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S1 Introduction

S1.1 Shenzhen River

The Shenzhen River which is the bourndary river between Hong Kong SAR of Shenzhen, originates from the Ngai Mai Ling of the Ng Tung Mountain, flows from the northeast to the southwest, and discharges into Shenzhen Bay (also known as Deep Bay). The river mouth of the Shenzhen River is on the East Side of the Bay.

Main tributaries of the Shenzhen River include the Sha Wan River and the Buji River on the Shenzhen side, the Ping Yuen River (River Ganges) and the Ng Tung River (River Indus) on the Hong Kong side. Total length of the river is 37 km, and the Stage III Project covers about 4 km. The water system of the Shenzhen River shows an arborization shape with a catchment area of 312.5 km^2.

S1.2 Objective of the Project

The main objective of the Shenzhen River Regulation Project is flood prevention.

S1.3 Purpose of EIA

The purpose of EIA for the Project includes:

1) To describe the proposed project and associated works together with the requirements and environmental benefits for the proposed project, as well as the necessity and objectives to conduct the project.

2) To identify and describe the elements of community and environment, which are likely to be affected by the proposed project, or likely to cause adverse impacts on the proposed project, including both natural and man-made environment and associated environmental constraints.

3) To identify and quantify the pollution sources and determine the significance of their impacts on sensitive receivers and the potentially affected usage.

4) To identify and quantify any potential losses or damage caused to flora, fauna and natural habitats.

5) To identify any negative impacts on cultural heritage and propose measures to mitigate the impacts

6) To propose infrastructure or mitigation measures, which can be used to minimize pollution, environmental disturbance and nuisance during construction and operation of the Project.

7) To investigate the feasibility, effectiveness and implication of the proposed mitigation measures.

8) To identify, predict and evaluate the residual environmental impacts (after taking remedial measures) and the cumulative effects during construction, operation phases of the Project on sensitive receivers and potentially affected uses.

9) To identify, assess and specify methods, measures and standards to be included in the detailed design, construction, operation of the Project, which are necessary to mitigate the residual environmental impacts and cumulative effects and reduce them to an acceptable level.

10) To design and specify the requirements for environmental monitoring and audit of the Project.

11) To identify additional studies necessary to implement the mitigation measures, monitoring and proposals recommended in the EIA report.

S2 Shenzhen River Regulation Project Stage III

S2. 1 Project Description

Stage III Project covers an area from the starting point of Stage I works (chainage 9+416. 963) to the confluence with Ping Yuen River (River Ganges) (chainage 13+465. 136) with a new river channel length of 4. 05 km. The implementation of Stage III Project is divided into two phases. Phase I mainly includes constructing new border patrol roads and fences before removing the existing border patrol roads and fences on both Hong Kong & Shenzhen sides affected by the Project. The design, management and construction for Phase I on the respective side will be carried out by Shenzhen and Hong Kong governments. The Phase Ⅱ works include the river improvement from the

starting point of Stage I works to the confluence with Ping Yuen River (River Ganges) and the reprovision of other facilities affected by the project. When completed, the river will be able to convey a 1 in 50 year flood.

Phase I of Stage Ⅲ Project mainly covers such items as constructing new border patrol roads and fences, part of the embankment construction and other associated drainage works.

The Phase II of the Project mainly includes following items:

(1) River channel Construction

1) Widen, deepen and straighten the existing river channel from the starting point of Stage I Project to the confluence with Ping Yuen River (River Ganges) together with improvement works to the confluence with the major tributaries, such as the Ng Tung River (River Indus), the Sha Wan River and the Ping Yuen River (River Ganges).

2) Protect the slopes and banks of the 4.05 km long new river channel.

3) Adopt effective measures to protect the riverbed in some sections with severe scouring.

(2) Embankment construction

Construct new embankment and the associated retaining structure on both sides of the new river channel.

(3) Bridge construction

The bridges affected by Stage III Project are Lo Wu Railway Bridge, the Old Lo Wu Footbridge, the New Lo Wu Footbridge, the Old Man Kam To Vehicular Bridge and the New Man Kam To Vehicular Bridge. All the five bridges will be strengthened or reconstructed.

(4) Reprovisioning Works

1) Reprovide the drainage system along both sides of the Shenzhen River.

2) Diversion of Dongjiang water mains.

3) Other reprovisioning works.

Figure S2. 1 shows the layout of Shenzhen River Regulation Project Stage III.

S2. 2 Design of the Project

(1) Flood protection standard

The Shenzhen River is designed against the flood event of 50-year reoccurrence and checked against 200-year reoccurrence without overtopping of embankment.

(2) Channel cross-section

The composite cross-section is normally used for the river channel of Stage III Project reach if geometrically possible. Vertical or mixed cross-section will also be adopted locally, if buildings or hills along the bank restrict the river course.

S2. 3 Construction Works

S2. 3. 1 *Channel Diversion*

During excavation, materials outside the existing river will be excavated first keeping the existing river bank as "diversion dike". When the excavation and placement of the embankment foundation is carried out on one side, the river channel on the other side will be used for diversion. After the completion of the embankment construction, the "diversion dike" will then be removed.

The cutting straight of river meanders between Man Kam To and Lo Wu Bridge and in Man Kam To section will be carried out in dry during dry season with the aid of a cofferdam.

S2. 3. 2 *Spoil Disposal*

The total amount of spoil generated in Phase II of Stage III Project will be 1,603,600 m^3, of which about 201,800 m^3 are contaminated spoil and 1,401,800 m^3 are uncontaminated spoil. In this report, the contaminated spoil refers to Class C soil specified in *Hong Kong Classification of Dredged Mud for Marine Disposal* (*Environmental Protection Department Technical Circular* (*TC*) *No.* 1-1-92). Others are classified as uncontaminated spoil.

Recommended spoil disposal scheme is: 201,800 m^3 of the contaminated soil should be placed in the East Sha Chau spoil dumping area; part of uncontaminated soil (500,000m^3, all from dry excavation) be placed in Nam Hang valley adjacent to the river; the remained 901,800 m^3 of uncontaminated soil is to be placed near Neilingding Island.

Spoils generated in Phase I are disposed separately in designated waste disposal grounds in Shenzhen and Hong Kong.

S2.3.3 *Borrow Area*

The borrow area is located in Shuijingdaliang Village of Buji Town. 113,200 m^3 of earth material is to be excavated with a haulage of 17-19 km.

S2.3.4 *Construction Methods for Main Works*

(1) Construction zoning

The construction of Stage III Project is divided into four zones (I-IV).

Zone I: From Lo Wu Bridge to the connection with Stage I works, namely from chainage 9+559 to 9+841, with a total length of 282 m.

Zone II: From Lo Wu Bridge to Man Kam To (chainage 9+844 to 11+387) with a length of 1,546 m.

Zone III: Man Kam To Boundary Crossing (chainage 11+387 to 11+735) with a length of 348 m.

Zone IV: From Man Kin To Boundary Crossing to the mouth of River Ganges (chainage 11+735 to 13+466) with a length of 1,731 m.

The construction zonation of Stage III Project is shown in Figure S2.1.

(2) Dredging and excavation

Clamshell dredger and long boom backhoe will be used for dredging, and hopper barge and trippers are used for transporting the excavated material. Suction dredger, which has better environmental performance could also be used for dredging. When the suction dredging method is adopted, the dredged material will be directly trans-

ported to banges at downstream of Lo Wu Bridge and no settlement basin will be needed in the construction site.

Backhoe or long boom backhoe is used in dry excavation of river channel, and lorries are used for transportation.

(3) Construction of the embankment

Wheel loaders with a capacity of 2-3 m^3 are to be used to take earth for embankment, and 10 t trippers are applied for transportation, 120 hp bulldozers for levelling, and 10 t vibrating rollers for compacting.

S2.4 Construction Programme

Construction for Phase I will start in Nov. 2001 and complete before Oct. 2003.

The period for construction of the main channel works will last for 39 months, from July 2001 to September 2004.

The construction schedule is shown in Table S2.1. Because the actual construction commencement date is far away from the present and can be influenced by many factors such as public objective, legal procedures and abministrative procedures of both sides etc. The actual commencement will finally be determined after completion of the necessary procedures.

S2.5 Environmental Benefits of the Project

Stage III Project possesses the following environmental benefits:

(1) Reducing or avoiding environmental pollution caused by flooding

The area along the Shenzhen River often suffers from flooding. Pollutant carried by floodwater often lead to environmental pollution in submerged area as the Shenzhen River is severely polluted.

Implementation of the Project can greatly enhance the flood control capability of the Shenzhen River to against 50-year reoccurrence flood, and the environmental pollution caused by flood would be greatly reduced.

(2) Improving the Shenzhen River water quality

表 S2-1 治理深圳河第三期工程施工计划时间表(1/5)

Table S2.1 Regulation of Shenzhen River Stage III Construction Schedule of Globle(1/5)

工程项目 ITEM		工程量 WORK QUANTITY 单位 UNIT	数量 QUANTITY	2000	2001	2002	2003	2004
第一阶段工程 PHASE I WORKS								
第二阶段工程 PHASE II WORKS					开工 STARTING			竣工 FIN
一、准备工程 PREPARATION WORKS								
1 施工围网 GUARD GRILLE AROUND THE JOB SITE		项 ITEM	1					
2 场内交通 SITE ACCESS		项 ITEM	1					
3 场地平整 LAND LEVELING AND DRAINING		项 ITEM	1					
4 施工企业 AUXILIARY FACTORY FOR CONSTRUCTION		项 ITEM	1					
5 临时房屋 TEMPORARY HOUSING		项 ITEM	1					
6 水电通讯系统 WATER AND POWER SUPPLY AND TELCOMMUNICATION SYSTEM		项 ITEM	1					
二、第I区工程 I AREA WORKS (9+417—9+841)								
重配工程: 深方1#涵 (9+588.7) MATCH WORKS: NORTH 1# DRANNING		座	1					
钢平台 STEEL PLATFORM	1 D325钢管桩 (7—10m) STEEL TUBE PILES	根	25					
	2 平台土石填筑 COFFERDAM FILLING	项	1					
	3 基础开挖 FOUNDION EXCAVATION	m^3	50					
	4 基础混凝土 CONCRETE FOR FOUNDATION	m^3	26					
	5 基础土石填筑 FOUNDION FILLING	m^3	30					
	6 钢平台安装 STEEL PLATFORM CONSTRUCTION	t	233					
	7 拆除钢平台 CUT OFF STEEL PLATFORM	项	1					
	8 拆除施工围堰 CUT OFF CONFFERDAM	项	1					
罗湖铁路桥 LU WO RAILWAY BRIDGE	1 地基加固灌浆 GRUTING	项	1					
	2 人工挖孔桩 (18—21m) MANUAL CONCRETE PILE	根	8					
	3 基础开挖 FOUNDION EXCAVATION	m^3	760					
	4 桥墩、桥台混凝土 CONCRETE FOR FOUNDATION	m^3	596					
	5 基础土石填筑 CUT OFF STEEL PLATFORM	m^3	550					
	6 新钢桥拼装 MAKING NEW STEEL BRIDGE	t	341					
	7 横移 MOVING	项	1					
	8 拆除旧桥墩 CUT OFF FOUNDATION OF OLD BRIDGE	项	1					

表 S2-1 治理深圳河第三期工程施工计划时间表(2/5)

Table S2.1 Regulation of Shenzhen River Stage III Construction Schedule of Globle(2/5)

工程项目 ITEM			工程量 WORK QUANTITY 单位 UNIT	数量 QUANTITY
罗湖人行老桥 LO WU OLD FOOTINGBRIDGE	1	基础开挖 FOUNDION EXCAVATION	m^3	45
	2	填筑 PLACEMENT	m^3	420
	3	桥墩、桥台混凝土 CONCRETE FOR FOUNDATION	m^3	9
	4	钢桥制安 STEEL BRIGE ASSEMBLE	t	56
	5	旧桥拆除 OLD BRIGE CUT OFF	座	1
罗湖人行新桥 LO WU NEW FOOTHBRIDGE	1	地基灌浆加固 FOUNDATION GRUTING	项	1
	2	钢套筒安装 STEEL PLATE STAKE	项	1
	3	基础加固混凝土 IMPERVIOUS CONCRETE FOR FOUNDATION	m^3	260
	4	钢套筒拆除 STEEL PLATE STAKE REMOVING	项	1
深圳堤防 NORTH EMBANKMENT	1	填筑施工平台 CONSTRUCTION PLACEMENT	项	1
	2	开挖 EXCAVATION	m^3	1440
	3	填筑 EMBANKMENT PLACEMENT	m^3	14260
	4	人工挖孔桩 (14—17m) MANUAL CONCRETE PILE	根	62
	5	地下连续墙 UNDERGROUND CONTINOUS WALL	m^2	2074
	6	现浇混凝土 PRECAST CONCRETE BLOCKS	m^3	2428
	7	土锚 GROUND ANCHORAGES	m	3190
	8	拆除施工平台 REMOVE CONSTRUCTION PLACEMENT	项	1
香港堤防 SOURTH EMBANKMENT	1	填筑施工平台 CONSTRUCTION PLACEMENT	项	1
	2	开挖 EXCAVATION	m^3	280
	3	筑堤 EMBANKMENT PLACEMENT	m^3	1370
	4	D600灌注桩 (16m) BORED PILE	根	2000
	5	现浇混凝土 PRECAST CONCRETE BLOCKS	项	1
	6	拆除施工平台 REMOVE CONSTRUCTION PLACEMENT	项	1
河道工程 RIVER WORKS	1	河道开挖 RIVER EXCAVATION	万m^3	14.84
	2	土工布铺筑 GEOTEXTILE PLACEMENT	m^2	4255
	3	碎石垫层 CRUSHED ROCK	万m^3	1.42
	4	抛石填筑 DUMPING RIPRAP	万m^3	1.70
	5	混凝土块 PRECAST CONCRETE BLOCKS	m^3	133
	6	混凝土墩 CONCRETE	m^3	77
	7	模袋混凝土 FABRIC CONCRETE	m^3	2068
碎石路面 broken stone road surfase			项	1
草皮护坡 GRASS SLOPE PRETECTION			项	1

表 S2-1 治理深圳河第三期工程施工计划时间表(3/5)

Table S2.1 Regulation of Shenzhen River Stage III Construction Schedule of Globle(3/5)

工程项目 ITEM			工程量 WORK QUANTITY 单位 UNIT	数量 QUANTITY
三、第II区工程 II AREA WORKS (9+841—11+387)				
重配工程 REMATCH WORKS	深圳2—7#涵 NORTH 2---7# DRANNING		座	6
	香港7—12#涵 SOURTH 7---12# DRANNING		座	6
深圳堤防 NORTH EMBANKMENT	1.填筑施工平台 CONSTRUCTION PLACEMENT		项	1
	2.开挖 EXCAVATION		万m^3	4.21
	3.填筑 EMBANKMENT PLACEMENT		万m^3	19.06
	5 地下连续墙 UNDERGROUND CONTINOUS WALL		m^2	4138
	6.现浇混凝土 PRECAST CONCRETE BLOCKS		万m^3	2.21
	7.土锚 GROUND ANCHORAGES		m	7040
	8.拆除施工平台 REMOVE CONSTRUCTION PLACEMENT		项	1
香港堤防 SOURTH EMBANKMENT	1.填筑施工平台 CONSTRUCTION PLACEMENT		项	1
	2.开挖 EXCAVATION		万m^3	3.88
	3.筑堤 EMBANKMENT PLACEMENT		万m^3	8.76
	4 D600灌注桩(16m) BORED PILE		根	643
	5 D2500灌注桩(30m) BORED PILE		根	56
	6 现浇混凝土 PRECAST CONCRETE BLOCKS		万m^3	1.72
	7.拆除施工平台 REMOVE CONSTRUCTION PLACEMENT		项	1
河道工程 RIVER WORKS	1.河道开挖 RIVER EXCAVATION		万m^3	76.94
	2.填筑 PLACEMENT		m^3	6841
	3 土工布铺筑 GEOTEXTILE PLACEMENT		万m^2	7.26
	4.碎石垫层 CRUSHED ROCK		万m^3	3.04
	5.抛石填筑 DUMPING RIPRAP		万m^3	5.02
	6.混凝土块 PRECAST CONCRETE BLOCKS		m^3	2124
	7 混凝土墩 CONCRETE		m^3	1112
	8 模袋混凝土 FABRIC CONCRETE		m^3	1769
碎石路面 broken stone road surfase			项	1
草皮护坡 GRASS SLOPE PRETECTION			项	1

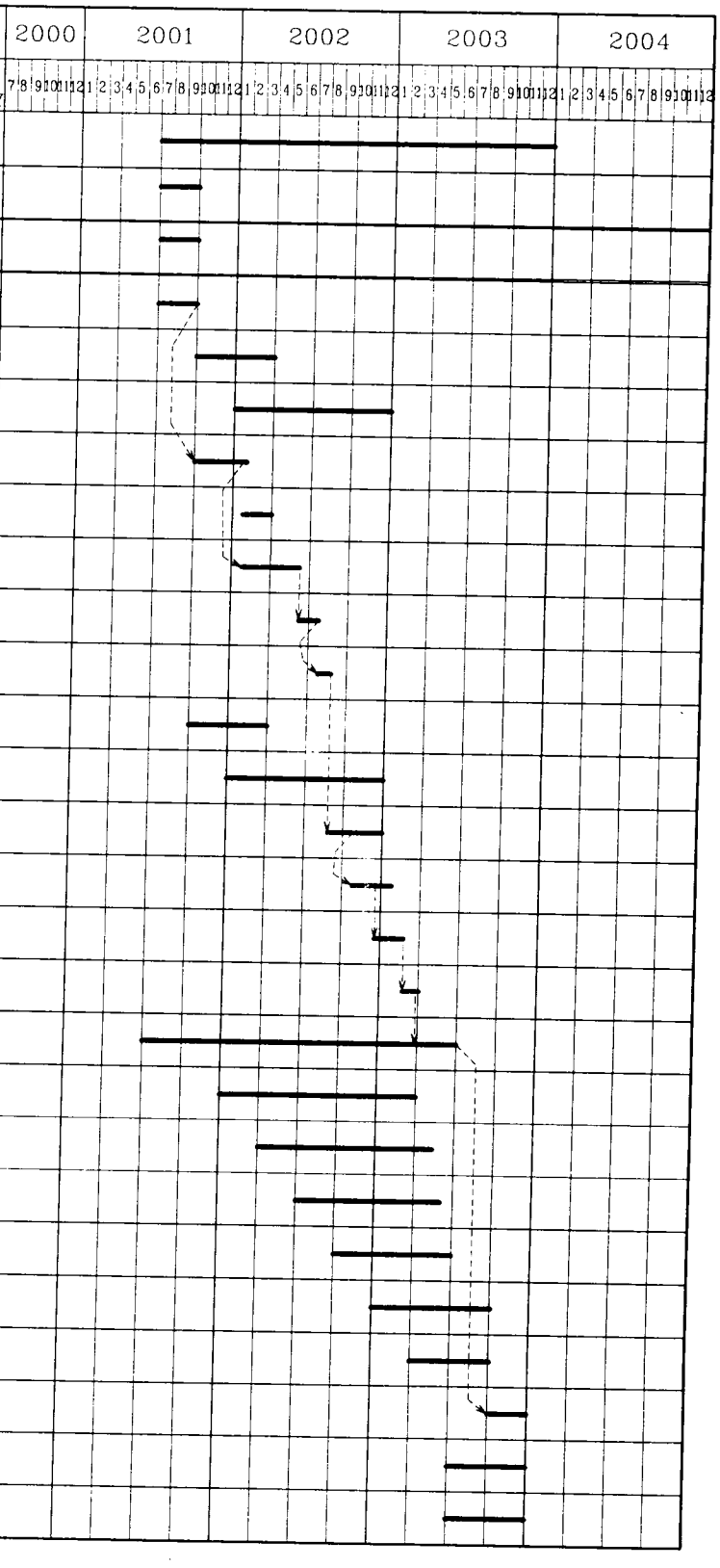

表 S2-1 治理深圳河第三期工程施工计划时间表(4/5)

Table S2.1 Regulation of Shenzhen River Stage III Construction Schedule of Globle(4/5)

工程项目 ITEM			工程量 WORK QUANTITY 单位 UNIT	数量 QUANTITY	2000	2001	2002	2003	2004
四、第III区工程 III AREA WORKS (11+387——11+735)									
重配工程 REMATCH WORKS		深圳8#涵 NORTH 8# DRANNING	座	1					
		文锦渡排水管渠 WEN JIN DU DRAINING SYSTEM	座	2					
		香港6、13—14#涵 SOURTH 6#13---14# DRANNING	座	3					
深圳堤防 NORTH EMBANKMENT	1.	开挖 EXCAVATION	m^3	9420					
	2.	筑堤 EMBANKMENT PLACEMENT	万m^3	10.89					
	3.	现浇混凝土 PRECAST CONCRETE BLOCKS	m^3	6463					
香港堤防 SOURTH EMBANKMENT	1.	开挖 EXCAVATION	万m^3	1.14					
	2.	填筑 EMBANKMENT PLACEMENT	万m^3	1.75					
	3.	现浇混凝土 PRECAST CONCRETE BLOCKS	m^3	8803					
河道工程 RIVER WORKS	1.	河道开挖 RIVER EXCAVATION	万m^3	19.90					
	2.	填筑 PLACEMENT	m^3	2406					
	3	土工布铺筑 GEOTEXTILE PLACEMENT	万m^2	2.15					
	4.	碎石垫层 CRUSHED ROCK	万m^3	0.82					
	5.	抛石填筑 DUMPING RIPRAP	万m^3	1.47					
	6.	混凝土块 PRECAST CONCRETE BLOCKS	m^3	574					
	7	混凝土墩 CONCRETE	m^3	330					
碎石路面 broken stone road surfase			项	1					
草皮护坡 GRASS SLOPE PRETECTION			项	1					
新建文锦渡至香港桥梁 CONSTRUCTION NEW BRIDGE TO HONGKONG	1.	基础开挖 FOUNDION EXCAVATION	m^3	5150					
	2.	填筑 PLACEMENT	m^3	11500					
	3	北岸桩基施工 NORTH BORED PILE	根	8					
	4	北岸承台施工 NORTH BEARING PLATFORM	项	1					
	5	北岸桥墩、桥台、墩帽、台帽施工 NORTH PIER*ABUTMENT	项	1					
	6.	南岸围堰施工 SURTH COFFERDAM	项	1					
	7	南岸桩基施工 SOURTH BORED PILE	根	8					
	8	南岸承台施工 SOURTH BEARING PLATFORM	项	1					
	9	南岸桥墩、桥台、墩帽、台帽施工 SOURTH PIER*ABUTMENT	项	1					
	10	桥梁架设 ASSEMBLE BRIDGE	项	1					
	11	桥面铺装 BRIDGE SURFACE CONSTRUCTION	项	1					
	12	试车 TRY	项	1					
拆除文锦渡旧桥梁 CUT OFF OLD BRIDGE TO SHENZHEN			座	2					

表 S2-1 治理深圳河第三期工程施工计划时间表(5/5)

Table S2.1 Regulation of Shenzhen River Stage III Construction Schedule of Globle(5/5)

工程项目 ITEM			工程量 WORK QUANTITY 单位 UNIT	数量 QUANTITY	2000	2001	2002	2003	2004
五、第IV区工程 IV AREA WORKS (11+735—13+467)									
重配工程 REMATCH WORKS	深圳9—12#涵 NORTH 9---12• DRANNING		座	4					
	香港1—5#、15#、16#涵 SOURTH 1---5• •15••16•DRANNING		座	7					
	碎石转送带改建工程 CRUSHED ROCK CONVEYER EQUIPMENT		项	1					
	木湖泵站管道改建工程 MU HU STEEL TUBE CONSTRUCTION		项	1					
深圳堤防 NORTH EMBANKMENT	1 填筑施工平台 CONSTRUCTION PLACEMENT		项	1					
	2. 开挖 EXCAVATION		万m^3	3.07					
	3. 填筑 EMBANKMENT PLACEMENT		万m^3	9.43					
	5 地下连续墙 UNDERGROUND CONTINOUS WALL		m^2	6616					
	6. 现浇混凝土 CONCRETE		万m^3	2.30					
	7. 土锚 GROUND ANCHORAGES		m	4830					
	8 拆除施工平台 REMOVE CONSTRUCTION PLACEMENT		项	1					
香港堤防 SOUTH EMBANKMENT	1 填筑 EMBANKMENT PLACEMENT		m^3	4800					
	2 现浇混凝土 CONCRETE		m^3	2762					
河道工程 RIVER WORKS	1. 河道开挖 RIVER EXCAVATION		万m^3	72.75					
	2. 填筑 PLACEMENT		万m^3	0.29					
	3 土工布铺筑 GEOTEXTILE PLACEMENT		万m^2	8.74					
	4. 碎石垫层 CRUSHED ROCK		万m^3	4.11					
	5. 抛石填筑 DUMPING RIPRAP		万m^3	7.12					
	7. 混凝土块 PRECAST CONCRETE BLOCKS		m^3	3299					
	8 混凝土墩 CONCRETE		m^3	1192					
沉井工程 MASON			项	1					
碎石路面 broken stone road surfase			项	1					
草皮护坡 GRASS SLOPE PRETECTION			项	1					
河道堤防工程量合计 QAUTITY TATOL	1. 开挖 RIVER EXCAVATION		万m^3	202		35	84	45	38
	2. 填筑 PLACEMENT		万m^3	53		4.5	19.2	19.7	9.6
	3 土工布铺筑 GEOTEXTILE PLACEMENT		万m^2	18.6			4.5	5.4	8.7
	4. 碎石垫层 CRUSHED ROCK		万m^3	9.4			2.0	3.3	4.1
	5. 抛石填筑 DUMPING RIPRAP		万m^3	15.3			2.5	7.1	5.7
	6. 混凝土 CONCRETE		万m^3	13.6		0.3	5.4	4.8	3.1

As both the storage capacity and the flood-tide exchanging volume of the river channels will considerably increase during the tidal period, and the time needed for the river water flowing into the sea will significantly cut down, pollutants in the River can be better diluted, decomposed and transformed. As a result, the existing polluted river water will be improved to some extent after implementation of the Project.

The clearance of the polluted river sediment is also beneficial to improving the Shenzhen River water quality.

Moreover, the improved flood discharge and hydraulic condition of the river provides a favourable condition to control the Shenzhen River water pollution.

(3) Protecting and improving ecosystem

Once a flood comes, some wild animals are usually drowned because there is not enough chance for them to escape. Some have to move to other places. As a result, their former habitats or feeding grounds are lost. Besides, all the dwarfs and bushes become slower in growth or even dead due to insufficient supply of sunlight and nutrients caused by inundation and slow flood retreating. Implementation of the Project can greatly enhance flood capability capacity of the Shenzhen River, providing a more safe living environment for the wild animals and plants in the region.

Meanwhile, the reduction of the environmental pollution caused by flooding will also be beneficial to improving the local ecological conditions.

The improvement of the Shenzhen River water quality is also beneficial to improving the aquatic ecosystem of the River.

(4) Abating odour

When the Project is finished, as the result of water quality improvement and silt clearance, the odour of the Shenzhen River will be significantly decreased, and even eliminated. This also contributes to improving, the air quality in surrounding area.

(5) Improving landscape and visual effects

After completion of the Project and implementation of the mitigation measures, the former messy scenes will be greatly improved. The river channel will become wider with the bed sediment dredged. There will also be rows of trees and green grasses

covering the banks. As a result, the landscape along both banks is much improved.

(6) Benefit to the public health

The frequent flooding provides a favourable breeding condition for mosquito and fly, which is adverse for public health. After completion of the project, the flooding could be eliminated, so that the breeding of mosquito and fly, etc. could be greatly reduced, which will be beneficial to public health.

S2.6 Potential Environmental Impacts of the Project

(1) Major works items

The major works items include: reprovision of border fence and border patrol road, constructing haul road; site formation; dredging; embankment protection; embankment construction; slope protection; borrowing; spoil disposal; bridge reconstruction; prepatation works and other reprovisioning works.

(2) Potential environmental impacts

Upon analysis, the potential environmental impacts of the project are listed in Table S2.2.

Table S2.2 Potential Environmental Impacts Caused by the Project

Item	Potential Environmental Impacts					
	Air	Noise	Water Quality	Ecology	Landscape and Vision	Cultural Heritage
Border fence	◎	○			◎	
Border road	◎	◎			○	
Construction traffic	◎	○			○	
Site formation	◎	○			○	
Dredging	●	●	●	●	●	
Bank protection	○	○	○	◎	◎	
Embankment construction	●	●		●	●	
Borrowing	●	◎		◎		
Spoil disposal	◎	●	◎	●	◎	
Bridge reconstruction	○	○	○	○	○	●
Reprovisioning works						

Item	Potential Environmental Impacts					
	Air	Noise	Water Quality	Ecology	Landscape and Vision	Cultural Heritage
Preparation works						

Note: ○ might have low impact.
◎ might have medium impact.
● might have high impact.
Blank indicates no impact.

S3 Technical Approach and Study Methodology

S3. 1 Technical Approach

The EIA follows the following technical approach:

(1) Invite experienced environmental experts to discuss and screen the major potential environmental impacts and major environmental issues, in the light of the scheme and present environmental setting;

(2) Carry out baseline evaluation to identify the present environmental conditions in the Study Area, on the basis of available data, field investigation and monitoring;

(3) Predict the potential environmental impacts caused by the Project, upon special study and simulation, incorporating expert's experience;

(4) Evaluate the environmental impacts caused by the Project according to relevant laws, regulations, standards; besides, the predicted results;

(5) Put forward remedial measures, assess the residual impacts and evaluate whether it meets the relevant policies and standards of both Shenzhen and Hong Kong;

(6) Make environmental monitoring and audit working plan to evaluate the actual environmental impacts and effectiveness of remedial measures.

S3. 2 Examination of Major Environmental Issues

According to the Project's features, regional environmental characteristics, Project's constraints and special requirements, as well as the EIAs findings for Stage I, Stage II of the Project and other similar projects, experienced environmental experts have identified the major environmental issues for the Project. These issues include the impact caused by spoil disposal and the impacts of the Project on ecology and water quality.

Besides the major environmental issues, other environmental impacts (such as impacts on air quality, noise, landscape and vision, cultural heritage etc.), should also be assessed.

S3.3 Review and Study of References

Information collection is focused on the area of the construction site and its vicinity. The main items include:

(1) Project data, such as scheme, design, and relevant investigation findings.

(2) Information about geology, landforms, hydrology, meteorology, soil, vegetation, habitats and socio-economy in the Project affected area.

(3) EIA reports for Stage I and Stage II of the Project, findings from environmental monitoring and audit and relevant study, as well as EIA reports of other similar projects.

(4) Associated laws, regulations, ordinances, standards related to environmental protection of both Shenzhen and Hong Kong.

(5) Environmental quality reports, environmental protection plan, other relevant data and information of Shenzhen City.

(6) Data about historic relics and cultural heritages in both Shenzhen and Hong Kong.

After reviewing the above information collected, an online search for relevant information at home and abroad has been made on the Internet concerning the major environmental issues of Stage III Project, with the focus on the impacts of spoil disposal and impacts on ecology.

S3.4 Environmental Baseline Survey

The objective of environmental baseline survey is to provide more comprehensive information. Factors included air, noise, water quality, sediment and bank soil, landscape and vision, cultural heritages, ecology and so on.

Survey methodology: including review and study of literature, field survey, photographing, sampling and monitoring, and study of aerial photos.

S3. 5 Special Study

The studied subjects include the prototype of water quality monitoring, river pollution source investigation, elutriation test and so on. The study results will be described in the relevant chapters of the report.

S3. 6 Modeling and Prediction

Fugitive Dust Model (FMD), which is extensively used by USEPA and agreed by Hong Kong Environmental Protection Department, is adopted for assessing the potential impacts of Project's construction activities on air quality.

The Hong Kong *Technical Memorandum for Construction Noise other than Pile Driving* is used for noise assessment and noise prediction for construction site. Items considered include noise from machinery, vehicles and vessels on construction site. For calculation of traffic noise other than the construction sites, the *Traffic Noise Calculation Method* issued by the UK Department of Transport is applied.

One-dimensional non-steady flow model for open channel is used for modeling the river flow coupling with tidal effect. Suspended load even sand unbalance sediment transport model is used for modeling river sediment transportation and channel deformation. Inter-tidal averaged one-dimensional estuary water quality model is applied for river water quality modeling.

Conceptual models have been set up for studing the relationships between propagation of fauna and flora and their habitats, as well as between fauna and flora. It enabled a close study on the inner relation of the regional ecosystem, and the potential impacts of Project construction on the ecosystem.

S3. 7 Impact Assessment

The potential impacts of Project on air, noise, water quality, riverbed substrate, and bank soil are evaluated through comparing the results of modeling and sampling analysis with the associated laws, regulations, and standards of both Shenzhen and Hong Kong. Moreover, the potential environmental impacts from dredged silt disposal are further evaluated through elutriation test, Hakason potential ecological hazard index calculation, and other relevant study findings.

The potential impacts of project on ecology is evaluated for both on site and off-site. As almost all potential ecological significante areas within site are located in the terri-

tory of Hong Kong Special Administrative Region, the impact evaluation is specifically carried out based on the Hong Kong *Technical Memorandum on Environmental Impact Assessment Process*. The quality of existing habitats, area of affected habitats, and degree of impact, are evaluated in detail. As for the off-site impact assessment, associated environmental laws, regulations and guidelines of the nation and Hong Kong Special Administrative Region are followed. Special attention is paid to evaluation of downstream impacts of potential water quality that may occur during construction, operation and maintenance period of the Project.

The impacts on water and soil losses and on public sanitation are evaluated in the light of the national relevant laws, regulations, and standards. The impacts on landscape, vision, and cultural heritages are assessed according to associated environmental laws, regulations and guidelines of the nation and Hong Kong Special Administrative Region.

S3. 8 Formulation of Mitigation Measures

Formulation of mitigation measures for Stage III Project is mainly on the basis of the experiences of Consultants and available scientific technologies in environmental protection, and the implementation and effectiveness of the mitigation measures of Stage I and Stage II. The best combination of mitigation measures is put forward after a comparison among various-alternatives.

S3. 9 Residual Impact Assessment

Residual impact assessment is mainly to evaluate the magnitudes of residual environmental impacts and environmental acceptability after carrying out environmental mitigation measures. The methodology is the same as those in Section S3. 7.

S3. 10 Requirements for Environmental Monitoring and Audit

Environmental monitoring and audit is an important mechanism for evaluating the impact of construction activities on the environment, providing an early-warning on whether the environments being stressed, and a means to protect the ecology and to minimize the adverse impacts on the environment as far as possible. The specific requirements for environmental monitoring and audit are formulated according to the technical guideline of Hong Kong *Technical Memorandum on Environmental Impact Assessment Process* and associated environmental standards and regulations of the nation.

Requirements for environmental monitoring and audit will be given separately in the *Environmental Monitoring and Audit Manual.*

S4 Potential Impact

S4. 1 Air Quality

The impact of the Project on air quality is dust emission during construction . Without mitigation measures, due to a raise of the TSP concentration above the ambient, TSP of two sensitive receivers on the Shenzhen side and four sensitive receivers on the Hong Kong side will exceed the standard. With mitigation measures, however, the daily mean TSP content at the sensitive receivers will decrease by 15 - 60% and satisfy the standards in both Shenzhen and Hong Kong.

During construction, emission from lorries, bulldozers, etc. would affect air quality to certain extent. It is known from similar experience that the exhausted NOx, CO and parthcalates will be rather limited and the impact is insignificant.

Bridge reconstruction, such as Man Kam To Bridge, will cause insignificant impact on air quality.

The construction activity might have an impact on the odour problem, but if proper mitigation measures are adopted, the pollution impact will decrease sharply, which won't exceed the requirement of 5 odour unit presented in Technical Memorandum on Environmental Impact Assessment Process.

As the scale of maintenance dredging is rather small (less than 500 thousand m^3) and the dredging is mainly done under water, it has little impact on air quality.

After the completion of the project, the air quality will be greatly improved along with the improvement of overall environmental quality in the region.

According to Annex 4 to Technical Memorandum on Environmental Impact Assessment Process, the impact on air quality would be acceptable after proper mitigation measures are adopted.

S4. 2 Noise

1) During the construction, on the Hong Kong side of the Shenzhen River, generally, it is not difficult to meet the standard of construction noise in daytime of Hong Kong.

When construction items independently operate, the noise at the NSRs 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. The Lo Wu Public School (2# on the Hong Kong side) will meet the noise standard of 70 dB(A) in daytime but in the examination period exceed the standard of 65 dB(A) by 2—4 dB(A). After proper mitigation measures are adopted, the noise level in the Lo Wu Public School can be reduced to an acceptable one of 63 dB(A).

2) It is difficult to satisfy the standard of construction noise in daytime in Shenzhen, as the standard is based on the boundary of construction site, during the construction the operation of single mechanical equipment would make the noise exceed the relevant standard. When construction items independently operate, the predicted noise values in Xiangxi Middle School and Huaqiao New Village and Xingxiou Village will all meet the standard; the values in dormitory of Station and Lo Wu No. 4 Village will exceed the standard with the exceeding ranges of 2—4 dB(A) in Lo Wu No. 4 Village and 10—12 dB(A) in dormitory of Station due to the close distance from the boundary of construction site(only 28m). Therefore, during construction additional measures must be adopted to reduce the noise to the acceptable level.

3) Since the noise standards in nighttime and public holidays are much stricter, the operation of single set of mechanical equipment might make the noise of the NSRs on both sides of the Shenzhen River exceed the standard. Therefore, the construction operation must be forbidden in nighttime and public holidays except in emergency situations.

4) On the Shenzhen side of the Shenzhen River, the operation of several construction items at the same time is forbidden within the distance of 145m from the NSRs but is allowable beyond the range. On the Hong Kong side, several construction items can operate at the same time only beyond the distance of 84m from the NSRs.

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

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

7) The NSRs on the Shenzhen side will be affected by the noise from shiping and the noise level of those exceeds the standard of Shenzhen during construction and maintenance periods. The impact on the Hong Kong side caused by shipping is acceptable, as the NSRs are commonly far away from the River. After proper mitigation measures are adopted, the impact of noise on the NSRs of both sides caused by shipping would be acceptable.

The residual impact on the NSR caused by construction noise and traffic noise during construction of the Project is acceptable after the recommended mitigation measures are applied.

According to Annex 5 to Technical Memorandum on Environmental Impact Assessment Process, the impact on noise would be acceptable after proper mitigation measures are adopted.

S4.3 Hydraulics, Sediment and Water Quality

After completion of Stage III Project, the reach below Ping Yuan River mouth can resist the flood of 50-year reoccurrence, and the flood-carrying condition upstream can be much improved.

Improvement of hydraulic condition in the reach downseream of the mouth of River Ganges will also induce local inverse channel scouring, As a result, the channel will be cut deeper and wider. The extent of scouring will progressing upstream. The erosion sediment will deposit in the Stage III reach below the mouth of River Ganges.

After continuous operation of two years, some sections of the Shenzhen River won't meet the design standard of the Project due to the stochastic occurrence of flood upstream. For the safety of flood releasing, maintenance dredging is needed after completion of Shenzhen River Regulation Project.

After the Project is completed, the reach from Lo Wu to the estuary of the Shenzhen River will be at deposition except during flooding.

Most of the re-suspended sediment produced by maintenance dredging will deposit in the channel.

Dredging will have an impact on water quality due to re-suspension of sediment. It is necessary to install silt curtains at 500m downstream and 200m upstream of the dredger to control the water quality at an acceptable level during dredging.

As the regulation project itself does not produce any pollution load to the Shenzhen

River, it will not directly worsen the river water quality. After proper mitigation measures are adopted, the impact to sediment re—suspension caused by project construction would be acceptable.

After the Project is completed, water pollution of the Shenzhen River will be eased as the dilution and dispersion conditions for pollutants are improved.

After proper mitigation measures are adopted, the river water quality would not become worsened due to maintenance dredging.

No significant impact will be caused on river water quality by dredging once the mitigation measures proposed in this EIA are implemented.

According to Annex 6 to Technical Memorandum on Environmental Impact Assessment Process, the impact on water quality would be acceptable after proper mitigation measures are adopted.

S4. 4 Spoil Disposal

The environmental impact arisen from dumping spoil is expected as follows:

(1) The impact on water quality caused by soil disposal is insignificant.

(2) Soil transportation is one of the major causes for exceedance of TSP at some sensitive receivers. After implementing the mitigation measures, TSP at all sensitive receivers can meet the standard.

(3) During spoil transportiation, noise from banges will cause some sensitive receivers on the Shenzhen side exceed the relevant standard, while no exceeding standard will be caused on the Hong Kong side. All NSRs can meet the standard after taking mitigation measures.

(4) 2. 3 hm^2 of marshes, 1. 2hm^2 of fishpond and 0. 8 hm^2 of woodlands will be lost due to spoil disposal. The affected woodland is sparsely and fragmentarily distributed, marshes are small in size with low quality, and fishponds have been abandoned. it is not expected to support animals of conservation value since the area is quite often fire-razed and no such animal have been found within the valley The disturbance will mainly be concentrated in filling area caused by spoil unloading and transporting. Some kind of fauna may be affected. They are mainly the grassland insects of low ecological significance and of commonly-seen species in Hcng Kong, which are not protected by local laws and regulations. In summary, the ecological impact caused by spoil disposal is rather insignificant.

(5) Occupation of marshes, fishponds, woodlands and low-lying grassland in spoil disposal sites will lead to losses of landscape elements, causing negative impact. But it can be restored and compensated on-site. Bareground after dumping will cause adverse impact on landscape, re-vegetation should be carried out after spoil dumping 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) The disposal ground will not impose any constraint on future development.

According to Annex 7 to Technical Memorandum on Environmental Impact Assessment Process, the environmental impact caused by dumping spoil would be acceptable after proper mitigation measures are adopted.

S4.5 Ecology

Impacts which will arise from the project include permanent and temporary impacts.

The permanent impacts include:

- direct loss of habitats;

Woodland: 1.1 hm^2; low-lying grassland/fallow field: 14.4 hm^2; agricultural land: 4.0 hm^2; marshes: 2.7 hm^2; fishponds: 2.1 hm^2

- increased fragmentation and affecting low-lying grassland and relevant animals;
- larger ecological barrier; and
- decreased wetland biota.

The temporary impacts include:

- disturbance to wildlife;
- impact of spoil barging;
- dust pollution;
- soil erosion;
- habitat damage; and

- fishponds drained dry: during construction, three fishponds will be drained dry, which will lead to losses of fishery and other species of aquatic biota.

The impact of spoil disposal on ecology is mainly permanent loss of habitat, including 2.3 hm^2 of marshes; 1.2 hm^2 of fishpond; 0.8 hm^2 of woodland; 5.1 hm^2 of hillside grassland; 0.2 hm^2 of Shrubland and 1.5 hm^2 of low-lying grassland / fallow field.

After mitigation measures are implemented, the residual ecological impacts would be relatively minor.

According to Annex 8 to Technical Memorandum on Environmental Impact Assessment Process, the impact on ecology would be acceptable after proper mitigation measures are adopted.

S4.6 Water and Soil Erosion

Due to river dredging, spoil disposal, dyke construction, material pile-up and other construction activities, the present landform configuration and land utilization patterns in relevant regions will be changed to different extents. In addition, as the original vegetation and some of water and soil conservation facilities might be damaged, the land will loss its original function of conserving water and soil, which might make 80% of the project site and its affected area (about 160 hm^2 or 1.6 km^2) become new soil erosion area.

If implementing soil conservation measures, it is expected that water and soil losses could be controlled and avoided.

S4.7 Landscape and Vision

(1) Landscape

In construction stage, construction of the project needs to occupy a large amount of land, this will affect the landscape resources, thus have a high negative impact on landscape resources. Besides, all construction equipment, construction site, and temporary construction establishments will cause high to moderate negative impacts on landscape character, River channel excavation and lining, embankment and bridge reconstruction will cause the change of local landscape character, leading to an impact on landscape character. In addition, part of the construction occupied land will become bared ground, therefore having a high negative impact on landscape character. But, the affected landscape resources can be compensated after mitigation measures

are taken. For example, high to moderate negative impact caused by construction can be mitigated by means of enhancing construction management.

The landscape resources affected by the Project is as follows:

Fishponds: 7. 00hm^2; marshes: 7. 33hm^2; farmland: 5. 7hm^2; woodland : 2. 51hm^2; hillside grassland: 6. 022hm^2; shrub land: 0. 4hm^2。

The restored landscape resources is given below:

Restored fishponds: 3. 6hm^2; transformed marshes: 2. 964hm^2; grass area: 11. 41hm^2; plantation of trees: 15570; increased water area by widening river channel: 20. 0hm^2; grasscrete on the top of embankment : 4. 0hm^2; grasscrete on the platform of river channel: 4. 0hm^2; grass area outside embankment : 6. 0hm^2.

In operation stage, with the fact that the water surfacce is wider; polluted sediments are removed and the newly built bridge are more beautiful, positive impacts on landscape resources can be expected.

After the project is finished, the river course layout will change, and the new channel is straighter than before, which has low negative impact on landscape character; the newly—built riverbanks modify local landscape character, which has moderate negative impact on landscape character; artificially concrete or block—stone lined new channel to form artificial river course, which has moderate to low negative impact. Moreover, on the first day of the operation stage, quality of the restored landscape resources cannot reach original level. Accordingly, the impacts on landscape character will still exist, though the landscape resources affected in construction stage will have been restored when construction is finished. However, the magnitude is small. After ten years, quality of the restored landscape resources can reach original level, and then, landscape impacts can be negligible.

(2) Visual Impact

In construction stage, negative visual impacts are mainly visual barrier to VSRs caused by all kinds of construction equipment, construction site and nets, storage, temporary housing and other construction establishments. Besides, bridge construction also cause visual barrier to VSRs. The bared construction sites can cause uncomfortable visual feeling to VSRs. But, negative visual impacts can be mitigated after measures are taken. For example, negative visual impacts caused by construction can be mitigated by means of enhancing construction management; restored landscape resources and restored vegetation on the construction site can help VSRs to regain good

visual feeling.

In operation stage, VSRs can get a good visual feeling because river channel is widened and therefore eyeshot is widened, and sediment in former river channel is removed, which will have positive visual impacts.

Newly-built bridges are basically placed at the site of existing bridges, but are more beautiful than existing bridges, therefore, they will form new visual barrier nor give rise to negative visual impact.

The new river course is artificially lined with concrete and block stones, it will give VSRs a visual felling not so good as that of the natural one which is usually covered with green plants. But, after mitigation measures are taken, plants will grow in the new river course, mitigating the negative visual impacts. The newly-built border fence and roads will be closer to VSRs because river channel is widened, their visual barriers will be a little greater than before, however, the negative impact is low.

To sum up, most negative landscape impacts in operation stage are unavoidable, but insignificant, and no special landscape mitigation measure is necessary. For mitigation of the negative visual impact caused by the new lined river course, grass concrete can be established on the of the new river channel.

(3) Conclusion

Negative landscape and visual impacts caused by the project are mainly within construction stage, and accordingly are temporary ones. Furthermore, most impacts can be mitigated to below moderate level after measures are taken.

In operation stage, landscape and visual impacts caused by the project include positive and also negative ones. The positive impacts are mainly in the magnitude of moderate to low. On the first day of the operation stage, negative impacts are mainly moderate, but gradually decrease after that time due to plantation of grass and tree etc. till the tenth year when the negative impacts will be negligible.

The landscape resources affected by the Project totally reaches 50. 612hm^2, the restored area amounts to 51. 974hm^2. It can be seen that the loss of landscape resources by the Project can all be compensated. To sum up, when the project is finished, landscape in the Project Area will not be significantly affected, and the key eyeshots will not be spoiled. Besides, construction of the project will not significantly spoil the aesthetic environment. Moreover, removal of bottom sediment and tree planting along the riverbanks will help beautifying the local landscape.

According to Annex 10 to Technical Memorandum on Environmental Impact Assessment Process, the impact to landscape and vision would be acceptable after proper mitigation measures are adopted.

S4.8 Cultural Heritage

Lo Wu Railway Bridge affected by the Project has certain historical value and will be remained. The old Lo Wu Pedestrian Bridge will be demolished but the relevant files preserved detailly.

Nga Yiu relics will not be affected by the project construction due to its isolation outside the construction zone.

Archaeological potential of the project area is low. However, a detailed archeological investigation is still recommended to ensure it.

According to Annex 10 to Technical Memorandum on Environmental Impact Assessment Process, the impact on cultural heritage would be acceptable after proper mitigation measures are adopted.

S5 Mitigation measures

The main mitigation measures recommended in the EIA are shown in Table S5.1.

S6 Environmental Monitoring and Audit

(1) Air quality

Baseline monitoring should be carried out within two months before construction starts. On the Shenzhen side, the baseline monitoring stations are located at Lo Wu and Xinxiu Village, while on the Hong Kong side, the stations are at Lo Wu and Muk Wu Pumping Station. A continuous five-day monitoring should be carried out and the parameter to be monitored is mean 24-hour TSP.

According to construction programme, two monitoring stations will be set up at the boundary of construction sites or near the representative sensitive receivers during construction period on each side. In addition, two reference stations with one on each side will be set up on locations not affected by project construction. Monitoring should be carried out in all the stations at the same time. On the Shenzhen side, TSP

monitoring is conducted once a week for mean 24 hours TSP. On the Hong Kong side, mean 24-hour TSP monitoring is to be conducted once a week. If excessive dust is generated by construction, 1-hour TSP should also be monitored three times a week.

(2) Noise

Baseline monitoring should be carried out within two months before construction commerces. On the Shenzhen side, the baseline monitoring stations are located at Lo Wu and Xinxiu Village; while on the Hong Kong side, the stations are at Lo Wu and Muk Wu Pumping Station. On the Shenzhen side the monitoring should lasts for five days, while for two consecutive weeks on the Hong Kong side.

According to the construction programme, four monitoring stations, two for each side, will be established at the boundary of the construction site or near the sensitive receivers during construction period. In addition, two reference stations, one for each side, will be set up at locations not affected by construction, and monitoring will be conducted once a week for Leq (30 min). If construction is needed at nighttime or on public holidays, the monitoring needs to be done three times a week at every station for Leq (5 min) on the Hong Kong side.

(3) Water quality

The baseline control stations for water quality monitoring are located at Lo Wu Bridge, San Pan Kou and the Ping Yuen River mouth and the Shenzhen River estuary. Monitoring should be conducted one month before construction commences. Sampling should be carried out weekly during that month for BOD_5, NH_3-N, TN, TP and Cu with samples taken during ebb tide and high tide of the day, for four weeks totally. Measurements for pH, DO, flow velocity, conductivity, suspended solids (SS) and salinity should similarily be conducted.

During construction period, fixed monitoring stations are to be set up in the Shenzhen River estuary and at 1,500 m (chainage 7+917 m) downstream of Stage III Project. In addition, a reference station is set up at 500 m upstream of dredging section (it will not be affected by construction activities). If there is any tributary around the dredging section a reference station should also be set up at upstream of each tributary where construction impact can not reach. A control station is set up at 1,000 m downstream of the dredging section. BOD_5, TN, NH_4^+-N, TP and Cu will be monitored monthly. Monitoring frequency for pH, DO, flow velocity, conductivity, suspended solids (SS) and salinity depends on dredging operation. Three days a week will be

conducted with sampling once each day during ebb tide and high tide respectively, till two weeks after completion of dredging operation; while sampling once a month for non-dredging period.

(4) Ecology

Survey is conducted through walking along the boundary of construction site within the Stage III Project Area from Lo Wu Bridge to the Ping Yuen River mouth. The parameters for monitoring include identification of species, number of each bird species, abundance and activities and bird habitats. Survey will be done once every month from October to next March during dirds migratory season, and once every two months for the rest of the year.

Upon completion of compensation and restoration works, survey should be carried out on the restored ponds, marshes and meanders to determine effectiveness of the recommended mitigation measures.

The species, quantity and abundance of birds, butterflies, dragonflies, amphibians and reptiles are to be monitored. In addition, the use of fishpond for bird, and fish in the restored ponds should also be observed.

The growth of the herbaceous and woody species should be included in the survey. The parameters for plant monitoring include species identification, survival rate (%), plant density (individuals/hm^2), plant height (m) and coverage rate (%).

Survey should be conducted on plants in grasscrete on embankment crests, the compensatory woodland in the Nam Hang middle valley. In addition, growth of the herbaceous and woody species planted should also be investigated. The parameters for plant monitoring include species identification, survival rate (%), plant density (individuals/hm^2), plant height (m) and coverage rate (%).

In first year, survey will be carried out once every three months, and then in second year, once every six months.

(5) Landscape and vision

On-the-spot inspection should be frequently carried out to monitor contractors' implementation of mitigation measures for protection of landscape and vision. The duty of the Engineer includes:

Dictating contractors to restrict their workers not to trample grassland arbitrary and not to damage trees to reduce the loss of vegetation as much as possible.

During site clearing before the construction formally starts, monitor contractors to replant trees retain top soil within site to other proper places.

When contractors design and build temporary construction facilities, reminding contractors to pay attention to apperance of the facilities.

Making inspection tours around the construction site frequently during construction stage, reminding contractors parking machines and vehicles in order, not to stack construction materials randomly. In addition, ugly looking things should be covered. Supervising and urging contractors to improve their performances, if it is not satisfactory.

When construction has been finished in each section of the construction site, supervising and urging contractors to remove all temporary construction facilities, to restore to its original state. If restoration is impossible, planting trees and grass to improve local landscape.

To supervise the effectiveness of the restored construction site by planting trees and grass. Monitoring parameters include survival rate of trees and grass, planting density, height of height plant and vegetation coverage rate (%). If survival rate and planting density cannot meet requirement, dictating contractors to replant.

(6) Monitoring of Cultural and Historical Heritage Protection

Before the Project commencement, environmental monitoring and audit team (ET) should consult with responsible departments to verify whether the archeological investigation has been done within construction site and whether cultural and historical heritages are found. If any archeological ruins are found in Project Area, the ET must immediately inform Hong Kong Antiquities and Monuments Office and work out mitigation measures such as removing heritages or archeological excavating etc., which should be approved in advance by the relevant authorities. Contractors will not be permitted to start construction until the relevant mitigation measures are applied.

Before construction, Environmental monitoring and audit team should make inspection tours around construction sites nearby the Nga Yiu relics, and urge contractors to isolate Nga Yiu relics outside the construction site by fence in order to avoid the negative impact on the relic caused by construction activities.

Before demolishing the old Lo Wu Pedestrian Bridge, Environmental monitoring and audit team should consult with relevant authorities whether the survey and photograph of the old bridge have been taken, the demolishment of the bridge by contrac-

tors can be conducted after these work has been finished.

Before demolishing Lo Wu Railway Bridge, Environmental monitoring and audit team should examine the demolishment scheme for the bridge, and consult with Shenzhen Cultural Relic Management Commission and Hong Kong Antiquities and Monuments Office respectively whether the scheme is approved and whether both sides reach the agreement on restoration place. During construction period, Environmental monitoring and audit team should frequently carry out on—the spot inspection to discover the possible archeological ruins. If any archeological ruins are found in Project Area, the ET must instruct contractors to stop construction activities temporarily in the relevant sites, and immediately inform Shenzhen Cultural Relic Management Commission (on the Shenzhen side) and Hong Kong Antiquities and Monuments Office (on the Hong Kong side). After proper measures are taken by the relevant authorities, contractors may be permitted to re—start construction activities.

(7) Monitoring of Water and Soil Conservation

Protective measures in construction material sites

During the borrowing period, Environmental monitoring and audit team should make on—the—spot inspection around borrow areas to monitor contractors's implementation of mitigation measures for water and soil conservation such as drainage ditches, settling tanks etc. , and instruct contractors to correct if they do not conduct the measures upon requirements.

Environmental monitoring and audit panel should monitor contractors 's spoil disposal during construction period, and remind contractors not to stack construction materials randomly to reduce water and soil erosion.

After completion of excavation in each borrow area, the construction site should be cleaned and vegetation should be restored.

Spoil disposal

During construction period, waste enclosing facilities should be established to effectively control water and soil erosion in spoil ground, and drainage facilities should be constructed in surrounding area of the spoil yard for draining.

Measures for preventing leakage should be adopted in transporting spoil, and if leakage happens, the improvement is needed.

After completion of soil disposal, soil should be covered on the surface of the disposal

ground and vegetation should be restored.

Excavation of river course and construction of embankments

The field that is not liable to eroding by run—off should be selected to specially store the silts and soils excavated, and temporary drainage ditch is needed in surrounding area to drain water.

Sod on outer slope of the new—built dyke should be planted and drainage facilities should be built.

Storage of construction material

The field that is not liable to eroding by run—off should be selected to pile the material in open air, and temporary drainage facilities should be needed in surrounding area to drain water.

Restoration of the construction site

When construction has been finished in each construction site, supervising and urging contractors to clear the construction site and restore the vegetation.

S7 Conclusion

The objectives of the Project proposed in the planning stage are practicable. The Project possesses the following environmental benefits: reducing the menace from flooding, improving water quality, abating odour and beautifying landscape.

The major potential environmental impacts from the project construction are summarized as follows:

The main impact of the Project on air quality is dust emission during project construction. Without mitigation measures, due to the raise of the TSP concentration above the ambient, TSP at two sensitive receivers on the Shenzhen side and four sensitive receivers on the Hong Kong side will exceed the standard concerned. With mitigation measures, however, the daily mean TSP content at the sensitive receivers will decrease by 15 - 60% and satisfy the standards concerned on both Shenzhen and Hong Kong sides. After completion of the Project, air quality will be greatly improved along with improvement of overall environmental quality in the region.

1) If without mitigation measures, the Lo Wu Public School will exceed the standard of 65 dB(A) in the examination period. When construction items (except bridge en-

forcement and reconstruction) independently operate, the forecasted noise value on dormitory of the Station and Lo Wu No. 4 Village exceed the standard. So, it is necessary to adopt accessional measures to reduce the noise to acceptable level.

Since the noise standards in nighttime and public holidays are much stricter, the operation of single set of mechanical equipment might make the noise of the NSRs on both sides of the Shenzhen River exceed the standard. Therefore, the construction operation must be forbidden in nighttime and public holidays except in emergency situations.

On the Shenzhen side of the Shenzhen River, the operation of several construction items at the same time is forbidden within the distance of 145m from the NSRs but is allowable beyond the range. On the Hong Kong side, several construction items can operate at the same time only beyond the distance of 84m from the NSRs .

During the construction and maintenance periods, the impact on NSRs caused by the traffic noise inside and outside the construction site is acceptable.

In the case of normal operation of the bridge, the impact on the NSRs by the traffic noise is acceptable.

Without mitigation measures, the NSRs on the Shenzhen side will be affected by the noise from shiping and the noise level of those exceed the standard of Shenzhen in the construction period. The impact on the Hong Kong side caused by shipping is acceptable, as the NSRs are commonly far away from the River. After proper mitigation measures are adopted, the impact to noise on the NSRs of both sides caused by shipping would be acceptable.

During the construction of the Project, the residual impact on the NSRs caused by construction noise and traffic noise is acceptable after the recommended mitigation measures are applied.

After Stage III Project is implemented, the 50-year recurrence flood can be controlled in the reach downstream of River Ganges mouth, and water level will lower remarkably.

During construction of Stage III Project, siltation is dominant in the reach from Lo Wu to the Shenzhen River estuary except for the flood season.

After completion of the project, except for heavy floods, most of the sediment from upstream will deposit in the regulated river course. During heavy floods, scouring will happen in the 1000 m reach downstream from Lo Wu.

Most of the re-suspended sediment from maintenance dredging will settle in river channel.

The Project will not deteriorate the water quality of the river directly. After the Project is completed, the Shenzhen River water pollution will be eased as the clilntion of dispersion condition for pollutants are improved.

No signilicant impact will be caused on river water quality by dredging once the mitigation measures proposed in this EIA are implemented.

Recommended spoil disposal scheme is :

201,800m^3 of the contaminated soil should be placed in the East Sha Chau spoil dumping area; part of uncontaminated soil (500,000m^3, all from dry excavation) be placed in Nam Hang region along the Project area and its adjacent corries;the remained 901, 800m^3 of uncontaminated is to be placed near Neilingdong Island.

If the recommended spoil disposal scheme is adopted, the impact on water quality caused by spoil disposal is insignificant and can be neglected. The impact on air quality caused by spoil disposal is minor and temporary. The short-term impact on noise caused by shipping can be acceptable. 2. 3 $hm^2$of marshes, 1. 2 $hm^2$of fishponds and 0. 8 $hm^2$of woodlands 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. Dust emission caused by spoil disposal will has the impact on plants of low ecological significance in the relevant area, but with mitigation measures the impact can be neglected. Dumping spoil will not increase the fragmentation of nearby important habitats. The disturbance wil 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, spoil disposal will not lead to significant ecological impact and unacceptable impact on landscape and vision. No potential impact of spoil disposal on cultural heritage will occur. 1. 2 hm^2 of fishpond will be lost due to spoil disposal, but no commercial activities will be affected because the fishponds have been abandoned.

Woodlands, marshes and ponds have great ecological importance within the Study Area. Only one protected plant species is found on the Hong Kong side of the Study Area, while several protected wildlife species are recorded in the marshes and ponds of the Study Area. Impacts from construction include losing habitat, destroying habi-

tat, increasing fragmentation, disturbance to wildlife, dust pollution on vegetation and soil erosion; while operational impact include habitat loss, larger ecological barrier and wetland biota decreasing.

In order to alleviate the ecological impacts, mitigation measures are essential. The residual impacts are very small if these measures are carried out effectively.

The habitats compensation will produce positive impact on ecology as the compensated area of woodland and wetland are more than their losses.

When the Project is finished, landscape in the project area will not be significantly affected and the key eyeshots will not be spoiled. Besides, construction of the Project will not significantly spoil the aesthetic environment in this region. Moreover, river bed sediment clearing and tree planting along the riverbanks will help improving the local landscape.

Lo Wu Railway Bridge affected by the Project has certain historical value and will be remained. Old Lo Wu Pedestrian Bridge will be demolished but a comprehensive record of the bridge will be kept.

Nga Yiu relics will not be affected by the project construction due to its exclusion from the construction site.

Archaeological potential of the Proiect area is low. However a detailed archaeological investigated is still recommended to ensure it.

As long as various mitigation measures and pollution control are implemented, Stage III Project will not cause unacceptable impact on air quality, noise, water quality, spoil disposal, ecology, soil erosion, landscape and vision, culture heritage, public health etc.. In other words, if all recommended environmental mitigation measures are adopted, the Project is environmentally acceptable.

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
Air	The main impact of the Project on air quality is dust emission in the construction period. Without mitigation measures, due to the cumulative effect of the predicted TSP above the background concentration, TSP at two sensitive receivers on the Shenzhen side and four sensitive receivers on the Hong Kong side will exceed the associated standard. With mitigation measures, however, the daily mean TSP content at the sensitive receivers will decrease by 15 – 60% and satisfy the associated standards on both Shenzhen and Hong Kong side. 2) During the construction, emission from trucks for carrying material, bulldozers, etc. would affect air quality to certain extent. It is known from similar experience that the exhausted NO_x, CO and particle will be	1) The vehicle velocity on the haul road and at the site shall be restricted within 8 km/h; 2) The bulldozer traveled on the haul road and at the site shall be limited within 8km/h; 3) Water spray shall be applied four times a day on the haul roads and twice a day at the construction site; 4) Every vehicle shall be washed to remove any dusty material from its body and wheels before leaving the site.; 5) The watering device shall be used during the handling of dusty material; 6) The sealed system shall be adopted for cement transportation; 7) Stockpiling of cement at open space shall be avoided; 8) All vent holes shall be fixed with	Contractor		X	X	

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	rather limited and the impact is insignificant. 3) Reprovisioning of Man Kam To Bridge Modification Project will cause no impact on air quality. 4) The construction activity might worsen the odor pollution, but if proper mitigation measures are adopted, it will not exceed the 5 odour unit set in Annex 4 of *Technical Memorandum on Environmental Impact Assessment Process*. 5) As the scale of maintenance dredging is rather small, it has little impact on air quality.	appropriate filter; 9) Watering and cleaning of the construction site, shall be carried out regularly especially during dry season; 10) Construction equipment with minimum dust emission shall be used; 11) The raw material for concrete production shall be wetted before putting in the concrete mixer; 12) Any stockpile of aggregates or spoil shall be completely covered and water applied. 13) Any stockpile of dusty material shall be located from any ASRs and the entrance of the construction site ; 14) The load on the vehicles shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the					

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing: Pre-construction Stage	Timing: Construction Stage	Timing: Maintenance Stage	Timing: Operation Stage
		vehicle; 15) The haul road and construction machinery should be arranged as far away as possible from the sensitive receivers; 16) Water spray shall be applied to dusty materials before it is unloaded on site; 17) In the process of typical concrete mixing, dustproof methods should be adopted, such as installing filter on the ventilation opening, watering regularly, spraying water at loading areas and enclosing part of or whole material-loading area etc.. 18) The contaminated mud shall be removed at once;					
Noise	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.	**Construction noise:** 1) The construction programme shall be arranged carefully. 2) The mechanical equipment shall be	Contractor		X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	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	carefully arranged to avoid working in the same area (especially on the site boundary) 3) Engine noise silencer muffler and temporary noise barrier shall be used as far as possible 4) Use quite power mechanical equipment 5) Unused equipment for a long time shall not be used and maintenance of renewal of equipment shall be carried out regularly 6) Setting up temporary noise barrier 7) On the Shenzhen side, within 145 m away from NSRs only one set of construction activity can be carried out. On the Hong Kong side , within 84m away from NSRs only one set of construction activity can be carried out. 8) Construction at night time shall be prohibited. **Shipping noise:**	Contractor		**X**	X	

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	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),	1) Whistling is prohibited 2) Adopting engine noise abatement, silencer; 3) Adopting engine enclosure					

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	the exceedance will be 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 84m away from NSRs.						

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	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,						

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	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.						
Water Quality	**(1) Construction period** The Project will not deteriorate the water quality since no pollution load is added by the Project itself. The bottom mud of the Shenzhen River has been severely polluted by inorganic and organic pollutants. The sediment re-suspension and pollutants re-emission arising from the dredging will indirectly affect the water quality in the partial section of the Shenzhen River. The affected extent is depended on	**(1) Construction method** Closed grab dredger shall be used for dredging of mud in the river channel. Silt curtain shall be used across the river channel at 200m upstream and 500m downstream of the dredging work to prevent the re-suspended sediment from transport to downstream of the river. Dreading rate shall be reduced by 10% or more if exceedance in relevant standards is recorded during the EM&A work. The dredging rate shall be further reduced until no exceedance is recorded. The construction method of separating and isolating the excavated channel from the existing river shall be used to reduce the	Contractor		X	X	

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	type of the construction equipment, quantity of the dredging mechanism and construction season, as well as the scope and site of dredging. The increase of total nitrogen caused by construction activities will be less than 20%. The bridge reconstruction, such as Man Kam To Bridge, will not cause any unacceptable impact on water quality. **(2) Operation phase** The water quality will be better than the current condition as the dilution and transport condition are improved. **(3) Maintenance dredging**	impact on water environment. Dredging grab raising speed shall be as slow as possible to avoid loss of sediment into the river water. Leakage of fuel oil shall be avoided. The mud shall be stacked steadily on the barges and the height of the stack shall be of suitable height to avoid leakage. Covering the stack of mud by suitable materials shall be used whenever necessary. **(2) Construction arrangement** Dredging shall be reduced as far as possible. The unavoidable dredging shall be arranged in high tide to avoid sediment re-suspension. Dredging shall be carried out at any one of the sections at a time only. Only one set of	Contractor		X	X	

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	During the operation stage, maintenance dredging will not increase pollution load of the Shenzhen River. The predicted water quality indicates that the river water quality will not become worsened due to maintenance dredging.	sections at a time only. Only one set of dredger is allowed to work at the same time. **(3) Mitigation measures for maintenance dredging** The mitigation measures used during the construction period are also applicable and effective in maintenance dredging.	Contractor			X	
Spoil Disposal	1) The impact on water quality caused by soil disposal is insignificant and can be neglected. 2) The impact on air quality is slight and temporary. 3) The short-time noise impact	**Water quality** 1) The management of barges shall be strengthened and discharge of wastewater into the water is not allowed. 2) Drainage ditches hall be provided at the	Contractor		X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	caused by spoil barging can be controlled below the acceptable level. 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. 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,	non-contaminated disposal ground to collect the surface run-off. Discharge shall be permitted only where the water complies with the requirements in "Standard for effluent discharge into group D inland water" in the Technical Memorandum of Water Pollution Control Ordinance in HK. **Air Quality** The contractors should take the following necessary measures to reduce dust emission: 1) The vehicle velocity on the haul road and at the site shall be restricted within 8 km/h; 2) Water spray shall be applied four times a	Contractor		X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	the ecological impact caused by spoil disposal is rather insignificant. 5) spoil disposal will not cause unacceptable impact on landscape and vision。 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.	day on the haul roads and twice a day at the construction site; 3）Every vehicle shall be washed to remove any dusty material from its body and wheels before leaving the site.; 4) The load on the vehicles shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle; 5) The haul road shall be located from ASRs as far as possible.; 6) The mud loaded onto the vehicles shall be covered during transportation to avoid leakage and odour emission.	Contractor		X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	8) There is no effect on future development of the spoil sites.	**Noise** 1) 1) Whistling is prohibited 2) Shipping must be prohibited from 11:00 pm-7: 00 am. **Ecology** The construction site shall be fenced to avoid disturbance on the wild life.. The marshes in the north of bloodworm ponds should be preserved for natural conservation. After completion of the Project, the marshes shall be permanently preserved.	Design engineer to design, contractor to construct, AFCD to maintain on Hong Kong side and SZRRO to maintain on Shenzhen side	X	**X**	**X**	X

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		Spoil disposal in the Nam Hang middle valley will form two platforms with elevations of 12 m and 18 m respectively. According to the project design, 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 areas 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.					

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		Construction work shall be arranged to avoid disturbance of barges to bird especially during bird migrating period. The construction programme should reflect this requirement. **Landscape** After completion of spoil disposal, the dumping ground must be cleared and re-vegetated. **Construction Method** Before construction activity begins, a detailed contaminated spoil distribution map should be made. During construction, the dredging of	Contractor		X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		Class C contaminated soil should be separated from dredging of other materials according to the map. A system should be designed to record the final disposal position of each part of contaminated soil.					
Ecology	**(1) Construction impact** Direct loss of habitat: Woodland: 1.1hm^2; Low-lying grassland/fallow field: 14.4 hm^2; agricultural land: 4.0 hm^2; marshes: 2.7 hm^2; ponds: 2.1 hm^2 Temporary damage of habitat: Woodland: 0.6 hm^2; shrub land: 0.4 hm^2; low-lying grassland/fallow field: 6.6 hm^2; agricultural land: 1.7 hm^2; marshes: 2.3 hm^2; ponds: 3.7	1) Reprovisioning of two-way vehicular bridge in Man Kam To; 2) No dumping of dredged spoil in ecologically important habitats adjacent to the construction site; 3) Ecological habitats outside the river channel shall be protected by fences / barriers; 4) Minimizing barging disturbance to wildlife; 5) Preventing the residual marshes from	Design engineer to design, contractor to construct, AFCD to maintain on Hong Kong side and SZRRO to maintain on Shenzhen side	X	X	X	X

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	hm^2 Increased fragmentation: Low-lying grassland and associated animals will be affected Disturbance to wildlife: In absence of mitigation measures, some amphibians & reptiles, and most birds & mammals are likely to be affected by loud noises, operational construction facilities and the presence of construction workers. Drying of the 3 fishponds during construction will cause loss of fish and other aquatic biota. Dust pollution: This impact on vegetation and animals can be mitigated easily, and will be small, if dust suppression and restoring vegetation measures are taken.	deterioration 6) Planting native species trees along the outside embankment slopes; 7) Restoring the abandoned meanders to marshcrete; 8) Restoring the temporarily occupied fishponds; 9) Establishing grasscrete along the crests of embankments; 10) Compensation for the lost woodland. 11) Creation of grasscrete berm along the embankments;	Design engineer to design, contractor to construct, DSD to maintain on Hong Kong side and SZRRO to maintain	X	**X**	X	X

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	Soil erosion: Negligible with run-off control and restoring vegetation measures in place. **(2) Operation impact** Reduce habitat value: without mitigation measures, the ecological value of the residual marshes will becomes lower than before. Larger ecological barrier: Low-lying grassland, marshes and associated animals will be affected Decreased wetland biota: Plants confined to wetlands will be eliminated and associated animals will be reduced. **(3) Impact caused by spoil disposal (adopting scheme 6):** Permanent loss of habitat:		on Shenzhen side				

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	Woodland: 0.8hm^2, Fishpond: 1.2 hm^2, Marshes: 2.3 hm^2, shrub land: 0.2 hm^2, hillside grassland: 5.1hm2,low-lying grassland /fallow land: 1.5 hm^2. Increased fragmentation: No fragmentation would be added to ecologically important habitats. Disturbance to wildlife: Very few animals would be displaced from the Nam Hang middle valley. They are common and not protected. Impact of spoil barging: The impact of spoil barging on the Deep Bay is not significant since the frequency of barging is very low.						

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	Dust pollution: Negligible if dust suppression and restoring vegetation measures are taken. Soil erosion: Minimal with run-off control and restoring vegetation measures in place.						
Landscape and Vision	**(1) Landscape impact** Excavation of the river channel, embankment, newly built border fences and border roads, spoil stack and temporary construction site will occupy pond, marsh, farmland, woodland and low grassland, affecting landscape resources, which are negative impacts. Loss or damage of landscape resources: Fishpond: 7.00 hm^2,	1) Design carefully and construct nicely to reduce losses of woodland, grassland, pond and marsh as much as possible. 2) When construction is completed, all temporary construction establishments must be removed in each construction site and original usage or vegetation must be restored. 3) Restore the temporary works area to its original usage and vegetation. 4) Roads planned for transportation of spoil	Design engineer to design, contractor to construct, AFCD to maintain on Hong Kong side and SZRRO to maintain on Shenzhen side	X	X	X	X

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	Marshes: 7.33 hm^2, Farmland: 5.7 hm^2, Woodland: 2.51hm^2, hillside grassland: 6.022hm^2, shrub land: 0.4 hm^2. Excavation and lining of the new river channel and embankment will cause moderate negative impacts on landscape character. A large amount of construction occupied land will become bared ground when construction is finished, it will has an impacts on landscape. Building dyke will cause moderate impacts on landscape. Bridge reconstruction will cause moderate impacts on landscape. Newly built border fence and patrol roads will have high	must be as far away from VSRs as possible. 5) All machinery and vehicles parked temporarily should be laid in order. 6) When temporary construction facilities, such as housing, storage and processing plant, are designed and built, aesthetic requirements must be considered in designing and construction. 7) For river section with vertical wall cross-section, liane will be planted on the dyke crests. （such as 爬墙虎） 8) Plant grasscrete on the newly built banks. 9) Restore the river meander into ponds and marshes and plant native riparian trees.	**Design**	X			

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	impacts on landscape. **（1）Vision impact** Strengthening of Lo Wu New Footbridge mainly aims at treating the foundations of the bridge. With the shelter from surrounding structures, no impact will be exerted on sensitive vision receivers. Reconstruction Lo Wu Old Footbridge will have a moderate negative impact on foot passengers and staff of border inspection station on both sides. Construction of Lo Wu Railway Bridge will have a moderate negative impact on foot passengers and staff of border inspection station on both sides. Construction activities, such as site clearance, excavation of river	10) A Landscape Master Plan should be submitted to relevant department before the commencement of the Project. 11) Establish grasscrete along the berm of the new river channel.	**engineer** Design engineer to design, contractor to construct, DSD to maintain on Hong Kong side and SZRRO to maintain on Shenzhen side	X	X	X	X

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	channel, construction of dikes, transportation of construction materials and spoil, construction equipment and site fence, will have a moderate impact on all sensitively vision receivers. Temporary construction work will have a moderate impact on all sensitively vision receivers. Reconstruction of Man Km To Bridge will have a moderate impact on staff of border inspection station on both sides.						
Cultural Heritage	The impacts on Lo Wu Railway Bridge and Lo Wu Old Footbridge are the main impacts on cultural relics. According to the plan of the Stage III Project, the bridge will be removed and replaced by a new bridge which will greatly affect	Responsible parties and funding agent: Project proponent Timing: 12 months before project commencement to the completion of the project A detailed scheme has to be worked out and agreed by both Shenzhen and Hong Kong on	DSD SZRRO	X	X		

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	bridge, which will greatly affect the Bridge's special historical significance.	whether to re-erect the Lo Wu Railway Bridge on the upper reach of the Shenzhen River but prohibit its use by passenger or to re-erect the bridge as a pedestrian bridge in other place or to preserve the bridge in the museum. Before the demolition of the Lo Wu Railway Bridge, the project proponents (Shenzhen River Regulation Office and Hong Kong Drainage Services Department) have to engage historical heritage experts whose qualification has to be verified by the Hong Kong Antiquities and Monuments Office and Shenzhen Relics Management Committee. The experts have to conduct a study on the "Dismantle of Lo Wu Railway Bridge " within at least 6 months before start of the project. The content of the "Dismantle of Lo Wu Railway Bridge " shall include detailed rules on information recording, dismantle					

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		procedures, dismantle programme, guidelines for preserving the dismantled materials, location of re-erection, restoration programme and detailed rules for restoration. The bridge shall only be demolished after the dismantle proposal has been approved by the Hong Kong Antiquities and Monuments Office and other relevant offices. The project proponent should preserve and store the parts of the bridge according to the Guidelines for preserving components of structures of the "Dismantle of Lo Wu Railway Bridge " The project proponent should employ experts for mapping, recording and taking photographs of the Lo Wu Old Footbridge. The project proponent should start the demolition of the bridge only after the mapping and photography are taken and the records are submitted to and approved by the Hong Kong Antiquities and					

Table S5.1 Summary Sheet of Environmental Impact from Project and Mitigation Measures

Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing: Pre-construction Stage	Timing: Construction Stage	Timing: Maintenance Stage	Timing: Operation Stage
		Monuments Office and Shenzhen Relics Management Committee. The ancient kiln should be excluded from the site and be protected by site fence. A detailed special archeology investigation should be carried out in the Study Area. If any archaeological sites are found in the Project Area, archaeologist must report to the Hong Kong Antiquities and Monuments Office and prepare further mitigation measures such as relocation of ancient site or archaeological excavation after the investigation. But the Hong Kong Antiquities and Monuments Office must approve these mitigation measures in advance.					
Water and Soil Conservati on	The present ground surface and land utilization pattern in these areas will be changed to different extents the original vegetation and	**(1) Preventive measures in borrow area** 1) Excavation should be carried out in steps of divided sub-areas, which should be restored timely after construction is completed. This	Contractor		X		

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Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	extents, the original vegetation and water and soil conservation function will be damaged. In addition, the original function of water and soil conservation of land will be lost due to river dredging, spoil disposal, and dyke construction, material pile-up and other construction activities. As a result, it will lead to about 80% of the land (about 260 hm^2 or 2.6 km^2) in project area and the affected area to become the new water and soil erosion area. If measures for water and soil conservation are not taken in the construction period, the gross water and soil erosion might be	will avoid the forming bare land to reduce water and soil erosion. 2) The water retaining facilities should be provided in upper-stream side of the excavation face to hold up the run-off from upper-stream; drainage ditches should e provided in the other marginal part for rainwater drainage in the surrounding area, to prevent the erosion around the borrow area. 3) Settling tanks shall be set up in theborrow area., In addition, water drainage system needs to be improved. 4) The slope of the excavated face must be less than the natural stable angle of the earth material. The height of the excavation shall generally be less than 4 m. 5) The spoils and rocks produced in the					

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Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
	caused by project is 3900 t.	borrow area shall be properly stored to prevent loss. They could be used for back-filling pits in the borrow area after completion of borrowing. 6) After borrowing, the area shall be restored in accordance with the measures for water and soil conservation. **(2) Measures for spoil disposal** 1) Cut-off facilities shall be established to effectively control water and soil erosion in spoil ground 2) Drainage ditch shall be constructed in surrounding area of the spoil disposal ground for draining. 3) After completion of disposal, soil shall be covered and vegetation shall be restored. 4) Measures for preventing leakage shall be adopted in transporting spoil.	Contractor		X		
		(3) Preventive measures for construction of river channel, embankment reprovisioning work	Contractor		X		

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Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		1) Proper dredging equipment shall be used to minimize the discharge and re-suspension of sediments in dredging operation in the existing river. 2) When excavation in new river channels or for reprovisioning work, dry excavation inside cofferdam is recommended to prevent water and soil erosion. 3) Dredging and excavation should be arranged in dry season as much as possible. 4) The site that is not liable to erosion by run-off shall be selected to store the soils excavated, with temporary drainage ditch in surrounding area to drain water. 5) Outer slope of the new built dyke shall be grassed with drainage facility. **(4) Preventive measures for material storage**					

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Parameters	Environmental Impacts	Mitigation Measures	Responsible parties	Timing			
				Pre-construction Stage	Construction Stage	Maintenance Stage	Operation Stage
		1) Measures for preventing leakage shall be adopted in transporting material. 2) The field that is not liable to erosion shall be chosen to store the material in the open air and the material shall be covered by felt. 3) Temporary drainage ditches shall be built in the surrounding area of the stockpiling area to drain water.	Contractor		X		
		(5) Restoration of the construction site	Contractor		X		

Note: DSD – Drainage Services Department of Hong Kong SAR Government
AFCD – Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government
SZRRO – Shenzhen River Regulation Office of Shenzhen Municipal Government