view.

Occupation of marshes, fishponds, woodlands and low-lying grassland in spoil site will lead to loss and alternation of landscape elements, causing certain adverse impacts. Bareground after disposal will also cause adverse impacts on landscape character. However, the loss of marshes, fishponds, woodlands and low-lying grasslands could be restored and compensated on-site, and vegetation will be recovered on the bareground after disposal.

(6) Potential Impact on Cultural Heritage

No cultural heritage is located within the spoil site for the Project, therefore, no potential impact on culture heritage will be caused by spoil disposal.

(7) Potential impact on the losses of fishponds and other commercial activities There are 1.2 hm^2 of abandoned fishponds in disposal site that has been silted and already connected with Shenzhen River, thus it is not suitable for fish-farming anymore. Therefore, no fishpond loss will be resulted from spoil disposal.

As there is no commercial activities in spoil disposal site, there will be no commercial loss caused by disposal spoil.

(8) Restriction to future development of the spoil site

It has been planned by Hong Kong SAR government that part of the spoil disposal site will be used for cemetery, while the Lands Department has approved the use of spoil disposal in this area. It is planned that this site will still be used for cemetery after it is filled up by spoil. Therefore, spoil disposal will not restrict the future development of this site.

7.6 Environmental Impact of Dredged Spoil from Maintenance

According to a deposition calculation, the average annual siltation amount of the River is 161,000 m^3 after the Project is put into operation. Two years later, the total amount will reach to 337,000 m^3. By then, maintenance will be necessary.

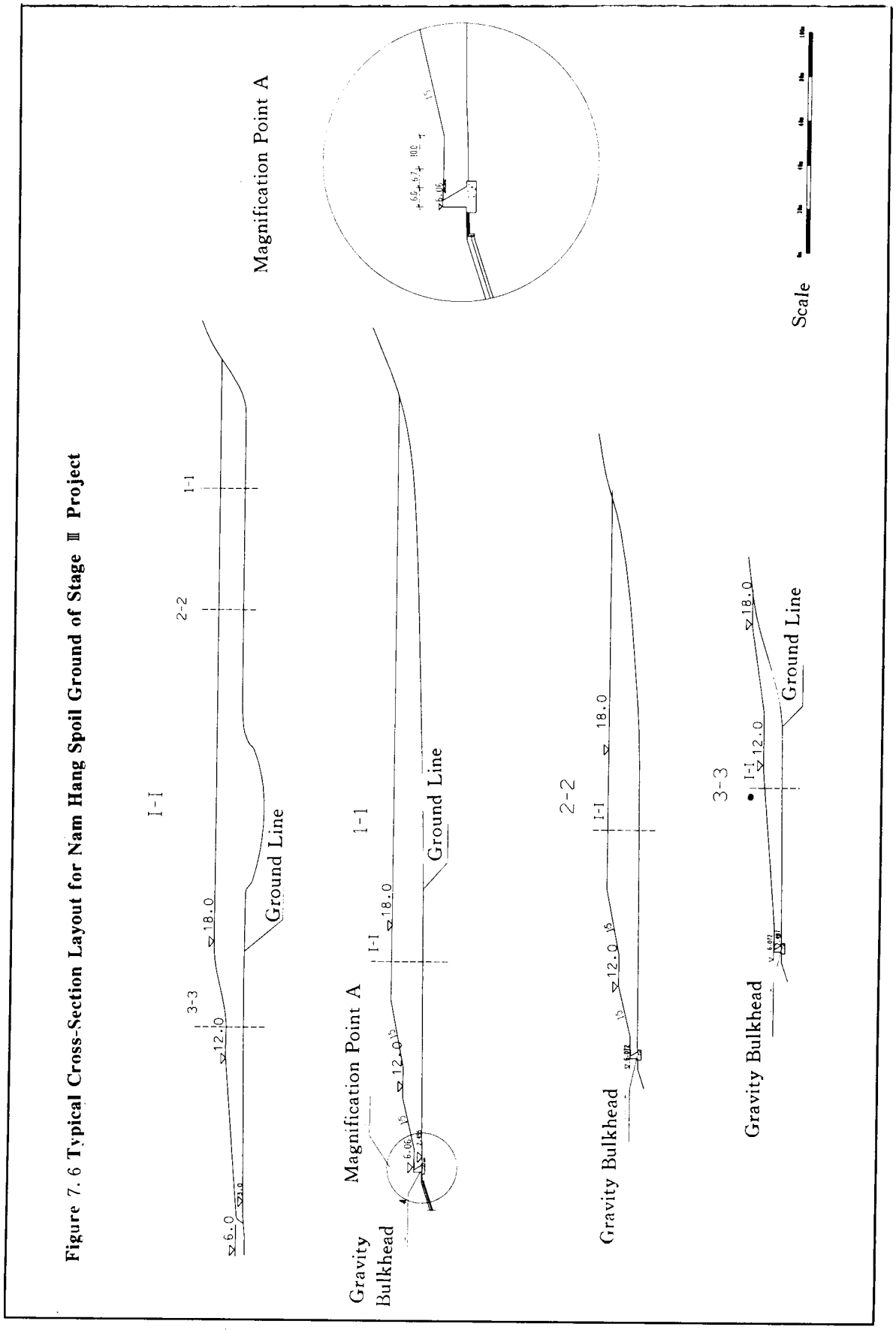

Figure 7. 6 Typical Cross-Section Layout for Nam Hang Spoil Ground of Stage Ⅲ Project

By now handling of dredged spoil from maintenance has not been decided. But it is clear that this will mainly depend on the degree of contaminated of the dredged spoil.

The monitoring results for the Buji River mouth show that the concentrations of heavy metals in mud are very high. The reason is maybe the fact that some of the mud comes from the upstream soil erosion, the other may come from the upstream undredged channel where there is a relatively serious pollution because of a long period of deposition. After Stage III Project, most of the channels would have been dredged, and the pollution sources along the Shenzhen River will be controlled. Thus it is estimated that the re-accumulated mud will be less polluted. Because there is undredged channel upstream, it is difficult to determine to what degree the improve ment will be.

Due to the space limitation within the construction site, and improvement of navigation condition, it is considered that small amount of spoil can be dumped into sea. But test should be done in advance to monitor the degree of contamination. The Class C contaminated spoil will be dumped into East Sha Chau, while uncontaminated spoil will be dumped into the site near Neilingding Island.

The dredging spoil will not cause wetland loss, limit development of spoil site, and will not cause other impacts on landscape, cultural heritage, fish ponds and other business activities. Due to only limited amount of the spoil will be produced in maintenance period, the air pollution and noise impact will not be more serious than that in construction period.

According to the Environmental Impact Assessment Regulation (Hong Kong), it is necessary to carry out EIA when the amount of dredged spoil is larger than 500,000 m^3. For this project, the amount of dredged spoil (once every two years) is about 337,000m^3, so EIA is not necessary. Because there is no such regulation in Shenzhen, the two governments from Shenzhen and Hong Kong will discuss whether EIA is necessary to be carried out for the maintenance dredging.

7.7 Mitigation Measures

Mitigation measures are proposed mainly for the recommended schemes.

7.7.1 *Water Quality*

1) Strengthen management of ships carrying spoil, and all the ships are not allowed to discharge oil-containing wastewater into the river or the sea.

2) Build drainage ditches around the spoil disposal site to collect rain water, and discharge is permitted only after sediment content meets Hong Kong *Rain Quality Control Criterion*, to prevent run-off carrying sediment into Shenzhen River.

7.7.2 *Air Quality*

The contractors should take the following necessary measures to reduce dust emission:

1) Limiting the speed of construction vehicles to less than 8 km/h at all construction roads and sites;

2) Watering roads and construction sites twice a day;

3) Vehicles must be equipped with wheel-clean facilities, or be washed before leaving construction site;

4) Covering materials on trucks when transporting;

5) If possible, making use of roads far away from sensitive receivers for transport;

6) Covering dredged sediment when transporting to avoid leakage and odor emission.

7.7.3 *Noise*

Measures should be taken for ships carrying spoil to reduce shipping noises, which may affect the receivers on both sides of the Shenzhen River (especially when whistling).

1) Shipping must be prohibited from 11:00 pm to 7: 00 am.

2) Taking measures to control ships noise.

As the impact of shipping noise on the sensitive receivers along the Shenzhen River is rather serious, it is necessary to take measures to reduce noise. The measures mentioned in Section 5.6 must be implemented.

7.7.4 *Ecology*

To prevent wild animals from disturbance, erect site fence around the spoil disposal site.

It is recommended that the marshes in the north of bloodworm ponds should be preserved for natural breeding. Besides, after completion, the marshes need to be permenantly preserved.

According to the design of the Nam Hang middle valley there will form two platforms with elevations of 12 m and 18 m, respectively. It is recommended to relocate the border fence onto the outer slope of the new dyke and plant trees and grasses on the platforms.

The area within the Sandy Ridge Cemetery are to be restored as grassland after completion of spoil disposal. The other part of the upper terrace is to be covered by local lignosa, including arbor and shrub. Priority is given to the native plants, which are more suited to the living conditions in the Nam Hang middle valley and also provide food for wild animals.

It is necessary to make reasonable construction schedule to avoid disturbing birds, and shipping density needs to be reduced during bird migrating period.

7.7.5 *Landscape*

After spoil disposal is finished, the spoil disposal sites must be cleared and re-vegetated.

7.7.6 *Construction Method*

Before construction activity begins, a detailed contaminated spoil distribution map should be made. During construction, the contaminated soil of Class C should be dredged and treated separately from other dredged material. A system shall be designed to record the final disposal position of each part of contaminated soil.

7.8 Residual Impact

The residual impact described here refers to the residual environmental impact of the

recommended schemes after mitigation measures are implemented.

7.8.1 *Residual Water Quality Impact*

The impact of shipping wastewater can be avoided thoroughly by strengthening shipping management.

After taking water and soil conservation measures, erosion can be avoided and it will not affect the water quality of the River, spoil disposal will not have any impact on water quality.

7.8.2 *Residual Impact on Air Quality*

By restricting vehicle speed in combination with watering, dust emission will reduce greatly, and will not cause TSP concentration exceeding relevant standard at sensitive receivers.

Vehicle emission has little effect on air quality.

After mitigation measures are taken, the impact of dust arisen from spoil transporting can be reduced to below the acceptable level.

7.8.3 *Residual Noise Impact*

The noise level will be acceptable after ta-king remedial measures.

7.8.4 *Residual Ecological Impact*

After implementation of proposed remedial measures, the marshes in the north of the bloodworm pond valley will be restored and improved.

The disturbance to wild animals is slight, after building fences around spoil disposal site.

The woodland loss will be compensated by re-vegetation after completion of spoil disposal.

In sum, the residual impact arisen from spoil disposing will be insignificant after taking mitigation measures.

7.9 Conclusions

(1) The quality of bank soil within the area of Stage Ⅲ Project is good and impact of terrestrial disposal on ecology is insignificant, thus it is permitted for disposal on land. Part of pollutant concentrations will exceed the limited value set by State Ocean Bureau for marine disposal. But results from the elutriation test indicate that associated requirements can be satisfied, therefore, it is permitted for disposal at the state designated places in the light of associated stipulation.

(2) More than half of the sediment is uncontaminated (or contaminated slightly) silt, which can be dumped at the state designated marine site. But part of the silt is heavy metal contaminated, reaching the Class C, and if terrestrial disposal is applied, extreme ecological damage will be induced. Thus, contaminated spoil is not allowed for terrestrial disposal.

(3) The recommended spoil scheme is that East Sha Chau is used as the contaminated spoil disposal site with a total disposal quantity of 201,800 m^3. 500,000 m^3 of uncontaminated spoil from dry excavation will be disposed in the low-lying lands and the valley in Nam Hang and nearby, while the remained 901,800 m^3 of spoil in areas near Neilingding Island.

(4) If the recommended scheme is adopted, the environmental impact arisen from spoil disposal is expected as follows:

1) The impact on water quality caused by disposing soils is insignificant and can be avoided. Water quality will not be affected by land spoil.

2) The construction will lead to concentration of TSP at some SARs being exceeded. The internal transportation is one of the exceedance reasons. After adopting mitigation measures, the concentration of TSP at all SARs will meet the standard. There is no obvious odor emission in spoil disposal site.

3) The noise caused by spoil barging will exceed noise limit at SNRs on Shenzhen side, with no exceedance on Hong Kong side. After adopting mitigation measures, the concentration of TSP at all SNRs will meet the standard.

4) 2.3 hm^2 of marshes, 0.8 hm^2 of woodlands and 1.2 hm^2 of fishponds will be lost

due to spoil disposal. However, the affected woodland is sparsely and fragmentarily distributed, marshes are small in size with low quality, and fishponds have been abandoned. The disturbance will mainly be concentrated in storage area caused by spoil unloading and transporting. Some kind of animals will also be affected, mainly the grassland insects of low ecological significance and of commonly-seen species in Hong Kong, which are not protected by local laws and regulations. In sum, the ecological impact caused by spoil disposal is rather insignificant.

5) Occupation of marshes, fishponds, woodlands and low-lying grassland in spoil disposal site will lead to losses of landscape elements, causing adverse impacts. But they can be restored and compensated on-site. Bareground after disposal will cause an adverse impact on landscape, re-vegetation must be carried out after disposal is completed.

6) No potential impact of spoil disposal on cultural heritage will occur.

7) The 1.2 hm^2 of fishpond, which will be lost due to spoil disposal, have been abandoned. No commercial activities will be affected.

8) There is no effect on future development of the spoil sites.

After taking mitigation measures, the impact caused by spoil disposal will be acceptable.