SFG3705 REV

Guangxi Hezhou Urban Water Infrastructure & Environment Improvement Project

Environmental Impact Assessment Report

Management Agency: Hezhou World Bank Loan Project Management Office

Prepared by: Guangxi Zhengze Environmental Protection Technology Co., Ltd.

Date: January 2018

CONTENT

1. General

Hezhou Municipality is located in the northeastern part of Guangxi Zhuang Autonomous Region (GZAR) in Southwest China. A prefecture-level city established in Year 2002 with Hezhou Prefecture and Wuzhou Prefecture as its predecessors, Hezhou Municipality administers two districts of Babu District and Pinggui Administration District and three counties of Zhongshan County, Fuchuan Yao Autonomous County and Zhaoping County, with a total population of 2.35 million. Hezhou Municipality is located at east longitude 111°25′～112° 03′ and north latitude 23°39′～25° 09′ and covers a total area of 11,855km^2. Hezhou Municipality is located at the border area of Hunan Province, Guangdong Province and GZAR, known as the “Three-Province Thoroughfare” and “Backyard of Guangdong, Hong Kong and Macao”. Along with the construction of four expressways of Gui-Wu Expressway, Guang-He Expressway (2009), Yong-He Expressway (2010), and Nan-He Expressway and three railways of Luo-Zhan Railway (2009), Gui-Guang High-Speed Railway and Liu-Shao Railway as well as the development of airport and harbor, Hezhou will set up an integrated transportation network with all-directional reach and embrace unprecedented development opportunities.

Hezhou Municipality does not only have advantages of geographic location, but also has rich ecological resources, in particular forest resources far much higher than the national average. Hezhou has a forest coverage rate of 72.88%, higher than the national average by a factor of 3.6 and ranks the second in the region. In addition, Hezhou Municipality has outstanding air quality and hot springs, waterfalls and beautiful scenery are distributed all over the city. Hezhou’s rich ecological resources have now become its most significant advantage and core competitiveness.

He River is the main river in Hezhou Municipality and runs across the city from northwest to southeast before it joins Xijiang River System in Fengkai, Guangdong. Finalization of the city’s development strategy of "further expansion to the southern and western parts, further extension to the eastern part and focused optimization of the northern part” and the development orientation of “an emerging industrial and tourism city along Gui-Guang Economic Belt and portal and hub city in Northeast Guangxi” has paved the way for He River to become an important river in the urban centre in Hezhou serving the important functions of industrial and agricultural water supply, urban flood discharge and providing services for the cultural activities of local residents.

Within the context of high-speed industrialization and urbanization and intensified global climate change over the recent years, Hezhou is in the face of increasingly prominent issues of frequent water disasters, aquatic ecological imbalance and water pollution and so on. All such issues have impeded the development of local economy and society. The main problems in flood control and water environment that Hezhou faces in the current stage include:

Firstly, the flood control and drainage infrastructure in the urban area of Hezhou is very weak in contrast to the frequent flood events. He River runs through the urban area of Hezhou Municipality, the major part of which is located in He Riverside belt along He River with no built dike or revetment in most parts. Without a sound flood control system, He River Watershed is very poor in terms of flood control. The increasingly frequent flood events have resulted in increasing serious economic losses. In the latest flood event in mid-November 2015, Hezhou experienced the heaviest winter rainfall ever recorded and 33 townships/towns/communities in the five counties/districts with a total population of 83,450 (including 4376 people for emergency displacement) and a total farmland area of more than 3100 ha were affected, ending up with a direct economic losses of over CNY 70 million.

Secondly, municipal infrastructure construction is slow and the living environment needs further improvement. In Hezhou, which was established as a municipality quite recently, the existing municipal infrastructures constructed at lower standards and the road network poorly planned in both layout and structure cannot meet the needs of the growing size of the city. Most of the drainage networks are combined system of wastewater and stormwater constructed in 1990s against lower design standard. In the developed areas, wastewater and rainwater are directly discharged into adjacent rivers or He River via surface flow or ditch without any treatment, resulting in deteriorated water quality in city rivers and He River. The key water quality indicators, such as ammonia nitrogen, total nitrogen and fecal coliform, have exceeded relevant standards, implying the presence of pollution from domestic wastewater.

Thirdly, some urban inland canals are slow in terms of water flow and deteriorated in terms of water quality because sediments and debris carried by the inner rivers of Huangansi and Shizigang flowing through the built urban area deposit on He River bed due to the absence of effective sewage interception. This situation is worsened by direct discharge of domestic wastewater of riverside residents and organizations. Consequently, He Rivers are very poor in terms of water quality and suffer from severe odors and black water.

Deteriorated water environment and poor municipal infrastructures have become a bottleneck for external communication and economic integration, a serious restriction to the social and economic sustainability of Hezhou Municipality and a serious threat to the water security of Pearl River-Xijiang River Watershed. In order to promote the flood control capacity of He River and the drainage capacity and integrated utilization of water resources in the project area and improve the ecological environment and municipal infrastructure of Hezhou Municipality to support integrated development of the city, Hezhou Municipal Government decided to apply for a loan from the World Bank (Hereinafter referred to as “WB”) for the project. WB Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project has been included in the national list of candidate projects utilizing WB loans. According to WB’s environmental policies, the project is categorized as a “Category A” project requiring a complete environmental impact assessment report, an environmental & social management plan and an executive summary. Hezhou Municipal Project Management Office of WB Loan (hereinafter referred to as the "PMO") entrusted Guangxi Zhengze Environmental Protection Technology Co., Ltd. (hereinafter referred to as "EIA consultant") to carry out the environmental impact assessment (hereinafter referred to as "EIA") for the Project.

1.1 Rationale

This report is prepared based on the requirements of the Law of the People's Republic of China on Environmental Impact Assessment, the Management Regulations on Environment Protection of Construction Projects, and the Notice on Strengthening Management of Environmental Impact Assessment of Construction Projects Utilizing Loans from International Financial Institutions as well as WB Safeguard Policies. The EIA process is carried out not only in accordance with relevant laws and regulations, policies and standards of China, but also the relevant policies of the World Bank.

1.1.1 PRC National Laws and Regulations and Sector Regulations on Environmental Protection and Social Issues

(1) Environmental Protection Law of the People's Republic of China (amended in Year 2014);
(2) Law of the People's Republic of China on Environmental Impact Assessment (amended in Year 2016);
(3) Law of the People's Republic of China on Prevention and Control of Air Pollution (amended in Year 2015);
(4) Law of the People's Republic of China on Prevention and Control of Water Pollution (amended in Year 2008);
(5) Law of the People's Republic of China on Prevention and Control of Noise Pollution (amended in Year 1997);
(6) Law of the People's Republic of China on Prevention and Control of Environmental Pollution of Solid Wastes (amended in Year 2016);
(7) Water and Soil Conservation Law of the Peoples Republic of China (amended in Year 2011);
(8) Flood Control Law of the People's Republic of China (amended in Year 2015);
(9) Interim Methods for Public Participation in Environmental Impact Assessment (SEPA Huanfa Circular No. 2006[28], Feb. 14, 2006);
(10) Methods for Public Participation in Environmental Protection (MoEP Decree No. (2015)35);
(11) Notice on Strengthening Management of Environmental Impact Assessment of Construction Projects Utilizing Loans from International Financial Institutions (Huanjian Circular No. [1993]324);
(12) Notice by the National Development and Reform Commission on Further Strengthening Management of Projects Utilizing Loans from International Financial Institutions (NDRC Foreign Investment Circular No. [2008]1269);
(13) Management Catalogue of EIA Categories of Construction Projects (Sept. 1, 2017);
(14) Notice by the State Council on Printing and Issuing the Action Plan on Prevention and Control of Water Pollution (State Council Circular No. [2015]17).
(15) Law of the People's Republic of China on Protection of Minors (Oct. 26, 2012);
(16) Stipulations on Prohibition of Use of Child Labour (Issued in 1991 by the State Council);
(17) Law of the People's Republic of China on Protection of Women's Rights and Interests (Aug. 28, 3005);
(18) Labor Law of the People's Republic of China (Aug. 27, 2009).

1.1.2 Technical guidelines and specifications of EIA

(1) Technical Guidelines on Environmental Impact Assessment – General (HJ2.1-2016)
(2) Technical Guidelines on Environmental Impact Assessment - Surface Water Environment (HJ / T2.3-93)
(3) Technical Guidelines on Environmental Impact Assessment - Atmospheric Environment (HJ2.2-2008)
(4) Technical Guidelines on Environmental Impact Assessment - Sound Environment (HJ2.4-2009)
(5) Technical Guidelines on Environmental Impact Assessment - Ecological Impact (HJ19-2011)
(6) Technical Specifications on Soil and Water Conservation in Development and Construction Project (GB50433-2008)

1.1.3 Environmental quality and pollutant discharge standards

Based on the features and nature of the Project, a comparative analysis will be carried out in the EIA process of the Project on the PRC national standards on environmental quality and pollutant discharge and the pollutant control standards and requirements included in General Guidelines on Environment, Health and Safety issued by the World Bank Group and the more stringent ones will be used as the basis for execution of the monitoring and assessment activities.

(1) Ambient Air Quality Standard (GB3095-2012);
(2) Surface Water Environmental Quality Standard (GB3838-2002);
(3) Sound Environmental Quality Standard (GB3096-2008);
(4) Soil Environmental Quality Standard (GB15618-1995);
(5) Integrated Air Pollutant Emission Standard (GB16297-1996);
(6) Odor Pollutant Emission Standard (GB14554-93);
(7) Integrated Wastewater Discharge Standard (GB8978-1996);
(8) Environmental Noise Emission Standards for Construction Sites (GB12523-2011);
(9) Ambient Noise Emission Standard on the Boundary of Industrial Enterprises (GB12348-2008);
(10) World Bank Group’s General Guidelines on Environment, Health and Safety;
(11) World Bank Group’s Guidelines on Water and Sanitation, Health and Safety.

1.1.4 Relevant plans and references

(1) The “13th Five-Year Plan ”of Water Conservancy Development in Guangxi
(2) The “13th Five-year Plan” of National Economic and Social Development of Hezhou Municipality (Draft);
(3) Master Environmental Plan of Hezhou Municipality (2016-2030) (exposure draft)
(4) Master Urban Plan of Hezhou Municipality (2016~ 2030);
(5) Report of Urban Flood Control Planning of Hezhou Municipality, Guangxi (2010 ~ 2030);
(6) Special Plan of Urban Road System and Vertical Design of Hezhou Municipality (2016~2030);
(7) Planning of Ecological Water Areas and Water Systems in Hezhou Municipality (2014-2030);

(8) Controlled Detail Plan of the “One River, Two Banks" Core Area of Hezhou Municipality;
(9) Comprehensive Planning of He River Watershed;
(10) Feasibility Study Report of Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project (31 October, 2017);
(11) Resettlement Plan of Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project (9 November, 2017).
(12) Dam Safety Assessment Report of the Project ;
(13) Report on the Soil and Water Conservation Program of the Project.

1.1.5 WB Safeguard Policies and Guidelines

The correlation of the project and the WB's safeguards policy / procedure is analyzed. The results are shown in Table 1-1 below.

Table 1-1 Correlation Analysis of the Project and the WB Safeguard Policies

S/N	Safeguard Policies	Triggered ?	Explanation
1	Environmental Assessment OP/BP 4.01	Yes	The project is designed to assist Hezhou Municipality to address its existing challenges on environmental protection and flood control. The proposed investments include river rehabilitation and dredging, improvement of drainage system (pumping stations), construction of sewage interceptor, WWTP and associated pipelines and roads, and strengthening of water and ecological environment monitoring capacity. Based on the characteristics and scope of the Project, it is anticipated that the Project will involve the following environmental impacts: (1) The construction activities in the downtown area of Hezhou Municipality will generate certain environmental and social impacts, especially to the nearby residents and historical and heritage buildings on Xiyue Street. (2) Dredging of He River and its tributaries will generate environmental and social impacts. In the EIA process, the sludge nature and dredging quantity have been assessed and methods for dredging, sludge transportation, treatment and disposal are designed to minimize the impacts on local environment and residents. (3) The construction works under the Project (river rehabilitation, pumping station and wastewater treatment plant) will involve land acquisition and resettlement and thus significant social impacts. (4) The Project and the other development activities already

Table 1-1 Correlation Analysis of the Project and the WB Safeguard Policies

S/N	Safeguard Policies	Triggered ?	Explanation
			implemented, to be implemented and reasonably foreseeable on the urban section of He River will have accumulative impacts on flood control and water environment, which, according to analysis, are primarily positive impacts. Therefore, the Project triggers World Bank OP4.01 and is identified as Category A Project.
2	Natural Habitats OP/BP 4.04	Yes	The policy is triggered because the construction and operation of proposed WB investments will have impacts on natural habitats including aquatic and terrestrial ecosystem along He River and its tributaries. As per the requirements of OP4.04, survey on aquatic and terrestrial ecosystem were conducted in the project-affected area and no critical/sensitive natural habitat has been identified. The project-related ecological impacts will be generally positive, and the anticipated adverse impacts are short-term, temporary and site-specific. The project has been developed in an environmentally sustainable way considering the protection of local species and biodiversity, and the specific mitigation measures were incorporated into the ESMP and ECOPs to ensure the potential adverse impacts were sufficiently addressed during construction and operation.
3	Forests OP/BP 4.36	No	The project will not finance activities that involve significant conversion or degradation of critical forest or related critical habitat defined under the policy. This policy will not be triggered.
4	Pest Management OP 4.09	No	The proposed project will neither procure pesticides nor result in increased use of pesticides. This policy will not be triggered.
5	Physical Cultural Resources OP/BP 4.11	Yes	The EA process confirms that He River rehabilitation subprojects of He River main watercourse rehabilitation (Guangming Bridge - Lingfeng Bridge section), Huang’ansi Flood Discharge Pump station and Discharge Canal Rehabilitation will have indirect impacts on some ancient buildings on the nearby historical and cultural street of Xiyue Street in the construction stage. In particular, a 120m-long downstream section of Huang’ansi Channel is part of this provincial-level protected historic quarter. A PCR management plan has been developed as part of the ESMP

Table 1-1 Correlation Analysis of the Project and the WB Safeguard Policies

S/N	Safeguard Policies	Triggered ?	Explanation
			and mitigation measures have been developed to avoid, minimize and compensate the project-related impacts. In addition, the RAP survey also found that the subproject of central green corridor will affect 53 new tombs of rural family and might generate impacts on local sacrificial customs. All the compensation and relocation measures for those tombs have been formally planned and developed in the RAP based on detailed survey and extensive consultation.
6	Indigenous Peoples OP/BP 4.10	No	The Project is located in Hezhou Municipality of GZAR. According to the investigation, there are no ethnic minorities in the project areas. Therefore, the project will not affect the ethnic minorities. Details will be further investigated during the project preparation.
7	Involuntary Resettlement OP/BP 4.12	Yes	Project components, including watercourse widening of He River and its tributaries for flood discharge, river-lake connection, Jiangnan WWTP, will involve extensive occupation of land and also private house demolition. Therefore, in the project design, the impact of land acquisition has been minimized. The Project triggers OP4.12 and a Resettlement Plan has thus been prepared.
8	Safety of Dams OP/BP 4.37	Yes	It has been found during environmental screening that there are two dams upstream of the proposed WB Loan Project. However, there are three small hydroelectric stations involved in the Project for rehabilitation. This policy is therefore triggered considering their direct impacts on the safety of proposed interventions. The Borrower has arranged one independent dam specialist to: 1) Inspect and evaluate the safety status of existing dams identified as relevant; 2) Review and evaluate the owner's operation and maintenance procedures; and 3) Provide a written report of findings and recommendations for any remedial work or safety-related measures.
9	Projects on International Waterways OP/BP 7.50	No	This Project involves no international waterways. The policy is not applicable and no action is required.
10	Projects in Disputed Areas OP/BP 7.60	No	All the project areas are in Guangxi and no disputed areas are involved.

1.2 Objectives of EIA

The main objectives of the EIA is to identify the current status of natural and social environment and environmental quality; evaluate the positive environmental impact of the project implementation; identify, screen and predict the possible negative impacts; propose effective mitigation measures and provide environmental & social management plan for the unavoidable negative environmental impacts so as to provide a rationale for the WB's independent assessment of the project as well as references and basis for project decision making, environmental management and engineering design optimization.

1.3 Principles of EIA

The EIA shall be organized and implemented in accordance with the principle of sustainable development and in a scientific, fair and practical way to support environmental decision-making and management. Principles to be followed include:

(1) Complying with the national industrial polices, environmental policies and regulations;
(2) Complying with the watershed and regional functional zoning plan, ecological protection plan and urban master plan and adopting an appropriate layout;
(3) Complying with laws and regulations on ecological protection such as biodiversity;
(4) Complying with policies of integrated resource utilization;
(5) Complying with land use policies; and
(6) Complying with pollutant discharge standards and regional environmental quality requirements.

1.4 Environmental functional zoning and evaluation criteria

1.4.1 Environmental functional zoning and environmental standards in force

(1) Atmospheric functional zoning

According to the Principles and Technical Method for Environmental Air Quality Functional Zoning (HJ14-1996), the project is located in a functional area subject to Class II standard specified in the Ambient Air Quality Standards (GB3095-1996）. The standard limits are shown in Table 1-2.

Table 1-2 Standard Values of the Ambient Air Quality Standard (Excerption)

Unit: mg/m^3

Assessment factor	Time of valuation	Class II limits
Total Suspended Solids (TSP)	Annual Average	0.20
	Daily Average	0.30
inhalable Particulate Matter （PM_{10}）	Annual Average	0.10
	Daily Average	0.15
Sulfur Dioxide （SO_2）	Annual Average	0.06
	Daily Average	0.15
	Hourly Average	0.50
Nitrogen Dioxide （NO_2）	Annual Average	0.08
	Daily Average	0.12
	Hourly Average	0.24

(2) Surface water functional zoning

Hezhou Municipality Water Functional Zoning, approved in 2012, defines the water functional zone of the total catchments of 32 medium and small rivers in Hezhou municipality with a catchment area ranging from 100km^2 to 1000 km^2. According to *Hezhou Municipality Water Functional Zoning*, one Class I water functional zone is defined in He River catchment – Hezhou He River Development Zone (i.e., 97.9km of river section of He River, from Dongxin Village of Fuyang Town, Fuchuan County to Hezhou and Longma Village). The targeted water quality of this zone is Class III standards of *Surface Water Environmental Quality Standards (GB 3838-2002)*. The remaining watersheds have not been defined and will follow Class IV standards of *Surface Water Environmental Quality Standards (GB 3838-2002).* The limits of the standards are shown in Table 1-3.

Table 1-3 Standard Values of Surface Water Environmental Quality Standard (Excerption)

Unit: mg/L

Item	Class Ⅲ Limits		Class IV Limits		Class V Limits
pH	6~9	Target water body: He River	6~9	Target water bodies: East Trunk Canal, Lining River, Changlong River, Huangtian Branch Canal, Guposhan Drainage Canal, East No. 5 Branch Canal, Huangansi Drainage Canal, Shizigang Drainage Canal	6~9
Dissolved Oxygen	5		3		2
Permanganate Index	6		10		15
BOD_5	4		6		10
COD	20		30		40
SS	30		60		150
NH_3-N	1.0		1.5		2.0
Total Phosphorus (TP)	0.2		0.3		0.4
Petro	0.05		0.5		1.0
Volatile Phenol	0.005		0.01		0.1
Cyanide	0.2		0.2		0.2
Anionic Surfactant	0.2		0.3		0.3
Sulfide	0.2		0.5		1.0
Copper（Cu）	1.0		1.0		1.0
Zinc (Zn)	1.0		2.0		2.0
Lead（Pb）	0.05		0.05		0.1
Cadmium (Cd)	0.005		0.05		0.01
Arsenic (As)	0.05		0.1		0.1
Hexavalent Chromium	0.05		0.05		0.1
Hg	0.0001		0.001		0.001

(3) Acoustic functional zoning

According to the acoustic environment functional zoning requirements in the *Acoustic Environmental Quality Standard* (GB3096-2008), the area along the Class II highway between Pinggui District and Guposhan Forest Park is classified as Class 4 acoustic environment functional zone while the residential areas with a distance of 35±5m on both side of the Class II highway is classified as Class 4a; schools, hospitals and other sensitive areas are classified as Class 2. The environmentally sensitive sites involved in the Project are located in Class 2 functional zones and the Class II standards specified in the Acoustic Environment Quality Standard (GB3096-2008) shall apply. Such standard values are shown in Table 1-4.

Table 1-4 Standard values of Acoustic Environment Quality Standard (Excerption)

Unit: dB（A）

Class	Daytime	Nighttime
Class 2	60	50
Class 4a	70	55

(4) Ecological functional zoning

According to the Ecological Functional Zoning Plan of GZAR, the Project is located in "Hezhou Central City Functional Zone".

1.4.2 Discharge standards

According to the project characteristics and discharge of pollutants, construction wastewater discharge, domestic wastewater discharge from the construction worker and wastewater discharge from sludge dewatering of Subproject 1 – Flood Control and Subproject 2 – Urban Drainage Improvement should meet Class I standard of Integrated Wastewater Discharge Standard (GB8978-1996). Exhaust gas from construction sites, river dredging sites and sludge dewatering sites should meet Integrated Air Pollutants Emission Standard (GB16297-1996) and the unorganized discharge limits of Odor Pollutant Emission Standard (GB14554-93). The construction site noise should meet the requirements of Environmental Noise Emission Standards for Construction Sites (GB12523-2011). The limits of these standards are shown in Table 1-5 ~1-8.

Table 1-5 Integrated Wastewater Discharge Standard

Unit: mg/L, except pH

Indicators	pH	SS	COD	BOD_5	NH_3-N	Phosphate	Oil	Anionic Surfactants
Limits	6～9	70	100	20	15	0.5	5	5

Table 1-6 Integrated Air Pollutant Emission Standard (Excerption)

Unit: mg/m^3

Indicators	TSP
Class	Unorganized discharge
Limits	5

Table 1-7 Odor Pollutant Emission Standard (Excerption)

Indicator	NH_3	Odor	H_2S
Class	2		
Limits	1.5	20	0.06

Table 1-8 Environmental Noise Emission Standards for Construction Sites (Excerption)

Unit: dB（A）

Standard	Item	Limits
Environmental Noise Emission Standards for Construction Sites (GB12523-2011)	Daytime [dB（A）]	70
	Nighttime [dB（A）]	55

During the project operation stage, the treated effluent and odor emitted by Jiangnan Wastewater Treatment Plant should meet Class 1A effluent discharge standard and odor emission standard of *Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002)* The noise from the wastewater treatment plant and drainage pumping stations should comply with Class 2 standards of *Ambient Noise Emission Standard on the Boundary of Industrial Enterprises* (GB12348-2008). The wastewater discharge from the associated project – Hezhou Municipal Solid Waste Landfill should meet the Class 2 standard of *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste(*GB16889-2008*)*. The discharge standards that the project should meet during the operation stage are shown in Table 1-9 ~ Table 1-12.

Table 1-9 Municipal Wastewater Treatment Plant Pollutants Discharge Standards (Wastewater)

Unit: mg/L, except pH

Indicators	pH	SS	COD	BOD_5	NH_3-N	TP	TN	Animal and vegetable oil
Limits	6～9	10	50	10	5（8）	0.5	15	1

Table 1-10 Municipal Wastewater Treatment Plant Pollutants Discharge

Standards (Exhaust gas)

Unit: mg/m³

Item	NH_3	H_2S	Odor concentration (dimensionless)
Limits	1.5	0.06	20

Table 1-11 Ambient Noise Emission Standard on the Boundary of Industrial Enterprises (Excerption)

Unit: dB(A)

Class	Daytime	Nighttime
Class 2	60	50

Table 1-12 Standard for Pollution Control on the Landfill Site of Municipal Solid Waste (Wastewater)

Unit: mg/L, except pH

Indicators	Chroma	COD	BOD_5	SS	TN	NH_3-N	TP
Limits	40	100	30	30	40	25	3
Indicators	Fecal Coliform	Hg	Cd	Cr	Cr^{6+}	As	Pb
Limits	10000 no./L	0.001	0.01	0.1	0.05	0.1	0.1

1.5 Assessment level

The assessment level of the Project is classified based on the characteristics, nature, scale, scope and degree of impacts, as well as the relevant requirements of the *Circular on strengthening EIA Management of Construction Projects Loaned by International Financial Organization* (Environment Supervision [1993] No. 324) issued by the former State Environmental Protection Administration and other ministries, the relevant “EIA Technical Guidelines” and “the World Bank Operational Manual – Environmental assessment OP4.01". The specific classification principles are shown in Table 1-13.

Table 1-13 EIA Classification of the World Bank Projects

Types of Assessment	Environment Impacts	Assessment Contents
Category A	Construction projects likely to generate great negative impacts on environment	Comprehensive EIA is required for these projects.
Category B	Construction projects likely to generate negative impacts on environment that are of limited scope and degree and may be significantly mitigated by means of advanced technology and mature prevention measures as regulated	Comprehensive EIA is generally not required for this category of projects, but special EIA or Environment Impact Analysis is required based on the project features and environment elements.
Category C	Construction projects that generate zero or little negative impacts on environment	Except for fulfilling the formalities of environment protection management, no EIA or Environment Impact Analysis is required for such projects.

Although the Project has significant positive impacts on local environment, especially in terms of flood control and water environment improvement, certain negative impacts will also be generated, including: (1) environmental and social impacts resulting from construction activities of the Project in urban center of Hezhou, especially the impacts on local residents and the historical buildings in the historical and cultural preservation area; (2) environmental and social impacts from the dredging operation of He River and its tributaries. The dredging load and sediment quality will be clarified in the preparation stage of the Project and it is estimated that the Project will produce about 184,590 m^3 of sludge with water content of 95% (equivalent to 18,500 m^3 of sludge cakes with a moisture content of 50%). A proper design has been worked out in the EIA for transport, treatment and disposal of dredged sediments based on the different sludge nature of the main watercourse, urban inland canals and branch canals involved in the Project to mitigate such impacts on the environment and local residents; and (3) significant impacts from land acquisition and resettlement to be involved in the project construction (river channel improvement, stormwater and sewage network improvement); (4) environmental and social impacts from reconstruction of the three small hydropower stations on the main watercourse of He River; (5) regarding the soil erosion impacts arising from river rehabilitation, road and pipeline construction, WWTP and pump station construction activities, water and soil conservation solutions are proposed in this EIA; (6) cumulative impacts of the Project and other constructed, planned and reasonably foreseeable development activities on the urban sections of the main watercourse of He River. Bank OP4.01 is triggered. Therefore, the project is proposed as a Category A project.

1.6 Key Assessment Tasks and Assessment Methods

1.6.1 Key Assessment Tasks

According to the national EIA technical guidelines and the requirements of World Bank Safeguard Policies, the key assessment tasks of the environmental impact report includes:

(1) Analyzing the overall positive benefits of the Project;
(2) Assessing the effects of the dredging works on river water quality, aquatic ecological environment, and proposing mitigation measures; analyzing the impacts of dredging order and proposing requirements on temporary disposal sites of dredged sediments and recommending plans of sediment transportation and disposal;
(3) Analyzing the impacts of water and soil erosion and developing soil and water conservation programs;
(4) Conducting cumulative impact analysis;
(5) Conducting alternative analysis;
(6) public participation and information disclosure;
(7) resettlement plan and social impact assessment;
(8) environmental & social management plan.

1.6.2 Assessment methods

According to the requirements in the *Regulations on Environmental Protection of Construction Projects*, Technical Guidelines on *Environmental Impact Assessment*, WB’s Safeguard Policies and WB’s EIA requirements for Category A projects, the EIA process of the Project is divided into three stages – TOR Preparation, Environmental Impact Prediction and Evaluation; and Report Preparation. The detailed tasks for each stage are shown in Figure 1-1 as follows.

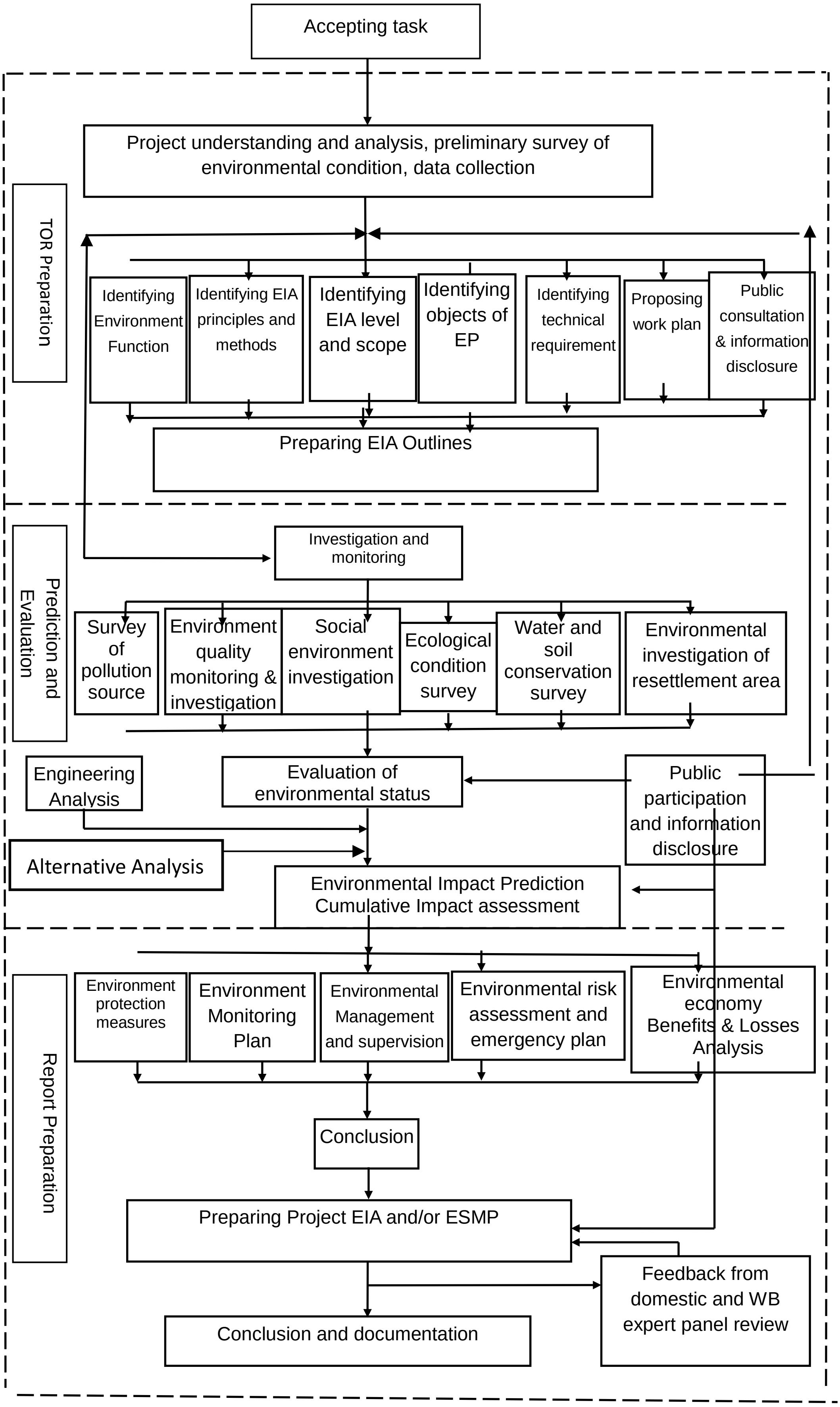


Figure 1-1 Flowchart of Project EIA Process

2. Engineering analysis

2.1 Project overview

2.1.1 Project background

Within the context of high-speed industrialization and urbanization and intensified global climate change, Hezhou is in the face of increasingly prominent issues of frequent water disasters, aquatic ecological imbalance and water pollution and so on. All such issues have impeded the development of local economy and society. The main problems in flood control and water environment that Hezhou faces in the current stage include:

Firstly, the flood control and drainage infrastructure are very weak in contrast to the frequent flood events. Secondly, the issue of environmental pollution has not been resolved. Thirdly, some urban inland canals suffer from deteriorating water quality due to limited water flow. And fourthly, the living environment is yet to be improved on account of the slow progress of municipal infrastructure development. These prominent water environment issues and the poor municipal infrastructures have become a “bottleneck” for economic integration, an obstacle to sustainable economic and social development, and a threat to water safety in the Pearl River and Xijiang River Watershed. In order to improve the flood control capacity of He River, the drainage and integrated water resource utilization in the project area and the ecological environmental and municipal infrastructure in Hezhou, Hezhou Municipal Government (HMG) decided to work with the World Bank and utilize a WB loan to implement Hezhou Urban Water Infrastructure and Environment Improvement Project.

2.1.2 Project objectives

To be implemented following the guidelines of development, livelihood and innovation and the principles of stabilized growth, deeper reform, strengthened restructuring, improved livelihood, controlled risks and integrated balancing and taking into consideration the relevant special plans and the practical situation and economic conditions, the Project intends to develop a system that covers flood risk management, urban drainage improvement, water environment improvement, ecological landscape promotion, and technical assistance management, etc. In addition, the Project will adopt the standards of “green water service, eco-friendly water service and storm and flood safety” to implement water environment rehabilitation and urban infrastructure development, safeguard regional drainage and flood safety, and improve regional water environment, and develop high standard and modern urban infrastructure and public service to support the sustainable development of Hezhou and demonstrate the integration of reform and innovation.

2.1.3 Project description

Hezhou is located in the northeastern part of GZAR. He River is a part of the Xijiang River System in the Pearl River Watershed and a major tributary of Xijiang River. It runs from northwest to southeast across the urban area and joins Xijiang River at

Huikai in Guangdong Province. Along with the all-direction expansion of Hezhou Municipality that identifies itself as an industrial and tourism city on the Guizhou-to-Guangdong Economic Belt and a portal and hub for Guangxi to the northeast direction, He River has become an important watercourse in the urban area with important functions to serve the city's needs for industrial and agricultural water, drainage and residents' cultural activities. The geographic location of the Project is illustrated in Figure 2-1.

The World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project comprises of the following three components:

Component 1: He River Flood Risk Resilience Improvement

This component aims at reducing the flood risks of He River urban section. The main contents include (1) upgrading (or demolishing) several small hydro-power stations to improve the flood discharging capacity; (2) widening some sections in the main watercourse of He River in the urban area to improve the flood discharging capacity and developing a green waterfront corridor; and (3) rehabilitating and connecting the main watercourse to Mawei River to divert upstream flood in the northern urban area to the downstream, and developing a green waterfront corridor to improve the flood discharging capacity and reducing the flood risk in downtown area.

Component 2: Urban Drainage and Wastewater Management Improvement

The purpose of this component is to rehabilitate and connect the urban water bodies including urban inland canals and lakes to improve the flood storage capacity, regulate the drainage and reduce flood risk, and improve the drainage capacity of tributaries and channels; to improve the urban water environment, especially at dry seasons, by developing wastewater collection and treatment facilities; and developing a "green circle and green corridor" by rehabilitating the water ways in the urban area. The main contents include (1) rehabilitating urban inland canals and developing green waterfront corridors to divert the local floods; (2) developing storm water pipelines and pumping stations at selected areas; and (3) developing Jiangnan WWTP and main sewers.

Component 3: Institutional Strengthening, Capacity Building and Project Management

This component will mainly improve the management capacity in Hezhou Municipality.

Subcomponent 3.1: Institutional strengthening

Integrated water management: Technical Assistance will be provided to streamline the management of the water affairs of the Hezhou Municipality. The details include: 1) to set up a mechanism for integrating the water sector master planning and coordinating multiple water-administrative government institutions to improve the consistency and efficiency of the water management in the city and 2) to further optimize the operation of the dams in the region towards an integrated water resources management. A flood risk early warning and management system will also be developed and training will be provided to protect vulnerable people (aged, children, and disabled) from floods.

Strengthening the institutional capacities in hydraulic, environmental and ecological monitoring, including: 1) strengthening capacity of Hezhou Environment Protection Bureau (HEPB) by constructing water quality monitoring stations and ecological monitoring station, providing equipment and data processing systems and training of

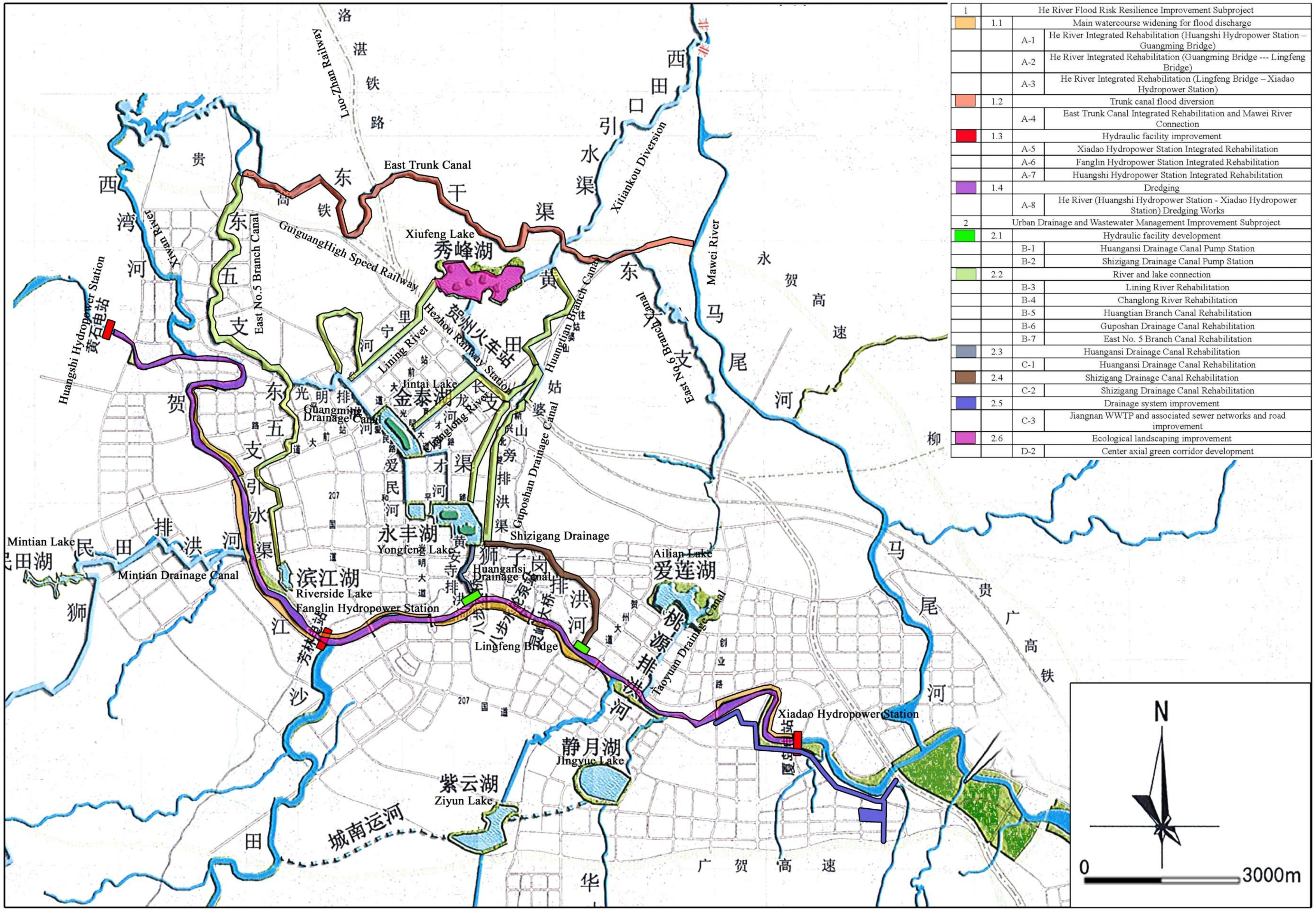
HEPB staff; and 2) Strengthening the capacity of the Project Implementation Units (PIUs), i.e. Hezhou Municipal Water Resources Bureau (HWRB) by constructing hydraulic station and training of staff.

Training and Study Tours. Trainings, workshop and study tours will be conducted to enhance the capacity of the official of the institutions involved in the water management of Hezhou Municipality.

Subcomponent 3.2: Project managmenet and supervision.

This subcomponent will provide institutional support to the PMO by: i) engaging a consulting firm to assist in finalizing the preliminary design, bidding documents, and final engineering designs; ii) advising construction supervisors in contract management; iii) preparing semi-annual project progress reports, mid-term review, and implementation completion report. The PMO will also engage with consultants as third-part to conduct the external EA and RAP reporting.

Figure 2-1: Project Location Map



1	He River Flood Risk Resilience Improvement Subproject		
	1.1	Main watercourse widening for flood discharge	
		A-1	He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge)
		A-2	He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge)
		A-3	He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower Station)
	1.2	Trunk canal flood diversion	
		A-4	East Trunk Canal Integrated Rehabilitation and Mawei River Connection
	1.3	Hydraulic facility improvement	
		A-5	Xiadao Hydropower Station Integrated Rehabilitation
		A-6	Fanglin Hydropower Station Integrated Rehabilitation
		A-7	Huangshi Hydropower Station Integrated Rehabilitation
	1.4	Dredging	
		A-8	He River (Huangshi Hydropower Station - Xiadao Hydropower Station) Dredging Works
2	Urban Drainage and Wastewater Management Improvement Subproject		
	2.1	Hydraulic facility development	
		B-1	Huangansi Drainage Canal Pump Station
		B-2	Shizigang Drainage Canal Pump Station
	2.2	River and lake connection	
		B-3	Lining River Rehabilitation
		B-4	Changlong River Rehabilitation
		B-5	Huangtian Branch Canal Rehabilitation
		B-6	Guposhan Drainage Canal Rehabilitation
		B-7	East No. 5 Branch Canal Rehabilitation
	2.3	Huangansi Drainage Canal Rehabilitation	
		C-1	Huangansi Drainage Canal Rehabilitation
	2.4	Shizigang Drainage Canal Rehabilitation	
		C-2	Shizigang Drainage Canal Rehabilitation
	2.5	Drainage system improvement	
		C-3	Jiangnan WWTP and associated sewer networks and road improvement
	2.6	Ecological landscaping improvement	
		D-2	Center axial green corridor development

Figure 2-2: Layout Map of Subprojects

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
1	**Flood risk control**			**67729.63**
A-1	He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge)	Rehabilitation of He River Huangshi Hydropower Station – Guangming Bridge section involves a total length of 12.66 km. The channel width between the dikes on both sides ranges from 120m to 150 m. There will be a 20.25 km long new dike including 18.85 km long earth dike and 1.4 km long flood retaining dike. The design water level of floods with a recurrence period of 50 years ranges from 107.4 m to 111.36 m. He Riverbed elevation is between 103.1 m and 98.47 m. He Riverbed slope is 0.0366%.	2019 and 2020	23515.46
A-2	He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge)	Rehabilitation of He River Guangming Bridge --- Lingfeng Bridge section involves a total length of 2.1 km. The channel width between the dikes on both sides ranges from 120m to 135 m. There will be a 2.4 km long new dike including 1.2 km long earth dike, 0.2 km long mobile gate dike and 1.0 km long flood retaining wall plus glass baffle dike. The design water level of floods with a recurrence period of 50 years ranges from 106.04 m to 107.4 m. He Riverbed elevation is between 96.25 m and 98.47 m. He Riverbed slope is 0.106%. Babu Bridge has significant back water effect and, therefore, it is planned to replace the 2 spans on the right side of He River with a new beam bridge to meet the flood control needs. After span increase, the bridge will be 35.5 m long and 8 m wide. The design elevation of He Riverbed beneath the bridge is 102.5 m, and the elevation of the bridge surface is between 108.75 m and 106.2 m.	2019 and 2020	17321.87
A-3	He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao	Rehabilitation of He River Lingfeng Bridge – Xiadao Hydropower Station section involves a total length of 6.9 km. The channel width between the dikes on both sides is between 120 and 186 m. A new flood dike in a total length of 5.98 km will be constructed, including a	2019 and 2020	6692.30

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
	Hydropower Station)	2.3 km long road dike section, a 1.0 km long flood retaining dike and a 2.68km long earth dike. The design water level of floods with a recurrence period of 50 years is between 103.12 m and 106.04 m. He Riverbed elevation is between 93.69 m and 96.25 m. He Riverbed slope is 0.037%.		
A-4	East Trunk Canal Integrated Rehabilitation and Mawei River Connection	The East Trunk Canal connects with the planned Bodailing Road in the upstream and the Xitiankou Diversion Canal in the downstream. The flood control standard is for floods with a recurrence period of 20 years. The total length of the works is 9.88 km. He Riverbed width is between 1.66 and 8 m and the opening is between 6.6 and 23.88 m. The design elevation of He Riverbed is between 118.64 m and 123.54 m. The design slope of He Riverbed is between 0.013% and 0.086%. The design water level is between 125.04 m and 119.47 m. The total dredging volume is 4610 m^3. The canal dike elevation will be based on existing dike with moderate modification. The elevation of the left bank dike is between 130.72 m and 119.77 m. The elevation of the right bank dike is between 131.62 m and 119.77m. The East Trunk Canal diversion canal connects with East Trunk Canal in the upstream and the Mawei River in the downstream. The total length of the works is 2.69 km. He Riverbed width is 6 m and the opening is between 11.22 and 12 m. The design elevation of He Riverbed is between 107.00 m and 118.64 m. The design slope of He Riverbed is between 0.28% and 0.42%. The design water level is between 119.47 m and 109.50 m. The dike elevation is between 119.77 m and 109.80 m.	2023 and 2024	12743.21
A-5	Xiadao	Xiadao Hydropower Station has an installed capacity of 6000kw with 3	2019 and 2020	305.10

Table 2-1： Summary of Project Activities for
Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
	Hydropower Station Integrated Rehabilitation	Nos. 2000 kw generator units. The average annual power generation capacity is 15.39 million kwh. The power station is a dam-type hydropower station with weir-top elevation of 96.13 m for the dam and 96.95 m for the hydraulic flap gates. Average single-hole width is 11 m for the 6-hole side and 28.7 m for the 3-hole side. The width of the center pier is 1.8 m. After comprehensive alternative comparison, the recommended alternative is to keep the existing structures and upgrade the external building surface of the plant, and to upgrade the upstream dike by increasing the dike top elevation by 0 to 1.0 m within 4 km length to ensure upstream flood safety. In addition it is recommended to integrate the operational scheduling of Xiadao Hydropower Station into the triple-prevention system (flood prevention, drought prevention and gale prevention system)of Hezhou..		
A-6	Fanglin Hydropower Station Integrated Rehabilitation	Fanglin Hydropower Station has an installed capacity of 525kw and 2 Nos. 100kW generator units, 1 No. 200kW generator unit and 1 No. 125kW generator unit. Hejiang Power Station has an installed capacity of 1000 KW for 5 No. 200kW generator units.The two hydropower stations share the same impounding dam and are dike-type hydropower station with a crest elevation of 102.72m, a base elevation of 97.71m. 33 sluice gates distributed in 11 spans will be arranged, with a maximum dike height of 4.26m and a dike section length of 225. According to the reconsturction program of Fanglin / Hejiang Hydropower Stations, these hydropower stations shall be buy-back hydropower stations and the existing sluice gates and intermediate sluice piers will be demilished and Fanglin Bridge will be retained. Rhe facade of the power plant buildings will be rehabilitated. 4 new	2018 and 2019	1631.30

Table 2-1： Summary of Project Activities for
Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
		centrifugal irrigation pumps with a unit capacity of $324m^3$ / h, a lift of 30m, and a motor power of 55 kW will be built. Due to water resistance, it is necessary to increase the height of a 4.4km long dike upstream of Fangling Bridge by 0 to 0.8m.		
A-7	Huangshi Hydropower Station Integrated Rehabilitation	Huangshi Hydropower Station is a run-off dam hydropower station with a total installed capacity of 1000kW and 5 Nos. 200 KW generator units. The designed annual power generation capacity is 4.7 million KWh. The dam type is a 100m long masonry gravity dam with a crest elevation of 109.00 m and a maximum dam height of 4.0m. The existing fixed dam with safety risks will be demolished and replaced with an adjustable hydraulic lifting dam, which will be designed into a continuous hydraulic lift dam with 13 holes and a single-hole-width of 7 m. The size of the new dam is n × B × H = 13 m * 7 m * 4.5 m. The water gate height is 4.5 m and the discharge channel width is 91 m. The water gate is composed of the upper deck, the gate chamber, the stilling basin and the Haiman section, with length of 6 m, 10 m, 10 m and 8.5 m, respectively.	2020	2008.01
A-8	He River (Huangshi Hydropower Station - Xiadao Hydropower Station) Dredging Works	Removal of silt, sandbank, sediment, garbage, weeds, debris, and construction waste such as brick and stone in the channel or on the bank. The dredging section is from GL6 + 100 to GL7 + 700 and from GL11 + 300 to GL13 + 300 with total length of approximately 3.6 km, a total dredging volume of approximately 332,500 m^3 (including 156,900n m3 of sediment and 175,600 m^3 of sand or stone).	2018 and 2019	2512.38
2	**Urban drainage improvement**			**106966.54**
B-1	Huangansi Drainage Canal	Huangansi Drainage Canal is used only for local flood discharge. The	2018 and 2019	1095.00

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
	Pump Station	design flow of the pumping station is 6.0 m^3/s.		
B-2	Shizigang Drainage Canal Pump Station	Shizigang Drainage Canal is used to transfer the storm water from the catchment upstream of Huangansi. The design flow of the pumping station is 36 m3/s.	2018 and 2019	8145.00
B-3	Lining River Rehabilitation	The rehabilitation works will follow the planned river alignment with a total length of6 km (4.38 km for Lining River and 1.62 km for Guangming Canal). The flood control standard for floods with a recurrence period of 20 years will be followed. The Lining River has a riverbed width ranging from 6 m to 8 m and an opening width of 10 m to 15 m. The design bottom elevation is between 102 m and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation on the left side is between 127.79 m and 119.77m and right side between 127.79 m and 120.07 m. The works for Guangming Channel is 1.62 km. The channel bottom width is between 6 m and 8 m and the opening width is between 10 m and 15 m. Its function is to transfer the supplement water from EastNo.5 Branch Canal to Jintai Lake instead of being a drainage canal. The design bottom elevation is between 102 m and 104 m and design slope is 0.3%.	2022	8380.20
B-4	Changlong River Rehabilitation	The rehabilitation works will follow the planned river alignment with a total length of4.90 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 6 m and 8 m, and the opening width is between 10 m and 15 m. The design bottom elevation is between 102 m and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation on the left side is between 127.79 m and 119.77m and right side between 127.79 m and 120.07	2022	9659.84

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
		m. The water replenishing channel of Changlong River upstream of Xiufeng Lake is 0.69 km long. Its function is to replenish water from Huangtian Canal to Xiufeng Lake and is not a drainage canal. The design bottom elevation is between 102 m and 104 m and the design slope is 0.3%.		
B-5	Huangtian Branch Canal Rehabilitation	The rehabilitation works will follow the planned river alignment with a total length of6.20 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 2 m and 10 m, and the opening width is between 7.5 m and 25 m. The design bottom elevation is between 102 m and 104 m. The design slope is between 0.067 and 0.3%. The design water level is between 105.4 m and 119.37 m. The design dike top elevation on the left side is between 105.7 m and 119.77m and right side between 105.7 m and 119.77 m. The dredging volume for Huangtian Canal is 7440 m3. Huangtian Branch Canal has interceptors along the canal to intercept the dry season sewage from Huangtian Township. The DN400 interceptor has a length of approximately 600 m.	2021	2811.91
B-6	Guposhan Drainage Canal Rehabilitation	The rehabilitation works will follow the planned river alignment with a total length of3.93 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 1 m and 1.9 m, and the opening width is between 2.6 m and 4 m. The design bottom elevation is between 103 m and 111.57 m. The design slope is 0.21%. The design water level is between 112.55 m and 105.22 m. The design dike top elevation on the left side is between 112.85 m and 105.52 m and right side between 112.85 m and 105.52 m. The dredging volume for Guposhan Drainage Canal is 3540 m3. As the intercepting facilities, DN 400 interceptors with a length of	2021	1476.42

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
		approximately 50m are installed at the end of Guposhan Drainage Canal or where it enters Shizigang Drainage Canal.		
B-7	East No. 5 Branch Canal Rehabilitation	The rehabilitation works will follow the planned river alignment. The East No.5 Branch Canal was used mainly for irrigation. After the Project it will serve for various functions including irrigation, drainage and landscaping. The canal alignment is adjusted and planned to be rerouted at Zhanqian Avenue and enters He River directly with a total length of 8.39 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 6 m and 8 m, and the opening width is between 10 m and 15 m. The design bottom elevation is between 102 m and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation is between 127.79 m and 119.77 m on the left side and between 127.79 m and 120.07 m on the right side.	2023 and 2024	6822.45
3	**Water quality improvement**			**33879.65**
C-1	Huangansi Drainage Canal Rehabilitation	The length of the rehabilitation works is 1.23 km. The flood control standard for floods with a recurrence period of 20 years will be followed. The main canal is 1.5 deep and 8 to 10 m wide. The design slope is 0.15%. The design bottom elevation is between 102.41 m and 100.70 m. The design dike top elevation is between 106.60 m and 102.80 m. The design discharge flow is 7.6 m3/s (and the maximum discharge capacity is 20 m3/s). The design water level is between 103.66 m and 101.95 m. The dredging volume is 8800 m3. The interceptor is DN400-500 and approximately 1900 m long.	2018 and 2019	1997.94

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
C-2	Shizigang Drainage Canal Rehabilitation	The length of the rehabilitation works is 3.72 km. The flood control standard for floods with a recurrence period of 20 years will be followed. The main canal is 21 to 32 m wide. The design slope is 0.09% to 1%. The design bottom elevation is between 103.00 m and 98.9 m. The design dike top elevation is between 105.36 m and 105.80 m. The design discharge flow is 104.4 m3/s. The design water level is between 105.33 m and 103.89 m. The dredging volume is 3300 m^3. The interceptor is DN500-600 and approximately 6000 m long.	2018 and 2019	12342.70
C-3	Jiangnan WWTP and associated pipeline networks	1 No. WWTP (Jiangnan WWTP) with a treatment capacity of 15000 m3/day. The main structures include: fine screen, aeration grit chamber (integrated with fine screen), A2/O micro-aeration oxidation ditch, distribution well, sedimentation tank, high-efficiency sedimentation tank, drum filter, buffer tank, gravity condensing tank, sludge storage tank, dewatering room, blower room, contact reactor tank, drainage pumping house, etc. The associated pipeline network includes: 5.384 km new sewage pipeline (including 3.084km long DN500-DN1350 gravity flow pipeline with and 2.3 km long DN 600 pressurized flow pipeline), and 1.165 km long DN500 new pre-buried sewage pipeline. Construction of a new road, namely Binjiangnan Road in a length of 5.56km and the associated facilities for storm water, sewage, power, telecommunication, lighting, landscaping and traffic management, etc.	2018 and 2019	21099.99
4	**Ecological landscaping improvement**			**11640.71**
D-2	Center axial green	Rehabilitation of Lining River and Changlong River focuses on	2021	11640.71

Table 2-1： Summary of Project Activities for Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

No.	Project activities	Description	Implementation schedule	Cost estimate 00,000 RMB
	corridor development	greening and afforestation. The deep water and shallow shoals will be utilized closely linked to the theme of riverside waterfront ecology to develop a riverside eco-park to deliver waterfront experience mainly in the form of gentle eco-slope. Within He River channel limited by the boundary of municipal roads and built areas, a waterfront greenbelt comprising of shallow water aquatic plants will be built with a greening area of 6.46 ha, a pavement area of 0.3 ha, a garden path area of 7.4 ha and pavilions and structures with a total area of 600 m^2.		
5	**Technical assistance**			**5483.58**
E-1	River governor system + Internet intelligent management and control system	Development of an urban early warning management system, improvement of main watercourse hydrological monitoring stations; development of branch channel hydrological monitoring stations.	2019 -2024	874.51
E-2	He River Watershed water environment monitoring, early warning and integrated management system	Development of automatic water quality monitoring stations for main watercourse and branch channels; construction of Municipal Environmental Monitoring Station as a part of the national standardization project; development of automatic water environment monitoring and early warning platform	2018 and 2019	4609.07

2.1.4 Project implementing agencies and schedule

(1) Management agencies

The World Bank Financed Hezhou Urban Water Infrastructure and Environment Improvement Project Leading Group (PLG) is the highest leading agency for the Project. Leaders from Hezhou Municipal Development and Reform Commission (HDRC), Hezhou Municipal Finance Bureau (HFB), Hezhou Municipal Human Resources Bureau (HHRB), Hezhou Municipal Land Resources Bureau (HLRB), Hezhou Municipal Environmental Protection Bureau (HEPB), Hezhou Municipal Housing and Construction Bureau (HHCB), Hezhou Municipal Transportation Bureau (HTB), Hezhou Municipal Water Resource Bureau (HWRB), Hezhou Municipal Audit Bureau (HAB), Hezhou Municipal Engineering Administration Bureau (HMEAB), Hezhou Municipal Planning Bureau (HPB), the State Asset Supervision and Management Commission (SASAC), Municipal Finance Office, Railway and Aerial Administration Office, Babu District and Pinggui District governments are also members of the Leading Group.

Under the Project Leading Group, a municipal project management office (PMO) is established to be responsible for the daily work. The municipal PMO is located at HDRC. The project implementing units (PIUs) include HWRB, HMEAB and HEPB.

(2) Construction schedule

The Project will be implemented in three stages: the preparation stage, the main works construction stage and the completion stage. The main tasks in the preparation stage are construction of access roads, living and production facilities inside and outside the project site; the main works construction mainly includes earthwork excavation, backfill, and construction of slope, dike, pumping stations and water gates; in the completion stage, the main tasks are site cleanup and documentation.

Based on the actual conditions, the Project is scheduled to be constructed over a period of 7 years, commencing in early January 2018 and ending with the final acceptance test at the end of December 2024.

2.2 Current conditions

2.2.1 Current conditions for urban flood control

Hezhou is located in the Babu Basin, spreading from east to west like a belt along He River. The elevation along He River is relatively low, with the minimum elevation of the built area ranging from 102.08 m to 103.08 m. As a result, buildings and streets in these areas suffer from flood almost every year. According to the historic records, the City was hit by major floods in the years of 1813, 1908, 1914, 1915, 1954, 1956, 1978 and 1994. Since the city was established, Hezhou Municipality has experienced major floods in the years of 2002, 2005, 2008 and 2020, with both the urban and rural areas flooded by river water overflowed from the dike, causing significant waterlogging and flooding disasters. The flood in 1994, in particular, caused huge loss in the urban area.

Hezhou is an emerging tourism city with its infrastructures being developed in all aspects. Its first effort in development of special plans for flood control can be traced back to Year 1995. However, up till now, the city still does not have a complete flood management system, making it the only municipal-level city in Guangxi having no integrated management system. The flood control and drainage infrastructure in Hezhou is still very weak, with most of He River sections in the city having no dikes or embankment. Even for some of those in place, the flood control capacity is insufficient. The only dikes in place are the 965m long dike from Jiangbeizhong Road and Jianan Road to Shizigang Drainage Canal, the 764m long dike from Hezhou Bridge to Guidong Electrical Company, and the 2836m long dike (still under construction) from Guidong Electrical Company to Wayoutou Section. Without a sound dike system, Hezhou still has a long way to go to improve its flood management system.

Built dike 1

Built dike 2

2.2.2 Current conditions of the drainage system

Currently in Hezhou there are 98.63 km drainage pipeline in place in total, most of which are combined sewers system. This is because they are mostly built in the 1990’s when the design standards were not as strict as today. The storm water is mainly discharged to surrounding area through scattered ditches or pipes, mostly of small diameter of 300*300 or DN300. In addition, due to severe sedimentation, the drainage capacity of the pipelines is very limited. Without separate stormwater and sewage pipeline systems, a part of the domestic sewage, industrial wastewater and storm water are discharged directly into Huangansi River, Shizigang Drainage Canal or He River. During storm events, storm water and sewage overflow will occur due to limited drainage capacity, causing significant impacts on daily life and hygiene of local people.

To the north of He River in the urban area, there are three major drainage canals, namely Huangansi Drainage Canal, Shizigang Drainage Canal, and Nanshetang Drainage Canal serving as the main drainage passage in the northern part of the City and joining He River eventually. Huangansi Drainage Canal and Shizigang Drainage Canal run across the downtown area, receiving most of sewage before entering He River. The service area of Nanshetang Drainage Canal is currently a suburban area with much less sewage to receive.

2.2.3 Current conditions of rivers to be rehabilitated

(1) Main watercourse of He River

The main watercourse of He River to be rehabilitated in the Project is approximately 21.6 km long. The sections under construction include Beidi Park Section, Jiangnanzhong Road Section, Dongludi Dike Section and Pinggui Section in the upstream. With a ground elevation of 102.8 m to 117.5 m on both banks, the existing river banks are mostly farmland, bamboo forest or dry lands except the built area section that is protected with a vertical retaining wall. Most parts of He River bank are floodplain and Level 1 terrace.

Photo No. 1 for current status of He River

Photo No. 2 for current status of He River

(1) Huangansi Drainage Canal

The section of Huangansi Drainage Canal to be rehabilitated is 1.23 km long. It has vertical masonry retaining wall on both sides except the natural slope in only some individual sections. Both sides are crowded with residential houses. The terrain is relatively flat, slightly high in the north and low in the south with elevations ranging from 103.9 m to 105.2 m. The water quality of the canal gradually deteriorates from upstream to downstream along with the increase of sewage discharge. In the upstream sections, there is basically no siltation while in the downstream section siltation is as thick as 1.0m. Results of geological survey and drilling show that the bedrock in the Project is not deep and the Project is located within the area of karsts terrain.

(2) Shizigang Drainage Canal

The section of Shizigang Drainage Canal to be rehabilitated is 3.8 km long. There are artificial dike along the both sides of the canal with masonry retaining wall except in some parts there are natural slopes which are now used as gardens for local residents. The canal is narrow with shallow and black water. With open canal and blind culvert each taking half of the canal, the canal involves thick sediments of 1.3 to 3.7m.

Shizigang Drainage Canal

Huangansi Drainage Canal

(3) Lining River, Changlong River, Huangtian Branch Canal and Guposhan Drainage Canal

The section to be rehabilitated is respectively 4.4km, 4.4km, 6.16km and 3.96km long for the planned Lining River, the planned Changlong River, Huangtian Branch Canal Guposhan Drainage Canal.

The landform in the area is typical peak-forest eroded plain featuring a flat terrain high in the northwest and low in the southeast. Banks along the canals are mostly farmland or dry land, partly having exposed base rock, and the current ground elevation ranges from 111.5 m and 119.3 m. The canals are, in most of the sections, supported by vertical retaining walls, with only a very few parts being soil slope. With a very small width, siltation in these parts is not serious.

(4) East Trunk Canal

The section to be rehabilitated for Guishidong Trunk Canal is 9.89 km long and is located in the northern part of the project area. The upstream and midstream section of the canal belong to eroded terrace terrain while the downstream section belongs to peak-forest eroded plain and peak-forest depressions. The existing canal is supported by vertical and inclined retaining walls. Wider than the other canals, but without perennial flow, the canal does not involve siltation. On both sides of the canal are farm land and dry land. In the upstream section, deep soil slope is formed through back filling. Some sections of the canal are close to limestone hills. The terrain of most of the project area belongs to karsts terrain.

Lining River

Changlong River

Huangtian Branch Canal

East Trunk Canal

(5) East No.5 Branch Canal

The diversion water gate for East No.5 Branch Canal is located at 43 + 075. It serves the irrigation needs for a land area of 24780 mu. The canal length is 11.78 km. The average flow at the start point and end point of the canal is respectively 1.8 m^3/s and 0.7 m^3/s. Jizishi Branch Canal is a branch of East No. 5 Canal starting at Xiwan Village and finally joining Huangansi River.

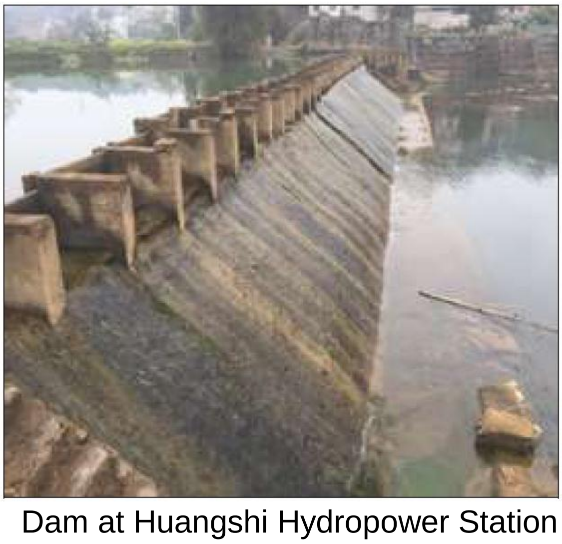
The diversion water gate for East No.6 Branch Canal is located at 54+090. It serves the irrigation needs for a land area of 18130 mu. The canal length is 10.13 km. The average flow at the start point and end point of the canal is respectively 1.61 m3/s and 0.1 m3/s. Due to aging and improper maintenance, some urban sections of the canal are already damaged. Irrigation water can only be supplied from another branch canal. Water from the canal joins Ailian Lake in the end.

East No.5 Branch Canal

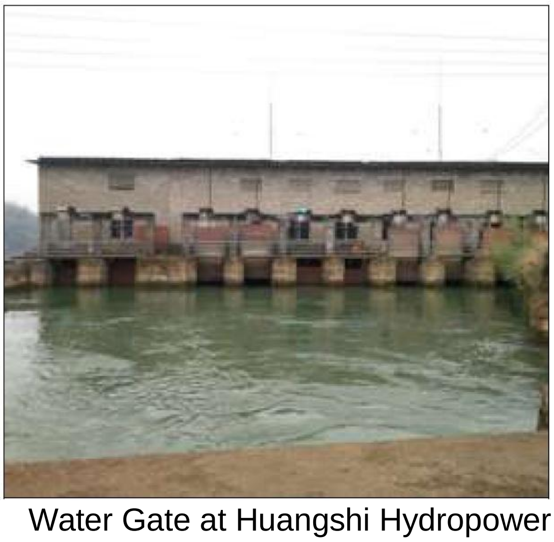
2.2.4 Current conditions of the hydropower stations to be upgraded

(1) Huangshi Hydropower Station

Huangshi Hydropower Station is located at Yangshou Town in Zhongshan County and is a run-off dam-type hydropower station. With the construction commenced in 1975, the hydropower station was completed and put into operation in 1978. It has a total installed capacity of 1000kW with 5 Nos. 200 KW generator units. The designed annual power generation capacity is 4.7 million KWh. The actual annual power generation is 4.3 million KWh. As a masonry gravity dam with a length of 100 m, a crest elevation of 109.00 m and a maximum dam height of 4.0 m, Huangshi Hydropower Station is currently operated and managed by Hezhou Huangshi Hydropower Station Co., Ltd. on behalf of Yangtou Town Government.



Dam at Huangshi Hydropower Station



Water Gate at Huangshi Hydropower Station

(2) Fanglin Hydropower Station

Fanglin Hydropower Station is located at 300 m upstream of the merging point of He River and Shatian River in the Pinggui District and is a run-off hydropower station. Adopting a masonry dam, the hydropower station dam is integrated with a 225m long, 11-span bridge across He River. 3 iron plate flap gates are installed for each span, totally 33 such flap gate for the entire bridge. The flap gate has a top elevation of 105.00m. When flood comes, it pushes off the flap gate and is discharged, restoring He River bed to nearly its natural status. The Fanglin Hydropower Station (right bank) was built in 1971 with an installed capacity of 450 kw for 2 Nos. 100kW generator units and 2 Nos. 125kW generator units. In 2001, the hydropower station was transferred to and operated and managed by Hezhou Minfeng Industry Co., Ltd. Fanglin Hydropower Station (left bank) commenced construction in July 1987 and started operation in October 1988. With an installed capacity of 1000 KW for 5 generator units, the power station is currently operated and managed by Babu District Hydropower Engineering Machinery Construction Team.

Dam at Fanglin Hydropower Station

Gates at Fanglin Hydropower Station

(3) Xiadao Hydropower Station

Xiadao Hydropower Station is located on the section of He River at Xiadao Village of Ertang Town in Babu District located 4 km away from the city. As a river-bed power station located on the right bank, the hydropower station commenced construction in October 1967 and was put into operation in July 1972. At the beginning, it contained one irrigation water pump and one small hydropower station with an installed capacity of 535 KW and an average annual power generation of 4.59 million kWh. After several upgrades and expansion, the hydropower station has achieved an installed capacity of 6000kW and a total storage capacity of 7.07 million m^3 and become a multi-function hydropower station of power generation, irrigation and navigation with a multi-year average power generation capacity of 20.13 KWh. Originally a 95.5m long rubber dam, the dam has been converted into a flap gate dam. The current water level is 101.80m and the minimum water level is 95.50m. As the inflow gets to more than 586 m^3/s, the hydropower station will suspend power generation and all flap gates and sediment washing gates will be opened for flood discharge. Based on the analysis of the characteristics of the rated head of the hydraulic turbine on the premise that the water head and flow needed for full load power generation is satisfied, Xiadao Hydropower Stations should adopt the following operation mode: (1) The hydropower station will operate in normal mode when inflow is less than 180 m^3/s and the dam water level is maintained at 101.80m (normal storage level); 2) Operation is suspended when inflow is greater than 180 m^3/s but less than 400 m^3/s.


Dam at Xiadao Hydropower Station


Gates at Xiadao Hydropower Station

2.3 Identification and scope of assessment of project impacts

2.3.1 Identification of environmental and social impacts

The project has three components, namely, He River Flood Risk Resilience Improvement, Urban Drainage and Wastewater Management Improvement, and Institutional Strengthening, Capacity Building and Project Management. These components are further divided into 23 subcomponents. The EIA summarized the contents, identified potential environmental and social impacts and proposed safeguard measures under the WB policy for these components. Details are summarized in Table 2-2.

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
1	Improving He River Flood Risk Resilience				
1.1	Main watercourse widening for flood discharge	A-1 He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge): Rehabilitation of He River Huangshi Hydropower Station – Guangming Bridge section involves a total length of 12.66 km. The channel width between the dikes on both sides ranges from 120m to 150 m. There will be a 20.25 km long new dike including 18.85 km long earth dike and 1.4 km long flood retaining dike. The design water level of floods with a recurrence period of 50 years ranges from 107.4 m to 111.36 m. He Riverbed elevation is between 103.1 m and 98.47 m. He Riverbed slope is 0.0366%.	Impact of river widening and dredging on hydrology; Construction stage: dust, wastewater, noise, solid waste (borrow and dispose, construction waste disposal, disposal site), soil erosion, construction camp; wet season construction risk and safeguard; construction vehicles' impact.	Permanent land acquisition, demolishing and resettlement, temporary land occupation.	Dike work ECOP, ESMP, EIA, RAP, SA*
		A-2 He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge): Rehabilitation of He River Guangming Bridge --- Lingfeng Bridge section involves a total length of 2.1 km. The channel width between the dikes on both sides ranges from 120m to 135 m. There will be a 2.4 km long new dike including 1.2 km long earth dike, 0.2 km long mobile gate dike and 1.0	Hydrological impacts of river widening and dredging; Construction stage: dust, wastewater, noise, solid waste (borrow and dispose, construction waste disposal, disposal site), soil erosion, construction camp; wet season construction risk and safeguard; construction vehicles' impact.	Permanent land acquisition, demolishing and resettlement; temporary land occupation,	Dike work ECOP, ESMP (PCR Management Plan**), EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		km long flood retaining wall plus glass baffle dike. The design water level of floods with a recurrence period of 50 years ranges from 106.04 m to 107.4 m. He Riverbed elevation is between 96.25 m and 98.47 m. He Riverbed slope is 0.106%. Babu Bridge has significant back water effect and, therefore, it is planned to replace the 2 spans on the right side of He River with a new beam bridge to meet the flood control needs. After span increase, the bridge will be 35.5 m long and 8 m wide. The design elevation of He Riverbed beneath the bridge is 99.95 m, and the elevation of the bridge surface is between 108.75 m and 106.2 m.		construction activity impact on the Xiyue Street historic cultural street and on the CCP Babu Special Branch historic site.	
		A-3 He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower: Rehabilitation of He River Lingfeng Bridge – Xiadao Hydropower Station section involves a total length of 6.9 km. The channel width between the dikes on both sides is between 120 and 186 m. A new flood dike in a total length of 5.98 km will be constructed, including a 2.3 km long road dike section, a 1.0 km long flood retaining dike and a 2.68km long earth dike.. The design water level of floods with a recurrence period of 50	Impact of river widening and dredging on hydrology; Construction stage: dust, wastewater, noise, solid waste (borrow and dispose, construction waste disposal, disposal site), soil erosion, construction camp; wet season construction risk and safeguard; construction vehicles' impact.	Permanent land acquisition, Demolishing and resettlement; Temporary land occupation	Dike work ECOP, ESMP (PCR Management Plan**), EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		years is between 103.12 m and 106.04 m. He Riverbed has an elevation of 93.69 m to 96.25 m and a slope of 0.037%.			

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
1.2	Diversion of flood in canals	A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection: The East Trunk Canal connects with the planned Bodailing Road in the upstream and the Xitiankou diversion canal in the downstream. The flood control standard is for floods with a recurrence period of 20 years. The total length of the works is 9.88 km. He Riverbed width is between 1.66 and 8 m and the opening is between 6.6 and 23.88 m. The design elevation of He Riverbed is between 118.64 m and 123.54 m. The design slope of He Riverbed is between 0.013% and 0.086%. The design water level is between 125.04 m and 119.47 m. The total dredging volume is 4610 m3. The canal dike elevation will be based on existing dike with moderate modification. The elevation of the left bank dike is between 130.72 m and 119.77 m. The elevation of the right bank dike is between 131.62 m and 119.77m. The East Trunk Canal diversion canal connects with East Trunk Canal in the upstream and the Mawei River in the downstream. The total length of the works is 2.69 km. He Riverbed width is 6 m and the opening is between 11.22 and 12 m. The design elevation of He Riverbed is between 107.00 m and 118.64 m. The design slope of He Riverbed is between 0.28% and 0.42%. The design water level is between 119.47 m and 109.50 m. The dike elevation is between	Impact of main watercourse widening and dredging on hydrology; Construction stage: small hydraulic facility with short duration, the impact is local and temporary and limited. The main impacts include dust, wastewater, noise and solid waste, temporary sediment storage site, transportation routes, sediment disposal plan; and dredging impact on water quality (temporary: SS)	Permanent land acquisition, Demolishing and resettlement; Temporary land occupation	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
1.3	Hydraulic facility upgrade	A-5 Xiadao Hydropower Station Integrated Rehabilitation: Xiadao Hydropower Station has an installed capacity of 6000kw with 3 Nos. 2000 kw generator units. The average annual power generation capacity is 15.39 million kwh. The power station is a dam-type hydropower station with weir-top elevation 96.13 m for the dam and 96.95 m for the hydraulic flap gates. Average single-hole width is 11 m for the 6-hole side and 28.7 m for the 3-hole side. The width of the center pier is 1.8 m. After comprehensive alternative comparison, the recommended alternative is to keep the existing structures and upgrade the external building surface of the plant, and to upgrade the upstream dike by increasing the dike top elevation by 0 to 1.0 m within 4 km length to ensure upstream flood safety. In addition it is recommended to integrate the operational scheduling of Xiadao Hydropower Station into the triple-prevention system (flood prevention, drought prevention and gale prevention system)of Hezhou.	Refer to A3, the impacts from dike works	Temporary land occupation, Impacts on normal operation of the power plant, and revenue	ESMP, EIA, SA
		A-6 Fanglin Hydropower Station Integrated Rehabilitation: Fanglin Hydropower Station has an installed capacity of 525kw and 2 Nos.	Water involved construction impact: dust, wastewater, noise, solid waste	Temporary land occupation;	ESMP, EIA, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		100kW generator units, 1 No. 200kW generator unit and 1 No. 125kW generator unit. Hejiang Power Station has an installed capacity of 1000 KW for 5 No. 200kW generator units.The two hydropower stations share the same impounding dam and are dike-type hydropower station with a crest elevation of 102.72m, a base elevation of 97.71m. 33 sluice gates distributed in 11 spans will be arranged, with a maximum dike height of 4.26m and a dike section length of 225. According to the reconsturction program of Fanglin / Hejiang Hydropower Stations, these hydropower stations shall be buy-back hydropower stations and the existing sluice gates and intermediate sluice piers will be demilished and Fanglin Bridge will be retained. Rhe facade of the power plant buildings will be rehabilitated. 4 new centrifugal irrigation pumps with a unit capacity of 324m³ / h, a lift of 30m, and a motor power of 55 kW will be built. Due to water resistance, it is necessary to increase the height of a 4.4km long dike upstream of Fangling Bridge by 0 to 0.8m. .	(demolishing waste, waste equipment and waste engine oil disposal), transportation vehicle's impact	Demolishing the Fanglin Hydropower Station dam will impact on local residents' travel and local traffic. Impacts on normal operation of the power plant, and revenue. Impacts on upstream irrigation and normal agricultural production.	
		A-7 Huangshi Hydropower Station	Impacts from waterworks: dust,	Temporary	ESMP, EIA,

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		Integrated Rehabilitation: Huangshi Hydropower Station is a run-off dam hydropower station with a total installed capacity of 1000kW and 5 Nos. 200 KW generator units. The designed annual power generation capacity is 4.7 million KWh. The dam type is a 100m long masonry gravity dam with a crest elevation of 109.00 m and a maximum dam height of 4.0m. The existing fixed dam with safety risks will be demolished and replaced with an adjustable hydraulic lifting dam, which will be designed into a continuous hydraulic lift dam with 13 holes and a single-hole-width of 7 m. The size of the new dam is n × B × H = 13 m * 7 m * 4.5 m. The water gate height is 4.5 m and the discharge channel width is 91 m. The water gate is composed of the upper deck, the gate chamber, the stilling basin and the Haiman section, with length of 6 m, 10 m, 10 m and 8.5 m, respectively.	wastewater, noise, solid waste (demolishing waste, waste equipment and waste engine oil disposal), transportation vehicle’s impact	land occupation Impacts on normal operation of the power plant, and revenue. Impacts on upstream irrigation and normal agricultural production.	SA

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
1.4	Dredging	A-8 He River (Huangshi Hydropower Station - Xiadao Hydropower Station) Dredging Works: Removal of silt, sandbank, sediment, garbage, weeds, debris, and construction waste such as brick and stone in the channel or on the bank. The dredging section is from GL6 + 100 to GL7 + 700 and from GL11 + 300 to GL13 + 300 with total length of approximately 3.6 km, a total dredging volume of approximately 332,500 m^3 (including 156,900n m3 of sediment and 175,600 m^3 of sand or stone). Dredging method: dredging boat.	Construction stage: solid waste: impacts from sediment temporary storage site, odor, sediment transportation routes, disposal plan, noise; dredging impact on water quality (temporary: SS).		ESMP,EIA
2	Improving Urban Drainage and Wastewater Management				

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
2.1	Hydraulic facility development	B-1 Huangansi Drainage Canal Pump Station: Huang'ansi Drainage Canal is used only for local flood discharge. The design flow of the pumping station is 6.0 m3/s. B-2 Shizigang Drainage Canal Pump Station: Shizigang Drainage Canal is used to transfer the storm water from the catchment upstream from Huangansi. The design flow of the pumping station is 36 m3/s.	Construction stage: small civil works. The impacts are local, temporary and insignificant. The impacts are from wastewater, waste air, noise, and solid waste. Operation stage: Noise impact from pumping house.	Permanent land acquisition, resettlement; Temporary land occupation; Construction for the pumping station will generate impacts on the Xiyue Street historic cultural street.	ECOP of Small Waterworks, ESMP, EIA, RAP, SA
2.2	River and lake connectivity	B-3 Lining River Rehabilitation: The rehabilitation works will follow the planned river alignment with a total length of 6 km (4.38 km for Lining River and 1.62 km for Guangming Canal). The flood control standard for floods with a recurrence period of 20 years will be followed. Lining River has a riverbed width ranging from 6 m to 8 m and an opening width of 10 m to 15 m. The design bottom elevation is between 102 m	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, wastewater, noise, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, etc. Operation stage: Noise impact from control gate.	Permanent land acquisition, Demolishing and resettlement; Temporary land occupation; During the	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation on the left side is between 127.79 m and 119.77m and right side between 127.79 m and 120.07 m. The works for Guangming Channel is 1.62 km. The channel bottom width is between 6 m and 8 m and the opening width is between 10 m and 15 m. Its function is to replenish water from East No.5 Branch Canal to Jintai Lake and is not a drainage canal. The design bottom elevation is between 102 m and 104 m and the design slope is 0.3%.		construction of the section underpassing Gui-Guang High-speed Railway, impacts will be generated on the railway base.	
		B-4 Changlong River Rehabilitation: The rehabilitation works will follow the planned river alignment with a total length of 4.90 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 6 m and 8 m, and the opening width is between 10 m and 15 m. The design bottom elevation is between 102 m and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation on the left side is between 127.79 m and 119.77m and right	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, wastewater, noise, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, etc. Operation stage: Noise impact from control gate.	Permanent land acquisition, Demolishing and resettlement; Temporary land occupation.	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
		side between 127.79 m and 120.07 m. The Changlong River in the upstream of Xiufeng Lake is 0.69 km long. Its function is to replenish water from Huangtian Canal to Xiufeng Lake and is not a drainage canal. The design bottom elevation is between 102 m and 104 m and design slope is 0.3%.			
		B-5 Huangtian Branch Canal Rehabilitation: The rehabilitation works will follow the planned river alignment with a total length of6.20 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 2 m and 10 m, and the opening width is between 7.5 m and 25 m. The design bottom elevation is between 102 m and 104 m. The design slope is between 0.067 and 0.3%. The design water level is between 105.4 m and 119.37 m. The design dike top elevation on the left side is between 105.7 m and 119.77m and right side between 105.7 m and 119.77 m. The dredging volume for Huangtian Canal is 7440 m3. The Branch Canal will also have interceptors along the canal to intercept dry season sewage from Huangtian Township. The DN400 interceptor has a length of	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, and noise, etc. The odor from dredging and sediment storage; the sediment storage site, transportation routes, and disposal plan; the dredging impact on water quality (temporary: SS); the dust and noise from laying interceptor pipelines.	Permanent land acquisition, demolishing and resettlement; Temporary land occupation; Interceptor pipeline laying might impact on other utility lines.	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		approximately 600 m.			
		B-6 Guposhan Drainage Canal Rehabilitation: The rehabilitation works will follow the planned river alignment with a total length of 3.93 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 1 m and 1.9 m, and the opening width is between 2.6 m and 4 m. The design bottom elevation is between 103 m and 111.57 m. The design slope is 0.21%. The design water level is between 112.55 m and 105.22 m. The design dike top elevation on the left side is between 112.85 m and 105.52 m and right side between 112.85 m and 105.52 m. The dredging volume for Guposhan Drainage Canal is 3540 m3. As	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, and noise, etc. The odor from dredging and sediment storage; the sediment storage site, transportation routes, and disposal plan; the dredging impact on water quality (temporary: SS); the dust and noise from laying interceptor pipelines. Operation stage: Noise impact from control gate.	Permanent land acquisition; Temporary land occupation; Interceptor pipeline laying might impact on other utility lines.	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
		the intercepting facilities, DN 400 interceptors with a length of approximately 50m are installed at the end of Guposhan Drainage Canal or where it enters Shizigang Drainage Canal.			
		B-7 East No. 5 Branch Canal Rehabilitation: The rehabilitation will follow the planned river alignment. The East No.5 Branch Canal was used mainly for irrigation. After the Project it will serve for various functions including irrigation, drainage and landscaping. The canal alignment is adjusted and planned to be rerouted at Zhanqian Avenue and enters He River directly with a total length of 8.39 km. The flood control standard for floods with a recurrence period of 20 years will be followed. He Riverbed width is between 6 m and 8 m, and the opening width is between 10 m and 15 m. The design bottom elevation is between 102 m and 104 m. The design slope is 0.3%. The design water level is between 125.58 m and 119.47 m. The design dike top elevation on the left side is between 127.79 m and 119.77 m and right side between 127.79 m and 120.07 m.	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, and noise, etc. The odor from dredging and sediment storage; the sediment storage site, transportation routes, and disposal plan; the dredging impact on water quality (temporary: SS). Operation stage: Noise impact from control gate.	Temporary land occupation, Permanent land acquisition, demolishing and resettlement; During the construction of the section underpassing Gui-Guang High-speed Railway, impacts will be generated on the railway base.. Excavation might affect	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
				other utility pipelines.	

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
2.3	Huangansi Drainage Canal Rehabilitation	C-1 Huangansi Drainage Canal Rehabilitation: The length of the rehabilitation works is 1.23 km. The flood control standard for floods with a recurrence period of 20 years will be followed. The main canal is 1.5 deep and 8 to 10 m wide. The design slope is 0.15%. The design bottom elevation is between 102.41 m and 100.70 m. The design dike top elevation is between 106.60 m and 102.80 m. The design discharge flow is 7.6 m3/s (and the maximum discharge capacity is 20 m3/s). The design water level is between 103.66 m and 101.95 m. The dredging volume is 8800 m3. The interceptor is DN400-500 and approximately 1900 m long.	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, and noise, etc. The odor from dredging and sediment storage; the sediment storage site, transportation routes, and disposal plan; the dredging impact on water quality (temporary: SS); the dust and noise from laying interceptor pipelines.	Permanent land acquisition, demolishing and resettlement; Temporary land occupation. Construction for the pumping station will generate impacts on the Xiyue Street historic cultural street, and on people's travel and traffic. Interceptor pipeline laying might impact on other utility lines.	ECOP of Small Waterworks, ESMP (PCR Management Plan), EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
2.4	Shizigang Drainage Canal Rehabilitation	C-2 Shizigang Drainage Canal Rehabilitation: The length of the rehabilitation works is 3.72 km. The flood control standard for floods with a recurrence period of 20 years will be followed. The main canal is 21 to 32 m wide. The design slope is 0.09% to 1%. The design bottom elevation is between 103.00 m and 98.9 m. The design dike top elevation is between 105.36 m and 105.80 m. The design discharge flow 104.4 m3/s. The design water level is between 105.33 m and 103.89 m. The dredging volume is 3300 m3. The interceptor is DN500-600 and approximately 600 m long.	Construction stage: small hydraulic civil works. The impacts are local, temporary and insignificant. The impacts are from dust, solid waste (borrow and disposal, location of disposal sites), transportation vehicles, soil erosion, and noise, etc. The odor from dredging and sediment storage; the sediment storage site, transportation routes, and disposal plan; the dredging impact on water quality (temporary: SS); the dust and noise from laying interceptor pipelines.	Permanent land acquisition, demolishing and resettlement; Temporary land occupation; Impacts on people's travel and traffic. Reopening of buried ditches will impact on shops revenue; Interceptor pipeline laying might impact on other utility lines.	ECOP of Small Waterworks, ESMP, EIA, RAP, SA

Table 2-2 Project activities and potential environmental and social impacts					
No.	**Project activity**	**Contents**	**Potential environmental impacts**	**Potential social impacts**	**Safeguard tools**
2.5	Improvement of drainage system	C-3 Jiangnan WWTP and associated pipeline networks and road improvement. Construction of 1 No. WWTP (Jiangnan WWTP) with a treatment capacity 15000 m3/day. The main structures include: fine screen, aeration grit chamber (integrated with fine screen), A2/O micro-aeration oxidation ditch, distribution well, sedimentation tank, high-efficiency sedimentation tank, drum filter, buffer tank, gravity condensing tank, sludge storage tank, dewatering room, blower room, contact reactor tank, drainage pumping house, etc. The associated pipeline network includes: 5.384 km new sewage pipeline (including 3.084km long DN500-DN1350 gravity flow pipeline with and 2.3 km long DN 600 pressurized flow pipeline), and 1.165 km long DN500 new pre-buried sewage pipeline. Construction of a new road, namely Binjiangnan Road in a length of 5.56km and the associated facilities for storm water, sewage, power, telecommunication, lighting, landscaping and traffic management, etc.	Construction stage: dust, noise, wastewater, solid waste (road excavation disposal amount and destiny, disposal sites arrangements), and soil erosion. Operation stage: odor in wastewater treatment, WWTP sludge, effluent discharge on He River water quality.	Permanent land acquisition; Temporary land occupation. Impacts on people's travel and traffic.	Road and pipeline network ECOP, ESMP, EIA, RAP, SA
/	/	All of above subprojects: A-1 to A-4; B-1 to B-7; and C-1 to C-3	Water replenishing, river rehabilitation and dredging together generate impacts		

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
			on the hydrology and water quality in He River and urban inland canals, and on the ecological system in He River. Water replenishing and river/lakes connectivity generate impacts on regional water resource utilization. Water replenishing and river/lakes connectivity have positive impacts on water storage, drainage and flood control.		
2.6	Ecological landscaping improvement	D-2 Center axial green corridor development: Rehabilitation of Lining River and Changlong River focuses on greening and afforestation. The deep water and shallow shoals will be utilized closely linked to the theme of riverside waterfront ecology to develop a riverside eco-park to deliver waterfront experience mainly in the form of gentle eco-slope. Within He River channel limited by the boundary of municipal roads and built areas, a waterfront greenbelt comprising of shallow water aquatic plants will be built with a greening area of 6.46 ha, a pavement area of 0.3 ha, a garden path area of 7.4 ha and pavilions and structures with a total area of 600 m^2.	Construction stage: Impacts of temporary land occupation on local ecological environment.	Permanent land acquisition; Temporary land occupation	ESMP, EIA, RAP, SA
3	Institutional Strengthening, Capacity Building and Project Management				

Table 2-2 Project activities and potential environmental and social impacts

No.	Project activity	Contents	Potential environmental impacts	Potential social impacts	Safeguard tools
3.1	hydrological monitoring station	E-1 River governor system + web-based intelligent management and control system: Development of an urban early warning management system, improvement of main watercourse hydrological monitoring stations; development of branch channel hydrological monitoring stations.	As a small water works with relatively short construction period, the impacts will be local, short and minimal.	Permanent land acquisition and temporary land occupation	Small waterworks, ECOP, ESMP, EIA, RAP, SA
3.2	Environment monitoring stations	E-2 He River Watershed water environment monitoring, early warning and integrated management system: Development of automatic water quality monitoring stations for main watercourse and branch channels; construction of Municipal Environmental Monitoring Station as a part of the national standardization project; development of automatic water environment monitoring and early warning platform.	No civil works involved, except equipment procurement. Rehabilitation and upgrading to be conducted on the basis of existing monitoring station and discharge of laboratory wastewater, exhaust gas, waste drugs and agents will be involved in the operation stage..		

*ECOP: Environmental Codes of Practice; ESMP: Environmental and Social Management Plan; EIA: Environmental Impact Assessment; RAP: Resettlement Action Plan; SA: Social Assessment.

**PCRMP: Physical Cultural Resource Management Plan

2.3.2 Scope of assessment

In order to make sure that the assessment is conducted in a more scientific and site-specific way, spatial scope for environmental elements baseline survey, impact prediction and assessment, and accumulative impact assessment are identified for the project implementation and associated facilities, based on the nature of the project, regional environmental characteristics, impact characteristics, World Bank requirements, national technical guidelines, and lessons learned and experience gained from similar domestic projects. They are summarized in Table 2-3.

The scope of assessment for the Project covers not only the scope required by domestic technical guidelines, but also the scope of temporary dewatering sites required for the relevant activities, e.g. dredging, and the associated facilities of the main works, e.g. construction camps, construction access roads, borrow area, disposal site, and Yongfeng Lake, Jintai Lake to be associated after river-lake connection, the linked construction works of Hezhou Municipal WWTP, Hezhou Municipal Solid Waste Landfill, and Hezhou Harmless Sludge Disposal Center, and special sites with social impacts, i.e. the Gui-Guang High Speed Railway, and the irrigation area affected by Fanglin Hydropower Station rehabilitation works.

In terms of timeframe, the scope of prediction and assessment over the various elements covers both the construction stage and operation stage.

Table 2-3 Spatial scope of assessment

Elements	Spatial scope	
	Baseline survey	Impact assessment
Surface water	He River main watercourse: from Huangshi Hydropower Station dam to Xiadao Hydropower Station dam Mawei River: from 500 m upstream of the merging point of East Trunk Canal into He River main watercourse. East Trunk Canal: entire watershed Lining River: entire watershed Changlong River: entire watershed Huangtian Canal: entire watershed East No.5 Branch Canal: from East Trunk Canal to where it merges into He River. Huangansi Drainage Canal: entire watershed Shizigang Canal: entire watershed Associated Jintai Lake and Yongfeng Lake: whole water body.	He River main watercourse: from Huangshi Hydropower Station to 2 km downstream of Mawei River merging point. All tributaries, canals and urban inland canals in baseline survey.

Table 2-3 Spatial scope of assessment

Elements	Spatial scope	
	Baseline survey	Impact assessment
Ambient air	The dredging sections of He River, Huangtian Branch Canal, Guposhan Drainage Canal, Shizigang Drainage Canal, Huangansi Drainage Canal, Proposed Jiangnan WWTP site, road and pipeline sites. Temporary sites including sediment dewatering site, construction camp, access roads, borrow area, disposal site Associated facilities including Hezhou WWTP, Hezhou Landfill, Hezhou Sludge Disposal Center, etc.	Dredging area in He River main watercourse, Huangtian Branch Canal, Guposhan Drainage Canal, Shizigang Drainage Canal, Huangansi Drainage Canal and 50 m within the boundary of sediment dewatering sites. Temporary dewatering site, construction camp, access roads, borrow area, disposal site. Within 100 m the boundary of proposed Jiangnan WWTP. Within 50 m the proposed pipeline boundary. Within 100 m the associated facilities including Hezhou WWTP, Hezhou Landfill, Hezhou Sludge Disposal Center, etc.
Sound environment	Villages, towns, schools and units at project implementation sites.	Within 30 m from construction site boundaries.
Ecological environment	Territorial ecological environment: Within 200 m from the both banks of He Rivers including He River main watercourse, tributaries, canals and urban inland canals; Within 200 m from the alignment of the re-routed rivers including Lining Rive and Changlong River. Within 200 m from the boundary of the WWTP and pipeline works. Aquatic ecological environment: He River main watercourse section in the urban area.	Territorial ecological environment: Within 200 m from the both banks of He Rivers including He River main watercourse, tributaries, canals and urban inland canals; Within 200 m from the boundary of temporary sites including the temporary dewatering site, borrow area, disposal site. Within 200 m from the boundary of other works. Aquatic ecological environment: He River main watercourse section from Huangshi Hydropower Station to 2 km downstream of the Xiadao Hydropower Station.
Social environment	Hezhou Babu District and Pinggui District, in particular, Gui-|Guang High-speed Railway and irrigation areas affected by Fanglin Hydropower Station rehabilitation works	Hezhou Babu District and Pinggui District, in particular, Gui-|Guang High-speed Railway and irrigation areas affected by rehabilitation works of Huangshi Hydropower Station and Fanglin Hydropower Station.

2.3.3 Identification of key targets for environmental protection

According to the domestic laws and regulations for EIA and World Bank Safeguard Policy, the principals for selection of environmental protection targets (sensitive sites) include:

(1) Special protection areas: areas requiring special protection specified in national regulations and planning or approved by people's governments at or above county level, such as drinking water source protection areas, nature reserves, famous scenic spots, ecological function protection areas, basic farmland protection areas, key soil erosion prevention and control areas, forest parks, geological parks, world heritage sites, key cultural resource protection units, etc.;

(2) Ecologically sensitive areas: areas with severe water shortages, habitats for rare animals and plants and aquatic creatures, spawning ground for fishes and shrimps, important wetlands, and natural fishing areas, etc.;

(3) Socially concerned area: population concentration area, cultural and educational area, office building areas for CCP and government agencies, nursing homes, hospitals, etc.;

(4) Physical cultural resources including the existing cultural resources, such as: obvious cultural relics, temples with historical and cultural value, representative local residential houses, ancestral halls, tombs, religious monuments, cultural relics and old trees, etc.

(5) Ethnic groups and involuntary resettlement.

(6) Sensitive objects for which environmental protection measures have difficulty in mitigating impacts based on the above screening principles and taking into consideration of the extent to which sensitive targets may be affected, mainly focusing on schools, hospitals, nursing homes, residents who need special attention.

Environmental protection targets selected based on the above principles and likely to be affected by the Project are summarized in Table 2-4.

Table 2-4 Summaries of key targets for environmental protection

<table>
<tr><th>Project name</th><th>Key environmental protection targets</th></tr>
<tr><td>Improving He River Flood Risk Resilience</td><td>
A. Construction stage
1. Surface water environment quality
<table>
<tr><th>Object</th><th>Target</th></tr>
<tr><td>Water bodies involved</td><td>Water qualities in He River, East Trunk Canal and the Mawei River.</td></tr>
</table>
2. Ecological protection target
<table>
<tr><th>Object</th><th>Target</th></tr>
<tr><td>Famous and ancient trees (not within the project area but close to the construction sites (within 50 m). the temporary borrow or disposal, construction waste storage, construction vehicles or equipment transportation might affect its normal growth.)</td><td>Banyan tree (Xialiangzhai Village, N24.41045°, E111.53795°), Banyan tree(Xialiangzhai Village N24.41004°, E111.53714°), Banyan tree(Xialiangzhai Village N24.40992°, E111.5369°), Banyan tree (Xialiangzhai Village N24.40956°, E111.53646°), Hackberry tree (Jiangbeizhong Road, N24.41264°, E111.54208°), Hackberry tree(Jiangbeizhong Road N24.40426°,E111.55506°,),Banyan tree (Jiangbeizhong Road, N24.40623°, E111.55424°), Camphor tree (Jiangbeizhong Road, N24.40658°, E111.55409°), Canephor tree (Xinan No.2 Alley, N24.41076°, E111.53140°), Camphor tree (Xinan No.2 Alley, N24.41068°, E111.53168°) Camphor tree (Xinan No.2 Alley, N24.41072°, E111.53164°) Banyan tree (Xinan No.2 Alley, N24.41034°, E111.53027°)</td></tr>
</table>
3, Ambient air and noise protection targets
<table>
<tr><th>Subproject name</th><th>Name of sensitive site</th><th>Nature</th><th>Location</th><th>Distance (m)</th><th>Basic information</th><th>Impact factors</th></tr>
<tr><td rowspan="7">A-1 He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge)</td><td>Shangsong Village</td><td>Residential</td><td>Left bank</td><td>3~30</td><td>55 families</td><td>Noise, dust</td></tr>
<tr><td>Shangsong Village</td><td>Residential</td><td>Right bank</td><td>3~25</td><td>12 families</td><td>Noise, dust</td></tr>
<tr><td>Xiwan Township temporary housing area</td><td>Residential</td><td>Left bank</td><td>2~20</td><td>52 families</td><td>Noise, dust</td></tr>
<tr><td>Xiwan Township residents</td><td>Residential</td><td>Left bank</td><td>2~20</td><td>38 families</td><td>Noise, dust</td></tr>
<tr><td>Pinggui District Government</td><td>Office</td><td>Left bank</td><td>6</td><td>Affecting 50 people’s office work</td><td>Noise, dust</td></tr>
<tr><td>Xiwanzhai Village</td><td>Residential</td><td>Right bank</td><td>3~25</td><td>68 families</td><td>Noise, dust</td></tr>
<tr><td>Residents near He River in Jinshuiwan Community</td><td>Residential</td><td>Left bank</td><td>9~16</td><td>Estimated 10 families moved in</td><td>Noise, dust</td></tr>
</table>
</td></tr>
</table>

Table 2-4 Summaries of key targets for environmental protection

Project name	Key environmental protection targets						
		(not moved in yet)					
		Jigongzhou	Residential	Left bank	5~30	9 families	Noise, dust
		Songmuji in Gonghe Village	Residential	Left bank	10~30	7 families	Noise, dust
		Gongqiaotou	Residential	Right bank	5~30	13 families	Noise, dust
		Longjiangdu	Residential	Right bank	13~30	3 families	Noise, dust
		Hezhou Institute	Education	Left bank	3~25	500 people	Noise, dust
		Sanjia Village	Residential	Left bank	2~25	13 families	Noise, dust
		Fanglin Street	Residential	Right bank	8~30	13 families	Noise, dust
		Hezhou Experimental Middle School	Education	Right bank	6~15	436 people (1 staff dormitory building and 1 student dormitory building)	Noise, dust
		Fanglin Village	Residential	Right bank	2~30	21 families	Noise, dust
		Laozengwu	Residential	Right bank	3~30	28 families	Noise, dust
		Residential building near He River in Wenyuanhuadu Community	Residential	Left bank	30	30 families (2 buildings)	Noise, dust
	A-2 He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge)	Residential houses in Xinan No.2 Alley in Babu District	Residential	Left bank	2~30	30 families	Noise, dust
		Residential houses in Xiyue Street	Residential	Left bank	2~10	69 families	Noise, dust
		Xialiang Village	Residential	Right bank	2~25	158 families	Noise, dust
	A-3 He River Integrated Rehabilitation	Diandengzhai Village	Residential	Right bank	3~30	52 families	Noise, dust
		Chushuitang Village	Residential	Right bank	3~20	8 families	Noise, dust
		Xiadao Elementary School	Education	Right bank	0	Approximately 200	Noise, dust

Table 2-4 Summaries of key targets for environmental protection

<table>
<tr><th>Project name</th><th>Key environmental protection targets</th></tr>
<tr><td></td><td>
<table>
<tr><td rowspan="3">(Lingfeng Bridge – Xiadao Hydropower Station)</td><td></td><td></td><td></td><td></td><td>people</td><td></td></tr>
<tr><td>Xiadaozhai Village</td><td>Residential</td><td>Right bank</td><td>50</td><td>17 families</td><td>Noise, dust</td></tr>
<tr><td>Jichitan Village</td><td>Residential</td><td>Left bank</td><td>2~30</td><td>20 families</td><td>Noise, dust</td></tr>
<tr><td>A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection</td><td>Xianghuadao Island</td><td>Residential</td><td>Right bank</td><td>13~26</td><td>8 families</td><td>Noise, dust</td></tr>
<tr><td>A-5 Xiadao Hydropower Station Integrated Rehabilitation</td><td>Jichitan Village</td><td>Residential</td><td>To the north of Xiadao Hydropower Station</td><td>10~15</td><td>2 families</td><td>Noise, dust</td></tr>
</table>
4, Social impact protection target
<table>
<tr><th>Subproject name</th><th>Object</th><th>Target</th></tr>
<tr><td>A-2 He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge)</td><td>Physical cultural resource</td><td>Historic site for CCP Babu Special Branch</td></tr>
<tr><td>A-6 Fanglin Hydropower Station Integrated Rehabilitation</td><td>Irrigation area</td><td>On the right bank side of Fanglin Hydropower Station, approximately 400 mu in Tianchang Village, 200 mu in Mintian Village and 1000 mu in Fanglin Village.</td></tr>
</table>
</td></tr>
<tr><td>Improving Urban Drainage and Wastewater Management</td><td>
A. Construction stage
1, Surface water environment quality
<table>
<tr><th>Object</th><th>Target</th></tr>
<tr><td>Water bodies involved</td><td>Water qualities in Huangansi Drainage Canal, Shizigang Drainage Canal, the Lining River, Changlong River, the Huangtian Branch Canal, and He River.</td></tr>
</table>
2, Ecological protection target
<table>
<tr><th>Subproject Name</th><th>Object</th><th>Target</th></tr>
</table>
</td></tr>
</table>

Table 2-4 Summaries of key targets for environmental protection

Project name	Key environmental protection targets						
	C-1 Huangansi Drainage Canal Rehabilitation	Famous and ancient trees (not within the project area but close to the construction sites (within 50 m). the temporary borrow or disposal, construction waste storage, construction vehicles or equipment transportation might affect its normal growth.)	Camphor tree (Jianshezhong Road, N24.41611°, E111.53616°), Camphor tree (Xinan No.1 Alley, N24.41330°, E111.535°) Camphor tree (Xiyue Street, N24.41255°, E111.53447°)				
	3, Ambient air and noise protection targets						
	Subproject name	Name of sensitive site	Nature	Location	Distance (m)	Basic information	Impact factors
	B-1 Huangansi Drainage Canal Pump Station	Residential houses in Xiyue Street	Residential	North of pumping station	2~20	20 families	Noise, dust
	B-2 Shizigang Drainage Canal Pump Station	Residential houses in Jiangbeizhong Road, Dormitory building for Transportation Bureau	Residential	North of pumping station	0~30	25 families	Noise, dust
	B-3 Lining River Rehabilitation	Pingjing	Residential	Starting point of the canal	10~30	8 families	Noise, dust
		Lijiatang	Residential	Left bank	5~30	4 families	Noise, dust
		Lining Village	Residential	Right bank	3~30	12 families	Noise, dust
		Daninggang Village	Residential	Left bank	6~30	20 families	Noise, dust
		Xiangjiayuan Community	Residential	Pass by	2~30	15 families	Noise, dust
		Taipingzhai Village	Residential	Right bank	10~30	6 families	Noise, dust
		Yingshi Elementary School	Education	Pass by	0	300 人	Noise, dust
	B-4 Changlong River Rehabilitation	Changlong Village	Residential	Both sides	3~30	58 families	Noise, dust
		Huangtian Township	Residential	Both sides	0~30	152 families	Noise, dust
		Douxing	Residential	Left bank	5~30	12 families	Noise, dust
		Yatanggang Village	Residential	Left bank	0~30	8 families	Noise, dust
	B-5 Huangtian Branch Canal	Huangtian Township	Residential	Right bank	0~30	87 families	Noise, dust
		Pinggui No.3 Middle	Education	Left bank	0~30	Approximately 120	Noise, dust

Table 2-4 Summaries of key targets for environmental protection

Project name	Key environmental protection targets						
	Rehabilitation	School				people	
	B-6 Guposhan Drainage Canal Rehabilitation	Xinzhai Village	Residential	Left bank	5~30	13 families	Noise, dust
		Huangtian Village	Residential	Both sides	0~30	68 families	Noise, dust
		Muyuanna Village	Residential	Both sides	0~30	46 families	Noise, dust
		Baijiazhai Village	Residential	Both sides	0~30	71 families	Noise, dust
		Shizigang Village	Residential	Right bank	0~20	52 families	Noise, dust
	B-7 East No. 5 Branch Canal Rehabilitation	Tianchongzhai Village	Residential	Both sides	0~30	26 families	Noise, dust
		Tangpingzhai Village	Residential	Both sides	0~30	18 families	Noise, dust
		Xiwan Village	Residential	Both sides	0~30	77 families	Noise, dust
		Xiwan Township	Residential	Both sides	0~30	165 families	Noise, dust
	C-1 Huangansi Drainage Canal Rehabilitation	Residential houses in Badaxi Road	Residential	Both sides	0~30	56 families	Noise, odor
		Residential houses in Qianjin Road	Residential	Both sides	0~30	30 families	Noise, odor
		Residential houses in Jianshezhong Road	Residential	Both sides	0~30	32 families	Noise, odor
		Residential houses in Youxing Alley	Residential	Both sides	0~30	82 families	Noise, odor
		Residential houses in Xiyue Street	Residential	Both sides	0~30	20 families	Noise, odor
	C-2 Shizigang Drainage Canal Rehabilitation	Residential houses in Wanquan Street	Residential	Both sides	0~30	240 families	Noise, odor
		Residential houses in Zhushan Road	Residential	Both sides	0~30	43 families	Noise, odor
		Residential houses in Longxing Alley	Residential	Both sides	0~30	46 families	Noise, odor
		Residential houses in Yinhe Street	Residential	Both side (reopening of 350 m buried ditches)	0~30	104 families	Noise, odor
		Backyard of Municipal Land	Office	Pass by, (reopening of 100 m buried	0	150 people's offices	Noise, odor

Table 2-4 Summaries of key targets for environmental protection

Project name	Key environmental protection targets						
		Resource Bureau		ditches)			
		Office building and dormitory building for Guidong Electricity Company	Office/residential	Pass by, (reopening of 150 m buried ditches)	0	200 people's offices and dormitories	Noise, odor
		Residential houses in Wangjia Alley	Residential	Both sides	0~30	30 families	Noise, odor
		Residential houses in Jianshe Road	Residential	Left bank	0~30	65 families	Noise, odor
		Residential houses in Longshan Road	Residential	Both sides	0~30	50 families	Noise, odor
		Residential houses in Xingguang Road	Residential	Both sides	0~30	190 families	Noise, odor
		Shops and pool in Municipal Water Resource Bureau	Office	Both sides	0	60 people	Noise, odor
		Residential houses in Pinganxi Road	Residential	Both sides	0~30	20 families	Noise, odor
		Office building for municipal hygiene and planning committee	Office	Both sides	0	100 people's offices	Noise, odor
		Office building, backyard and dormitory building for Babu District Transportation Bureau	Office/residential	Pass by	0	80 people's offices, 14 families	Noise, odor, traffic
		Residential houses in Jiangbeizhong Road	Residential	Both sides	0~30	15 families	Noise, odor
	C-3 Jiangnan WWTP and	Residential houses in Niulanpai	Residential	Both sides	0~30	20 families	Noise, dust

Table 2-4 Summaries of key targets for environmental protection

<table>
<tr><th>Project name</th><th>Key environmental protection targets</th></tr>
<tr><td></td><td>
<table>
<tr><td>associated pipeline networks</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
4, Social impact protection target
<table>
<tr><th>Subproject name</th><th>Object</th><th>Target</th></tr>
<tr><td>C-1 Huangansi Drainage Canal Rehabilitation, B-1 Huangansi Drainage Canal Rehabilitation</td><td>Physical cultural resource</td><td>The protected buildings in Xiyue Street historic cultural street, including the old dike, the Yijing Bridge, the Stone Wall, the Tianyi Cigarettes Shop, the Qianji Convoy Store, the Jiancheng Rice Store, etc., are not in the project area, but they might be affected during the construction stages.
The ancient dike, ferry and city walls are in the project area.</td></tr>
<tr><td>A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection, B-3 Lining River Rehabilitation</td><td>Railway facility</td><td>The intersection between East No.5 Branch Canal and Gui-Guang High Speed Railway (DW0 + 628 to DW0 + 655)
The intersection between Lining River and Hezhou Railway Station (LN1 + 025 to LN1 + 147.5)</td></tr>
</table>
B. Operation stage
Noise protection targets
<table>
<tr><th>Subproject name</th><th>Sensitive site name</th><th>Location</th><th>Distance (m)</th><th>Nos. of families</th></tr>
<tr><td>B-1 Huangansi Drainage Canal Pump Station</td><td>Residential houses in Xiyue Street</td><td>North of the pumping station</td><td>10m</td><td>27</td></tr>
<tr><td>B-2 Shizigang Drainage Canal Pump Station</td><td>Residential houses in Jiangbeizhong Road</td><td>North of the pumping station</td><td>20m</td><td>8</td></tr>
</table>
</td></tr>
<tr><td>Institutional Strengthening, Capacity Building and Project Management</td><td>No specific protection targets because the amount of works is small and the impacts are insignificant.</td></tr>
</table>

2.4 Planning compliance analysis

2.4.1 Compliance with the Hezhou Municipality Master Urban Plan

The Hezhou Municipality Master Urban Plan (2016-2030) stipulated the nature, the development objectives, the scale of the city, and formulated relevant policies for regional cooperation, economic transformation, social harmony and ecological protection, identified the layout of spatial and structural development, and planned the supporting system for the center urban area. The details of the planning and the compliance of the Project with the plan are summarized in Table 2-5.

Table 2-5: Compliance of the Project with the Hezhou Municipality Master Urban Plan (2016-2030)

Item	Planning	This project	Compliance analysis
Nature	The nature of the city is identified as: a world famous city with long life expectation, a new industry, tourism, and leisure city on the Gui-Guang High Speed Railway, and the important portal of Guangxi to the eastern and central regions, a livable modern city with good ecological system and style.	The project objective is to improve the flood management, reduce wastewater pollution and enhance water resource management planning in Hezhou.	The implementation of the Project is important in realizing the identified nature of the city.
Development direction	Using He River and the existing State Road 207 as axis, the city will focus expansion towards northwest and across He River to the south bank, and also moderately towards the east.	The project area are mainly He River main watercourse in the urban area, and the urban inland canals and lakes.	The implementation of the Project can help the city develop in its direction
Spatial structure	To build a "one main center, four sub-centers, two axis, and three regions" in terms of spatial layout of the municipality. One main center: the Hezhou city. Four sub-centers: Zhongshan, Xindu, Fuchuan and Zhaoping cities. Two axis: the main axis and secondary axis for urban development. Three regions: the central core development region, the western ecological conservation region, and the eastern region for the Guangdong and Guangxi Cooperation Area.	This project can help develop a "green circle and green corridor" spatial structure in Hezhou through the rehabilitation of the water way system.	The implementation of the Project is in line with the spatial layout of the city.
Wastewater management system	The central urban area is divided into 7 catchments for sewage collection. 7 WWTPs are planned, including the Hezhou WWTP (existing to be upgraded), Shatian WWTP, Jiangnan WWTP, Hejie WWTP, Xiwan WWTP, and Wanggao Industrial	The project will develop the Jiangnan WWTP and its associated storm water and sewage main to ensure effective collection and treatment in the catchment in the future.	The implementation of the Project can improve the storm water and sewage management, and help improve the

Table 2-5: Compliance of the Project with the Hezhou Municipality Master Urban Plan (2016-2030)

Item	Planning	This project	Compliance analysis
	Park WWTP.		regional water environment.
Center urban area landscaping plan	Spatial layout with one belt, four axis, nine areas and multiple corridors. One belt: a water front landscape belt with integrated “water and green” along the “mother river” of Hezhou – He River. Four axis: including the Ailian Lake Ecological Green Axis, the Jichitan Ecological Green Axis, the Huangansi Ecological Green Axis and He Riverside Ecological Green Axis. Nine areas: including the High Speed Railway Commercial Area, the Cultural and Art Area, the Administration and Finance Area, the Gardening Green City Area, the Ecological Industrial Area, the Ethnic Tribal Custom Area, the Ancient Hezhou City Area, the Low-carbon Industrial Area and the Leisure Tourism and Residential Area. Multiple corridor: there are many riverside landscaping corridors and roadside landscaping corridors in the downtown area.	By widening and dredging in He River main watercourse, and branch channels (Lining River and Changlong River), Huangtian Branch Canal, Guposhan Drainage Canal, East No.5 Branch Canal, Huangansi Drainage Canal and Shizigang Drainage Canal, increase their flood carrying cross-sectional area. By diverting, regulating, pumping and draining, reduce the water levels. The project will develop 6.5 ha greening area along the central main green corridor to develop an ecological green corridor.	The project is in line with the Hezhou Water Way System Plan.

2.4.2 Compliance analysis with Hezhou Municipality Urban Flood Control Plan

The urban flood control plan is a special plan under the city master plan. It aims at solving the problem that the city has barely any flood control facility and has been suffering from flooding problems for long time, and at preparing the urban flood safety system, so that it can support the urban development in Hezhou. Its scope covers the area from the Liantang Township in the east, and to the Xiwan Street in the west, from the Etang Town in the south and to the Luoyang-to-Zhanjiang Railway in the north. The planed timeframe is to short term to 2020 and long term to 2030. The details of the plan the compliance analysis with the project are summarized in Table 2-6.

Table 2-6: Analysis of Compliance of the Project with Hezhou Municipality Urban Flood Control Plan (2015-2030)

Item	Planning	This project	Compliance analysis
Overall layout	Based on the layout of He River and its tributary, and on the existing city layout and its expansion direction, the Plan proposed a flood control system that consists of three districts and seven sub-districts, including the Xiwan sub-districts and Pinggui sub-districts under the Pinggui District; the Shatian sub-districts, Jiangbei sub-districts, Jiangnan sub-districts, Liantang sub-districts under the Hezhou Core Urban District, and the Hejie sub-districts in Hejia Township. For each sub-district, the flood control standard is different based on its significance. The urban area along He River main watercourse will use once every 50 years reoccurrence frequency after regulation from upstream reservoir. For the urban area along the tributary without upstream reservoir regulation, the standards of once every 20 – 50 years reoccurrence frequency will be used. In each sub-district, flood control dike will be built along He River and its tributaries including Xiwan River, Pangu River, Huashan River and Mawei River. Flood control gate and pumping stations will be built at the merging site of each outlet of drainage ditch and He Rivers.	The flood control standard for He River under the Project is floods with a recurrence period of 50 years.	The project is in line with Hezhou Municipality Urban Flood Control Plan (2015-2030)
Planned flood control facility	Short term (2020): the planed facilities include : Pinggui New District Dike (He River), Huangtian Dike, Jiangnan Dike (Jiangnan He River Dike - south bank, Pangu River dike – both sides, Huashan River dike – left bank dike and right bank embankment), Hejiedong Dike (town area), Hejiexi Dike (town area). The total dike length is 26.33 km and total	In the A-1 He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge) subproject, the length for rehabilitation is 12.569 km. The project widens the watercourse to break the bottleneck	The implementation of the Project will be supplementary for the existing flood control facilities.

Table 2-6: Analysis of Compliance of the Project with Hezhou Municipality Urban Flood Control Plan (2015-2030)

Item	Planning	This project	Compliance analysis
	embankment length is 30.272 km. Long term (2020-2030), the planned facilities include: Shatian Embankment, Hezhou Institute Dike, Fanglin Senior High School Dike, Liantangdong Dike, Liantangxi Dike, Hejiedong Dike, Hejiexi Dike. The total dike length is 24.766 km and total embankment length is 30.935 km.	sections (control width between dikes is 120 m). The dike elevation is between 112.07 m and 112.52 m at stake number 17+200-19+500 at Pinggui New Area, sufficient to meet the flood control requirement, therefore the dike at this section will remain intact. In the A-2 He River Integrated Rehabilitation (Guangming Bridge --- Lingfeng Bridge) subproject, the length for rehabilitation is 2.1 km. The project widens the watercourse to break the bottleneck sections (control width between dikes is 120 m). The dike on the north bank from Babu Bridge to Lingfeng Bridge is already in place. Therefore this subproject will focus on the right bank to widen the channel and develop new dike. In the A-3 He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower Station) subproject, the length for rehabilitation is 6.9 km. He River alignment will remain unchanged. The project widens the watercourse to break the bottleneck sections (control width between dikes is 120 m). The left bank is the Jiangbei Dike in place. The right bank from Lingfeng Bridge to Huashan River is under construction. The subproject will focus on the widening of the 3 km	

Table 2-6: Analysis of Compliance of the Project with Hezhou Municipality Urban Flood Control Plan (2015-2030)

Item	Planning	This project	Compliance analysis
		section from Huashan River entry point to Xiadao Hydropower Station dam, and building the new dike for this section.	
Planed drainage facility	(1) Short term In short term there will be 14 drainage pumping station (total installed capacity 6585 kw and total flow 121.06 m3/s) and 17 drainage gates (total flow 293.09 m3/s) and 2 connecting pipeline. a. Pinggui Management District According to the layout and topography of Xiwan River Xiwan Group Tea Farm, and the Xiwan Bridge right bank renovation project (Xiwanxi Dike) in Pinggui Management District, one flood control gate will be established for each of the three drainage catchments including the Pinggui Senior High School catchment, Pinggui Coal Mine Catchment, and the Xiamaling Catchment. A pumping station will also be established for the Pinggui Senior High School catchment. b. Core Urban Area District For the Jiangbei sub-district, 4 drainage gates will be established for Liwu, Lianhualing, Pingdizhai and Tianchong, respectively, and 2 pumping stations will also be installed; 3 drainage gates and 3 pumping stations will be established at the end of the Huangansi, Shizigang and Taoyuan drainage canals, respectively. 5 drainage gates and 5 pumping stations will be established at the catchments of Xuewu of Jiangnan dike, Babu Bridge, Chengnan, Pangu River and Huashan River, respectively.	By widening and dredging in He River main watercourse, and branch channels (Lining River and Changlong River), Huangtian Branch Canal, Guposhan Drainage Canal, East No.5 Branch Canal, Huangansi Drainage Canal and Shizigang Drainage Canal, the project will increase their flood carrying cross-sectional areas. In addition, by diverting, regulating, pumping and draining, the project will help reduce the water levels. The project will also install 2 drainage pumping station at catchment area near end of the Huangansi and Shizigang Drainage Canals so that floods with high water level will be drained by gravity while floods with low water level will be drained by pumping.	This project is an important part of the planned flood control facilities in the special plan.

Table 2-6: Analysis of Compliance of the Project with Hezhou Municipality Urban Flood Control Plan (2015-2030)

Item	Planning	This project	Compliance analysis
	c. Hejie Town District For Hejie Town District, the short term works are focused on flood control on the left bank of He River and the right bank of Daning River to protect the town area. based on the topographic condition, the area is divided into 4 catchments, namely the Caijiacun Village, the Hejie Town, the Shenshuiping and the Chenjia Village. 4 drainage water gates will be established for the 4 catchment respectively. 3 pumping stations will be installed for the Caijiacun Village, the Hejie Town, the Shenshuiping catchments respectively. (2) Long term In long term there will be development of 5 drainage pumping station (total installed capacity 4585 kw and total flow 64.31 m3/s) and 19 drainage gates (total flow 315.45 m3/s), and 8 connecting pipeline, rehabilitation of 2 drainage canals, and expansion of 3 flood diversion canals. a. Core Urban Area District Jiangbei sub-district: expand 3 flood diversion canal (Zhutudun, Xintang and Chongtang) to discharge the storm water of maximum 24-hour storm of once every 20 years reoccurrence frequency. In the city, develop Yongfeng Lake to regulate the flood in Huangansi Catchment; plan the Taibai Lake to regulate the flood in Nanshetang Catchment. Rehabilitate the Huangansi and Shizigang Drainage Canals, and conduct dredging and channelizing for the canals. Jiangnan sub-district: Conduct dredging and channelizing for the canals by rehabilitating the Xuewu Drainage Canal. The drainage canal can be divided into two sections separated at		

Table 2-6: Analysis of Compliance of the Project with Hezhou Municipality Urban Flood Control Plan (2015-2030)

Item	Planning	This project	Compliance analysis
	Nanhuan Road. The first section is 0.89 km from Fanglin Village Yutian Group to the Nanhuan Road culvert. The second section is 1.129 km from the Nanhuan Road culvert to He River while passing by the Zeng's ancestral hall and the Xuewu at Fanglin Village. The flow carrying capacity is 12.1 m3/s. In the long term the catchment in the area is the Fanglin catchment. At Fanglin Senior High School, one drainage gate and one pumping house will be installed. b. Hejie Town District For Hejie town district, the long term plan is to develop flood control dikes on both sides of He River to protect the town. Based on the topographic condition, there will be 6 catchment areas, namely the Litangping, Lijiazhai, Niuzailing, Nanchong, Zhouwuzhai and Longjiazhai catchments. For these catchments, 6 drainage gates will be installed respectively.		

3. Due Diligence of Linked Projects

3.1 Linked Project Screening

According to the project appraisal, the World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project (hereinafter referred to as “The Project”) mainly have the following linked projects: Guangxi Main Tributary He River Integrated Rehabilitation, Hezhou Jintai Lake Integrated Water Environment Improvement, Hegang Yongfeng Lake Integrated Water Environment Improvement, Hezhou WWTP, Hezhou Sludge Harmless Disposal, Hezhou Solid Waste Landfill, etc. as detailed in Table 3.3-1.

Table 3-1 Linked Projects Screening Results

Sub-project		Linkage with the Project
Main watercourse Widening for Flood Control	A-1 He River Integrated Rehabilitation (Huangshi Hydropower Station – Guangming Bridge)	Hezhou Urban Flood Control under Guangxi Main Tributary He River Integrated Rehabilitation Project (Pingguixincheng Dike: Existing river dike will be kept as it is in the linked project; under the Project, connection dikes will be constructed where there is no river dike.) Huangtian Dike: Existing river dike will be kept as it is in the linked project. Under the Project, connection dikes will be constructed where there is no river dike.)
	A-2 He River Integrated Rehabilitation (Guangming Bridge – Lingfeng Bridge)	Hezhou Urban Flood Control under Guangxi Main Tributary He River Integrated Rehabilitation Project (Jiangbei Dike: the north dike from Guangming Bridge to Lingfeng Bridge is Jiangbei Dike which was already built. Under the Project, dike height will be increased and bank road will be widened to the south dike, and a new flood dike will be constructed)
	A-3 He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower Station)	Hezhou Urban Flood Control under Guangxi Main Tributary He River Integrated Rehabilitation Project(Jiangbei Dike: dike height will be increased on existing Jiangbei Dike. Jiangnan Dike: under construction and to be connected with the Project at the upstream and downstream sections).
	A4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection	Hezhou Municipality Solid Waste Landfill: to receive dewatered sludge cake from river dredging under the Project.
Dredging	A-8 He River (Huangshi Hydropower Station – Guangming Bridge) Dredging	Guangxi Main Tributary He River Integrated Rehabilitation Project Hezhou Urban Area Flood Control: within the same river reach, dredging will occur in He River course and not affect existing river dike. Hezhou Municipality Solid Waste Landfill: to receive dewatered sludge cake from river dredging under the Project.
River-lake connection	B-3 Lining River Rehabilitation	Hezhou Municipality Jintai Lake Integrated Water Environment Improvement project: Lining River and Changlong River are located upstream of Jintai Lake, which serves as the hub of river-lake connection and the function of flood control and storage regulation.
	B-4 Changlong River Rehabilitation	
	B-5 Huangtian Canal Rehabilitation	Hezhou Municipality Yongfeng Lake Integrated Water Environment Improvement Project: Huangtian Branch Canal is upstream of Yongfeng Lake, which serves as the hub of river-lake connection and the function of flood control and storage regulation. Hezhou Municipality WWTP: to receive and treat sewage collected by interceptor sewer pipe network Hezhou Municipality Solid Waste Landfill: to receive dewatered sludge cake from river dredging in the Project.
	B-6 Guposhan Drainage Canal Rehabilitation	Hezhou Municipality Yongfeng Lake Integrated Water Environment Improvement project: Guposhan Drainage Canal is upstream of Yongfeng Lake, which serves as the hub of river-lake connection and the function of flood control and storage regulation. Hezhou Municipality WWTP: to receive and treat sewage collected by interceptor sewer pipe network Hezhou Municipality Solid Waste Landfill: to receive dewatered sludge cake from river dredging in the Project.

Table 3-1 Linked Projects Screening Results

Sub-project		Linkage with the Project
Huangansi Drainage Canal Rehabilitation	C-1 Huangansi Drainage Canal Rehabilitation	Hezhou Municipality Yongfeng Lake Integrated Water Environment Improvement project: Huangansi River is downstream of Yongfeng Lake, which serves as the hub of river-lake connection and the function of flood control and storage regulation. Hezhou Municipality WWTP: to receive and treat sewage collected by interceptor sewer pipe network; Hezhou Municipality Solid Waste Landfill: to receive dewatered sludge cake from river dredging in the Project.
Shizigang Drainage Canal Rehabilitation	C-2 Shizigang Drainage Canal Rehabilitation	
Drainage System Improvement	C-3 Jiangnan WWTP and Associated Sewer Network and Road Improvement	Hezhou Sludge Harmless Disposal: to receive sludge from Jiangnan WWTP.

Figure 3-1 Project and Linked Projects Layout Map

Figure 3-1: Project and Linked Projects Layout Map

3.2 Due Diligence

3.2.1 Guangxi Main Tributary He River Integrated Rehabilitation Project

Subproject A-1, A-2 and A-3 under the Main Watercourse Widening of the Project are linked to Hezhou Urban Flood Control under Guangxi Main Tributary He River Integrated Rehabilitation Project. Here described as follows is the due diligence for Hezhou Urban Flood Control under Guangxi Main Tributary He River Integrated

Rehabilitation Project.

1. **Contents and scope of Guangxi Main Tributary He River Integrated Rehabilitation Project**

Pinggui New City Dike: Located on the right dike of He River reach within Pinggui Administration District, Pinggui New City Dike starts at the end point of Pinggui New City river dike Fujiang section (STA. PG1+080.00), with Shanzhou Head and Xiwan village along its route, and ends at Shiniudu at the lower reaches of Xiiwan village with a total length of 1.07km. The flood control dike is designed against the Dike-Park-Road model: planned municipal road + dike width 6m + bank revetment.

Huangtian Dike: Located at left bank of He River reach within Pinggui Administration District, Huangtian Dike starts at Jigongtou Mountain in Pinggui Administration District and ends at 400m close section downstream of Dongmu Park with a total length of 3.066km.The whole dike is earth dike. The design water level is 111.24~110.27m and 15 wharfs are included in the design.

Jiangbei Dike Flood Control Improvement River Dike: Jiangbei Dike starts at He River Bridge and ends at Wayaotou, comprising of Jiangbei West Dike, Jiangbei Middle Dike and Jiangbei East Dike. The total length of dike is 6.127km and the dike is a mixture of earth dike / earth and rock mixed dike / masonry dike / concrete mixture dike with a design water level of 108.78~ 104.60m and include 29 wharfs.

Jiangnan Dike Flood Control Improvement River Dike: Jiangnan Dike comprises of Jiangnan Dike of He River section, Pangu River left and right dike sub-dike and Huashan River left sub-dike. Jiangnan Dike of He River section starts at Xihuan Road connecting He River Bridge, runs along Pangu River Estuary and ends at Huashan River Estuary. The dike has a total length of 4.524 km with a design water level of 108.78~104.25m and there are 20 wharfs included.

2. **Approval of Environmental Protection**

Hezhou Municipality EPB issued approval for *Guangxi Main Tributary He River Integrated Rehabilitation Project EIA Report* on January 8th, 2016.

3. **Status of Project Construction**

Currently, construction has been completed for Pinggui New City Dike, Huangtian Dike and Jiangbei Dike in Guangxi Main Tributary He River Integrated Rehabilitation Project Hezhou Municipality Urban Flood Control Project, Jiangnan Dike has not been completed construction, which is planned to be completed in 2018.

3.2.2 Hezhou Jintai Lake Integrated Water Environment Improvement project

B-3 and B-4 as a part of He River-lake connection Works under the Project will be connected with Jintai Lake. Here described as follows is the due diligence work for Hezhou Jintai Lake Integrated Water Environment Improvement Project:

1. Scale and Scope of Construction

Jintai Lake of Hezhou Municipality is located south of Zhanqian Avenue, east to Aimin Road, north to Wanxing Road and west to Xiangda No.1 Road of Hezhou Municipality. The construction scope includes: 1 proposed Jintai Lake, 2.379km of Jintai Lake revetment, 1.845km of Yucai River improvement (the downstream of Jintai Lake connects to existing Guangming Drainage Canal through Yucai River), 3.69km of proposed Yucai River revetment, 1 proposed Hydraulic Lift Dam at Yucai River, associated works including artificial island and municipal landscaping facilities.

2. Approval of Environmental Protection

Hezhou Municipality EPB issued approval for the EIA of Inter-provincial He River Watershed (Xiwan to Xiadao river reach) Jintai Lake Integrated Water Environment Improvement Project EIA on November 8th, 2016.

3. Status of Construction

The project is not yet constructed and is estimated to be completed in September, 2019.

3.2.3 Hezhou Municipality Yongfeng Lake Integrated Water Environment Improvement Project

B-5, B-6 and C-1 as a part of He River-lake connection Works under the Project will be connected with Yongfeng Lake. Here described as follows is the due diligence work for Hezhou Yongfeng Lake Integrated Water Environment Improvement Project.

1. Scope and Scale of Construction

Location: an area south to Heping Road, east to Aimin Road in Hezhou Municipality, along Xinhua Road to Yucai Road intersection, and west to Zhushan Road to Guposhan Avenue.

Construction scope and scale: 1 new Yongfeng Lake, 6.60km of ecological revetment of Yongfeng Lake, 1.30km of Aimin River Improvement (upstream of Yongfeng Lake connects to Jintai Lake through Yucai River and Aimin River), 2.60km of Aimin River ecological revetment, 1 hydraulic lift dam each on Aimin River, Huangansi River and Shizigang River, 30m of proposed Guangming Avenue bridge, proposed associated artificial island and municipal landscaping facilities.

2. Approval of Environmental Protection

Hezhou Municipality EPB issued approval for the EIA of Inter-provincial He River Watershed (Xiwan to Xiadao river reach) Jintai Lake Integrated Water Environment Improvement Project EIA on November 8th, 2016.

3. Status of Construction

The project is not yet constructed and is estimated to be completed in September, 2019.

3.2.4 Hezhou Municipal WWTP

Sewage discharge from B-5 Huangtian Canal Rehabilitation Project, B-6 Guposhan Drainage Canal Rehabilitation Project, C1 Huangansi Drainage Canal Rehabilitation and C2 Shizigang Drainage Canal Rehabilitation is conveyed to Hezhou Municipality WWTP. Here described as follows is the due diligence study for Hezhou Municipality WWTP:

1. Hezhou Municipality WWTP Construction Scope and Scale

Hezhou Municipality WWTP is located at the north dike of He River Wayaotou in Lingfeng Village, Babu Township, Hegang City (originally the Red Brick Factory in Hezhou Municipality). The plant occupies an area of 55,274.29 m^2. It was constructed in 2 phases. Phase I of the WWTP involves a land occupation of 46,236.69 m^2 and a design capacity of 30,000 t/d and provides service to the planned Jiangbei District of Hezhou Municipality as the service area of approximately 15~17 km^2 and a population of 175,000, mainly designed for treatment of domestic wastewater from urban area.

Phase II of the WWTP project is located at the west side of Phase I and has a design capacity of 30,000 m^3/d. Service area: expanded to receive wastewater from Babu Center Group, Taibai Lake District and Rufengzhai Industrial Park.

2. Approval of Environmental Protection

GZAR EPB issued the approval for *Hezhou Municipality WWTP EIA Table* on December 10th, 2007. GZAR Environmental Protection Department issued approval for *Hezhou Municipality WWTP Project Completion Environmental Protection Acceptance Monitoring Report Table* in June 2010. Hezhou Municipality EPB issued approval for *Hezhou Municipality WWTP Expansion Project EIA Table* (Phase II project) on July 25th, 2016.

3. Status of Construction and Operation

Hezhou Municipality WWTP Phase I was put into trial operation in 2008 and official operation in December 2010. Phase II of the WWTP commenced in August, 2016 and is scheduled to complete and put into operation in October 2017.

Status of construction for sewer pipe networks: Jiangbeizhong Road Branch Sewer Rehabilitation Project was completed at the end of 2013 and connected with 7 sewer outfalls; construction for interceptor trunk sewer from Babu Bridge to Wanxing Road intersection was completed in December 2015; currently the sewer pipe networks in urban area is continuously being improved.

4. Treatment Processes

Hezhou Municipality WWTP Phase I uses A2/O oxidation ditch as treatment process. After secondary treatment, wastewater is disinfected using UV light to meet *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* Class IA Standard and then the effluent is discharged into He River through 600 m discharge pipe. Sludge is dewatered and condensed and no sludge nitration tank is being used. The volume of sludge after dewatering is 16.8t/d. After dewatering (water content 80%), sludge cake is transported to Guangxi Hezhou Sludge Harmless Disposal Plant for treatment. After such treatment, sludge achieves a moisture content of 60% and then transported to Hezhou Municipality Solid Waste Landfill for landfill.

Detailed in the following table are the results of review of 2017 Quarter 3 Hezhou Municipality WWTP monitoring data published by Hezhou Municipality EPB on GZAR Government Integrated Public Information Platform and the water quality characteristics of the influent and effluent of Hezhou Municipality WWTP.

Table 3-2 Influent and Effluent Water Quality Characteristics

Design Daily Treatment Capacity (t/d)	Effluent Flow (t/d)	Monitoring Criteria	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Standards (mg/L)	Unit	Standard Compliance (Y/N)
30,000	30,096.00	pH	/	7.36-7.47	6-9	N/A	Y
		BOD	/	2.5	10	mg/L	Y
		TP	/	0.06	0.5	mg/L	Y

Table 3-2 Influent and Effluent Water Quality Characteristics

Design Daily Treatment Capacity (t/d)	Effluent Flow (t/d)	Monitoring Criteria	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Standards (mg/L)	Unit	Standard Compliance (Y/N)
		COD	62	6	50	mg/L	Y
		TSS	/	7	10	mg/L	Y
		Fecal Coliforms	/	17	1000	个/L	Y
		NH3-N	10.42	0.05	5	mg/L	Y
		TN	/	4.48	15	mg/L	Y
		Petroleum	/	0.09	1	mg/L	Y

Based on the table above, the effluent of Hezhou Municipality WWTP Phase I meets Class IA standard *of the Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002)*and is discharged into He River.

Phase II uses “A^2/O (anoxic→anaerobic→aerobic) + Chemical Phosphorus Removal + Filtration” treatment process. Wastewater is treated in the A^2/O process, then disinfected by UV and discharged into He River through effluent discharge pipe. Sludge from Hezhou WWTP is dewatered and condensed. No sludge nitration tank is used. Sludge cake is transported to Guangxi Hezhou Sludge Harmless Disposal Plant for disposal. Phase II of the WWTP adopts the same treatment process as Phase I. Based on the operation situation of WWTP Phase I, the A^2/O treatment process used in Phase II can ensure the compliance of Class 1A standard in the *Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002)*.

5. Compatibility of Wastewater Treatment Capacity

Hezhou Municipality WWTP Phase I has a design capacity of 30,000 m^3/d. According to data provided by Guangxi Hezhou Beijing Enterprises Water Group Limited, the annual average daily influent is 25,990 m^3 in 2016; Phase II has a design capacity of 30,000 m^3/d, and is scheduled to be put into operation in October 2017. The sewage interceptor component under the project has a design flow of 15,000 m^3/d and the interception area is a part of the service range of this WWTP and its treatment capacity will meet the demand for treatment of wastewater collected by interceptor sewer.

6. Summary

According to the due diligence of Hezhou Municipality WWTP, the construction and operation of WWTP Phase I project meet relevant laws and regulations of the nation, and meet the requirement for EIA approval procedure. All the pollutants meet the respective standards and the project has passed the acceptance of environmental protection; Hezhou Municipality WWTP Phase II is under construction and planned to be put into operation in October 2017. The subprojects of B-5 Huangtian Drainage Canal Rehabilitation, B-6 Guposhan Drainage Canal Rehabilitation, C1 Huangansi Drainage Canal Rehabilitation and C2 Shizigang Drainage Canal Rehabilitation under the Project will be implemented after 2018 and the planned WWTP will meet the wastewater treatment demand of the Project. After the Project is put into operation, the construction and operation status of WWTP Phase II will be continuously tracked.

3.2.5 Hezhou Municipality Sludge Harmless Disposal Project

Sludge generated from Jiangnan WWTP under The Project will be treated by Hezhou Municipality Sludge Harmless Disposal Project, the results of due diligence of which are described as below:

1. Construction Scope and Scale of Hezhou Municipality Sludge Harmless Disposal Project

Hezhou Municipality Sludge Harmless Disposal Project is located in Jiuniu Village in Liantangxinyan Village in Hezhou Municipality, with a treatment capacity of 100t/d (counted as 80% water content), a land occupation of 5,917.87 m^2, the total footprint of the plant is 1,356.97 m^2, and a total investment of 23.73 million RMB. It will mainly receive dewatered sludge from domestic WWTP in all level cities and townships in Hezhou (with 80% water content). No sludge from industrial WWTP is involved..

2. Approval of Environmental Protection

Hezhou Municipality EPB issued approval for *Hezhou Municipality Sludge Harmless Disposal Project EIA Report* on November 8th, 2016.

3. Status of Construction and Operation

Construction for Hezhou Sludge Harmless Disposal Project started in January 2016. The trial operation was carried out in August. Hezhou Sludge Harmless Disposal project accept dewatered sludge from domestic WWTP of all cities and townships in Hezhou (with 80% water content). Currently, it accepts sludge from 4 domestic WWTPs (Hezhou Municipality WWTP, Zhongshan County WWTP, Fuchuan County WWTP and Shaoping County WWTP) in a capacity of 33.3 t/d. Treated sludge with a water content of lower than 60% meets relevant standards and requirements in GB/T 23485-2009 *Disposal of Sludge from Municipal Wastewater Treatment Plant - Quality of Sludge for Co-landfilling* and will be co-landfilled with domestic solid waste in Hezhou Municipality Solid Waste Harmless Disposal Plant Landfill. Filtered wastewater will be collected and treated by EIC-MBR Integrated Wastewater Treatment System and the treated effluent shall meet Class I standard of the *Integrated Wastewater Discharge Standard* and then discharged into Mawei River to the northeast of the Project.

4. Treatment Process

Hezhou Municipality Sludge Harmless Disposal Project uses “Dilution Regulation + Advanced Dewatering” treatment process, with the sludge delivered to site (80% water content) dewatered to a water content of 60%. Discharged sludge is disposed through landfill disposal.

5. Analysis of Compatibility of Sludge Harmless Treatment Capacity

The design capacity of Hezhou Sludge Harmless Treatment Project is 100 t/d. Currently, Hezhou Sludge Harmless Treatment Project accepts sludge from 4 domestic WWTPs with total quantity of 33.3 t/d, so the project still has a redundant treatment capacity of 66 t/d. Jiangnan WWTP in the Project generates 3 t/d of sludge, accounting for 4.5% of the treatment capacity of 66 t/d. Therefore, Hezhou Sludge Harmless Treatment Project can meet the demand for sludge disposal of the Project.

6. Summary

Sludge generated by Jiangnan WWTP will be treated by Hezhou Sludge Harmless Treatment Project.

According to the due diligence results for Hezhou Sludge Harmless Treatment Project, the Project is currently in trial operation stage and its construction and operation meet requirements of relevant national laws and regulations. After project implementation, the operation status will be continuously monitored and tracked for Hezhou Sludge Harmless Treatment Project and the supervisory monitoring requirements listed in its EIA will be included in the Environmental Management Monitoring Plan of the Project. The monitoring reports will be regularly submitted as one of the mandatory deliverables of The Project.

3.2.6 Hezhou Municipality Domestic Solid Waste Landfill

1. Scope and Scale of Construction

Hezhou Municipality Domestic Solid Waste Landfill is located in Dafachong on the west side of Jiuniu Village in Xiyan Village, Liantang Township, Hezhou Municipality. The landfill will manly handle domestic solid waste from the downtown area of Hezhou Municipality (including Liantang Town and Hejie Town) and a part of the domestic solid waste from Pinggui District. The landfill occupies an area of 129,114 m^2 and comprises of 2 landfill zones. Landfill Zone No.1 has a capacity of 370,000 m^3 and a daily design treatment capacity of 180 t of domestic solid waste. 1 leachate treatment station as an associated facility has been constructed with a daily treatment capacity of 300 m^3 . Landfill Zone No.2 has a capacity of 1.92 million m^3 and is not yet constructed.

2. Approval of Environmental Protection

Hezhou Municipality Domestic Solid Waste Landfill was initially named as Guangxi Hezhou Municipality Domestic Solid Waste Harmless Disposal Plant. On October 30th, 2002, GZAR EPB issued approval for *Guangxi Hezhou Municipality Domestic Solid Waste Harmless Disposal Plant Environmental Impact Assessment Report*, and granted approval for the construction. On April 22nd, 2005, due to the big adjustment of treatment method and composition, at the 22nd executive meeting of Hezhou Municipality Government, the plant was renamed Guangxi Hezhou Municipality Domestic Solid Waste Harmless Disposal Plant from Hezhou Municipality Domestic Solid Waste Landfill. On May 9th, 2005, GZAR EPB issued approval for *Hezhou Municipality Domestic Solid Waste Landfill Environmental Impact Assessment Report.* In October 2017, Hezhou Municipality Babu District EPB issued approval for *Hezhou Municipality Domestic Solid Waste Landfill Seepage Treatment Station Upgrading and Reconstruction Project Environmental Impact Assessment Report.*

3. Status of Construction and Operation

Construction of Hezhou Municipality Domestic Solid Waste Landfill No.1 was completed and put into operation in 2008.

4. Treatment Process and Standard Compliance

Hezhou Municipality Domestic Solid Waste Landfill was put into operation in 2008. The selected solid waste treatment process is sanitary landfill and the leachate treatment process is “Biological Treatment + Flocculation and Sedimentation”. The treated leachate meets Class II standards specified in the *Standard for Pollution*

Control on the Landfill Site of Municipal Solid Waste (GB16889-1997).

It is specified in Articles 9.1.2 - 9.1.3 of the *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008) that all existing and newly constructed municipal solid waste landfills shall meet water pollutants discharge limits in Table 2 starting from July 1st, 2009. After July 1st, 2011, all existing municipal solid waste landfills shall treat its own municipal solid waste leachate against the water pollutants discharge limits in Table 2.

According to data of the conventional monitoring of the municipal solid waste landfill conducted by City Environment Monitoring Station in the recent 5 years, COD, BOD_5 and TN in treated leachate from Hezhou Domestic Solid Waste Landfill exceed the limits in *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008) (See details in Table 3.3 below). Therefore, Hezhou Domestic Solid Waste Landfill applies temporary measures for disposal of leachate by means of transporting the pretreated leachate in tankers to Hezhou Municipality WWTP for further treatment. Meanwhile, Hezhou Domestic Solid Waste Landfill conducted upgrading and reconstruction for solid waste leachate treatment station by relocating the leachate regulation tank from Landfill No.1 to Landfill No.2 where the leachate is treated with "Membrane Biological Reactor (MBR) + Nanofiltration (NF) + Reverse Osmosis (RO)" process. According to the predicted results included in the *Environmental Impact Assessment Report* for *Hezhou Municipality Domestic Solid Waste Landfill Leachate Treatment Station Upgrading and Reconstruction Project,* after such upgrading and reconstruction of seepage treatment station, treated leachate can meet the limits specified in Table 2 of the *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008).

Table 3.3 Summary of Conventional Monitoring Data of Hezhou Municipality Solid Waste Landfill

Unit: mg/L (Chromaticity : multiple, Total Coliform : CFU/L)

Location	Criteria	Hehuanjian (Jiang) Zi 〔2010〕No. 099 2010.7.1	Hehuanjian (Jiang) Zi [2011] No. 135 2011.12.14	Hehuanjian (Jiang) Zi 〔2012〕No. 104 2012.6.21	Hehuanjian (Jiang) 〔2013〕 No.111 2013.10.15	Hehuanjian (Jiang) [2014] No.75 2014.7.7	Hehuanjian (Jiang) 〔2015〕 No.45 2015.6.5	Hehuanjian (Jiang) 〔2016〕 No.51 2016.9.30	Standard for Pollution Control on the Landfill Site of Municipal Solid Waste (GB16889-2008)
Treated Leachate	pH	7.89	6.86~7.56	7.20~7.34	7.65~7.68	7.56~7.76	7.76~7.78	6.38~7.82	6~9
	Chromaticity	—	4	16	4	40	8	32	40
	SS	—	28	50	11	6	13	12	30
	COD	**362**	**165**	**203**	95	92	31	**166**	**100**
	BOD_5	—	**48**	**31**	25.7	23.5	9.5	**38.8**	**30**
	NH_3-N	**242.0**	1.871	**37.65**	9.285	2.251	2.201	20.88	25
	TN	—	8.322	**62.8**	29.8	27.8	**44.3**	**214**	**40**
	TP	0.349	0.09	0.07	0.18	0.05	10.01	0.14	3
	Total Mercury	0.955	ND	0.01228	ND	ND	0.00062	ND	0.001
	Total Lead	0.2L	ND	0.087	ND	ND	ND	ND	0.1
	Total Cadmium	0.05L	ND	0.082	0.0005	0.0002	ND	ND	0.01
	Total Arsenic	0.046	ND	0.0032	0.0006	0.0019	0.0014	0.0021	0.1
	Total Chromium	—	0.016	ND	0.005	ND	ND	ND	0.1
	Chromium-6	0.004L	0.010	ND	ND	ND	ND	ND	0.05
	Total Coliform	170	1700	2100	1700	30	350	30	10000

5. Treatment Capacity

Hezhou Municipality Domestic Solid Waste Landfill is currently using Landfill No.1 with capacity of 370,000 $m^{3.}$ As of September 2017, a capacity of 320,000 m^3 has been used, with a balanced capacity of 50,000 m^3. In the meanwhile, Hezhou Municipality Domestic Solid Waste Landfill, scheduled to be completed in December 2017, will upgrade and reconstruct the solid waste leachate treatment station by relocating the leachate regulation tank from Landfill No.1 to Landfill No.2, and using the former site of the leachate regulation tank as a landfill site (with a design capacity of 300,000 m^3), making the total balanced capacity reach 350,000 m^3. Calculated based on the existing solid waste delivery of 700 t/d, the future demand for 3 years will be satisfied. Sludge cake generated from dredging in the Project is 18,459 m^3, accounting for 5.3% of the total balanced capacity. Therefore, the capacity of Hezhou Municipality Domestic Solid Waste Landfill can meet the landfill demand of the Project.

6. Summary

According to the due diligence conducted for Hezhou Municipality Domestic Solid Waste Landfill, the leachate discharged from the landfill does not meet standard limits listed Table 2 of the *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008), but the landfill is currently upgrading and reconstructing the leachate treatment station scheduled to be commissioned in December 2017. The subprojects of A-8: He River Main Watercourse Dredging, C-1 Huangansi Drainage Canal Rehabilitation and C-2 Shizigang Drainage Canal Rehabilitation will be implemented in 2018-2019 and the dewatered sludge to be generated from these subprojects will be disposed in Hezhou Municipality Domestic Solid Waste Landfill. Therefore, it is recommended that Hezhou Municipality Domestic Solid Waste Landfill should accelerate the reconstruction progress and implement the final acceptance of environment protection as a part of the final acceptance process according to the national and provincial regulations. In addition, after the Project is completed, the status of construction and operation of the Leachate Wastewater Treatment Station Upgrading and Reconstruction Project of Hezhou Municipality Domestic Solid Waste Landfill will be followed up with and the supervisory monitoring requirements included in the EIA of Hezhou Municipality Domestic Solid Waste Landfill will be incorporated into the Environmental Management Monitoring Plan of the Project, with its monitoring report regularly submitted as one of the mandatory deliverables of the Project.

4. Status quo Survey and Analysis

4.1 Natural environment conditions

4.1.1 Geographical location

Hezhou Municipality is located in the northeastern part of GZAR, at 111°05 '~ 112°03' east longitude and 23°39 '~ 25°09' north latitude in the border area of Hunan, Guangdong, Guangxi provinces and embraces the most convenient access from South Western China to Guangdong Province, Hong Kong and Macau. Hezhou Municipality borders Lianshan County, Huaiji County and Fengkai County of Guangdong Province to the east, Shaoping County and Zhongshan County to the west, Cangwu County to the north, and Fuchuan Yao Autonomous County and Jianghua County in Hunan Province to the south. Hezhou Municipality has a total area of 11,822 km^2, accounting for 5.01% of GZAR, including 4,062 km^2 for mountains, 1,420 km^2 for plains and 6,373 km^2 for low hills. Hezhou Municipality administers 1 district (Babu District), 2 counties (Shaoping County and Zhongshan County), 1 Autonomous County (Fuchuan Yao Autonomous County) and Pinggui Administrative District.

The project construction activities will occur in urban area in Pinggui District and Babu District. Babu District is where Hezhou Municipality Government located, which borders Lianshan County, Huaiji County and Fengkai County in Guangdong Province to the east, Shaoping County and Zhongshan County to the west, Cangwu County to the north, and Fuchuan Yao Autonomous County and Jianghua County in Hunan Province to the south. Pinggui District is located on the North Western side of Hezhou Municipality, with its south eastern part at 7.5 km from urban center of Hezhou Municipality, north western part at 31 km from Zhongshan County urban area, and at the boundary of Hezhou Municipality Babu District and Zhongshan County.

4.1.2 Geology and Geomorphology

Hezhou is geologically a part of Nanling mountainous area and also a part of hilly area across Guangdong and Guangxi Provinces. High mountains are mostly distributed in the northern and eastern parts, with a succession of mountain ranges extending from the east to the north and then to the south.

The northern part of Babu District is a mountainous highland, starting from north eastern boundary to south western end, with a succession of mountain ranges; the mid-south part is mostly towering and steep mountains, with 5 small basins of Nanxiang, Guiling, Lisong, Babu and Xidu distributed in mountain valleys; high mountains are located in the middle part, which naturally forms a terrain that is higher in the northern part and lower in the southern. The whole district is mostly covered by mid-level and lower level mountains forming 5 small basins Nanxiang, Guiling, Lisong, Babu and Xidu in the valleys.

Pinggui District is located in Nanling mountainous area, which is also a part of hilly area cross Guangdong and Guangxi Provinces, belonging to two of the five big mountain systems including Dupangling and Mengzhuling, and the transition zone between 1° north to tropic of cancer (north latitude 24°17′~24°46′) and subtropical monsoon climate zone. The terrain is rather complicated, including plain area, hilly area, basin and mountainous area. Eastern, northern, western and south western sides of the County are mountainous area, with multiple mountains and high terrain surrounded, in the middle, there is depressed basins. Plain area and hilly area with mild slope is distributed between edge of mountain and basins.

4.1.3 Seismic Intensity

According to *Code for Seismic Design of Buildings* (GB50011—2010) Appendix A, the seismic fortification intensity is 6 for Hezhou Municipality and all the buildings (structures) shall be designed with 6 seismic fortification intensity and a basic seismic acceleration rate of 0.05g.

4.1.4 Meteorology and Climate

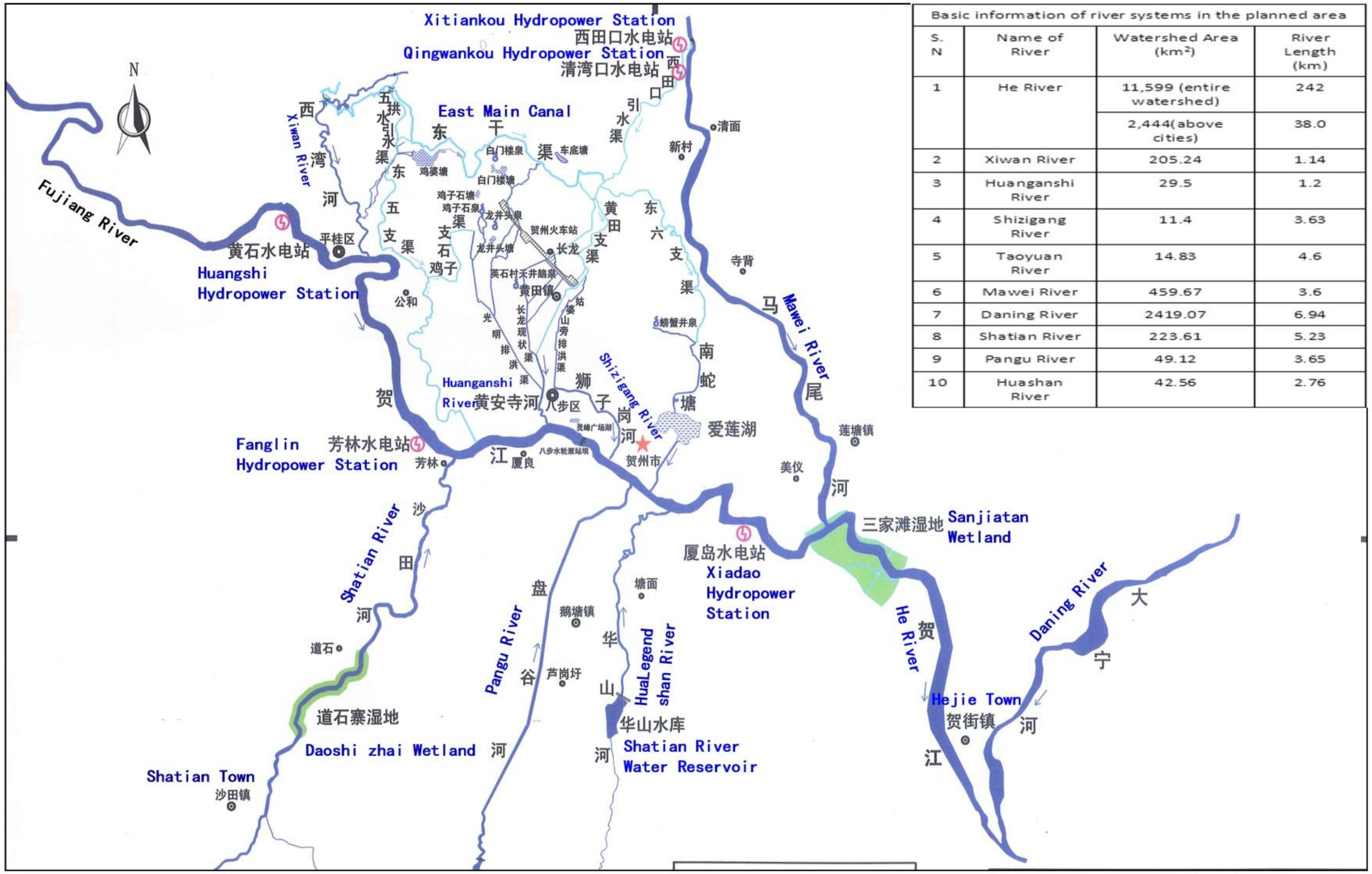
Hezhou Municipality is located in the eastern part of Guangxi Province, within subtropical monsoon climate zone south to 10°north to tropic of cancer, with subtropical monsoon climate. The climate is characterized by four distinct seasons and a high temperature and rainy summer. Winter is mild and dry; Spring is warm, wet, and rainy, with late spring cold; Autumn has clear sky and dry weather. Cold, heat, dryness and flood have big changes due to the influence of monsoon during the year. Wind speed is small and prevailing wind direction is WN, the secondary prevailing wind direction is E.

According to precipitation data from 1952 to 2014 collected by Hezhou Municipality meteorological station, multi-year annual average precipitation is 1565.0mm, with maximum annual precipitation 2324.90mm (1973), minimum year 1006.3mm (1956). Precipitation is unevenly distributed during a year, with rainy season from mid-April to mid-September, and highest precipitation from April to August, accounting for 67.5% of the annual precipitation. The maximum multi-year average annual 24-hr rainfall is 113.0mm, the maximum 24-hr rainfall measured is 301.7mm (July 22nd, 1994), multi-year average evaporation is 1575.3mm.

4.1.5 Hydrology

The main river in Hezhou Municipality urban area is He River, He River belongs to Xijiang River system of The Pearl River Watershed as a primary tributary of Xijiang River. He River is originated from Ming Mountain in Changchun Village, Mailing Township, Fuchuan County in Guangxi Province and flows through Fuchuan County, Zhongshan County, Hezhou Municipality, Fengkai County in Guangdong Province to the south and then into Xijiang River in Jiangkou Township, Fengkai County. He River course starting from its origin to U shape river reach in Pinggui District urban area is named as Fujiang River while the downstream section from the U shape river reach is named as He River, with a total length of 3,573km and an average slope of 0.47‰ in the main river course. According to data from Hejieduling Hydrological Station, the normal flow rate in He River is $80.3m^3/s$ and the minimum and maximum flows are respectively $16.2m^3/s$ (1986) and $1,500m^3/s$.

He River flows through the city area from north to the east and divides the urban area into the southern and the northern parts. The main tributaries in the northern part include Xiwan River, Mawei River and Daning River and while those in the southern part are Shatian River, Pangu River and Huashan River. The main drainage canals in the northern part are Huangansi, Shizigang and Nanshetang drainage canals while those in the southern part are Xuewu and Chengnan drainage canals. Figure 4-1 is the layout map of He River water resources in the urban area.



Basic information of river systems in the planned area			
S. N	Name of River	Watershed Area (km^2)	River Length (km)
1	He River	11,599 (entire watershed)	242
		2,444(above cities)	38.0
2	Xiwan River	205.24	1.14
3	Huanganshi River	29.5	1.2
4	Shizigang River	11.4	3.63
5	Taoyuan River	14.83	4.6
6	Mawei River	459.67	3.6
7	Daning River	2419.07	6.94
8	Shatian River	223.61	5.23
9	Pangu River	49.12	3.65
10	Huashan River	42.56	2.76

Figure 4-1 He River Water Resources

4.2 Overview of Social Environment

4.2.1 Administrative Division and Population

Hezhou Municipality is located in the northeastern part of GZAR occupying an area of 11,900 km^2 and administers 2 Districts, 2 Counties, 1 Autonomous County, including Babu District, Pinggui District, Zhongshan County, Shaoping County and Fuchuan Yao Autonomous County.

The total population of the City amounted to 2.4252 million at the end of 2016, increased by 33,000 from the previous year. Population of permanent residents is 2.0387 million, increased by 12,800 from the previous year, including an urban population of 896,600.

4.2.2 Social and Economic Development

The regional GDP in 2016 was CNY 51.822 billion, representing an increase of 8.1 percent over the previous year. The added value of the primary industry was CNY 11.177 billion, increased by 4.1% over the previous year; the added value of the second industry was CNY 21.155 billion, increased by 10.0% over the previous year; the added value of the tertiary industry was CNY 19.489 billion, increased by 8.3% over the previous year. The added value of primary, secondary and tertiary industries accounted for 21.57%, 40.82% and 37.61% of GDP, respectively, and the contribution to economic growth was 11.19%, 49.94% and 38.87%, respectively. The average GDP per capita is CNY 25,499 per capita calculated based on permanent population.

4.2.3 Culture, Education and Health

The city has many research institutions in the disciplines of agriculture, forestry, agricultural machinery and science and technology information. There are 746 primary schools in Hezhou Municipality with 291,346 primary school students, achieving a schooling rate of 100% for school-age children. There are 4 high schools, 8 secondary schools, and 103 junior high schools hosting 67,839 students and 2 special education schools with 1,523 students on campus. Hezhou Municipality has 25 kindergartens with 1,213 preschool classes and 5988 children. There are 20 secondary specialized (vocational) schools of different types, 1 general institution of higher education, 10 schools of various kinds of adult schools. The City as a whole has a teaching faculty of 21,936 persons in senior, junior and vocational middle school. There are 112 medical and health institutions, 93 hospitals and health centers, and 2587 hospital beds.

4.2.4 Transportation

With an urban area of up to 15 km^2, Hezhou Municipality has 121 urban roads in a total length of 73.68km. The transportation system in Hezhou Municipality mainly comprises of highways and waterways. National Highway 207 and 323, as well as 3 provincial highways run through the city; Guilin-Wuzhou Expressway and Luoyang-Zhanjiang Railway Guangxi Section, Guangzhou-Hezhou Expressway also run across Hezhou Municipality, constituting a local transportation system “like five dragons flying towards the sea”. Hezhou Municipality has a total length of 2,543km for classified roads, including more than 300km for Class II roads. The percentage of high-class roads in the city’s road network is far much higher than the provincial average of GZAR. With a road density 21.27km/100km^2, Hezhou has basically achieved the goal of connecting every county to Class II roads, some towns and townships to asphalt pavement roads and every village to roads accessible to motorized vehicles. Waterway transportation mainly relies on Guijiang River and He River that joins Xijiang River and connects Wuzhou Port, providing a 1-day waterway access to Guangzhou, Hong Kong and Macau.

4.2.5 Landscape and Culture Relics

(1) Landscape

There are rich and beautiful scenic spots in Hezhou Municipality, which include natural landscapes such as Guposhan Mountain National Forestry Park, Hezhou Hot Spring, Yushilin, Ziyunxianjing and Bishuiyan Stone, etc.

According to site investigations, The Project will not involve any scenic area, natural preservative zone or forestry parks and the project area are mainly farmlands or residential areas. However, due to frequent damage from flood on He River dike and littering and dumping of garbage into He River by riverside residents, parts of the project areas along He River are dirty and messy from the landscape view.

(2) Physical Cultural Resources

Hezhou boasts of rich reserves of cultural relics and simple but deeply-rooted folk customs. The Kirin Wine Vase (Qilinzun) a nationally-valued cultural relics (with a history of 2300 years from the Spring and Autumn period) was unearthed in Hezhou Municipality; the humane historical destinations include Shantianmafeng Wugui Bridge, Longjing Ancient Village, Zhuang Minority Cultural Village, and Local Yao Minority Cultural Park, etc,; the historical streets include Xiyue Street Historical and Cultural Quarter, Hedong Street and Xiwan Hydropower Station Street, and relics such as the Old Site of Babu Special Branch of the Chinese Communist Party (CCP). According to investigation, the components of He River Integrated Rehabilitation (Guangming Bridge – Lingfeng Bridge) and Huangansi Drainage Canal Rehabilitation under the Project will affect Xiyue Historical Cultural Street. He River Integrated Rehabilitation (Lingfeng Bridge – Xia Island Hydropower station) Project will affect the Old Site of CCP Babu Special Branch.

1. Xiyue Street Historical and Cultural Quarter

Xiyue Street Historical and Cultural Quarter is located in the mid-southern urban area of Babu District and borders the old site of Pingle Special Administration to the west, Babu Bridge to the east, the Linjiang north shore to the south and the north border of Xiyue Street to the north. As one of the first historical and cultural quarter of GZAR, the Quarter involves a planned area of protection of 5.17 ha, including a core area of protection of 1.78 hectares, accounting for 34.43% of the preserved area. The streets and lanes in the area have a full length of 509 m. In the historic and cultural quarter, there are six immovable historical relics including Babu Old River Bank, Yijing Bridge, Heweizhongjian Stone Wall, Tianyi Tobacco Shop, Qianji Pawnshop and Jiancheng Rice Shop and four recommended historic architectures. Land area occupied by traditional buildings, including the immovable cultural relics, historic buildings and traditional style buildings, accounts for 63.62% of the total area of the preserved zone.

Preservation elements of Xiyue Street Historical and Cultural Quarter is shown in Figure 4-1 as follows.

Figure 4-2 Preservation Elements of Xiyue Historical & Cultural Street

Table 4-2 Catalog of Historical Buildings on Xiyue Street

Name of buildings	Location	Protection nature	Usage	Year	Description	Characteristics and values	Current situation
Yijing Hotel	`No.66 Xiyue street	Historical building	Commercial	Republic of China era	A 3-storey brick-wooden structure with an area of 308.2 m^2, the hotel used to be the gathering place for progressive activists during the period of Anti-Japanese war.	It is among the few well-preserved representative buildings of commercial sector in Hezhou from late Qing dynasty.	The building was already demolished and reconstructed against the original architecture style in August 2016.
Tobacco company	No.71 and No.73 of Xiyue Street	Historical building	Commercial and residential	Republic of China era	A 3-storey brick-wood structure with an area of 205.7 m^2, the building was built as the site office of He County Tobacco company. It is a building overhang with 2 stories (with an attic on the second floor), two bays in the front and back, with flush-gable-roof and brick-wood structure, green brick walls and small tiles. The staircase is in the middle of the two buildings, with a patio for lighting. The front and rear façades are heavily decorated with beauteous western-style gray plasters.		Shop
Sino-Soviet Friendship Association	No.6 Shajie Street	Historical building	residential	Republic of China era	A 3-storey brick-concrete structure with an area of 664.1m^2, the building has white walls and green tiles, with 5 pentagrams decorated on the wall. The association played a special role in promoting Sino-Soviet relations.	It is a building of the specific historical period in Hezhou and a representative building in the historical period of the Republic of China.	idle and uninhabited
Pousutong	Xiyue	Historical	residential	Republic	A 3-storey brick-wood structure	A representative	idle and uninhabited

Table 4-2 Catalog of Historical Buildings on Xiyue Street

Name of buildings	Location	Protection nature	Usage	Year	Description	Characteristics and values	Current situation
	Street	building		of China era	with an area of 376.0m^2, the building is located in No.33 Shajie Lane and nearby Sanban Bridge. It is a well-preserved architecture of the Republic of China era, where Ms He Xiangning used to live.	building in the Republic of China era with value of historical research in the city development and lifestyle of urban residents in Hezhou.	
Yijing Bridge	East side of Sanban Bridge, Shajie Lane	Immovable cultural relics	transport	Republic of China era	A stone masonry bridge that is about 20m long and 5.5 meters wide, the bridge was built in 1934 financed by Babu Chamber of Commerce and carries the inscribed text of Zhang Tingjian. It is an ancient stone bridge in Xiyue Street.		In normal service
Heweizhongjian stone wall	Xiyue Street	Immovable cultural relics	/	Qing Dynasty	The masonry wall of Heweizhongjian Stone Wall was built on 6th of lunar January utilizing fund raised by the squires for control floods of He River.		Preserved as original
Babu old dike	Xiyue Street	Immovable cultural relics	Transport	Republic of China era	370m long revetment along the left bank of He River, it was built with the funds raised by Shen Hongying during the Republic of China era. The entire river revetment is stacked with stones along He River.		Preserved as original
Tianyi Tobacco shop	No.23 Xiyue Street	Immovable cultural relics	Commercial and residential	Republic of China era	IA 3-storey brick-wood structure covering an area of 665.1 1m^2, the building adopt a flush-gable-roof and brick-wood structure of green brick walls. In	The building is the typical commercial and residential building of	The first floor is occupied as shops whilst the second and third floors are idle.

Table 4-2 Catalog of Historical Buildings on Xiyue Street

Name of buildings	Location	Protection nature	Usage	Year	Description	Characteristics and values	Current situation
					1948 it was established by underground communist party Fanglin branch to be the CCP underground communication station in Eastern Guangxi, functioning as the main communication station for Babu underground CCP groups during the era of the War of Liberation.	Hezhou during the specific period as well as the representative building during the Republic of China era.	
Qianji pawnshop	No.8 Shajie Lane, Xiyue Street	Immovable cultural relics	commercial	Republic of China era	A 3-storey brick-wood structure covering a floor area of 529.7 m^2, the building used to be a pawnshop run by Canton merchants in Hezhou. At the main entrance it is featured with the plaque “Qianji pawnshop”. The windows of the building façade are specialized, with lacework on the mullion. The second floor is featured with a small attic of well-designed shape. The building is heavily decorated with a variety of decorations with western style. In the periphery of the buildings are mostly commercial houses.	It is among the few well-preserved representative buildings of commercial sector in Hezhou during the Republic of China era	idle and uninhabited
Jiancheng rice shop	No.10 Hebian Lane, Xiyue Street	Immovable cultural relics	residential	Republic of China era	It is a 2-storey brick-and-wood structure covering an area of 243.1 m^2. During the period of the Republic of China, it was a rice shop owned by Guangdong merchants in Hezhou. As a typical brick-wood building, the		idle and uninhabited

Table 4-2 Catalog of Historical Buildings on Xiyue Street

Name of buildings	Location	Protection nature	Usage	Year	Description	Characteristics and values	Current situation
					first floor has a masonry wall while the second floor has a façade mainly comprising of logs. At the entrance, there are 4 well-preserved steps.		

2. Old Site of CCP Babu Special Branch

The Old Site of CCP Babu Special Branch is located within Xiadao Primary School of Xiadao Village, Etang Township. As a representative building of the modern times constructed in 1943, the main school building is designed into a U-shaped plane with a north-facing gate. Nowadays, the teaching building has been destroyed, with only the school gate preserved. On its west, a “Memorial Hall of CCP Babu Special Branch” is constructed for exhibition of historical materials of CCP Babu Special Branch. The CCP Babu Special Branch has led the underground party work in Babu, Yongying, Guiling, Nanxiang and Pinggui mining area. The Old Site of CCP Babu Special Branch was back then a key activity base and is currently still an important red cultural heritage in Hezhou district and a base for patriotic education with important value for red cultural tourism development.

4.2.6 Local Drinking Water Sources

According to the *Letter of Approval by GZAR People’s Government on Classification Proposal Hezhou Urban Drinking Water Source Protection Zone* (GZAR Guizheng Letter〔2016〕No. 203) issued in 2016, it has been approved to cancel the He River Babu Drinking Water Source Protection Zone and establish the Guishi Reservoir Drinking Water Source Protection Zone. The project area involves no drinking water source protection zone.

4.3 Status Quo of Ecological Environment

4.3.1 Status Quo of Constructional Land Use

He River section included in the Project belongs to Babu-He Street Basin in terms of regional topography, with large tracts of farmland and village residential houses on both banks. In the basin, karsts topography is widely developed, creating a landform featuring in mountain peaks and woods valley, depressions and isolated peak plains.

He River section of He River in Pinggui District is located in the leading edge of the He River first terrace. This curved river section has exposed sand and gravel on He Riverbed and shoals widely distributed in the upstream riverbed.

Jiangbei dike in Babu District is located in the first terrace on the left bank of He River, with a bank base from He River Bridge to Guangming Bridge mostly comprising of farmland and dry land and the dike slope of bamboo revetment. He River section from Guangming Bridge to Babu Bridge is located in old urban area, with densely populated residential buildings and houses on both sides. and the existing dike slope is consisted of masonry retaining wall and bamboo revetment. He River section between Babu Bridge and Hezhou Bridge is new urban area, with an undulating terrain mostly covered by farmland and dry land.

4.3.2 Status Quo of Terrestrial Ecology

Hezhou Municipality is located to the north of Tropic of Cancer and belongs to the subtropical monsoon climate zone. The area for evaluation is located in the urban area, where, due to long history of urban development, the primary ecological environment has been severely damaged, with no native vegetation and the existing vegetation being secondary natural vegetation or artificial vegetation. The natural vegetation is divided into warm evergreen coniferous forest, limestone mountain deciduous broadleaf shrub and warm and hot grass, with majority of the vegetation warm evergreen coniferous forest and limestone mountain deciduous broadleaf shrub, and warm and hot grass as minor vegetation. Artificial vegetation consists of evergreen economic forest, paddy field and dry land, with mostly paddy field and dry land. The regional ecology system is mainly an agricultural ecosystem and forestry ecosystem and the quality of terrestrial ecology is average.

Currently the majority of the tree species in the project evaluation area are common greening and landscaping plants such as bamboo and willow, etc., as well as crops. There are a small number of hydrophilic birds in the area.

4.3.3 Status Quo of Aquatic Ecology

Here described as follows is the analysis and evaluation of the status quo of aquatic ecology in the He River Watershed introduced in the *Report on Post Evaluation of the Ecological Impacts of Abrupt Environmental Incidents in He River* (July 2013):

1. Phytoplankton

In July 2013, a total of 40 Phytoplankton was monitored in He River, including 4 species of *Cyanophyta*, 1 *Cryptophyta*, 1 *Euglenophyta*, 1 *Pyrrophyta*, 10 species of *Bacillariophyta* and 23 species of *Chlorophyta*, which accounts for 10%, 2.5%, 2.5%, 2.5%, 25% and 57.5% of the total species, respectively, with *Chlorophyta* the highest proportion and *Bacillariophyta* the second highest.

2. Cell Density of Phytoplankton

The total density of algae cells in He River Watershed is in the range of 5.54×10^5 ~ 1.16×10^7cells/L, Guishi reservoir has the highest density of algae cells.

In all river sections in He River Watershed, *Cyanophyta, Bacillariophyta* and *Chlorophyta* have relatively high cell density; however, different species has different distributions at different monitoring sites.

3. Phytoplankton-based Water Quality Evaluation of He River

Monitoring results at three monitoring sites at Guishi reservoir, the confluence of He River and Mawei River, and under Xindu bridge within the evaluation area show that the Shannon - wiener diversity indexes (H’) are all slightly lower than 3.0. According to the Phytoplankton biological diversity index, the aquatic ecological environment of He River Watershed is good.

4. Fishes

The major economic fish species in He River Watershed are Crucian, Grass Carp, Sharpbelly, Southern quasi sharpbelly, Black Amur Bream, Catfish, Yellow catfish, etc., which are common in Guangxi and Guangdong Provinces, they are the major economic fish species. The major fish species for cage culture in this river section are *Siniperca scherzeri, Spinibarbus denticulatus*, Grass Carp and Yellow Catfish, etc. According to different living water layer for different fish species, the fish ecological groups of He River water system can be divided into following groups:

Mid-upper layer group: Sharpbelly, *Siniperca scherzeri,* Rhodeus lighti, etc., these fish species are mainly living in the mid-upper layer of the stagnant water body during the non-winter season, often with the regularity of cluster activities.

Mid-lower layer group: most of species under Carp, Crucian, Siluridae, Bagridae and

Xenocypris argentea Gunther and *Leuciscinae*.

5. “Spawning Grounds” Investigations of Fishes in the Project Watershed

It has been observed through interviews with specialists in local fishery authority and site investigations that, since the water flow in the entire He River Watershed (Fujiang River to Yuhemianshi) is relatively gentle and slow, the annual net flow rate has an uneven distribution; due to relatively high-intensity development of this River Watershed, a number of large dams are built during the construction of hydropower stations, blocking the pass ways for fishes and their habitats; with the biological characteristics of He River fishes taken into account, there is no centralized large spawning ground in He River (Fujiang River to Yuhemianshi) basin, no spawning ground for large fish, and no spawning ground for fish that lays floating eggs such as grass carp, silver carp and bighead fish, and no small spawning grounds for fish that lays sticky eggs such as carp, crucian, catfish, etc.

The overwintering ground for river fish is often in deep water. He River (Fujiang River to Yuhemianshi) is located in subtropical area, with relatively short low-temperature periods in winter. With the relatively shallow water depth and the interruption by large dams, He River has no overwintering ground for river fishes.

The fish feeding ground is normally located where there is abundant food, He River (He Jiang River to Yuhemianshi) has dense population on both banks and rich aquatic-plants in midstream and upstream basin, providing abundant food for fishes.

4.3.4 Status Quo of Agricultural Ecology

The major crops in the evaluation area include the common crops of rice, corn, Sanhua plum, water chestnut, tobacco and vegetables, etc. and there is no local special species. Rice is double cropping rice, part of which is used as dry crops and vegetables in winter season.

4.3.5 Status Quo of Soil Erosion

According to Notice by GZAR *People’s Government on the Zoning for Key* Soil *Erosion Prevention and Improvement Zones in GZAR* (Guizhengfa〔2017〕No.5), Hezhou Municipality Babu District is one of the Key Soil Erosion Prevention and Improvement Zones while Pinggui District is not.

The project area belongs to the southern red soil hilly area as a part of the Class II zones in the National Soil Erosion Classification Plan and the southeastern Gui low mountain area defined in the GZAR Soil and Water Preservation Planning and Zoning Program with a soil loss tolerance of 500t/(km ^{2}·a). Investigation in the status quo in the project area shows that the type of soil erosion in the project area is mainly water erosion, in the form of surface scours and gully scours and the project area belongs to the slight-to-mild soil erosion area. The average soil erosion modulus background value in the project area is approximately 317t /(km ^{2} ·a).

4.4 Status Quo Investigation and Evaluation of Environment Quality

4.4.1 Status Quo Investigation and Evaluation of Ambient Air Environment Quality

According to the *Technical Guidelines for Environmental Impact Assessment Atmospheric Environment* (HJ2.2-2008), the project area mainly involves the urban area in Hezhou Municipality and its adjacent villages. Therefore, the conventional monitoring data from automatic monitoring stations in the city area is used for the analysis of the status quo of air environment quality in the project area. For the proposed WWTP, NH_3, H_2S, and odor concentration are added as the criteria of monitoring. Since the Project involves sediment dredging in He River course, which will cause odor emission, odor is sampled and analyzed based on the distribution of sensitive sites. The layout of the monitoring sites is shown in Figure 4-2.

I. Ambient Air Monitoring of SO_2, NO_2, and PM_{10}

Environmental Quality Weekly Report for Hezhou Municipality in Year 2017 (Issue No.24) published by Hezhou Municipal EPB is quoted for ambient air quality evaluation of the urban areas of Hezhou Municipality conducted under the Project. Details of the monitoring data are included in Annex Table 1.

Analysis of the weekly monitoring data indicates that the monitoring factor AQI index at various monitoring sites in Hezhou urban area is generally in the range of 27~65, indicating that the air quality is good and the air quality at all monitoring sites meets Class II standard specified in *Ambient Air Quality Standard* (GB3095-2012).

II. NH_3 and H_2S Monitoring

1. Location of Monitoring sites

A11 Shatian WWTP site, A12 proposed Jiangnan WWTP site as detailed in Figure 4.2-2.

2. Monitoring Time and Frequency

Sampling was carried out continuously for 2 days from May 16th 2017 to May 17th 2017 to monitor the 1-hour average level, with each sampling lasting for 45 minutes.

3. Monitoring and Analysis Methodology

The status quo monitoring and analysis of ambient air quality in the Project is conducted according to *Methods for Monitoring and Analysis of Ambient Air and Exhaust Gas* 4th Edition (Ministry of Environmental Protection, 2003). Details of the analytical methods are listed in Table 4-3.

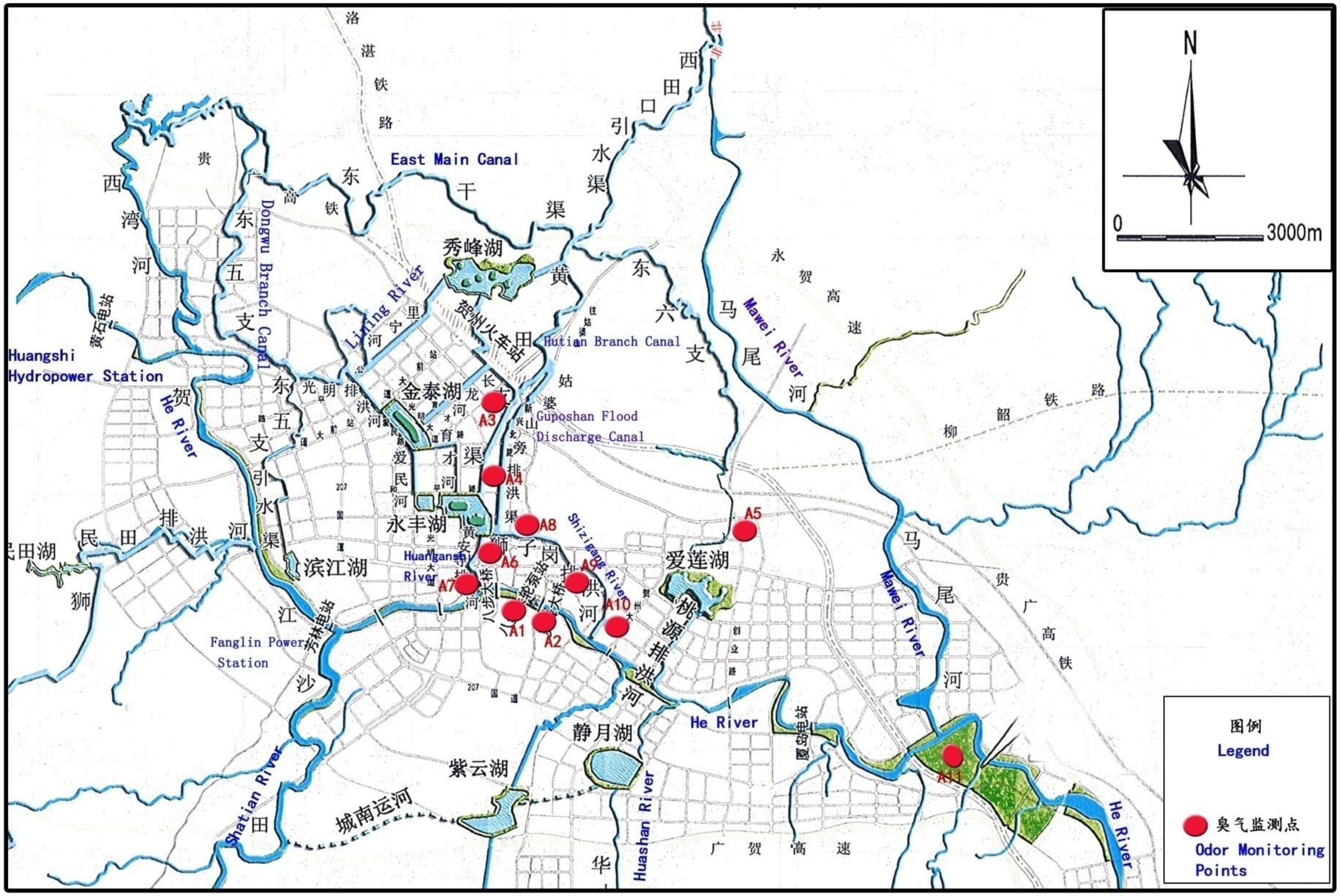


Figure 4-3 Layout Map of Odor Emission Monitoring Points

Table 4-3: Monitoring and Analysis Methods and Detection Limits

S/N	Monitoring Items	Analytical Methods	Detection Limits
1	H_2S	Methylene blue spectrophotometric method *Methods for Monitoring and Analysis of Ambient Air and Exhausted Gas 4th Edition* Ministry of Environmental Protection, 2003	0.001mg/m³
2	NH_3	Environmental air ammonia determination Nessler's reagent colorimetric method HJ 533-2009	0.01mg/m3 （10ml of absorption liquid, 45L of sampling volume）

4. Evaluation Methods

Calculating the percentage of maximum mass concentration value versus corresponding standard mass concentration limits at various sampling time:

$P=C_i/S_i$

Where:

P_i—the percentage of maximum mass concentration value versus corresponding standard mass concentration limits;

C_i—the measured pollutant concentration, mg/m^3;

S_i—the evaluated pollutant concentration, mg/m^3.

Note: for undetected items, the standard limits are calculated using 50% of the detected value.

5. Evaluation Standards

H_2S and NH_3 are evaluated according to *Hygienic Standards for the Design of Industrial Enterprises*（TJ36-79）.

6. Analysis of Monitoring and Evaluation Results

The monitoring results are listed in Annex Table 2.

According to the data listed in annex table, the monitoring data of H_2S and NH_3 at proposed WWTP site complies with the momentary maximum allowable concentration in *Hygienic Standards for the Design of Industrial Enterprises*（TJ36-79）for residential area.

III. Status Quo Monitoring of Odor Emission

Table 4-4 Locations of Odor Concentration Monitoring Sites

Watershed	Monitoring Location	Monitoring Factor
He River	A1 South side of He River dredging section, at Qiangdong Road close to riverside residential areas A2 South side of He River dredging section, at Nanshan Road close to riverside residential areas	Odor Concentration
Huangtian Branch Canal	A3 Huangtian Branch Canal dredging section, at Sanqi bridge close to riverside residential areas	
Guposhan Drainage Canal	A4 Guposhan Drainage Canal dredging section, at Shizigang close to riverside residential areas	
Taoyuan Drainage Canal	A5 Taoyuan Drainage Canal dredging section, at Xindu Village close to riverside residential areas	
Huangansi Drainage Canal	A6 Huangansi Drainage Canal dredging section, at Fumin Rd close to riverside residential areas A7 Huangansi Drainage Canal dredging section, at Xiyue St. close to riverside residential areas	
Shizigang Drainage Canal	A8 Shizigang Drainage Canal dredging section, at Zhushan Rd. close to riverside residential areas A9 Shizigang Drainage Canal dredging section, at Wangjiao Rd. close to riverside residential areas A10 Shizigang Drainage Canal dredging section, at Yinhe St. close to riverside residential areas	
He River	A11 at proposed Jiangnan WWTP site	

3. Monitoring Time and Frequency

Monitoring was carried out for 1 day on May 16th, 2017, with 4 sampling per day at each monitoring site.

4. Monitoring and Analytical Methods

The status quo of ambient air quality in the Project was monitored and analyzed according to *Methods for Monitoring and Analysis of Ambient Air and Exhausted Gas 4th Edition* (by Ministry of Environmental Protection, 2003). Details of the analytical methods are listed in Table 4-5.

Table 4-5 Detection and Analytical Methods for Odor Concentration

No.	Monitoring Item	Analytical Method	Detection Limits
1	Odor Concentration	Triangle Odor Bag Method	10（No Unit）

5. Evaluation Standard

Since there is no environment quality standard for odor, the monitoring value for odor emission is evaluated based on *Integrated Air Pollutant Emission Standard*（GB16297-1996）Table 1 secondary standards.

6. Evaluation of Status Quo Monitoring Results

Monitoring results are listed in Appendix Table 3. Reference is made to the odor concentration limits specified in Class II standard indicated in Table 1 in the *Integrated Air Pollutant Emission Standard* (GB16297-1996). Results of this monitoring show that odor emission at Xiyue St. close to riverside residential areas along A7 Huangansi Drainage Canal dredging section and at Zhushan Rd. close to riverside residential areas along A8 Shizigang Drainage Canal dredging section exceeds the Class II standard indicated in Table 1 in the *Integrated Air Pollutant Emission Standard* (GB16297-1996) while the other monitoring sites meet the above standard.

According to site investigation, due to historical reasons, no sewer pipe network was constructed at Huangansi and Shizigang Drainage Canal sections and domestic wastewater from residents along He River was directly discharged into He River course without any treatment, causing deterioration of the water quality and odor emission, and relatively high odor concentration in He Riverside residential areas.

4.4.2. Status Quo Investigation and Evaluation of Water Environment Quality

According to the *Environmental Impact Evaluation Technology Guidelines for Surface Water Environment* (HJ2.3-1993), with the terrain features along He River taken into consideration, the Project involves the water systems of He River, Mawei River, Changlong River, Lining River, Shizigang River, East Trunk Canal, Dongwu Branch Canal, Huangansi Drainage Canal and Shizigang Drainage Canal. Status quo monitoring of water environment of the surface water in the region was conducted in July 2016 and May 2017 by a qualified monitoring unit authorized by the project owner while the monitoring data and results of Babu District EPB for key rivers in Babu District are quoted for the status quo of water quality in Mawei River. Details of regional surface water monitoring are described as follows:

1. Location of Monitoring sites and Monitoring Frequency

Location of the monitoring sites is shown in Figure 4-3.

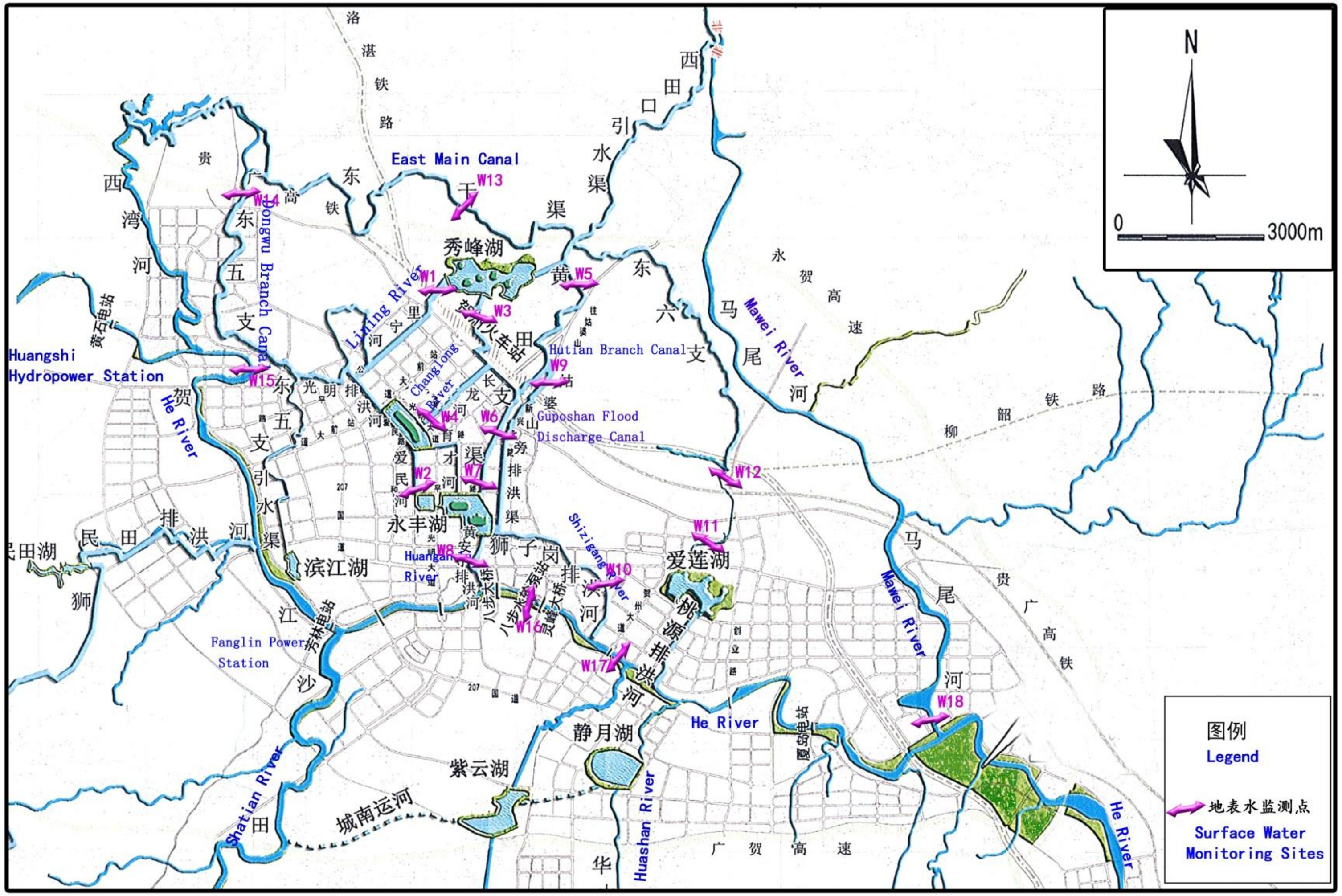


Figure 4-4 Layout Map of Surface Water Status Monitoring Sites

Table 4-6 Location of Surface Water Monitoring Sites in the Project

No.	Monitoring Location	Monitoring Time	Monitored Items
1	W1 Lining River start point section	2016.6.6~2016.6.8 Continuous sampling for 3 days, 1 sampling each day	22 items including pH, DO, COD_{Mn}, BOD5, COD, TSS, NH3-N, TP, Petroleum, Volatile Phenol, Cyanide, Anionic surfactant, Sulfide, Copper, Zinc, Lead, Cadmium, Arsenic, Chromium 6, Mercury.
2	W2 Lining River and Huangtian Branch Canal confluence point front section		
3	W3 Changlong River start point section		
4	W4 Changlong River Tianbaotang section		
5	W5 Huangtian Branch Canal start point section		
6	W6 Huangtian Branch Canal Anshan village section		
7	W7 Huangtian Branch Canal Shizigang section		
8	W8 Huangansi River Jianshezhong Rd. section		
9	W9 Shizigang River start point section		
10	W10 Shizigang River Wangjiang section		
11	W11 Taoyuan River Dawodu section		
12	W12 Guishidongliu Branch Canal Nanshetang section		
13	W13 Guishidong Trunk Canal section		
14	W14 Guishidongwu Branch Canal start point section		
15	W15 He River Jigong Island section		
16	W16 He River Babu Bridge section		
17	W17 He River Lingfeng Bridge section		
18	W18 Mawei River and He River confluence front section	2017.3.21, 2017.6.27 1 sampling each day	

2. Monitoring Methods

Sampling methods are adopted from the *Technical Specifications on Environment Monitoring* published by Ministry of Environmental Protection. The water quality analysis methods are adopted from *Surface Water Environmental Quality Standard* (GB3838-2002) Table 4. Details are listed in Table 4-7.

Table 4-7 Analysis Methods for Basic Items of Surface Water Environmental Quality Standard

No.	Monitoring Items	Analysis Methods	Detection Limits（mg/L）	Source of methods
1	pH	Glass electrode method	0.01pH	GB/T6920-1986
2	DO	Iodometric method	0.2	GB/T7489-1987
3	TSS	Gravimetric method	4	GB11901-1989
4	COD_{Mn}	Determination of permanganate index	0.5	GB/T11892-1989
5	BOD_5	Dilution and inoculation method	0.5	HJ505-2009
6	COD	Fast confined catalytic digestion-spectrophotometer (including spectrophotometer)	5	*Methods for Monitoring and Analysis of Water and Wastewater* (4th Edition)
7	NH3-N	Nessler's reagents spectrophotometer method	0.025	HJ535-2009
8	TP	Ammonium molybdate spectrophotometric method	0.01	GB/T11893-1989
9	TN	Alkaline persulphate digestion UV spectrophotometer	0.05	HJ636-2012
10	Petroleum	Infrared spectrophotometric method	0.01	HJ637-2012
11	Volatile Phenol	4-AAP spectrophotometric method	0.0003	HJ503-2009
12	Cyanide	Spectrophotometric method	0.004	HJ484-2009
13	Anionic surfactant	Ethylene blue spectrophotometric method	0.05	GB7494-1987
14	Sulfide	Ethylene blue spectrophotometric method	0.005	GB/T16489-1996
15	Chromium 6	1,5-diphenylcarbazide spectrophotometric method	0.004	GB/T7467-1987
16	Copper（Cu）	Inductively coupled plasma mass spectrometry	0.00008	HJ700-2014
17	Cadmium（Cd）		0.00005	
18	Lead（Pb）		0.00009	
19	Zinc (Zn)		0.00067	
20	Arsenic (As)	Atomic fluorescence spectrometry	0.0002	HJ694-2014
21	Mercury		0.00001	

3. Evaluation Standard

Water quality in He River and Mawei River shall meet *Class III standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*. All rest of the flood discharge rivers and rivers within the city shall meet Class IV standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002) , which means W15~W19 shall meet Class III surface water standard, W1~W14 shall meet Class IV surface water standard.

4. Evaluation Methods

Single factor evaluation method is used for evaluation. The formula is:

$$S_{ij}=C_{ij}/C_{si}$$

Where:

S_{ij}——the standard index of pollutant i at monitoring point j, standard index larger than 1 indicates water is polluted by pollutant I;

C_{ij}——concentration of pollutant i at monitoring point j;

C_{si}——surface water quality standard of water quality parameter i.

The standard index of DO is:

$$S_{DO,j} = 10 - 9\frac{DO_j}{DO_s} \qquad DO_j < DO_s$$

$$S_{DO,j} = \frac{\left|DO_f - DO_j\right|}{DO_f - DO_s} \qquad DO_j \geq DO_s$$

Where:

S_{DOj}——water quality index of DO;

DO_f——saturated DO level, mg/L;

DOs——DO standard，mg/L；

DO_j——measured level of DO，mg/L；

$DO_f=468/(31.6+T)$；

T——water temperature，℃。

Water quality index of pH is:

$$S_{pH,j} = \frac{7.0 - pH_j}{7.0 - pH_{sd}} \qquad pH_j \leq 7.0 \; S_{pH,j} = \frac{pH_j - 7.0}{pH_{su} - 7.0} \qquad pH_j > 7.0$$

Where:

$Sp_{H，j}$——pH water quality index；

pH_j——measured pH；

pH_{su}——pH upper limit of surface water quality standard;

pH_{sd}——pH bottom limit of surface water quality standard;

Standard index of water quality parameter greater than 1 indicates that the water quality parameter exceeds the limits specified in the water quality standard; a greater standard index of water quality parameter indicates a more severe noncompliance with the water quality standard.

5. Monitoring Results and Evaluation Conclusion

Monitoring results for surface water are listed in Table 4 as attached while the evaluation results are described in Table 5

(1) Analysis of water quality monitoring results for urban canal

Lining River: The water quality at W1 Lining River start point section and W2 Lining River and Huangtian Branch Canal confluence point front section meets *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)* and the water quality in Lining River meets Class IV quality standard for surface water.

Changlong River: All the monitoring items at W3 Changlong River start point section meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*; NH_3-N and TP at W4 Changlong River Tianbaotang section exceed *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*; NH_3-N exceeds the standard by a factor of 0.01 and TP by a factor of 0.5.

Meanwhile, the TP at W4 Changlong River Tianbaotang section exceeds *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002) while the* water quality at Changlong River is worse than Class V.

Huangtian Branch Canal: All the monitoring items at W5 Huangtian Branch Canal start point section meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*; NH_3-N and TP at W6 Huangtian Branch Canal Anshan village section exceed *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*, NH_3-N exceeds the standard by a factor of 3.31 and TP exceeds the standard by a factor of 0.83. NH_3-N at W7 Huangtian Branch Canal Shizigang section exceeds *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)* by a factor of 0.89.

Meanwhile, NH_3-N and TP at W6 monitoring section, NH_3-N at W7 monitoring section exceed Class V standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002) while the water quality in Huangtian Branch Canal is worse than Class V.

Huangansi River: NH_3-N and TP at W8 Huangansi River Jianshezhong Rd. section exceed *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002), with* NH_3-N exceeding the standard by a factor of 0.9 multiplier and TP by a factor of 0.07.

Meanwhile, NH_3-N at monitoring section exceeds Class V standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002) and the water quality in Huangansi River is worse than Class V standard.

Shizigang River: All the monitoring items at W9 Shizigang River start point section meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)*; NH_3-N and TP at W10 Shizigang River Wangjiao section exceed *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002), with* NH_3-N exceeding the standard by a factor of 3.85 and TP by a factor of 0.47.

Meanwhile, NH_3-N and TP at W10 monitoring section exceed Class V standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002)and the water quality in Shizigang River is worse than Class V, with water pollution in the downstream section worse than the upstream.

Guishidong Trunk Canal: All the monitoring items at W13 cross section of Guishidong Trunk Canal meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002) and the* water quality at Guishidong Trunk Canal meets Class IV standard.

East Trunk Canal No.5 Branch Canal: All the monitoring items at W14 Guishidongwu Branch Canal start point section meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002)* and the water quality at East Trunk Canal meet Class IV standard.

In summary, water quality in Lining River, Guishidong Trunk Canal and East Trunk Canal No.5 Branch Canal meet *Class IV standard specified in the Surface Water Environmental Quality Standard (GB3838-2002);* water quality in Changlong River, Huangtian Branch Canal, Huangansi River and Shizigang River is worse than Class V, indicating that these rivers are severely polluted mainly for the following reasons: The water systems of Changlong River, Huangtian Branch Canal, Huangansi Drainage Canal and Shizigang Drainage Canal do not only perform the function of flood discharge, they also accept domestic wastewater from areas along He Rivers as drainage channels for industrial and domestic wastewater. The received domestic sewage has exceeded the self-purification capacity of He Rivers, causing deteriorated water quality in the urban canal water system.

(2) Analysis of water quality monitoring results of the main watercourse of He River and the tributary of Mawei River

He River: All the monitoring items at W15 He River Jigongzhou section, W16 He River Babu Bridge section and W17 He River Lingfeng Bridge section meet Class III standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002) , indicating that the water quality in He River meet Class III standard.

Mawei River: All the monitoring items at W18 Mawei River and He River confluence front section meet Class III standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002) , indicating that the water quality in Mawei River meet Class III standard.

In summary, water quality in He River and Mawei River meets Class III standard specified in the *Surface Water Environmental Quality Standard* (GB3838-2002).

4.4.3 Status quo investigation and evaluation of acoustic environment quality

1. Layout of monitoring sites

According to *Technical Guidelines for Noise Impact Assessment* (HJ 2.4-2009). monitoring was conducted at representative environmentally sensitive sites along the Project. Details of the locations of the monitoring sites are listed in Table 4-8 and Figure 4-4.

Table 4-8 Noise Monitoring sites

No.	Name of Monitoring Points	Description of Surrounding Environment
1	N1 Jigongzhou	Villages
2	N2 Tianchong Village	Villages
3	N3 Sanjia Elementary School	Villages
4	N4 Huzhou College	Located in urban area adjacent to National Highway G207
5	N5 Sanjia Village	Villages, adjacent to Fanglin Road
6	N6 Hezhou Municipality Experimental Elementary School	Adjacent to Wenyuan Road
7	N7 Wenyuanhuadu	Urban residents, adjacent to Fanglin Road
8	N8 Xiyue Street	Old urban residential area
9	N9 Hezhou Municipality Transportation Bureau	Adjacent to Jiangbeizhong Road
10	N10 Xiwan Elementary School	Xijie street residents committee (RC), surrounded by residents committee (RC) residents
11	N11 Lining Village	Villages
12	N12 Changlong Village	Villages
13	N13 Huangtian Township	Township residents, adjacent to Guposhan Avenue
14	N14 Pinggui No.3 Junior High School	Adjacent to Guposhan Avenue
15	N15 Qianjin Road Elementary School	Urban area, adjacent to Qianjin Road
16	N16 Babu District Experimental Elementary School	Urban area, adjacent to Qianjinxi Road
17	N17 Hezhou Municipality People’s Hospital	Urban area, adjacent to Qianjinxi Road
18	N18 Anshan Village	Suburban area, adjacent to Zhushan Road
19	N19 Guangji Obstetrics and Gynecology hospital	Urban area, adjacent to Guposhan Avenue
20	N20 Technician Training School	Urban area, adjacent to Anshanxi Road
21	N21 Hezhou Municipality Chinese Medicine Hospital	Urban area, adjacent to Longshan Road
22	N22 Baimian Mountain	Village
23	N23 Dawodu	Village

2. Monitoring Methods and Frequency

Noise measurement is carried out according to *Environmental Quality Standard for Noise* (GB3096-2008) in a weather condition with no rain, no snow and no thunder storm and a wind speed of less than 5m/s. Monitoring time was June 7th 2016~June 8th 2016, once each in day and at night. The monitoring hours are 6:00~22:00 in day time and 22:00~6:00 in night time.

3. Evaluation Methods

Monitoring sites in residential area on both sides of flood discharge river in the urban area of Babu District are located on one side of the main street and the applicable standard for the noise level at these monitoring sites is Class 4a in the *Environmental Quality Standard for Noise* (GB3096-2008). The local acoustic environment for hospitals, government offices and residential areas along He River shall meet Class 2 standard specified in the *Environmental Quality Standard for Noise* (GB3096-2008).

4. Conclusion of Noise Monitoring and Evaluation

Results of noise monitoring are listed in Table 6 as attached. Noise in day and night time at all sensitive sites along the Project meets the respective standard requirements in the *Environmental Quality Standard for Noise* (GB3096-2008), indicating that the project area is in a generally good condition in terms of acoustic environment quality.

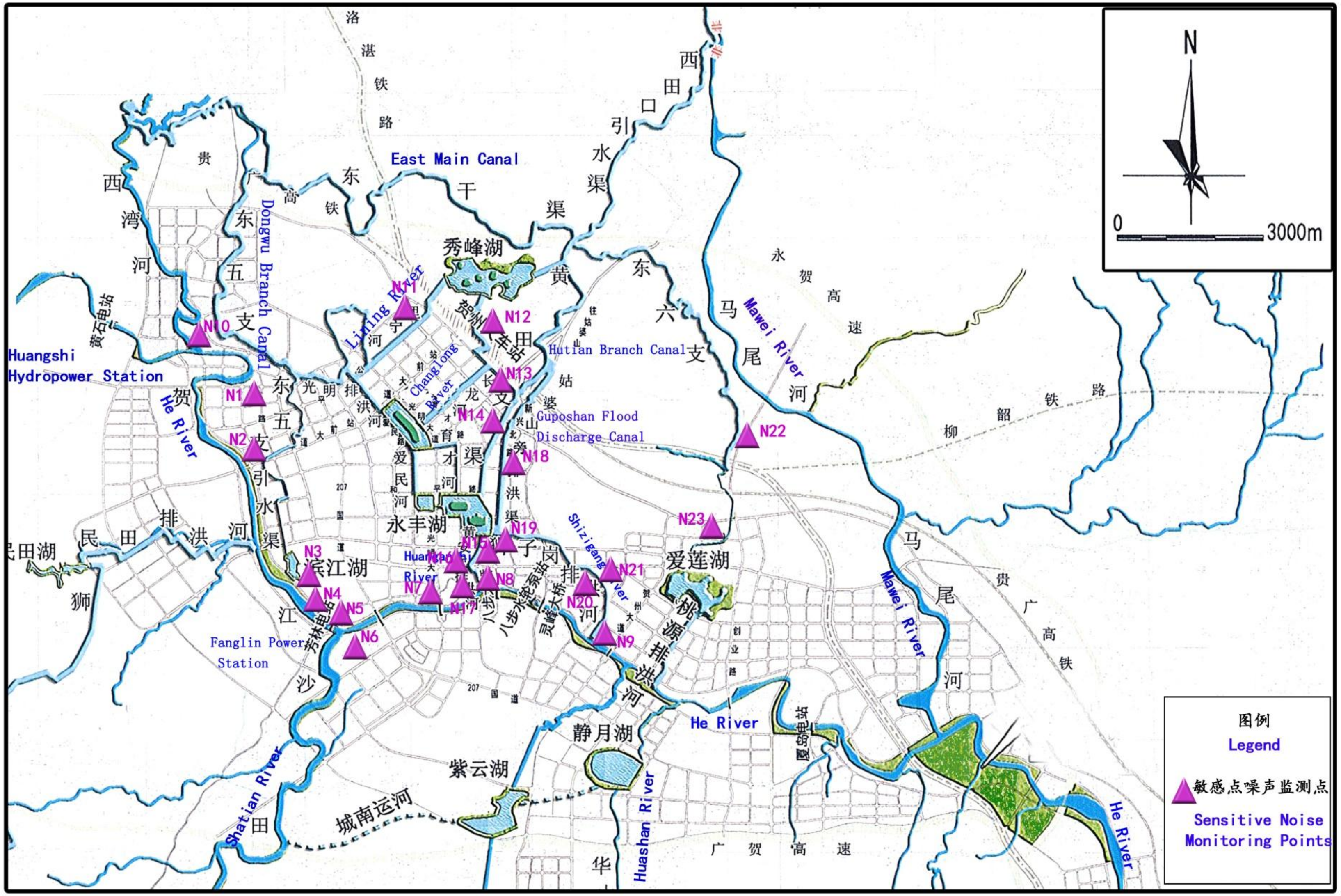


Figure 4-5 Layout Map of Sensitive Noise Monitoring Sites in the Project Area

4.4.4 Status Quo Investigation and Evaluation of Soil Environment Quality

1. Layout of monitoring sites

Based on the project characteristics and with the length and scope of impact of river dredging section taken into account, sites of investigation of the soil background value are mainly distributed along the dredging section of the main watercourse of He River with a total of 8 soil monitoring sites as listed in Table 4-9 and Figure 4-5.

Table 4-9 Soil Monitoring sites

Monitoring sites Location	Sampling Depth	Soil Characteristics
S21 500m upstream of Lingfeng Bridge (right bank)	20cm	Gray brown, loam
S22 1000m upstream of Lingfeng Bridge (right bank)	20cm	Brown, loam
S23-1 50m upstream of Fanglin Hydropower Station（left bank）	20cm	Yellow brown, loam
S23-2 50m upstream of Fanglin Hydropower Station（right bank）	20cm	Brown, loam
S24-1 1000m upstream of Fanglin Hydropower Station（left bank）	20cm	Brown, loam
S24-2 1000m upstream of Fanglin Hydropower Station（right bank）	20cm	Brown, loam
S25-1 2000m upstream of Fanglin Hydropower Station（left bank）	20cm	Brown, loam
S25-2 2000m upstream of Fanglin Hydropower Station（right bank）	20cm	Brown, loam

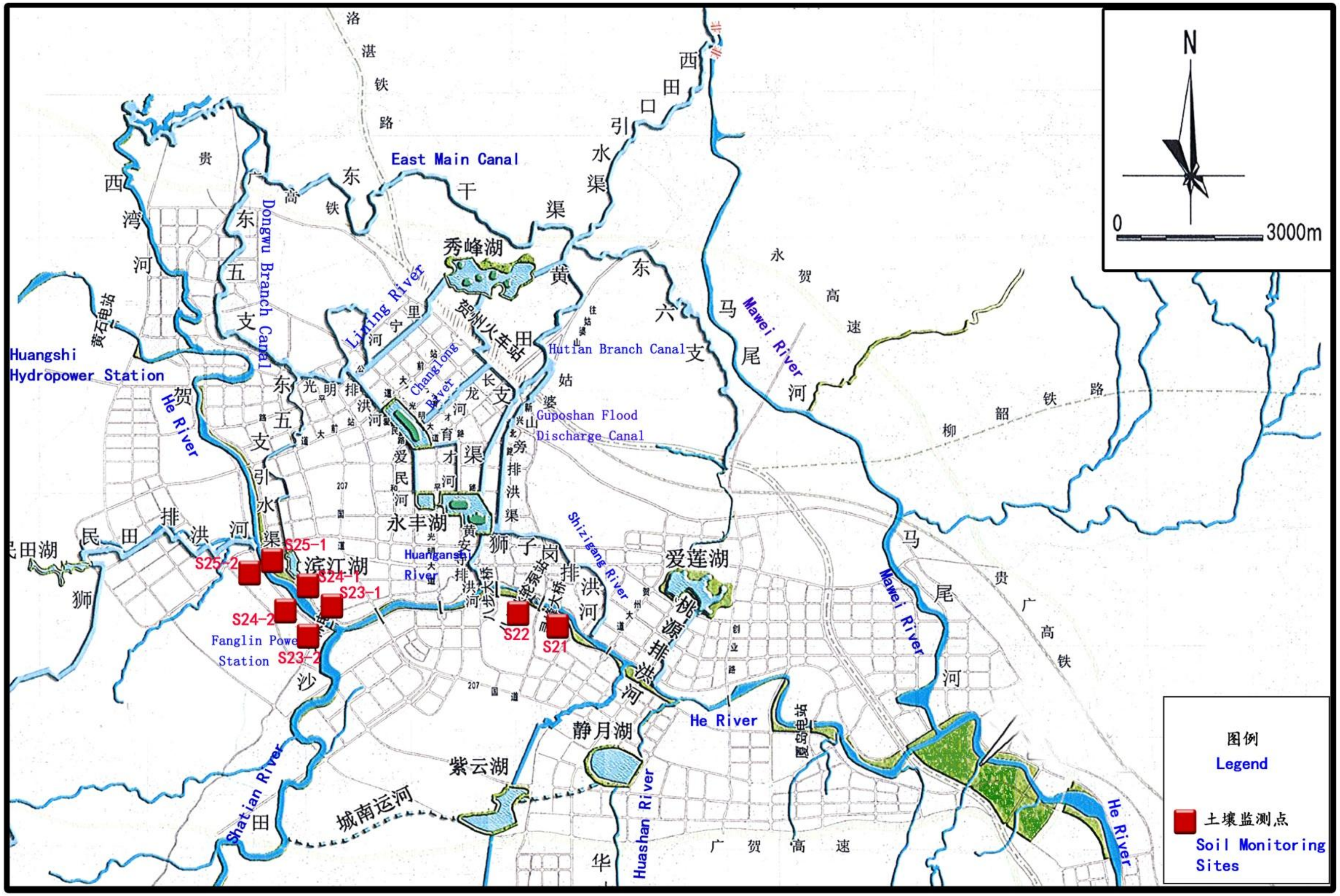


Figure 4-6 Layout Map of Soil Monitoring Sites in the Project Area

(2) Monitoring Items

Monitoring items: pH, Copper, Zinc, Lead, Chromium, Cadmium, Mercury and Arsenic.

(3) Monitoring and Analysis Methods

Soil monitoring and analysis is conducted according to the relevant stipulations in the *Technical Specification of Soil Analysis* and the Monitoring and Analysis Methods of *Soil Environment Quality*. The soil analysis methods and detection limits are listed in Table 4-10.

Table 4-10 Soil Monitoring Items and Analysis Methods

Type	Item	Analysis Methods and Source	Detection Limits
Substrate, Soil	pH	Determination of pH in soil, NY/T 1377-2007	0.1 pH
	Arsenic	Determination of total mercury, arsenic and lead in soil, Atomic Fluorometry GB/T 22105.2-2008	0.01mg/kg
	Mercury	Determination of total mercury, arsenic and lead in soil, Atomic Fluorometry GB/T 22105.2-2008	0.002mg/kg
	Cadmium	Determination of lead and cadmium in soil, Graphite furnace atomic absorption spectrophotometer, GB/T 17141-1997	0.01mg/kg
	Lead	Determination of lead and cadmium in soil, Graphite furnace atomic absorption spectrophotometer, GB/T 17141-1997	0.1mg/kg
	Copper	Determination of copper and zinc in soil, Flame atomic absorption spectrophotometer, GB/T 17138-1997	1mg/kg
	Zinc	Determination of copper and zinc in soil, Flame atomic absorption spectrophotometer, GB/T 17138-1997	0.5mg/kg
	Total Chromium	Determination of total chromium in soil, Flame atomic absorption spectrophotometer, HJ491-2009	5mg/kg

(4) Monitoring time and frequency

One sampling was conducted in the period from September 15th to September 17th, 2017.

(5) Evaluation Methods and Evaluation Standards

The evaluation is conducted according to Class II standard specified in the Environmental Quality Standard for Soils (GB15618-1995) using the single factor standard index method.

Formula： $P_i = C_i / S_i$

Where:

Pi——mass index of soil pollutant, Pi>1 means soil is polluted;

Ci——content of soil pollutant;

Si——evaluation standard.

(6) Monitoring results and evaluation

Monitoring and analysis results are listed in Table 7.

According to monitoring results, arsenic detected at S25 2000m upstream of Fanglin Hydropower Station (left bank) exceeds *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* by a factor of 1.5; arsenic and mercury detected in soil on the right bank exceeds Class III standard, with arsenic exceeding the standard by a factor of 1.63 and mercury by a factor of 1.9.

Cadmium, arsenic and mercury detected at S24 1000m upstream of Fanglin Hydropower Station (left bank) exceeds *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995) respectively by a factor of 0.29, 0.31 and 0.10.* Arsenic in soil on the right bank exceeds Class III standard by a factor of 0.45.

Soil at S23 50m upstream of Fanglin Hydropower Station (left bank) meet *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* ; Mercury at right bank exceeds Class III standard by a factor of 0.15.

Cadmium and arsenic at S22 300m upstream of Lingfeng Bridge (right bank) exceeded *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995), respectively by a factor of 0.06 and 0.05.*.

Soil at S21 500m downstream of Lingfeng Bridge meets *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* .

In summary, except the monitoring results of soil monitoring sites at S21 500m downstream of Lingfeng Bridge (right bank) and S23 50m upstream of Fanglin Hydropower Station (left bank), the soil quality detected at the monitoring sites at S25 2000m upstream of Fanglin Hydropower Station (left and right banks), S24 1000m upstream of Fanglin Hydropower Station (left and right banks) , S23 50m upstream of Fanglin Hydropower Station (left bank) , S22 1000m upstream of Lingfeng Bridge (right bank) does not meet *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* and the noncompliant monitoring items are Arsenic, Mercury and Cadmium.

Cause analysis: According to *Investigations of Background Values of a number of Metal Elements in the Agricultural Soil Environment in the Northeastern Parts of GZAR* published by Guangzhou Agricultural Environment Monitoring Station, the background values of copper, zinc, lead, cadmium and nickel are the highest in soil developed from limestone substrate and the background values of arsenic, mercury and cadmium are the highest in soil developed from quaternary red clay. Soil in Hezhou Municipality is mainly developed from quaternary red clay, which belongs to the karsts landform and limestone substrate is distributed in a certain proportion. Therefore, the background value of heavy metals is relatively high. According to 2014 *Report on Soil Environment Quality Monitoring in Areas around Centralized Drinking Water Sources in Hezhou Municipality,* the soil monitoring results at Hezhou Babu water intake point (the water intake located at 600m upstream of Guangming Bridge in Hezhou Urban area has already been cancelled) indicate that arsenic exceeds the standard by a factor of 1.70-7.30, implying that the background values of heavy metal factors in soil in the project area in Hezhou are relatively

high.

The results of this monitoring process further demonstrate that the background values of arsenic, cadmium and mercury in soil in the project area are high.

4.4.5 Investigation and Evaluation for Existing Condition of Sediment Environmental Quality

1. Layout of Monitoring sites

Based on the project characteristics and the length and scope of impact of He River dredging section, totally 15 sediment monitoring sites are distributed at upstream, midstream and downstream of He River dredging section as detailed in Table 4-10 and Figure 4-6.

Table 4-10 Layout of Sites and Frequency of Sampling for Sediment Monitoring

<table>
<tr><th>Watershed</th><th>Monitored Section</th><th colspan="2">Monitoring methods and monitoring items</th></tr>
<tr><td>He River</td><td>S1 100m downstream of He River and Huangansi River confluence
S2 Lingfeng Bridge
S3 100m downstream of He River and Shizigang River confluence</td><td rowspan="11">Based on sampling and analysis methods in Environmental Quality Standard for Soils (GB15618-1995), the monitoring items include pH, copper, zinc, lead, total chromium, cadmium, mercury and arsenic</td><td rowspan="11">According to Identification Standards for Hazardous Wastes- Screening Test for Leaching Toxicity (GB5085.3-2007), the monitoring items include lead, cadmium, mercury, arsenic and chromium 6.</td></tr>
<tr><td>East Trunk Canal</td><td>S4 East Trunk Canal dredging section</td></tr>
<tr><td>Dongwu Branch Canal</td><td>S5 Dongwu Branch Canal dredging section
S6 downstream of Dongwu Branch Canal dredging section</td></tr>
<tr><td>Dongliu Branch Canal</td><td>S7 Dongliu Branch Canal dredging section</td></tr>
<tr><td>Huangtian Branch Canal</td><td>S8 Huangtian Branch Canal dredging section</td></tr>
<tr><td>Guposhan Drainage Canal</td><td>S9 Guposhan Drainage Canal dredging section</td></tr>
<tr><td>Taoyuan Drainage Canal</td><td>S10 Taoyuan Drainage Canal dredging section</td></tr>
<tr><td>Huangansi Drainage Canal</td><td>S11 upstream of Huangansi Drainage Canal dredging section
S12 downstream of Huangansi Drainage Canal dredging section</td></tr>
<tr><td>Shizigang Drainage Canal</td><td>S13 upstream of Shizigang Drainage Canal dredging section
S14 midstream of Shizigang Drainage Canal dredging section
S15 downstream of Shizigang Drainage Canal dredging section</td></tr>
<tr><td rowspan="2">He River</td><td>S16 500m downstream of Lingfeng Bridge (right bank)</td></tr>
<tr><td>S17 300m upstream of Lingfeng Bridge (left and right bank)</td></tr>
</table>

Table 4-10 Layout of Sites and Frequency of Sampling for Sediment Monitoring

Watershed	Monitored Section	Monitoring methods and monitoring items	
	S18 50m upstream of Fanglin Hydropower Station (left and right bank)		
	S19 1000m upstream of Fanglin Hydropower Station (left and right bank)		
	S20 2000m upstream of Fanglin Hydropower Station (left and right bank)		

Note: During actual sampling, sediments detected at S18 upstream of Fanglin Hydropower Station (right bank) and S19 1000m upstream of Fanglin Hydropower Station (right bank) exceed 1m in depth and, therefore, vertical layered sampling was conducted at these 2 sections.

2. Monitoring Time and Frequency

Sampling time for S1~S15 is May 16th, 2017. S16~S20 are additional monitoring and the sampling time is September 15 to September 17, 2017. One sampling was conducted at each sampling point.

3. Monitoring and Analysis Methods

The same analysis methods and detection limits for soil monitoring are adopted for sediment as detailed in Table 4-10.

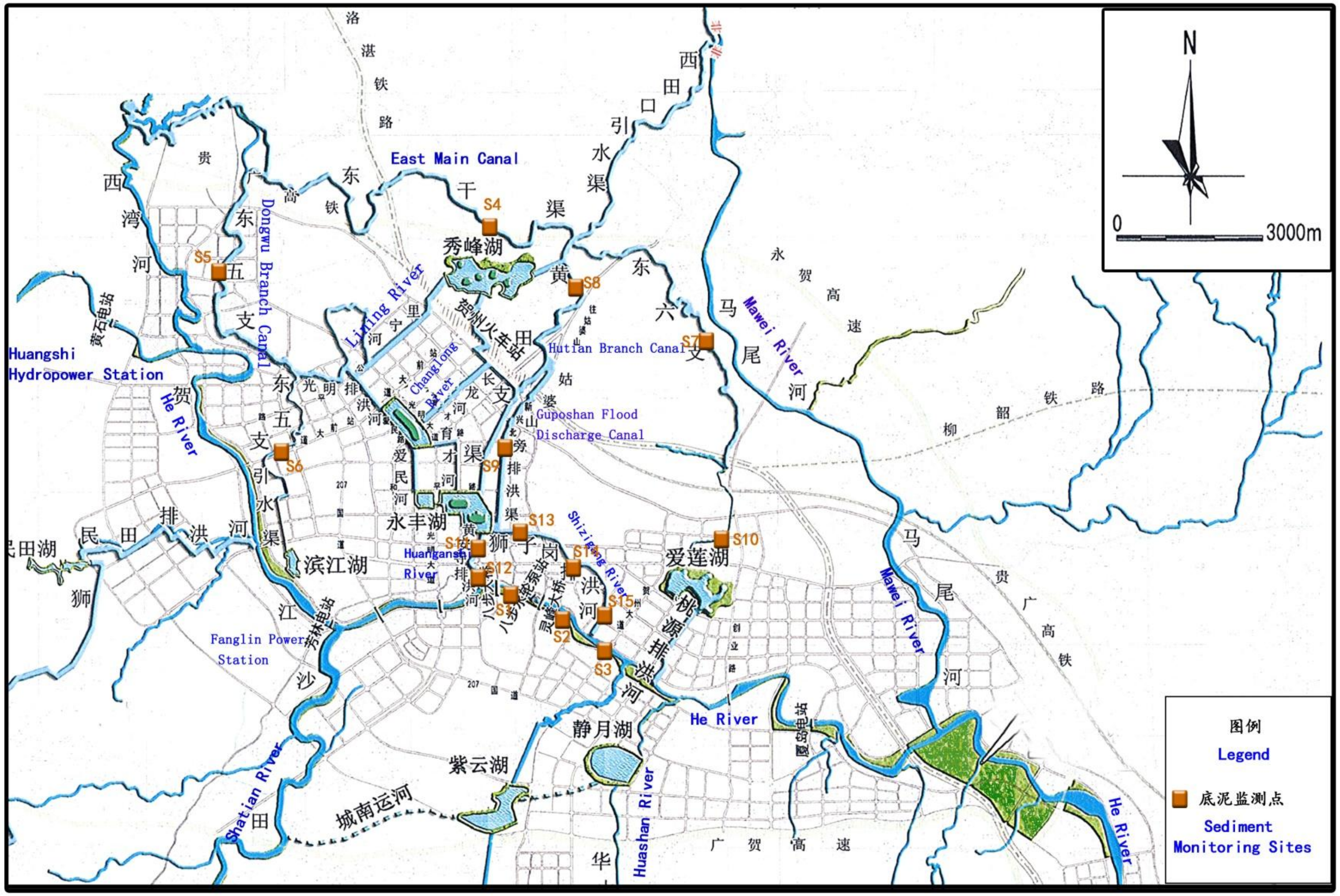


Figure 4-7 Layout Map of Existing Sediment Monitoring Sites

4. Evaluation Methods and Evaluation Standard

Single factor standard index method is used for the evaluation,

Formula : $P_i = C_i / S_i$

Where:

Pi —— mass index of soil pollutant, Pi>1 means soil is polluted;

Ci —— content of soil pollutant;

Si —— evaluation standard.

Environmental Quality Standard for Soils (GB15618-1995) Class III standard is used for evaluation standards.

5. Monitoring Results and Evaluation

Monitoring results are listed in Table 8. Based on sediment monitoring data, the sediment monitoring results at river dredging sections is analyzed as follows:

Dongwu Branch Canal dredging section: The monitoring item of arsenic at S4 upstream and downstream of Dongwu Branch Canal dredging section exceeds Class III standard by a factor of 0.435 at the upstream section and 0.863 at downstream section.

Huangtian Branch Canal: The monitoring items of cadmium and arsenic at S7 Huangtian Branch Canal dredging section exceed Class III standard requirement, with cadmium exceeding the standard by a factor of 1.38 and arsenic by a factor of 0.063.

Guposhan Drainage Canal: Te monitoring items of cadmium and arsenic at S9 Guposhan Drainage Canal dredging section exceed Class III standard, with cadmium exceeding the standard by a factor of 0.91 and arsenic by a factor of 0.6.

Huangansi Drainage Canal: The monitoring items of zinc, cadmium and arsenic at Huangansi Drainage Canal dredging section exceed Class III standard. At S11 upstream of Huangansi Drainage Canal dredging section, zinc exceeds the standard by a factor of 0.19, cadmium by a factor of 1.93, arsenic by a factor of 0.41 at S11 while at S12 downstream of Huangansi Drainage Canal dredging section, zinc exceeds the standard by a factor of 0.09, cadmium by a factor of 1.73 and arsenic 0.555.

Shizigang Drainage Canal: The monitoring item of arsenic at S13 upstream of Shizigang Drainage Canal dredging section exceeds Class III standard by a factor of 0.275; the monitoring items of zinc, cadmium and arsenic at S14 midstream of Shizigang Drainage Canal dredging section exceed Class III standard respectively by a factor of 0.14, 1.12 and 1.135. At S15 downstream of Shizigang Drainage Canal dredging section, the monitoring items of zinc, cadmium, arsenic and mercury exceed Class III standard, respectively by a factor of 0.27, 1.6, 1.14 and 0.48.

He River dredging section: The monitoring item of arsenic at S1 100m downstream of Huangansi River confluence monitoring section exceeds Class III standard by a factor of 0.45; cadmium and arsenic at S2 Lingfeng Bridge He River section monitoring section exceed the standard respectively by a factor of 0.25 and 1.39; the monitoring item of arsenic exceeds the standard at S3 downstream of He River and Shizigang River confluence by a factor of 1.95.

East Trunk Canal dredging section: The monitoring item of arsenic at S4 East Trunk Canal dredging section exceeds the Class III standard by a factor of 1.875.

Analysis of supplementary monitoring results is as follows:

Lingfeng Bridge dredging section: All the monitoring items at S16 500m downstream of Lingfeng Bridge (right bank) meet *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* ;

All the monitoring items at S17 300m upstream of Lingfeng Bridge (left bank) meet Class III standard; the monitoring items of cadmium and arsenic at S17 300m upstream of Lingfeng Bridge (right bank) exceeds Class III standard by a factor of 0.14 and 0.25 respectively.

Fanglin Hydropower Station dredging section: The monitoring items of cadmium and arsenic at S18 50m upstream of Fanglin Hydropower Station exceed Class III standard respectively by a factor of 0.08 and 0.63; layered sampling was conducted for the sediment at S18 50m upstream of Fanglin Hydropower Station (right side) and the monitoring items of cadmium and arsenic exceed Class III standard by a factor of 0.42 and 0.463 respectively. Cadmium in lower layer sediment exceeds the standard by a factor of 1.24.

The monitoring item of arsenic at S19 1000m upstream of Fanglin Hydropower Station (left bank) exceeds Class III standard by a factor of 0.13; layered sampling was conducted for the sediment at S18 1000m upstream of Fanglin Hydropower Station (right side) and the monitoring items of cadmium and arsenic exceed Class III standard respectively by a factor of 1.32 and 1.205, with cadmium in lower layer sediment exceeding the standard by a factor of 0.79 and arsenic 0.88.

The monitoring items of cadmium and arsenic at S20 2000m upstream of Fanglin Hydropower Station (left bank) exceed Class III standard respectively by a factor of 0.91 and 0.905; the monitoring items of cadmium and arsenic at S20 2000m upstream of Fanglin Hydropower Station (right bank) exceed Class III standard requirement respectively by a factor of 0.98 and 1.295.

In summary, the monitoring items of zinc, cadmium, arsenic and mercury at He River sediment monitoring sites in the Project are found unexceptionally exceeding *Class III standard specified in the Environmental Quality Standard for Soils (GB15618-1995)* . Standard noncompliance for heavy metals is relatively severe at Shizigang Drainage Canal, Huangansi Drainage Canal and upstream of Fanglin Hydropower Station dredging section.

Analysis of causes for standard noncompliance:

(1) According to the analysis in section 4.4.4, the background values of arsenic, cadmium and mercury in the soil in the project area are relatively high.

(2) Hezhou Municipality has rich mineral resources. With more than 60 proven mineral resources in its territory, Hezhou is known as the largest white marble mine in central and southern China and ranks the first in terms of the reserves of tungsten, tin, rare earth, veneer granite, and silicon stone in GZAR. Hezhou has a long history of mining and long-term scattered and small private mines have been the cause of direct discharge of untreated wastewater from mine pit, mining selection, metallurgical refinery and tailings into He River course. As a result of lasting accumulation of heavy metals and discharge into He River, heavy metal content in river sediment is found exceeding the standard.

6. Identification of Leaching Toxicity

In order to identify the sediment leaching toxicity and determine if the sediment is hazardous, monitoring was carried out for the sediment leachate based on *Identification Standards for Hazardous Wastes - Screening Test for Leaching Toxicity* (GB5085.3-2007). The monitoring items include lead, cadmium, mercury, arsenic and Chromium 6. Monitoring results are listed in Table 9 as attached.

According to monitoring data, Lead, Cadmium, Arsenic, Mercury, Chromium 6 in sediment leachate are all within the concentration limits for hazardous chemicals specified in *Identification Standards for Hazardous Wastes* (GB5085.3-2007), thus not belonging to hazardous waste, and can be disposed according to *Standard for Pollution Control of Sites for Storage and Disposal of General Industrial Solid Wastes* (GB18599-2001).

4.5 Pollution Sources in the Project Area

Situated at midstream and downstream of He River, Hezhou Municipality has rich water resources, which is the strong support for its industrial and agricultural development. Along with the acceleration of urbanization, discharge of domestic wastewater is increasing each year. At river sections near the urban area, in dry season, large amount of domestic sewage is directly discharged into He River, forming a pollution belt along He River. The estuaries of Huangansi Drainage Canal and Shizigang Drainage Canal at the northern part of city are the largest discharge outlets in urban area while the inland rivers accept wastewater along the urban section of He Rivers and finally join into He River.

4.5.1 Investigation on pollution sources of He River and its tributaries

According to site investigation and in association with the investigation materials on the existing condition of He River urban section pollution sources conducted by Hezhou Municipal EPB, there are the following pollution sources for the urban section of He River. The section from Fanglin Hydropower Station to Xiadao Power Station has a total length of 11km and there are a total of 44 stormwater and wastewater discharge outlets along He River. 2 of these outlets are industrial wastewater discharge outlets, namely, the Ecological Industrial Park discharge outlet and Guidong Electronics industrial wastewater discharge outlet (the two enterprises have self-built wastewater treatment stations and the effluent meets *Integrated Wastewater Discharge Standard* Class I standard before discharge into He River); the other 42 discharge outlets are combined sewer outlets (one of which is a temporary domestic wastewater treatment facility effluent outlet for Jiangnan District, which mainly collects domestic sewage from Jiangnan District and treats wastewater to meet Class I standard specified in the *Integrated Wastewater Discharge Standard* before discharged into He River; the rest of the outlets are all for direct discharge of wastewater). The main discharge outlet into He River urban section are Shizigang Drainage Canal, Huangansi Drainage Canal and the effluent outlet of Hezhou Municipal WWTP, accounting for 51.9% of the total discharges. Due to large flow in He River, the natural treatment capacity is high and currently, the water quality in He River urban section still meet Class III standard for surface water quality.

River Watershed of Mawei River is located in an agricultural farming area, with agricultural pollutants along He River flowing into He River with rainfall. Therefore, the NPS pollution is the main pollution source. Currently, land is undeveloped on both sides of He River and water quality in Mawei River meets Class III standard for surface water quality.

4.5.2 Water Quality Pollution is Severe in Inner Rivers

According to *Investigation Report on Black and Odorous Water Bodies in the Urban Area of Hezhou Municipality*, He Rivers where black and odorous water bodies are found in Hezhou urban area are mainly the downstream section of the main watercourses of Shizigang Drainage Canal and Huangansi Drainage Canal as well as their tributaries on the east side.

Due to historical reason, the control width of Shizigang and Huangansi Drainage Canals are relatively narrow within the project area and the flood control feature is difficult to achieve. In addition, there is no reserved regulation volume at the upstream sections and waterlogging can easily occur once there is a storm. Shizigang Drainage Canal is already channelized.

Huangansi Drainage Canal is the largest pollutant discharge outlet and there a large number of residential buildings along He River in the urban area, with combined domestic wastewater and stormwater collected, conveyed and discharged in combined sewers into He River. The east tributaries join the main watercourse at Gong Bridge Health Clinic and enter the densely populated residential area. Domestic wastewater directly discharged from the residential areas along He River is the main pollution source. Meanwhile, there are extensive farmland and residential areas surrounding the upstream of Huangansi River, with lotus root and rice as the major crops. Agricultural fertilizer and chemical residues flow into Huangansi River with surface runoff, causing extensive discharge of pollutants. In the meanwhile, decomposed organics from crops such as lotus root and rice also flow into Huangansi River along with surface runoff. The water quality in He River is worse than Class V water quality, causing severe black and odorous water body.

Shizigang Drainage Canal is the major drainage canal and one of the pollutant discharge outlets in urban area. There a large number of residential buildings along He River in the urban area, with combined domestic wastewater and stormwater collected, conveyed and discharged in combined sewers into He River. The water quality in He River is worse than Class V water quality, causing severe black and odorous water body.

Changlong River and Huangtian Branch Canal are for agriculture irrigation. However, since He River Watersheds are located in undeveloped urban area, large area of farmland and few residents are located along He Rivers, due to the underdeveloped infrastructure in the area, Changlong River and Huangtian Branch Canal serve as the drainage canal for the industrial and domestic wastewater along He Rivers and the water quality in He River is worse than Class V.

Artificial water diversion canals in Hezhou Municipality urban area include East Trunk Canal and Dongwu Branch Canal. The water supply is mainly diverted from Guishi Reservoir and used for irrigation along the canal. Land use along the canal mainly include farmland and dry land, with agricultural pollutants discharged into the canal along with rainfall, making NPS pollution as the major pollution source in this watershed.

5. Environmental Impact Assessment and Mitigation Measures

5.1 Environmental Impacts and Mitigation Measures during Construction

Based on the nature of project activities, environmental impacts for the construction period and operation period are identified respectively. Construction activities that will generate environmental impacts include earth excavation, earth and construction material transportation, watercourse widening, dike construction, dredging, hydropower station improvement and construction of WWTP and associated pipeline networks. Therefore, major environmental impacts during construction include soil erosion caused by excavation, exhaust emission and noise from transportation of earth and construction material on construction site and construction access roads, and wastewater discharge from construction camp and sediment dewatering facility and odor from dredging and temporary storage of dredged sediment. Additionally, social impacts include disturbance to local traffic by construction vehicles and Fanglin Hydropower Station improvement, impact to physical cultural resources (Xiyue Block and The Old Site of CCP Babu Special Branch) by He River rehabilitation, interference with railway from river-lake connection, and impact on existing farmland irrigation by Fanglin Hydropower Station improvement. Environmental impacts during construction will be assessed in these aspects. Particularly, as dredging will affect multiple environmental elements such as ambient air and water, dredging impacts and mitigation measures will be analyzed in a separate subsection.

5.1.1 Soil Erosion Analysis and Mitigation Measures

5.1.1.1 Analysis of Soil Erosion Impact

(i) Causes of Soil Erosion

Vegetation will be removed in the process of construction site clearing, leveling, watercourse widening, road construction and pipeline construction. Excavation of drainage foundation trench will lead to temporary earth storage; excavation and backfilling associated with watercourse and pipeline construction will change original landform and generate new unstable slope without vegetation. Affected by the aforesaid construction activities, surface erosion and gully erosion will be caused by rain in the project area.

(ii) Environment Impact of Soil Erosion

(a) Increased turbidity and impacts on water quality of the rovers

Soil will directly enter He River in the process of watercourse excavation and lead to high turbidity of river water and deteriorated water quality, if construction is not under good management. Waste soil generated from dike construction, site excavation or road construction will flow into He River through stormwater runoff and affect water quality especially in strong wind and heavy rain, if the soil is not cleaned in a timely manner or not properly covered.

(b) Loss of Land Vegetation, Decreased Land Production and Degraded Ecology

Affected by soil erosion associated with construction site clearing, surface runoff will carry more suspended solids, inorganic and organic substances into He River and cause degraded water function, adverse impact on aquatic environment for water supply and inconvenience of daily life of local residents. Decreased land production, degraded water body function and deteriorated ecological environment caused by soil erosion will hinder sustainable economic development in surrounding area.

5.1.1.2 Result of Soil Erosion Prediction

Prediction indicates that construction of the Project will disturb land area of 399.88 hm^2 and damage water and soil conservation facility of 294.38 hm^2. Quantity of waste soil that requires for permanent disposal is 1,273,400m^3. Soil loss during construction will total 136,787 tons. . Occurrence of soil erosion concentrates in construction period and concentrates in construction site of He River rehabilitation, temporary soil storage site, borrow area and waste soil disposal site.

5.1.1.3 Water and Soil Conservation Zone and Measures

(i) Water and Soil Conservation Zone

The water and soil conservation zone of the Project is divided into four Class 1 conservation zones, namely, flood risk control construction zone, urban drainage improvement construction zone, water quality improvement construction zone and temporary construction zone.

(ii) General layout of water and soil conservation measures

(a) Flood risk control construction zone

(1) He River Rehabilitation (Huangshi Hydropower Station to Guangming Bridge)

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 227,900m^3 surface soil, 227,900m^3 surface soil backfill, and construction of 15,123 m long bio-swale (already included in the technical design).

Greening measures: 330031 m^2 embankment slope covered with grass, 30246 m^2 planting of trees, bush and grass, and 60 m^2 vertical greening (already included in the technical design).

Temporary measures: temporary covering by 10,000m^2 dense-mesh net (newly

included in the technical design).

(2) He River Rehabilitation (Guangming Bridge to Lingfeng Bridge)

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 31300 m^3 surface soil, 31300 m^3 surface soil backfill, and construction of 750 m long bio-swale (already included in the technical design).

Greening measures: 99,030 m^2 embankment slope covered with grass, 750 m^2 planting of trees, bush and grass; 944m^2 for vertical greening; 1145m^2 for key area greening and 137998m^2 for greening in total (already included in the technical design).

Temporary measures: temporary covering by 1,000 m^2 dense-mesh net (newly included in the technical design).

(3) He River Rehabilitation (Lingfeng Bridge to Xiadao Hydropower Station)

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 35,100 m^3 surface soil, 35,100 m^3 surface soil backfill, and construction of 3,040 m long ecological swale (already included in the technical design).

Greening measures: 102,554 m^2 embankment slope covered with grass, 3,040 m^2 planting of trees, bush and grass, 64,441m^2 for greening (already included in the technical design).

Temporary measures: temporary covering by 7,000 m^2 dense-mesh net (newly included in the technical design).

(4) East Trunk Canal Rehabilitation and Connecting Trunk Canal and Mawei River

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

East Trunk Canal Rehabilitation

Structural measures: removal of 20,100 m^3 surface soil, 20,100 m^3 surface soil backfill, 12300m^2 for permeable bricks (already included in the technical design).

Greening measures: 62,424 m^2 three-dimensional geo-technical net embankment slope with grass, 16,343 m^2 for greenbelt and 99,492m^2 for greening (already

included in the technical design).

Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).

Flood Diversion Canal of East Trunk Canal

Structural measures: removal of 5,500 m^3 surface soil, 5,500 m^3 surface soil backfill, 5386m for ecological swale; 5386m^2 for permeable bricks (already included in the technical design).

Greening measures: 24267 m^2 three-dimensional geo-technical net embankment slope with grass, 5386 m^2 greening belt, 4200 m^2 landscaping and greening (already included in the technical design).

Temporary measures: temporary covering by 3,000 m^2 dense-mesh net (newly included in the technical design).

(b) Urban Drainage Improvement Construction Zone

(1) Huangansi Stormwater Pump Station

Cut slope and ground without vegetation being removed should be covered with dense-mesh net during construction, and temporary drainage channels and structures should be built on construction site.

Structural measures: 20 m long stormwater pipelines (already included in the technical design)

Temporary measures: 42 m long temporary earth drainage channel, 2 temporary sedimentation tanks, and temporary covering of dense-mesh net of 100 m^2 (newly included in the technical design)

(2) Shizigang Stormwater Pump Station

Cut slope and ground with vegetation being removed should be covered with dense-mesh net during construction, and temporary drainage channels and structures should be built on construction site.

Structural measures: 150 m long stormwater pipelines (already included in the technical design)

Temporary measures: 150 m long temporary earth drainage channel, 2 temporary sedimentation tanks, and temporary covering of dense-mesh net of 500 m^2 (newly included in the technical design)

(3) Lining River Rehabilitation

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 28,600 m^3 surface soil, 28,600 m^3 surface soil backfill (already included in the technical design).

Greening measures: 56146 m^2 three-dimensional geo-technical net embankment slope covered with grass, 9310 m^2 greening belt, 35,020 m^2 landscaping and greening (already included in the technical design).

Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design).

(4) Changlong River Rehabilitation

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 22,600 m^3 surface soil, 22,600 m^3 surface soil backfill, 6306m for ecological swale (already included in the technical design).

Greening measures: 47113m^2 three-dimensional geo-technical net embankment slope covered with grass, 7966 m^2 greening belt, 29,630 m^2 landscaping and greening (already included in the technical design).

Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design).

(5) Dongwu Branch Canal Improvement

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 45,000 m^3 surface soil, 45,000 m^3 surface soil backfill, 4270m for ecological swale, 18675m^2 for permeable bricks (already included in the technical design).

Greening measures: 113930 m^2 bush planting and 7685 m^2 greening (already included in the technical design).

Temporary measures: temporary covering by 15,000 m^2 dense-mesh net (newly included in the technical design).

(6) Huangtian Branch Canal Improvement

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: removal of 24,400 m^3 surface soil, 24,400 m^3 surface soil backfill, 18750m^2 for permeable bricks (already included in the technical design).

Greening measures: 54260m^2 three-dimensional geo-technical net embankment slope covered with grass, 14880m2 for greenbelt and 45000 m^2 for landscaping (already included in the technical design).

Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design).

(7) Guposhan Drainage Canal Improvement

Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction.

Greening measures: 6000 m^2 for landscaping (already included in the technical design).

Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).

(c) Water Quality Improvement Construction Zone

(1) Huangansi Drainage Canal Rehabilitation

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and land surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: 6,500 m^3 surface soil backfill (already included in the technical design).

Greening measures: 21,528 m^2 greening, and 1,920 m^2 wetland planting (already included in the technical design).

Temporary measures: temporary covering by 3,000 m^2 dense-mesh net (newly included in the technical design).

(2) Shizigang Drainage Canal Rehabilitation

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and land surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.

Structural measures: 3,990 m long bio-swale, 2,247 m long covered drainage channel, and 9,000 m^3 surface soil backfill (already included in the technical design).

Greening measures: 23,340m^2 three-dimensional geo-technical net embankment slope covered with grass, 30,057 m^2 greening, and 3,990 m^2 wetland planting (already included in the technical design).

Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (newly

included in the technical design).

(3) Jiangnan WWTP and Associated Pipeline Construction

Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Temporary drainage channels and other drainage structures should be built on site.

Structural measures: removal of 5,000 m^3 surface soil, 5,000 m^3 surface soil backfill and 800 m long stormwater pipelines (already included in the technical design).

Greening measures: 0.96 hm^2 landscaping and greening (already included in the technical design).

Temporary measures: 880 m long temporary earth drainage channel, 4 temporary sedimentation tanks, and temporary covering by 1,000 m^2 dense-mesh net (newly included in the technical design).

(4) Binjiangnan Road Construction

Surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Temporary drainage channels and other drainage structures should be built on site.

Structural measures: removal of 99500 m^3 surface soil, 99500 m^3 surface soil backfill and 5,560 m long stormwater pipelines (already included in the technical design).

Greening measures: 146126m^2 vegetated slope and 21770m^2 road greening (already included in the technical design).

Temporary measures: 11,120 m temporary earth drainage channel, 20 temporary sedimentation tanks, and temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).

(d) Temporary Construction Zone

(1) Construction access roads

Surface soil should be removed and be stored in temporary storage site in The main watercourse of He River rehabilitation zone, and temporary drainage and sedimentation structures should be built along both sides of the road. The site should be restored at the end of the construction stage.

Structural measures: removal of 41600 m^3 surface soil, 41600 m^3 surface soil backfill and 20.82 hm^2 for land rehabilitation (newly included in the technical design).

Greening measures: 5.12 hm^2 for forest land restoration and 7.04 hm^2 for grass land restoration (newly included in the technical design).

Temporary measures: 138,660 m temporary earth drainage channel, and 139 temporary sedimentation tanks (newly included in the technical design).

(2) Construction Site and Camp

Surface soil should be removed and be stored in designated storage site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary material storage site should be covered during and restored at the end of the construction stage.

Structural measures: removal of 9,000 m^3 surface soil, 9,000 m^3 surface soil backfill and 4.50 hm^2 for land rehabilitation (newly included in the technical design).

Greening measures: 0.11 hm^2 garden plot restoration and 2.71 hm^2 grass land restoration (newly included in the technical design).

Temporary measures: 4,685 m temporary earth drainage channel, and 26 temporary sedimentation tanks, and 7,700 m^2 dense-mesh net (newly included in the technical design).

(3) Temporary Soil Storage Site

Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored at the end of the construction stage.

Structural measures: 18.05 hm^2 for land rehabilitation (newly included in the technical design).

Greening measures: 4.31 hm^2 forest land restoration, 1.38hm^2 garden restoration and 2.22 hm^2 grass land restoration (newly included in the technical design).

Temporary measures: installation and removal of 8,658 m long temporary straw bag stuffed with soil, 5,758 m temporary earth drainage channel, and 53 temporary sedimentation tanks, and 206,250 m^2 dense-mesh net (newly included in the technical design).

(4) Borrow Area

Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage channels and structures should be built around the site. The borrow area should be restored at the end of the construction stage through surface soil backfill and vegetation replanting.

Structural measures: removal of 11,080 m^3 surface soil, 11,080 m^3 surface soil backfill, 36.95 hm^2 for land rehabilitation, 3,800 m long brick masonry drainage channel, and 15 brick masonry sedimentation tanks (newly included in the technical design).

Greening measures: 36.95 hm^2 grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design).

Temporary measures: 1,000 m retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design).

(5) Waste Disposal Site

Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage channel and various drainage structures should be built around the site. The disposal site should be restored at the end of the construction stage through surface soil backfill and vegetation replanting.

Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3 for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage channel, and 4 brick masonry sedimentation tanks (newly included in the technical design).

Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (newly included in the technical design).

Temporary measures: installation of 2,000 m^2 dense-mesh net (newly included in the technical design).

(6) Mud transfer tanks

Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches.

5.1.2 Analysis of Social Impacts and Mitigation Measures

5.1.2.1 Land Acquisition and Resettlement Impacts and Mitigation Measures

Resettlement will inevitably affect daily life of residents in the project area in certain period of time. The IAs will provide resettlement compensation in cash and will work with local governments to make proper arrangements in accordance with concerned policies to ensure livelihood of the relocated residents to avoid social issues. Details of social impacts and mitigation measures associated with land acquisition and resettlement are given in Section 8 of this report and Resettlement Action Plan of the Project.

5.1.2.2 Impact on Railway Operation Safety and Mitigation Measures

Dongwu branch canal and Lining River, under Improving Urban Drainage and

Wastewater Management component, cross existing Gui-Guang high-speed railway. As required by urban area flood control safety program, rehabilitation of Dongwu branch canal and Lining River will be needed as below:

Jacking of two-hole culvert with size of 3.0 m in width, 2.2 m in height and 26 m in length will be done at intersection of Dongwu branch canal and Gui-Guang high-speed railway, located at DW0+628 to DW0+655. Construction platform is 40 m in length and 11 m in width, located at DW0+588 to DW0+628. Affected width of culvert jacking is same as width of the construction platform.

Jacking of three-hole culvert with size of 3.7 m in width, 2.0 m in height and 122.5 m in length will be done at intersection of Lining River and Hezhou Railway Station, located at LN1+025 to LN1+147.5. Construction platform is 140 m in length and 16 m in width, located at LN0+885 to LN1+025. Affected width of culvert jacking is same as width of the construction platform.

In accordance Regulation on Railway Transportation Safety Protection, the DI is coordinating with the railway authority, Nanning Railway Bureau, and the final construction program will be approved by Nanning Railway Bureau before put into implementation.

5.1.2.3 Impact on Public Traffic and Mitigation Measures

Soil, construction material (sand, cement) and waste soil storage and transportation during construction will increase local traffic flow, occupy existing road, and cause traffic congestion and access difficulty. Pipeline construction has significant impact to local traffic. Temporary earth storage associated with pipeline construction during construction will have significant traffic impact. Open excavation for laying road-crossing wastewater interception pipelines will interrupt road traffic and cause significant traffic impact. Construction activities that affect daily life of the residents include foundation excavation, excavation and pipeline laying, backfilling, and road excavation and occupation, which will reduce urban road surface, decrease traffic capacity, lead to road blockage and congestion, traffic inconvenience of local residents, and also will affect social economy to some extent.

Particularly, occupation of school access road will cause access difficulties of students, school staff and parents and may affect access safety of the students and normal school activities, including Hezhou College, Pinggui No.3 Middle School, Hezhou Pilot Middle School and Xiadao Primary School in urban area.

Rehabilitation of Fanglin Hydropower Station includes improvement of existing river-crossing gate dam (combination of gate dam and bridge) and connection of bridge approach and upstream and downstream dike. Fanglin Bridge will be closed during construction in order to ensure construction and traffic safety, and access of nearby residents in Fanglin Street and Tianchang Village south to Fanglin Bridge will be affected.

The following measures should be taken to avoid public traffic impact caused by construction activities:

1. For construction activities that will affect public traffic, construction program should be provided to public traffic authority in advance for arrangements for adjusting public traffic route, and construction cannot commence until permission is obtained.

2. Signs should be set on construction site before construction indicating construction description and schedule, requesting public understanding of inconvenience caused by construction activities, and disclosing contact information and complaint hotline. This information could be disclosed in advance through media, micro-blog and wechat, as possible.

3. Excavation and backfilling should be done by zone.

4. Temporary access roads should be built when construction site is near public facilities like bus stop. Material transportation should be scheduled to avoid peak hours to reduce peak traffic volume. Separate construction access road should be built for construction in rural area to avoid use of rural road and damage of rural road by oversize equipment and vehicle.

5. Pipeline construction should avoid peak hours or traffic diversion and adjustment should be done by traffic police in peak hours to mitigate traffic congestion and ensure convenience of pedestrians to minimize traffic impact to local residents.

6. Training on construction management and environmental protection should be strengthened.

   For construction near school, traffic diversion and adjustment should be done by traffic police in peak hours of the school, and temporary traffic lights and other signs should be set. During construction of Fanglin Hydropower Station improvement, travel from Fanglin Street and Tianchang Village to area north of He River will be re-routed along Fanglin Road, G207 and Sanjia Bridge or through Mintian rural road and Bahuang Class 2 road. Traffic re-routing plan is subject to approval of traffic police and road closing and re-routing signs will be posted.

5.1.2.4 Impact on Underground Pipelines

Foundation excavation may interfere with existing underground pipelines and damage of existing pipelines will affect daily life of the residents. Based on existing pipeline survey, existing pipelines that will be possibly affected by project construction activities are listed in **Table 5-1**.

Table 5-1 Associated Underground Pipelines of the Project

SN	Construction Works	Location of Concerned Pipelines	Type of Pipelines
1	He River	23 m upstream of Sanjia Bridge	Water Supply Pipeline

Table 5-1 Associated Underground Pipelines of the Project

SN	Construction Works	Location of Concerned Pipelines	Type of Pipelines
	Rehabilitation		
2	Shizigang Stormwater Pump Station	Babu District Transport Bureau on Middle Jiangbei Road	Water Supply Pipeline, combined stormwater and sewage pipeline, TV cable, street light cable
3	Lining River Rehabilitation	Intersection of Lining River and Zhanqian Road	Street light cable, TV cable
4	Changlong River Rehabilitation	Intersection of Changlong River and Guangming Road	Street light cable, TV cable
5	Guposhan Drainage Canal Improvement	East of Guposhan Road	Water Supply Pipeline, TV cable
6	Dongwu Branch Canal Improvement	Intersection with G207 Road	Water supply pipeline, natural gas pipeline, combined stormwater and sewage pipeline, electricity, communication, TV and street light cables
7	Huangansi Drainage Canal Rehabilitation	Intersection with Badaxi Road	Natural gas pipeline, water supply pipeline, TV cable, street light cable, combined stormwater and sewage pipeline, communication cable
		Intersections with Qianjin Road and middle Jianshe Road	Combined stormwater and sewage pipeline, communication, electricity and street light cables, water supply pipeline, TV cable
8	Shizigang Drainage Canal Rehabilitation	Intersection with Guposhan Road	Water Supply Pipeline, TV cable, communication cable, combined stormwater and sewage pipeline, street light cable, natural gas pipeline
		Intersection with Wanquan Street	Water Supply Pipeline
		Intersection with Zhushan Road	Street Light cable
		Intersection with Bada Road	combined stormwater and sewage pipeline, TV cable, water supply pipeline, street light cable, communication cable, natural gas pipeline
		Yinhe Street section	Street light cable, combined

Table 5-1 Associated Underground Pipelines of the Project

SN	Construction Works	Location of Concerned Pipelines	Type of Pipelines
			stormwater and sewage pipeline,
		Intersection with middle Jianshe Road	TV cable, water supply pipeline, communication cable, combined stormwater and sewage pipeline, street light cable, electricity pipeline
		Intersection with Pinganxi Road (Municipal Land Resources Bureau)	TV cable, water supply pipeline, communication cable, combined stormwater and sewage pipeline, street light cable, electricity pipeline, natural gas pipeline
		Intersection with Longshan Road	TV cable, water supply pipeline, communication cable, combined stormwater and sewage pipeline, street light cable, natural gas pipeline
		Intersection with West Anshan Road	TV cable, natural gas pipeline , combined stormwater and sewage pipeline, street light cable, communication cable, water supply pipeline
		Intersection with Xingguang Road	Communication cable, electricity pipeline, TV cable, street light cable, water supply pipeline, combined stormwater and sewage pipeline
		Intersection with Pinganxi Road (Municipal Water Resources Bureau)	Communication cable, TV cable, street light cable, water supply pipeline, combined stormwater and sewage pipeline, natural gas pipeline
		Intersection with middle Jiangbei Road	Same as Shizigang Stormwater Pump Station

The following mitigation measures should be required to avoid impact of pipeline interruption to daily life of residents caused by excavation for pipeline construction.

1. The contractor should further coordinate with municipal and urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment and depth, and establish pipeline coordination team. Prior approval should be obtained from municipal and urban development authorities for excavation interfering with underground pipelines.
2. Construction plan and emergency response plan should be developed based on pipeline alignment and depth to avoid interference with existing underground

pipelines as much as possible.

3. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities to be prepared for emergency responses.

5.1.2.5 Impact of Fanglin Hydropower Station Improvement on Irrigated Area and Mitigation Measures

Based on investigation, Fanglin Hydropower Station has irrigation function to some extent. Relying on high water level contributed by barrage, river water can flow to irrigation channels through diversion culverts by gravity. Irrigation area of Fanglin Hydropower Station covers about 400 mu dry and paddy field in Tianchang Village, 200 mu farmland in Mintian Village and 1,000 mu farmland in Fanglin Village on the right bank. Crops on the farmland include corn, rice, peanut, sweet potato, vegetable and water chestnut. As water level will decrease due to removal of gate dam during Fanglin Hydropower Station improvement and river water cannot flow to the farmland by gravity, farmland irrigation of Tianchang, Fanglin and Mintian villages will be affected.

In order to ensure normal irrigation of paddy and dry farmland in Tianchang, Fanglin, and Mintian villages on the right bank, project design includes new construction of a small-sized irrigation lift station with cost of CNY 4 million. River water will be lifted by three pumps with designed delivery head of 30 m and distance of 800 m and diverted to irrigated area in Tianchang, Fanglin and Mintian villages through existing water diversion culverts and channels.

5.1.2.6 Impact of Covered to Open Canal and Mitigation Measures

Rehabilitation of Shizigang Drainage Canal includes the restoration of existing covered canal into open canals. The precast slabs covering the existing canal under Yinhe Street will be removed; parking lot of Hezhou Municipal Land Resources Bureau will be partly excavated; pavement of the internal roads in the sites of the office and staff dormitory buildings of Guidong Power Company will be demolished to restore the covered canals with a length of 350 m, 100 m and 150 m respectively at these sites into open canals. Buildings/structures affected are temporary shops constructed over the precast-slab covered canal on Yinhe Street, existing parking lot over the covered canal in the Land Resource Bureau office area, and office and staff dormitory buildings and roads of Guidong Power Company. During the restoration of the covered canals to open canals, traffic on major roads in this area will not be interrupted, including Badaxi Road, Jianshezhong Road, Pinganxi Road and Jianshedong Road. During construction, residents in Yinhe Street have to make a detour of 100 m to Badaxi Road to cross the canal, and internal access in residential area of Guidong Power Company will be affected and Jianshedong Road will be relied on as before for going out. Business of shops in Yinhe Street will not be restored after change of the canal, and income of the shop owners will be affected. Part of the parking lot of Hezhou Municipal Land Resources Bureau will not be restored, and the resulted gap of parking space will be filled up by diverting traffic, restricting access of vehicles from other organizations and taking advantage of the surrounding parking lots. For the sake of traffic accessibility for residents of Yinhe Street, Hezhou Municipal Land Resources Bureau and Guidong Power Company, it is considered in technical design that a small-sized river-crossing bridge is built for each of Yinhe Street, Hezhou Municipal Land Resources Bureau and Guidong Power Company. Impacts on normal operation of Yinhe Street shops, Hezhou Municipal Land Resources Bureau and Guidong Power Company will be mitigated through resettlement compensation, and details are given in Resettlement Action Plan of the Project.

5.1.2.7 Community health

The Project involves 22 construction camps in the construction process and these construction camps will host approximately 60 to 80 persons in the peak period.The planned construction camps are mostly located in open spaces in the outskirt or on the river banks, with Shizigang Construction Camp No. 1 as an exception located in the downtown area; a certain distance has been considered in the planning from the construction camps to the residential areas. In the camps, simple barracks will be constructed to provide shelter for construction workers and the construction camps will be fenced up to form a relatively enclosed and independent space so as to minimize flow of people and contact between construction workers and community residents. Therefore, in the construction stage of the Project, the construction workers will have little communication and contact with local community in Hezhou and the risks of community health will also be relatively insignificant.

Analysis shows that the construction workers of the Project are mainly local people and only a limited number of non-local workers are needed. Therefore, with the small number of non-local workers, the Project will not incur problems of increase of population due to the immigration of families of the construction workers and thus brings no pressure on the community service. China has relatively comprehensive laws and regulations on labor and various criminal offenses (e.g. sexual harassment, etc.) and strict law enforcement. The overall social security condition in Hezhou is fine and the community is harmonious. In summary, the negative impacts likely to arise from the construction workers of the Project on the local community will be very insignificant.

In order to safeguard community health and prevent negative impacts on local community by the construction workers, the following measures should be taken:

(1) Basic hygienic facilities should be provided in the construction camps and managed with greater efforts to avoid spread of diseases.

(2) All efforts should be made to control the scale of Shizigang Construction Camp No. 1 and a certain distance should be kept from the construction camp site to the residential areas. Local workers should be employed to the best possibility.

(3) Education on laws, social security and traffic safety should be organized for the workers to promote their awareness of safety.

(4) Health education should be organized for workers to increase their knowledge of HIV and other infectious diseases and encourage them to take protective measures and avoid spread of diseases to others by using condoms.

(5) Education on environmental protection should be organized for the workers to assure that the ESMP requirements are followed for disposal of wastewater and solid wastes on the construction camps to prevent spread of diseases.

5.1.3 Environmental Impacts of Dredging and Sediment Disposal and Mitigation Measures

5.1.3.1 Dredging and Sediment Dewatering Methods and Disposal method

Different dredging methods are selected based on size of water body. For He River that has wide water surface and large quantity of dredged sediment, cutter suction dredger is selected. Dredged sediment is treated at No.1 and No.2 dewatering facilities located along He River into sludge cake with 50% moisture content. Dewatering effluent is discharged back to He River. Huangansi and Shizigang Drainage Canals have a worse water quality and stinky sediment due to domestic sewage received along the canal throughout the year. These two canals are located in densely populated urban center with limited operation space. Therefore suction pumping plus manual excavation is selected for dredging. Dredged sediment with a 95% water content will be hauled by fecal suction trucks to No. 1 dewatering site located along He River. The sediment will be dewatered to sludge cake with 50% moisture content, and the effluent is discharged to He River. Mechanical excavation supplemented by manual excavation is chosen for dredging of Huangtian Branch Canal, Guposhan Drainage Canal and East Trunk Canal. These canals are surrounded by farmland and unused land with adequate operation space, therefore onsite movable vehicular dewatering facility is used and effluent is discharged back to the canals. Interception and diversion + dry dredging may be used as the dredging method for the inner rivers of Shizigang Drainage Canal and Huang’ansi Drainage Canal provided that the construction condition (the space of operation is available for interception and diversion of the inner rivers) is available and a sound regional intercepting pipeline network is in place. Dredging methods, siting of sediment dewatering facility and final disposal methods for He River and its tributaries are shown in **Table 5-2**.

Table 5-2 Dredging and Sediment Disposal Methods for He River and Its Tributaries

Subcomponent	River/Canal	Implementation Time	Quantity of Dredged Sediment	Surrounding environment	Dredging and Transportation Method	Dewatering Location	Disposal method
A-8 The main watercourse of He River Dredging	The main watercourse of He River	2018-2019	156,900 m^3 (water content 95%), equivalent to 15,690 m^3 sludge cake with 50% moisture content	Urban Area	Cutter suction dredger + dewatering facility at dewatering site	Sediment from Lingfeng Bridge section to No. 1 dewatering site, and Sediment from Fanglin Bridge section to No. 2 dewatering site	Solid Waste Landfill
C-1 Huangansi Drainage Canal Rehabilitation	Huangansi Drainage Canal	2018-2019	8,800 m^3 (water content 95%), equivalent to 880 m^3 sludge cake with 50% moisture content	Adjacent to Residential Area	Manual operation + sludge pump + fecal suction truck + No. 2 dewatering site at dewatering site	To No. 1 dewatering site	Solid Waste Landfill
C-2 Shizigang Drainage Canal Rehabilitation	Shizigang Drainage Canal	2018-2019	3,300 m^3 (water content 95%), equivalent to 330 m^3 sludge cake with 50% moisture content	Adjacent to Residential Area	Manual operation + sludge pump + fecal suction truck + dewatering facility at dewatering site	To No. 1 dewatering site	Solid Waste Landfill

Table 5-2 Dredging and Sediment Disposal Methods for He River and Its Tributaries

Subcomponent	River/Canal	Implementation Time	Quantity of Dredged Sediment	Surrounding environment	Dredging and Transportation Method	Dewatering Location	Disposal method
B-5 Huangtian Branch Canal Improvement	Huangtian Branch Canal	2020	7,440 m^3 (water content 95%), equivalent to 744 m^3 sludge cake with 50% moisture content	Farmland, Unused Land	Manual operation + mechanical excavation + bankside vehicle-mounted drying equipment	No dewatering site is needed	Solid Waste Landfill
B-6 Guposhan Drainage Canal Improvement	Guposhan Drainage Canal	2020	3,540m^3 (water content 95%), equivalent to 354 m^3 sludge cake with 50% moisture content	Farmland, Unused Land	Manual operation + mechanical excavation + movable vehicle-mounted drying equipment	No dewatering site is needed	Solid Waste Landfill
A-4 East Trunk Canal Rehabilitation and Connection with Mawei River	East Trunk Canal	2022	4,610 m^3 (water content 95%), equivalent to 461 m^3 sludge cake with 50% moisture content	Farmland, Unused Land	Manual operation + mechanical excavation + movable vehicle-mounted drying equipment	No dewatering site is needed	Solid Waste Landfill

Dredged sediment has a water content as high as 95% or more, and dewatering is required. Movable vehicular dewatering facility is used for East Trunk Canal, Huangtian Branch Canal and Guposhan Drainage Canal, and sediment dewatering is done along the canal. As Huang'ansi Drainage Canal and Shizigang Drainage Canal both flow through the densely populated urban area and connection of fecal suction truck and vehicular dewatering facility may cause sediment leakage and spill, a fixed sediment dewatering site is required. The advantage of fixed dewatering facility is the easy implementation of retaining, covering, interception, odor removal and ground cleaning measures. Two fixed dewatering facilities are set for preliminary drying of sediment from He River, Huang'ansi Drainage Canal and Shizigang Drainage Canal. Dewatering Facility No.1 (located on flood land along He River about 100 m upstream of Lingfeng Bridge) and Dewatering Facility No. 2 (located on flood land along He River about 100 m upstream of Fanglin Bridge) cover a land area of approximately 500 m^2 each and are equipped with temporary sediment storage tank, dewatering operation area, interception channel and wastewater collection tank.

Sediment monitoring results given in Section 4 show that the monitored values of arsenic and cadmium in the sediment of He River and the urban inland canals could not meet Environment Quality Standard for Soil (GB15618-1995) Class III limits for normal agricultural and forest production and plant growth, therefore the dredged sediment is not suitable for application to forest land or dry farmland. Based on investigation there are no any other sediment disposal methods in Hezhou City such as incineration facility or co-incineration cement kiln, therefore dewatered sediment will be hauled to Hezhou municipal solid waste landfill for disposal. Sludge cake will be transported in closed vehicle to the landfill for disposal. Transportation route from No. 1 dewatering site to solid waste landfill covers distance of about 14 km through south Lingfeng Road, G207, Gongye Road, G323, and landfill access road. Transportation route from No. 2 dewatering site to solid waste landfill covers distance of about 18 km through Fanglin Road, Guangming Road, G207, Gongye Road, G323, and landfill access road. Transportation route is selected to minimize environmental impacts by avoiding densely populated area and shortening transportation distance. Locations of dewatering facilities and transportation routes are demonstrated in **Figure 5-1**.

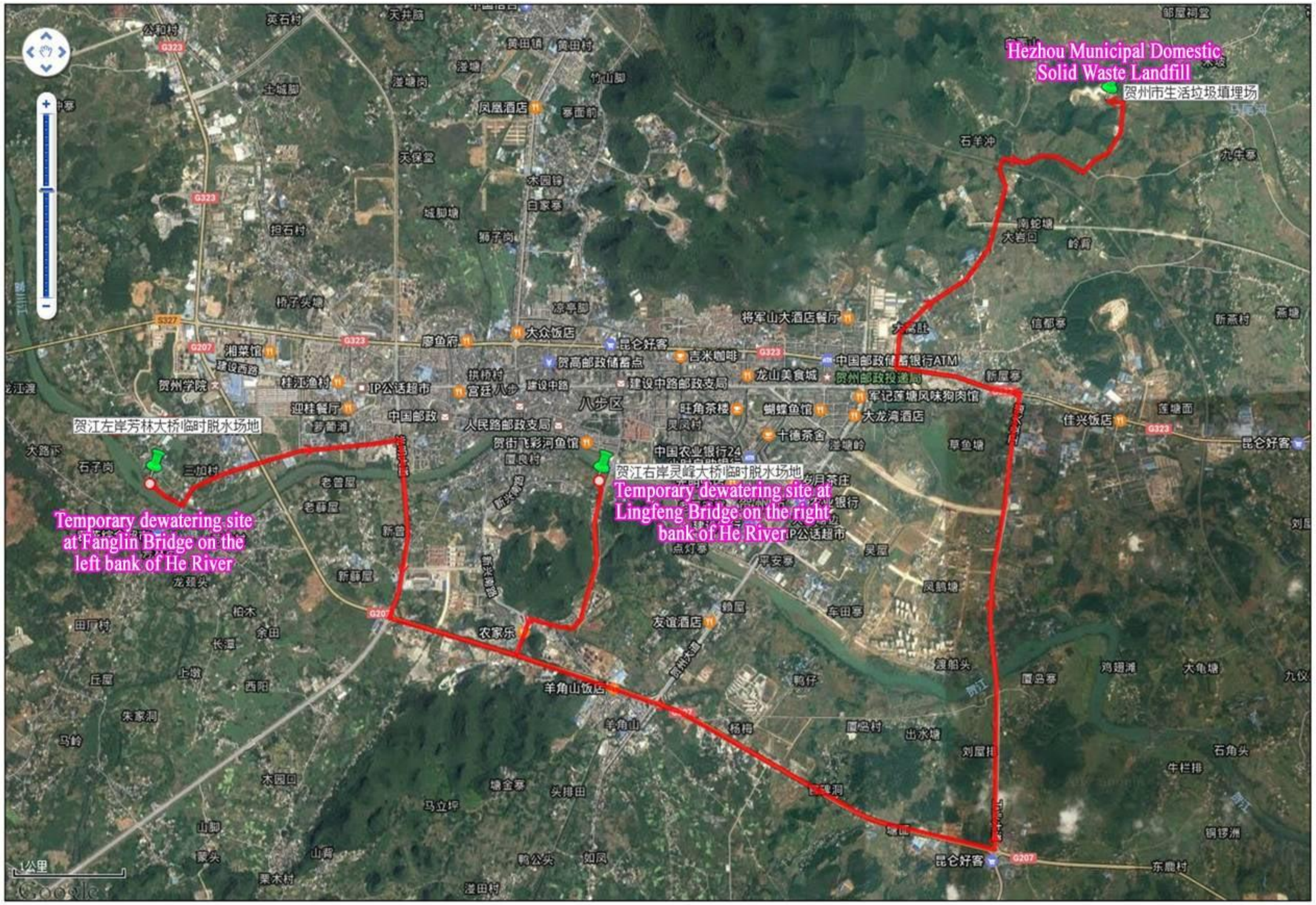


Figure 5-1: Schematic Diagram of Sludge Dewatering Sites and Transportation Routes

5.1.3.2 Ambient Air Impact of Dredging and Sediment Dewatering and Mitigation Measures

Dredging methods with less ambient air impact are selected through comparison of alternatives during design. For example, cutter suction dredger is selected for He River dredging andsuction pump selected for urban river dredging. In the underwater dredging, the water seal has effective control of odor emission and can significantly reduce odor generated in the process of sediment agitation. Meanwhile, dredging is scheduled in autumn and winter with low temperature and organic substance fermentation rate, which will generate less odor emission compared with dredging in summer and minimize odor impact from the source. Moreover, doors and windows of residential buildings in densely populated area along Huang'ansi Drainage Canal and Shizigang drainage canal are usually closed in autumn and winter, which will weaken direct impact of dredging odor to residents. For sections of Shizigang Drainage Canal that will be changed from covered to open canal, residents of Yinhe Street, staff in Land Resources Bureau and Guidong Power Company office buildings and residents in residential area of Guidong Power Company will be directly affected by odor emission once canal cover is removed. Odor impact will be greatly mitigated through scheduling construction activities in autumn and winter.

Dredged sediment with a water content of 95% from He River, Huang'ansi Drainage Canal and Shizigang Drainage Canal will be hauled to dewatering facilities No.1 and No.2 for dewatering. Temporary sediment storage in dewatering facility will generate odor emission, and analogical method is adopted for analysis of odor pollution intensity. Dry-method dredging of Mudanjiang City Nanpaozi Lake is used as reference, as the way of odor generation is similar of dry-method dredging and temporary sediment storage process in terms of direct sediment exposure to air. Analysis of odor intensity is showed in **Table 5-3**.

Table 5-3 Odor Intensity of Mudanjiang Nanpaozi Lake Dry Dredging

Distance	Odor Intensity	Level
Bankside	Significant	Level 3
30 m away from Bank	Insignificant	Level 2
80 m away from Bank	Very Insignificant	Level 1
More than 100 m away from Bank	No	Level 0

Analogical analysis indicates there will be significant odor next to temporary sediment storage tank, and odor intensity will decrease to Level 2 at 30 m away, better than odor intensity standard limit of Level 2.5 to 3.5. There will be almost no odor 50 m away from the storage tank. Dewatering facilities are located along He River, and environmental sensitive receptors are avoided during site selection. Distance between dewatering facility and the nearest sensitive receptor is more than 100 m, therefore temporary sediment storage in dewatering facility will not have impact on environmental sensitive receptors.

Sludge cake with moisture content of 50% should be transported out in a timely manner, and quicklime and deodorant should be supplied for site disinfection and odor removal. In addition, personal health protection supplies should be provided to construction workers to effectively mitigate impact of odor.

5.1.3.3 Impact of Dredging and Dewatering on Water Environment and Mitigation Measures

Environmental-friendly and mature cutter suction dredging method is used for The main watercourse of He River. Suspended solid concentration around the cutter suction dredger will increase to some extent during dredging, but the coarse particles will settle rapidly after the fine particles are sucked up to the dredging boat. Moreover, as He River has large water flow and diluting capacity, small scope of sediment disturbance will not deteriorate water quality. Huang'ansi Drainage Canal, Shizigang Drainage Canal, East Trunk Canal, Huangtian Branch Canal and Guposhan Drainage Canal have small quantity of dredged sediment, but the canals are quite narrow and cutter suction dredger is not suitable for dredging. Sludge suction pump or mechanical excavation has advantage of flexible operation and slight disturbance to river water quality. Therefore, impact of dredging on water environment is temporary, and river water quality will be improved as large quantity of substrate pollution sources are removed and organic pollutant release is greatly reduced.

Dredged Sediment with water content of 95% from He River, Huang'ansi Drainage Canal and Shizigang Drainage Canal will be transported to No.1 and No.2 dewatering sites located along He River for dewatering. Stormwater leaching and river water scouring may cause generation of muddy runoff during temporary sediment storage and secondary pollution to He River. Additionally, dewatering effluent still contains suspended solids and organic pollutants although majority of the solids has been intercepted by dewatering, therefore wastewater treatment facility is required on sediment dewatering site.

(a) Interception ditch surrounding the temporary sediment storage tank will be built to divert wastewater to sedimentation tank;

(b) Stormwater and dewatering effluent collected in the interception ditch should be treated in wastewater sedimentation tank before discharged to He River; and

(c) Sediment should be dewatered and hauled out of the site in a timely manner to avoid generation of leachate from storage of large quantity of sediment.

5.1.3.4 Impact of Dredged Sediment and Disposal Measures

Dredging methods, siting of dewatering facilities and final sediment disposal methods for He River and its tributaries are shown in Table 5-2. Dredged sediment with water content of 95% will be dewatered In an integrated drying facility to sludge cake with moisture content of 50%. Sludge cake should be transported out of site for disposal in a timely manner to avoid stormwater erosion or river water scouring and secondary pollution to surface water. Retaining, covering and interception measures should be taken to effectively mitigate impact of sediment leakage and overflow. Additionally, quicklime and deodorant should be provided for odor removal.

Following project implementation schedule, quantities of sludge cake with moisture content of 50% from sediment dredging and dewatering of He River, Huang'ansi Drainage Canal and Shizigang Drainage Canal are 15,690 m^3, 880 m^3 and 330m^3 respectively. Implementation period of East Trunk Canal, Huangtian Branch Canal and Guposhan Drainage Canal rehabilitation is 2020 to 2022, and quantities of sludge cake with moisture content of 50% will be 744 m^3, 354 m^3 and 461 m^3 respectively. Sludge cake will be hauled to Hezhou solid waste landfill for disposal. Currently capacity of zone 1 plus capacity contributed by original adjustment tank of this landfill can meet demand for solid waste disposal of Hezhou City in the coming three years and can also accommodate disposal of sludge cake from the Project.

5.1.4 Impact of Noise and Mitigation Measures

5.1.4.1 Analysis of Construction Noise

Construction noise is generated by construction machine and transportation vehicle. Construction noise occurs in a certain period, temporarily and not in fixed locations. Noise varies with construction machine. Intensity of major noise sources is projected in **Table 5-4.**

Table 5-4 Noise Level of Major Construction Machines

SN	Construction Machine	Noise Level/dB (A) (5 m away from the machine）
1	Loader	90
2	Truck	87
3	Pump	80
4	Vibrator	79
5	Bulldozer	90
6	Excavator	83
7	Sludge Suction Pump	80

As shown in Table 5-4, operation of multiple machines at the same time will lead to superposition of noise level. According to the prediction, it is estimated that the superimposed noise level will increase by no more than 3 dB(A). As shown in **Table 5-5**, noise level of construction machine decreases with distance.

Table 5-5 Prediction of Noise Level Varying with Distance

Unit: dB (A)

Construction Machine	Intensity of Noise Source (Distance: 5m)	Distance (m)								
		15	30	50	80	100	150	200	300	500
Loader	85	75.5	69.4	65.0	60.9	59.0	55.5	53.0	49.4	45.0
Truck	87	77.5	71.4	67.0	62.9	61.0	57.5	55.0	51.4	47.0

Pump	80	70.5	64.4	60.0	55.9	54.0	50.5	48.0	44.4	40.0
Vibrator	79	69.5	63.4	59.0	54.9	53.0	49.5	47.0	43.4	39.0
Bulldozer	85	75.5	69.4	65.0	60.9	59.0	55.5	53.0	49.4	45.0
Excavator	83	80.2	74.2	69.7	65.6	63.7	60.2	57.7	54.2	49.7

In accordance with Hezhou Urban Area Environmental Noise Standard Application Zoning, the Project is located in Class II area and applicable standard is Acoustic Environment Quality Standard (GB 3096-2008) Class 2 with a noise limit of 60 dB (A) for daytime and 50 dB (A) for nighttime. Major construction plants include excavator, bulldozer, loader, vibrator and dump truck with an operation noise level ranging from 80 to 90 dB (A). Prediction results in Table 5-5 show that impact of excavation noise is within 150 m during daytime and 500 m during night at places there is no any sound barrier between noise source and receptors. Noise level can be reduced by 15-25 dB (A) when temporary hoarding and sound barrier are installed, and noise level at environmental sensitive receptors caused by construction equipment will range from 54 to 60 dB(A) after mitigation measures are taken, which meets Environmental Quality Standard for Noise (GB3096-2008) Class 2. Benefited from noise buffering by the first row residential buildings, the second row residential buildings are almost not affected by construction noise. In this case, noise impact during construction concentrates on area within 30 m of the construction site. Sensitive receptors within 30 m of the construction site are listed in Table 2-4. Particularly, more stringent noise reduction measures should be taken to mitigate impact of construction noise on Hezhou College, Hezhou Pilot Middle School, Pinggui No.3 Middle School and Xiadao Primary School. Construction activities should be prohibited during normal school time to avoid disturbance.

5.1.4.2 Noise Impact Mitigation Measures

The ESMP includes common practices to mitigate noise impact by better managing construction activities such as earth excavation, earth and material transportation and construction of buildings and structures. Major mitigation measures include:

(1) Advanced and reliable low-noise equipment should be selected.

(2) Construction period is from 8:00 to 20:00, with construction activities being suspended from 12:00 to 14:00 for noon break. Construction activity during night is allowed only when permission is obtained from construction authority and approved by local EPB and disclosed to nearby residents.

(3) Construction activities should be reasonably scheduled avoiding operation of multiple high-noise machines at the same time and on the same construction site. Construction period should be shortened as possible to minimize noise impact on construction workers.

(4) Vibration damping foundation or support should be used for machines that generate high noise, including use of damping material.

(5) Noise from transportation vehicle will affect sensitive receptors along the route to some extent. The contractor should improve environmental awareness of the construction workers, understand local folk custom and habit, and carefully schedule transportation time and limit vehicle speed and prohibit use of horn in environmentally sensitive area such as densely populated area.

(6) The contractor should consult with nearby agencies, residents and schools, and arrange construction activities with high noise in summer and winter vacations and holidays as much as possible. Meanwhile, construction should be accelerated to shorten construction period. High-noise construction activities should be concentrated in weekends to minimize impact on nearby sensitive receptors.

(7) High-noise construction plants should be located on the construction site far away from residential area. 1.8m high hoarding for noise reduction should be installed on construction site located within 5 m of residential area.

(8) The contractor should have reasonable construction staffing to shorten working time of workers that operate high-noise machine. Earmuff should be provided to construction workers to reduce noise impact.

(9) All the construction equipment should be maintained on a regular basis to keep them in good condition, reduce noise and prolong operation life.

(10) Stringent requirements should be made for construction scheduling, machine and vehicle operator and operation practice.

Particularly, temporary sound barrier not lower than 2m and with good noise reduction effect should be installed on construction site near Hezhou College, Hezhou Pilot Middle School, Pinggui No.3 Middle School and Xiadao Primary School., and construction during normal school time should be avoided.

5.1.5 Impact on Physical and Cultural Resources and Mitigation Measures

Rehabilitation of He River (Guangming Bridge to Lingfeng Bridge), rehabilitation of Huang'ansi Drainage Canal and construction of Huangansi stormwater pump station will possibly affect ancient wharf and city wall in Xiyue historical and cultural block. This project will do nothing to the ancient dike other than backfilling and compression outside the ancient wharf and city wall to ensure dike stability. Landscaping construction will be combined with flood control dike outside existing Babu river dike to demonstrate prosperous shipping culture of Hezhou City in old time with the subject of “silk road on the sea and thousands of boats racing across He River”. Meanwhile, corridor frameworks are designed to hide vertical flood control gate.

In order to protect memorial hall and old school gate of The Old Site of CCP Babu Special Branch that may be affected by He River rehabilitation (Guangming Bridge to Lingfeng Bridge), project scope has been optimized in the design stage to avoid protected area of Xiyue historical and cultural block and new buildings and structures are designed in consistent style with existing historical and cultural block.

Embankment design has been revised by changing the originally-designed T-shaped revetment to vertical retaining wall to avoid interference with the Old Site of CCP Babu Special Branch.

Uncontrolled construction activities and weak relics protection awareness of the construction workers may lead to damage to structure of the relics and pollution, and the damage may be irremediable. Therefore, physical and cultural resources management plan included in the ESMP specifies major measures for construction activities concerning physical and cultural relics as below:

(1) Protective Measures for Xiyue Historical and Cultural Block

(i) Protection of existing river dike and ancient wharf, construction of ancient-style recreational waterside bridge and corridor, and construction of wastewater interception pipelines along He River;

(ii) Training on Historical and Cultural Relics Protection Law and local regulations on historical and cultural relics protection should be provided to the construction team before site mobilization, in order to increase historical and cultural relics protection awareness of the construction workers;

(iii) Local historical and cultural relics authority should be consulted by the IA prior to construction and realistic relics protection program should be developed;

(iv) Detailed construction program should be prepared before construction activities commence. Relics protection signs should be posted on construction site providing information of nature of the relics, importance, protected scope, protection measures, and contact person and channel of the historical and cultural relics authority;

(v) Safety and stability of the relics in construction area should be ensured. Site safety rules and operation practice should be prepared based on concerned national laws and regulations and various requirements by the IA should be followed, to make sure relics will not be damaged or stolen;

(vi) Manual excavation should be adopted in protected scope of the relics instead of use of excavator and piling machine to minimize vibrating impact;

(vii) Setting of construction camp or temporary surface soil storage site should be banned within protected scope of the relics;

(viii) Oversize vehicle and equipment are not allowed to enter protected scope of the relics;

(ix) Relics protection training should be provided to the construction workers by contractor. Construction activities should be kept far away from the relics as possible to avoid damage to the relics;

(x) In the event fossil, ancient coin, valuable article, ancient structure and other relics of geological or historical significance are found during construction, construction activities should be stopped immediately and this should be promptly reported to construction supervisor, the IA and local relics protection authority. Effective measures should be taken to protect the site and construction activities should not continue until permission is obtained from local authority; and

(xi) Knowledge of physical and cultural resources should be delivered to Xiyue Street residents for them to understand historical and economic value of these relics and get involved in physical and cultural relics protection and development of protection plan and regulations.

(2) Protective Measures for the Old Site of CCP Babu Special Branch

(a) Local historical and cultural relics authority should be consulted by the IA prior to construction and realistic relics protection program should be developed;

(b) Training on Historical and Cultural Relics Protection Law and local regulations on historical and cultural relics protection should be provided to the construction team before site mobilization, in order to increase historical and cultural relics protection awareness of the construction workers;

(c) Detailed construction program should be prepared before construction activities commence. Relics protection signs should be posted on construction site providing information of nature of the relics, importance, protected scope, protection measures, and contact person and channel of the historical and cultural relics authority;

(d) Safety and stability of the relics in construction area should be ensured. Site safety rules and operation practice should be prepared based on concerned national laws and regulations and various requirements by the IA should be followed, to make sure relics will not be damaged or stolen;

(e) Manual excavation should be adopted in protected scope of the relics instead of use of excavator and piling machine to minimize vibrating impact;

(f) Setting of construction camp or temporary surface soil storage site should be banned within protected scope of the relics;

(g) Oversize vehicle and equipment are not allowed to enter protected scope of the relics;

(h) Relics protection training should be provided to the construction workers by contractor. Construction activities should be kept far away from the relics as possible to avoid damage to the relics; and

(i) In the event fossil, ancient coin, valuable article, ancient structure and other relics of geological or historical significance are found during construction, construction activities should be stopped immediately and this should be promptly reported to construction supervisor, the IA and local relics protection authority. Effective measures should be taken to protect the site and construction activities should not continue until permission is obtained from local authority.

5.1.6 Impact on Ambient Air and Mitigation Measures

Major air pollution source during watercourse widening, construction of drainage gates, pump station and water replenishing canal improvement, construction of road and pipelines is dust caused by open excavation, which includes dust from earth excavation, onsite storage and backfilling, dust suspension caused by people and vehicles, as well as transportation vehicle leakage.

Transportation vehicle is the major source of construction dust. Construction access road of 80.9 km will be built, 65.4 km of which will be rebuilt and maintained as embankment road and the remaining 15.5 km access road will be restored once construction is completed. Moving vehicle wheels generate dust, especially heavy vehicle that generates more dust. Vehicle moving faster generates greater quantity of dust. Meanwhile, dust generation is related to physical condition of road surface and cleanness condition. On fully dry road surface, dust generated can be calculated by the following empirical formula:

[illegible]

Where:

Q - Quantity of dust from vehicle moving, kg/km/vehicle

V - Velocity, km/h;

W - Weight, ton

P - Quantity of dust on road surface, kg/m^2

Under normal meteorological condition, dust generation by a 10 ton vehicle driving through 1 km road surface with different cleanness degrees and under different driving velocities is given in **Table 5-6**.

Table 5-6 Dust Generation Varying with Driving Speed and Road Surface Cleanness

Unit: kg/km/vehicle

Pkg/m^2） / Velocity（km/h）	0.1	0.2	0.3	0.4	0.5	1.0
5	0.051	0.086	0.116	0.144	0.171	0.287
10	0.102	0.172	0.232	0.288	0.342	0.574
15	0.153	0.258	0.348	0.432	0.513	0.861
20	0.204	0.344	0.464	0.576	0.684	1.148
30	0.306	0.516	0.696	0.864	1.026	1.722

Table 5-6 indicates that vehicle that moves faster generates more dust under the same road surface cleanness condition, and dirty road surface causes more dust when vehicle speeds are the same. Analogy analysis shows that impact of the dust generated by construction site and transportation road under natural wind condition is confined to the scope within 50 km. 4 to 5 times of water spraying on the road during construction will reduce dust suspension by approximately 70%. Speed limit and keeping road clean are effective measures for reducing dust caused by vehicles. Dust control measures, such as watering on and covering of onsite lime, soil and sand as well as construction debris, should be taken. Transportation of construction material and waste soil should be covered and should not be overloaded. Vehicle wheels should be cleaned before the vehicle leaves construction site, and leakage and spill should be avoided. Environmental sensitive receptors within 50 m along the transportation route are listed in Table 2-4 (Distribution of Environmentally Sensitive Sites).

He River dredging and river and lake connecting subcomponents have many sensitive receptors and APs that are mostly located within a distance of 50 m from the project area. ESMP provides necessary construction practices for better management of excavation, soil and material transportation and building/structure construction to minimize dust impact. Major mitigation measures include the following：

(a) Construction site management should be strengthened. Transportation vehicle should be in good condition and should not be overloaded for cement and lime transportation, and covering and enclosing measures should be taken to avoid spill and reduce dust generation. Reasonable locations should be selected for material and waste soil storage, and material such as cement and lime should be stored at the same area and wind protection and covering measures should be taken. Sand screening and cement bag opening should be done in the lee, and site that has significant dust generation should be installed with windbreak facilities.

(b) Clean-up and water spraying can be done for dust control on construction site and road. Spraying water 4 to 5 times each day on construction site is suggested. Practice in China concluded that Integrated Air Pollutant Emission Standard (GB16298-1996) can be met by adopting these mitigation measures, in terms of concentration of uncontrolled emission of particulates. Damaged vegetation should be restored in a timely manner.

(c) Transportation vehicles should be cleaned and washed in a timely manner before leave construction site. Wheel washing equipment should be provided on site to clean earth on the wheels.

(d) Onsite fume control should be enhanced. Toxic fume and gas emission is prohibited on construction site to mitigate waste gas pollution to sensitive receptors.

(e) Stringent site management measures should be taken, which include installation of hoarding not lower than 2 m along both sides of construction site, enclosed construction, containment structure installed at hoarding bottom with no space between hoardings and between hoarding and containment structure, and setting of

No-entry signs for banning non-construction workers to enter the site.

(f) Loading/unloading and transportation process should be strictly managed. Transportation of sand, cement and waste soil should be covered, and construction material should be loaded and unloaded carefully.

(g) Temporary storage of earth and sand during construction should be covered and watered, and should be hauled out of the site as early as possible.

(h) Start-up frequency of fuel powered machine should be minimized to effectively reduce exhaust generated by construction plants.

(i) Transportation vehicle and construction equipment should be properly maintained to keep normal operation and avoid more exhaust emission caused by improper maintenance. Use of equipment that significantly violates applicable emission standard should be banned.

5.1.7 Impact on Water Environment and Mitigation Measures

24 construction sites and camps are set in total. Storage of construction material such as asphalt, fuel and chemicals should be properly managed and be covered as necessary to avoid water environment pollution to He River and its tributaries caused by stormwater runoff in rainy season. Oily wastewater during construction is generated from leakage and spill in the process of construction equipment repair and maintenance, which includes lubricant, diesel and petrol and may pollute water body. This type of wastewater is characterized by small quantity and greatly varying concentration and very limited scope affected. Proper measures should be taken by the contractor to prevent potential water pollution. Large amount of construction workers will be required during construction, which are mostly local workers and will generate certain quantity of domestic sewage. As most of construction areas are located in built urban area, existing municipal infrastructure and sanitation facilities can be used for treatment of domestic sewage of the construction workers and no separate facilities are needed. Where municipal infrastructure and sanitation facility are absent in construction area, necessary environmental protection facilities should be provided or mitigation measures should be taken.

Hydropower station improvement have potential surface water pollution caused by dike construction, drilling debris associated with hydropower station foundation construction, construction wastewater (drilling wastewater, oily wastewater) and disturbance to local water by dredging activities.

The ESMP includes common practices for management of construction activities to mitigate impact on water environment, and major measures to be taken include the following:

(a) Sand and stone processing wastewater should be treated in sedimentation tank, and the effluent should be reused for concrete production and dust control rather than discharged into nearby water body. Construction slurry should be pumped into sedimentation tank for treatment and drying through evaporation. Construction machine cleaning wastewater should be treated in oil separation and sedimentation tanks and the effluent should be reused for dust control and vehicle cleaning.

(b) Siting of construction site should fully accommodate need for drainage and should be far away from water body. Construction site, warehouse, and diesel and asphalt storage site as well as asphalt making facility should not be located within 500 m of He River. Necessary measures should be taken to prevent discharge of pollutants into He River, especially through stormwater runoff in rainy season.

(c) Operation area should be kept clean during construction to prevent discharge of wastewater and pollutants into the open channel and penetration.

(d) In the event onsite oil fuel storage is required, anti-seepage measures should be adopted for storage and use to prevent oil leakage and spill and water pollution.

(e) Foundation construction should be done in non-rainy days as much as possible to minimize impact on construction activities due to shallow groundwater level.

(f) Water-related construction such as hydropower station and dredging should be done in dry season as much as possible, and construction period should be shortened as possible to reduce disturbance to water body.

(g) Personal protective equipment and life-saving appliance should be provided to prevent accident.

(h) Domestic sewage and solid waste collection and treatment facilities should be provided in construction camp without centralized municipal facilities. Domestic sewage can be discharged to nearby farmland as fertilizer, after treated.

5.1.8 Impact of Solid Waste and Mitigation Measures

Solid wastes during construction are mostly contributed by removal of existing river dams of Fanglin and Huangshi power stations, demolition of buildings acquired, construction of new structures (sand and stone, lime, concrete, timber, waste brick, and earth) as well as domestic solid waste generated by construction workers. Construction solid waste will total 99,100 m^3 and will be hauled to municipal construction solid waste landfill in Huangtian Town Gonghe Village for disposal.

In addition, hazardous waste such as waste oil may enter surface water and cause water quality pollution if storage and transportation is not properly managed. Therefore, management measures should be enhanced in response to possible generation of hazardous waste, which include provision of special container for collecting waste oil from equipment maintenance and repair and provision of onsite emergency-responsive box, sand or saw powder for absorbing waste oil.

Based on earth balance analysis, during construction the Project will have excavation of 3,433,500 m^3, filling of 5,451,500 m^3, reuse of 59,100 m^3 excavated earth, 3,291,400 m^3 earth from external source, and final disposal of 1,273,400 m^3 (184,600 m^3 sediment will be dewatered and hauled to Hezhou municipal solid waste landfill for disposal, 556,400 m^3 will be transported to Hezhou City electronic technology ecological industrial park for lowland filling, and 532,400 m^3 will be hauled to the disposal site of the Project).

Two borrow areas have been selected for the Project. One borrow area is located 1,000 m east to Hezhou City electronic technology ecological industrial park. This borrow area occupies 16.85 hm^2 hilly land covered mostly with grass and eucalyptus. The other borrow area is located 750 m west to Gongye Road and 100 m north to G207 road, occupying 20.1 hm^2 hilly land covered mostly with grass and eucalyptus. One disposal site will be set southwest to Donglu Village and 500 m south to Guang-He Highway, covering total land area of 7.40 hm^2. This disposal site will receive residual surface soil, unusable earth and stone, and soft earth. Water and soil conservation and restoration measures for borrow area and disposal site are described in Section 5.1.1

5.1.9 Ecological Impact Analysis and Mitigation Measures

5.1.9.1 Impact on Terrestrial Ecosystem and Mitigation Measures

The project area is located in the built urban area or city outskirt without native vegetation. Ecosystem in the project area is composed of urban ecosystem and farmland ecosystem. Vegetation along He River mainly comprises of bamboo forest and bushes, and vegetation along urban inland canals comprises of farmland crops, aquatic plants and artificial secondary forest. Rehabilitation of He River will affect habitat of some waterside birds. Survey shows major bird species frequently found along He River include partridge, cuckoo, drongo cuckoo and oriental skylark, which are all ordinary species.

Construction will damage vegetation habitat, and the direct result of vegetation damage will be land bareness, and greater water and wind erosion. Furthermore, modified ecosystem structure and function will lead to deterioration of regional ecological environment. Movement of construction plants and workers during construction will significantly damage vegetation on construction site. Therefore, necessary environmental protection measures should be taken during construction for effective control of impact of construction activities on local vegetation. For example, scope of construction activities should be narrowed and construction period should be shortened as much as possible, and vegetation should be restored once construction is finished to minimize local ecological impact. Construction activities will disturb inhabitation and breeding of waterside bird species along He River, but ecological system along He River will be restored after construction and will be improved over time.

After implementation of the Project, introduction of variety of local plant species that are adapted to local condition will not only increase number of regional plant species and population and vegetation coverage, but also will improve environmental quality and provide better condition for normal growth of plants.

Survey results indicate that 15 ancient and rare trees are distributed in Xialiang

Village, Middle Jiangbei Road, Xiyue Street, Xinaner Street, Xinanyi Street and Jianshezhong Road along He River are not within the construction area of the Project, but quite near the construction site, approximately 50 m away from the site. Normal growth of these trees will possibly be affected by earth taking and disposal, storage of construction solid waste, moving of construction vehicles and transportation of construction equipment, therefore attentions should be paid during construction and the following protective measures should be taken.

1. Construction scope should be narrowed and construction period should be shortened as much as possible;
2. Tree felling, unauthorized transplanting, bark peeling, root digging and injection of toxic and hazardous substances to trees should be prohibited;
3. It is not allowed to construct buildings or structures, lay pipelines, install power cables, excavate borrow areas, mine sand and stone, flood or seal the ground, emit fumes, discharge wastewater and dump solid wastes, stockpile or dump flammables, explosives or toxic and hazardous substances in the area with a distance of less than 5m from the outer edge of the crown shadow of trees.
4. It is not allowed to engrave, nail, wind, hang or support or stack articles on or around tree trunks; and
5. Construction vehicles and plants are not permitted to enter or roll the area with a distance of less than 5m from the outer edge of the crown shadow of trees.

5.1.9.2 Impact on Aquatic Ecology and Mitigation Measures

Water-related construction activities and dredging may affect aquatic ecosystem of He River and its tributaries. Ecological survey reveals all the aquatic animals in He River are ordinary species, and there is no fish spawning field, feeding field, winter habitat or rare aquatic animal species in He River. He River dredging covers a river length of 3.6 km. Small-scope of water-related hydropower station improvement and dike construction are scheduled in dry season. Huang’ansi Drainage Canal, Shizigang Drainage Canal, Huangtian Branch Canal and Guposhan Drainage Canal are all located in urban area with intensive human activities, and major functions of these canals are flood discharge and providing water for irrigation purpose. Polluted by domestic sewage, these canals have deteriorated water quality and severe sediment deposit. Major aquatic plant species is green alga, and benthos organism is ordinary benthos species. There is no fish spawning field, feeding field, winter habitat or rare aquatic animal species in these canals, and none of these canals is important natural habitat.

Water-related construction and dredging will result in disappearance of some benthos lives, but this will be restored over time after dredging is finished. Therefore, implementation of the Project will have insignificant impact on aquatic life and will not degrade or modify ecology of He River and urban inland canals.

5.1.10 Conclusion of Dam Safety Assessment and Action Plan

World Bank Safeguard Policy OP/BP 4.37 for dam safety is triggered by the Project. Therefore, Hezhou Water Resources Bureau, the IA, collected basic information of the concerned 21 dams, conducted dam safety survey, and proposed rehabilitation measures and action plan for dam with issues, and proposed completion date. Information of the dams is summarized in **Table 5-7**, and dam rehabilitation program and action plan are given in **Table 5-8**.

Table 5-7 Summary Dam Information

SN	Reservoir/Dam	Location	Basic Information of Reservoir/Dam				Existing/Under Construction/New Construction		Safety Assessment/Maintenance in the last 5 Years	
			Dam Type	Dam Height, m	Reservoir Capacity, 10,000 m^3	Function	Construction Time	Operation Status	Safety Assessment	Maintenance
1	Guishi Reservoir Dam in Hezhou City	Middle stream of Fuchuan River	Masonry gravity dam	42.7	59,500	Flood control, power generation, irrigation, and aquaculture	1966.3	Normal	2005.1	2009.1
2	Chayuan Reservoir Dam in Zhongshan County	On Fujiang River, tributary of He River, located east to Huping and Weilanggu villages in Zhongshan Town of Zhongshan County	Clay core dam	19.3	156	Irrigation, supplemented by flood control	1968.3	Normal	2008.12	2010.12
3	Junchong Reservoir Dam in Zhongshan County	Near Rongma Village of Zhongshan Town	Clay core dam	13.5	576	Irrigation, supplemented by flood control	1970	Normal	2007.5	2008.4
4	Luojiu Reservoir Dam in Zhongshan County	On Fu River of Zhu River Watershed, near Luojiu Village on Zhongshan Town in Zhongshan County	Homogeneous earth dam	18.4	54	Irrigation, supplemented by flood control	1981.5	Normal	2010.7	2012.11
5	Hongshuiping Reservoir Dam in Fuchuan County	On Keda River (tributary of Baisha River), at foot of Gupo	Concrete double-arch dam	43.7	870		1991.2	Normal	2009.12	2011.5

Table 5-7 Summary Dam Information

SN	Reservoir/Dam	Location	Basic Information of Reservoir/Dam				Existing/Under Construction/New Construction		Safety Assessment/Maintenance in the last 5 Years	
			Dam Type	Dam Height, m	Reservoir Capacity, 10,000 m^3	Function	Construction Time	Operation Status	Safety Assessment	Maintenance
		Mountain near Baisha Town Baisha Street of Fuchuan County								
6	Shalongchong Reservoir Dam in Fuchuan County	Upstream of Baisha River in Baisha Town of Fuchuan County	Homogeneous earth dam	30	492	Irrigation, supplemented by flood control	1977.5	Normal	2007.5	2008.4
7	Shidong Reservoir Dam in Pinggui District	Upstream of Mafeng River (tributary of He River in Zhu River Watershed) in Babu District of Hezhou City	Clay core dam	39.5	1658	Irrigation, flood control, water supply and power generation	1963.3	Normal	2007.3	2008.12
8	Huashan Reservoir Dam in Pinggui District	On Huashanchong River (primary tributary of He River), north to Etang Town Huashan Village of Hezhou City Babu District	Clay core dam	20	579	Irrigation, supplemented by flood control	1964.4	Normal	2007.8	2008.11
9	Pangu Reservoir Dam in Pinggui District	At end of Panguchong River, tributary of He River	Clay core dam	30.9	388	Irrigation, supplemented by flood control	1976.12	Normal	2007.5	2008.7
10	Dachong Reservoir Dam in	On tributary of He River, at Shatian	Homogeneous earth dam	20	85	Irrigation, supplemented	1976.11	Normal	2008.12	2011.12

Table 5-7 Summary Dam Information

SN	Reservoir/Dam	Location	Basic Information of Reservoir/Dam				Existing/Under Construction/New Construction		Safety Assessment/Maintenance in the last 5 Years	
			Dam Type	Dam Height, m	Reservoir Capacity, 10,000 m^3	Function	Construction Time	Operation Status	Safety Assessment	Maintenance
	Pinggui District	Town Daoxi Village of Hezhou City Pinggui District				by flood control and aquaculture				
11	Dayao Reservoir Dam in Pinggui District	On Dayao River, tributary of He River of Zhu River Watershed Xijiang water system	Clay core dam	40	322	Irrigation, supplemented by flood control	1975	Normal	2008.11	2010.12
12	Guishan Reservoir Dam in Pinggui District	Guishan River, primary tributary of He River	Clay core dam	26.5	432	Irrigation, supplemented by power generation and flood control	1974.3	Normal	2007.8	2009.11
13	Changtang Reservoir Dam in Pinggui District	On Fujiang River (tributary of He River), south to Yangtou Town Jinzhu Village of Hezhou City Pinggui District	Clay core dam	11.5	171	Irrigation, supplemented by flood control	1957.4	Normal	2008.11	2011.1
14	Luoxi Reservoir Dam in Pinggui District	On Fujiang River (tributary of He River), northwest to Wanggao Town Luoxi Village of Hezhou City	Homogeneous earth dam	19.5	123	Irrigation, supplemented by aquaculture	1910s	Normal	2008.11	2010.12

Table 5-7 Summary Dam Information

SN	Reservoir/Dam	Location	Basic Information of Reservoir/Dam				Existing/Under Construction/New Construction		Safety Assessment/Maintenance in the last 5 Years	
			Dam Type	Dam Height, m	Reservoir Capacity, 10,000 m^3	Function	Construction Time	Operation Status	Safety Assessment	Maintenance
		Pinggui District								
15	Huimiandu Reservoir Dam in Pinggui District	On Lisong River (tributary of He River of Zhu River Watershed Xijiang water system) within Huangtian Town Luhua Village of Pinggui District	Masonry gravity dam	34	330		1986.1	Normal	2014.2	2016
16	Guangming Reservoir Dam in Pinggui District	Tributary of He River in Zhu River Watershed	Homogeneous earth dam	25	127	Irrigation	1960.1	Normal	2010.1	2010.9
17	Guanyawo Reservoir Dam in Pinggui District	Yangtou Town Dajing Village of Hezhou City Pinggui District	Homogeneous earth dam	15.8	95	Irrigation, supplemented by flood control and aquaculture	1955.3	Normal	2008.12	2011.12
18	Zhemu Reservoir Dam in Pinggui District	On small tributary of Fujiang River, tributary of He River	Homogeneous earth dam	16.5	26.6	Irrigation	1950s to 1960s	Normal	2008.12	2011.12
19	River Dam of Xiadao Power Station in Hezhou City	On He River section near Etang Town Xiadao Village of Hezhou City Babu District	Reinforced concrete gate dam	4.5	707	Irrigation and power generation	1972.7	Normal		

Table 5-7　Summary Dam Information

SN	Reservoir/Dam	Location	Basic Information of Reservoir/Dam				Existing/Under Construction/New Construction		Safety Assessment/Maintenance in the last 5 Years	
			Dam Type	Dam Height, m	Reservoir Capacity, 10,000 m^3	Function	Construction Time	Operation Status	Safety Assessment	Maintenance
20	River Dam of Fanglin Hydropower Station in Hezhou City	On He River section near Shatian Town Fanglin Village of Hezhou City Pinggui District	Masonry gravity dam	4.26	178	Irrigation and power generation	1971.1	Normal		
21	River Dam of Huangshi Power Station in Hezhou City	On He River section near Yangtou Town Huangshi Village of Hezhou City Pinggui District	Masonry gravity dam	4	30	Power generation and irrigation	1978.1	Normal		

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
1	Guishi Reservoir Dam in Hezhou City	Reservoir risk elimination and rehabilitation was inspected and accepted by Guangxi Autonomous Region Water Resources Department in 2015. The reservoir has gone through extremely heavy flood in 2015 and is under safe operation. Issues include unclear responsibility allocated for auxiliary dam management, lack of observation data processing and analysis capacity by dam safety monitoring staff, and need for landslide mass treatment at Wugong Mountain. Follow-up action plan is required.	(1) Diversion of seepage collected from gallery top drain to discharge channel to keep gallery dry; (2) Closer coordination with Fuchuan Water Resources Bureau for clear responsibility allocation for safety management of auxiliary dam; (3) Provision of professional training on observation data analysis for dam safety monitoring staff; (4) Analysis of observation data of the last 5 years; (5) Development of automatic dam safety monitoring system; (6) Study on extent of impact on facility safety by scouring pit behind overflow dam; and (7) Special geo-investigation and design necessary for treatment of Wugong Mountain landslide mass. Completion time: 31 December 2021 Cost estimate： CNY 13 million
2	Chayuan Reservoir Dam in Zhongshan County	Technical design of Chayuan Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6	(1) Restoration/new construction of channel connecting with discharge culvert; (2) Adding dam seepage monitoring facilities;

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		years. Issues include 3m wide dam crest not in compliance with criteria and artificial damage to right retaining wall of discharge culvert channel. Follow-up action plan is required.	(3) Change of existing drainage channel downstream from draining prism to seepage collection channel and construction of measuring weir for seepage observation; (4) Increasing the thickness of downstream slope of the dam to widen the dam crest to 4 meters. （5）Improving the flood control emrgency response plan. Completion time: 31 December 2021 Cost estimate： CNY 2.5 million
3	Junchong Reservoir Dam in Zhongshan County	Technical design of Junchong Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include 3m wide dam crest not in compliance with criteria and absence of seepage interception channel next to the draining prism. Follow-up action plan is required.	(1) Removing/trimming of weed on downstream slope and downstream draining structure as early as possible; (2) Adding dam seepage monitoring facilities; (3) Change of existing drainage channel next to draining prism to seepage collection channel for seepage observation; and (4) Widening downstream slope of the dam to widen dam crest to 4 meters. (5) Improving the flood control emrgency response plan. Completion time: 31 December 2021 Cost estimate： CNY 2 million
4	Luojiu Reservoir Dam in Zhongshan County	Technical design of Luojiu Reservoir risk elimination and rehabilitation in 2014 generally meets requirements of applicable standards and the construction quality meets the design	(1) Installation of reservoir water gauge for water level observation; and (2) Adding dam seepage monitoring facilities;

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		requirements. The reservoir has been under normal operation for 3 years. Issues include absence of reservoir water level observation, and absence of seepage collection channel downstream from the draining prism. Follow-up action plan is required.	(3) Construction of seepage collection channel next to draining prism and installation of measuring weir for seepage observation; (4) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 30,000
5	Hongshuiping Reservoir Dam in Fuchuan County	Technical design of Hongshuiping Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality met design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, weed growing at right jetty head, and inadequate facilities. Follow-up action plan is required.	(1) Enhancement of daily operation management, and weeding on right jetty head; and (2) Installation of water gauge for reservoir. (3) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 100,000
6	Shalongchong Reservoir Dam in Fuchuan County	Technical design of Shalongchong Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of upstream and downstream slope clean-up and maintenance for a long time, and damage of dam top road. Follow-up action plan is required.	(1) Weeding on upstream and downstream slope, restoration of dam top road as early as possible to restore dam appearance. (2) Adding dam seepage monitoring facilities; (3) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 300,000
7	Shidong Reservoir	Technical design of Shidong Reservoir risk elimination and	(1) Improving seepage collection channel next to the draining prism

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	Dam in Pinggui District	rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include absence of seepage collection channel downstream from the draining prism, absence of monitoring capacity of reservoir staff, and absence of emergency response program. Follow-up action plan is required.	for seepage observation; (2) Provision of professional training on use of dam safety monitoring equipment and preliminary information processing; and (3) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 200,000
8	Huashan Reservoir Dam in Pinggui District	Technical design of Huashan Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include dam crest width of around 3.5 m that is not in compliance with criteria, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Construction of seepage collection channel next to draining prism for seepage observation; (2) Adding dam seepage monitoring facilities; (3) Widening downstream slope of the main and auxiliary dam to widen dam crest to 4 meters to meet criteria requirement; (4) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (5) Improving flood control emergency response program. Completion time: 31 December 2021 Cost estimate：CNY 3 million
9	Pangu Reservoir Dam in Pinggui District	Technical design of Pangu Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7	(1) Construction of seepage collection channel next to slope draining structure for seepage observation; (2) Adding dam seepage monitoring facilities ; (3) Improving flood control emergency response program; and

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		years. Issues include dam top width of 3.5 m that is not in compliance with criteria, absence of seepage collection channel downstream from the draining prism, and absence of emergency response program. Follow-up action plan is required.	(4) Widening downstream slope of the dam to widen dam crest to 4 meters. Completion time: 31 December 2021 Cost estimate： CNY 2 million
10	Dachong Reservoir Dam in Pinggui District	Technical design of Dachong Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; construction of seepage collection channel next to draining prism for observation of dam seepage; (2) Adding dam seepage monitoring facilities ; (3) Extension of new discharge culvert pipe, and new construction of diversion channel; (4) Improving flood control emergency response program; and (5) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. Completion time: 31 December 2019 Cost estimate： CNY 400,000
11	Dayao Reservoir Dam in Pinggui District	Technical design of Dayao Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of reservoir water level observation, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (4) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 300,000

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		required.	
12	Guishan Reservoir Dam in Pinggui District	Technical design of Guishan Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ; (3) Weeding within 20 m of the dam, improvement of seepage collection channel next to draining prism for observation of dam seepage; (4) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (5) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 300,000
13	Changtang Reservoir Dam in Pinggui District	Technical design of Changtang Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities (3) Improvement of seepage collection channel next to draining prism for observation of dam seepage; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (4) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 350,000
14	Luoxi Reservoir Dam in Pinggui	Technical design of Luoxi Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable	(1) Change of drainage ditch next to draining prism of main dam to seepage collection channel; installation of long culvert pipe linking

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	District	standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	auxiliary dam discharge culvert pipe and channel, and change of existing drainage ditch to seepage collection channel; observation of main and auxiliary dam seepage. (2) Adding dam seepage monitoring facilities ; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. (4) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 400,000
15	Huimiandu Reservoir Dam in Pinggui District	Dam safety assessment was done by design institute hired by Pinggui District Water Resources Bureau in February 2014. Design for reservoir risk elimination and rehabilitation was approved by Guangxi Autonomous Region Water Resource Bureau in November 2015. Construction commenced in August 2016 and is in progress. Technical design meets requirements of applicable standard, and construction quality will be assessed once finished. Currently no follow-up actions are required.	
16	Guangming Reservoir Dam in Pinggui District	Technical design of Guangming Reservoir risk elimination and rehabilitation in 2013 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 4 years. Issues include absence of seepage collection channel next	(1) Change of drainage channel to seepage collection channel for seepage observation of the dam; (2) Adding dam seepage monitoring facilities ; (3) Confirmation of dam top elevation and dam crest width; and

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		to draining prism, inaccuracy of dam top elevation, and absence of emergency response program. Follow-up action plan is required.	(4) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 300,000
17	Guanyawo Reservoir Dam in Pinggui District	Technical design of Guanyawo Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of seepage collection channel next to draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Adding dam seepage monitoring facilities ; (2) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. (2) Construction of seepage collection channel for seepage observation of the dam and the closed old culvert; (3) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 300,000
18	Zhemu Reservoir Dam in Pinggui District	Technical design of Zhemu Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, absence of seepage collection channel next to draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ; (3) Change of drainage ditch downstream from the draining prism to seepage collection channel, and installation of measuring weir for dam seepage observation; (4) Improving flood control emergency response program; (5) Widening downstream slope of the dam to widen dam crest to 4 meters; and (6) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year.

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
			Completion time: 31 December 2021 Cost estimate： CNY 1.5 million
19	River Dam of Xiadao Power Station in Hezhou City	Dam safety specialists have been employed for safety assessment of hub facility, and safety assessment report is expected to be available by the end of October.	(1) A dam and workshop safety monitoring system will be constructed in accordance with the requirements of the “Technical Specifications on Safety Monitoring of Concrete Damsd (DL/T5178-2003) and in association with the actual situations of the Project so as to monitor the gate dam and horizontal and vertical displacement, inclination, pier joint and crack opening and closing degree and foundation uplift pressure, leakage. (2) A separate circuit breaker and protection circuit will be added to ensure the safe operation of booster station. (3) The left gate of the overflow gate dam will be repaired to assure safe opratoin of the barrage dam. Pier joint and crack opening and closing degree Uplift pressure of foundation Leakage volume Completion time: 31 December 2021; Cost estimate: CNY 500,000
20	River Dam of Fanglin Hydropower Station/Hejiang Power Station in	Dam safety specialists have been employed for safety assessment of hub facility, and safety assessment report is expected to be available by the end of October.	

Table 5-8 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	Hezhou City		
21	River Dam of Huangshi Power Station in Hezhou City	Dam safety specialists have been employed for safety assessment of hub facility, and safety assessment report is expected to be available by the end of October.	

5.2 Analysis of Environmental Impacts in the Operation Stage

This Project includes three components, namely, Improving He River Flood Risk Resilience, Improving Urban Drainage and Wastewater Management, and Institutional Capacity Building and Project Management. Once completed, the Project will improve the urban flood control capacity, mitigate local water pollution, increase landscaping value, improve ecological environment, and improve municipal infrastructure of Hezhou Municipality. Adverse environmental impacts include effluent, odor and noise generated by Jiangnan WWTP operation and noise generated by stormwater pump stations. As a whole, the Project will have significant benefits and insignificant adverse impacts.

5.2.1 Analysis of Environmental Benefits during Operation

5.2.1.1 Change of Hydrological Condition and Flood Control Benefits

(i) Change of He River Hydrological Condition and Flood Control Benefits

In the watercourse widening works under the Project, the natural gradient of the main watercourse of He River will be maintained and sections with uneven riverbeds and serious sedimentation (e.g. the section upstream of existing hydropower station) will be dredged without widening of the main river channel. Water flow of He River is determined by precipitation and catchment area that are not changed due to the implementation of the Project. Therefore, the Project will not result in changes of the water flow of He River. As the main water channel will not be widened, the hydrological conditions such as the water velocity and flow rate in normal and dry seasons will not change.

Hydrological modeling analysis is conducted over the relationship between inundation loss and engineering investment under different flood control standards. Results of such analysis show that the most cost effective scenario will be achieved when flood control system is designed against the flood control standard for floods with a recurrence period of 50 years for main watercourse and floods with a recurrence period of 20 years for tributaries. The DHI-MIKE series software is used for modeling analysis and the actual topographic map is used, with the engineering design and inflow locations of each sub-catchment area on the main watercourse identified. Based on the finalized center line of the main watercourse, a hydraulic model is developed for He River and its tributaries to evaluate urban area inundation and economic loss under the applicable flood control standards and determine the technical design and mitigation measures.

Modeling calculation indicates that, when flood is controlled within the main channel, the regional flow section will decrease from the urban area floodplain section to the main channel section under the scenario of designed flood level. Peak flood flow and velocity in main watercourse will increase by approximately 10%, compared with existing peak flood in urban area floodplain section.

As an emerging tourism city, rapid development of various infrastructures in Hezhou

City will increase risk of regional soil erosion. The slightly increased river course scouring impact due to the increased peak flow and velocity after rehabilitation will be mitigated by sand control using adjustable power station flashboard. Meanwhile, revetment construction, vegetated revetment, ecological swale and other structural measures, planting measures, temporary protective measures will be taken to prevent soil erosion and form an integrated and scientific soil erosion prevention system and reduce sand discharge into He River.

Analysis indicates that, without rehabilitation of He River and its tributaries, the flooded area and average flooded depth of Hezhou urban area will be 13.10km^2 and 1.23 m respectively under floods with a recurrence period of 50 years. The flooded area is mainly located in the middle reaches of He River mostly occupied by residential buildings, hospital and school buildings between Guangming Bridge and Lingfeng Bridge on the left bank of He River. The total floor area of the flooded buildings and farmland area will be 3.22 km^2 and 9.88 km^2 respectively, causing economic loss of approximately CNY 2.044 billion.

Main watercourse will be improved through dike and revetment construction, river dredging and hydropower station improvement. The dike and revetment construction includes the construction of a multi-functional dike of Xiyue Street section and dikes of other river sections. River dredging covers an 2km long river section upstream of Fanglin Hydropower Station and the 1.6 km long river section upstream and downstream of Lingfeng Bridge. Hydropower station improvement includes upgrade of Huangshi, Fanglin and Xiadao power stations. These rehabilitation measures will increase flood discharge capacity of main river course and avoid flooding of urban area. The flood control capacity of Hezhou Municipality is improved through the promotion of the flood control standards of both the main watercourse and the tributaries. Improvement of flood control capacity of the main river course alone will have the flood control standard promoted to the level for floods with a recurrence period of 50 years and reduce the flooded urban area by about 9 km^2 or 68.7% and economic loss by approximately CNY 1.70 billion or 83.2%, thus capable of safeguard the flood safety in the urban area to a large extent.

(ii) Change of Urban Canal Hydrological Condition and Flood Control Benefits

Rehabilitation of urban inland canals will be done through river/lake retention, water diversion and discharge measures. Jintai Lake and Yongfeng Lake will be used for retention of regional peak flood flow to release pressure on downstream river course. Jintai Lake and Yongfeng Lake have a retention capacity of 300,000 m^3 and 590,000 m^3, respectively. Huang'ansi Drainage Canal is only used for discharge of stormwater within its own catchment area, and water received from upstream will be diverted to Shizigang Drainage Canal. Stormwater lift stations will be built at Huangansi and Shizigang canal estuaries to lift stormwater of urban area to river when He River is at high water level. River rehabilitation will eliminate inundation occurrence in urban area under 1-in-20 years precipitation and ensure urban safety. Meanwhile, river-lake connection, and water diversion and water replenishment will increase water flow as a whole, increase assimilative capacity of urban inland canals and help improve water environment.

Under scenario of rehabilitation of He River and without rehabilitation of its tributaries, flooded area and average flooded depth of Hezhou urban area will be 3.10 km^2 and 1.07 m respectively under floods with a recurrence period of 20 years. Flooded area concentrates in lower-elevated area along Huangansi and Shizigang canals occupied by residential buildings, hospitals and schools, especially protected Xiyue historical and cultural block located downstream of Huangansi canal. Total flooded floor area of the buildings and farmland area will be 0.38 km^2 and 2.72 km^2 respectively, causing economic loss of approximately CNY 250 million.

5.2.1.2 Benefits of Water Environment Improvement

The existing urban rivers in Hezhou City are mostly natural channels with low drainage capacity and without efficient management. Major issues include small discharge section, serious sediment deposit and the resulted weak flood discharge capacity. Uncontrolled wastewater discharge along Huang'ansi Drainage Canal, Shizigang Drainage Canal, Huangtian Branch Canal and Guposhan Branch Canal has resulted in deteriorated water quality and occupied or covered watercourse. The Project intends to address the problems of restricted space of watercourse, inflow of wastewater from both banks and water-human separation. This Project will follow the water system planning and implement ecologically-friendly river rehabilitation and river section determination on the basis of the existing water surface ratio. Service roads will be built along He River and trees and grass will be planted as the boundary line of He River channel. Wastewater will be intercepted along He River in dry season and Jiangnan WWTP and associated pipeline networks will be built to increase wastewater collection rate, reduce pollutant loading into He River, and finally improve water quality of He River.

(i) Benefits of River-Lake Connection, Water Diversion and Wastewater Interception

River-lake connection is favorable for the establishment of an urban river system and replenishment of fresh water. The first major source for water replenishment is Xitiankou Water Diversion Canal that diverts water from Mawei River with maximum diversion flow of 2.0 m^3/s. The other source is Wugongshui Water Diversion Canal that diverts water of Xiwan River with maximum diversion flow of 1.51 m^3/s. The standby source for water replenishment is Guishidong Trunk Canal that diverts water from Guishi Reservoir. Regular renewal of river and lake water achieved through river/lake connection will help improve self-purifying capacity of water body, prevent occurrence of water body eutrophication, ensure landscaping water use requirements being met by artificial lake, and ensure water quality will not deteriorate through regular renewal.

Wastewater interception along He River will greatly reduce pollutant load discharged into He Rivers and improve river water quality. Based on catchment area, quantities of wastewater intercepted will be 4,300 m^3/d along Huang'ansi Drainage Canal, 6,500

m^3/d along Shizigang Drainage Canal, 1,600 m^3/d along Huangtian Branch Canal, and 2,600 m^3/d along Guposhan Drainage Canal, respectively. Wastewater interception totals 15,000 m^3/d along the four urban rivers. Treatment of wastewater intercepted in Hezhou municipal WWTP will reduce pollutant loading into He River in terms of COD, BOD, SS, TN, NH_3-N and TP by 1888.88 t/a, 903.38 t/a, 1231.88 t/a, 328.5 t/a, 221.75 t/a and 3 t/a, respectively. Pollutant load reduction benefits are significant.

(ii) Benefits of Pollution Reduction by the WWTP

After the Project is fully completed, water quality of He River and its tributaries will be improved. This project will have significant benefits in improving flood control and aquatic environment. Operation of Jiangnan WWTP will greatly reduce pollutant load into He River, as shown in **Table 5-9**.

Table 5-9 Pollutant Load Reduction by WWTP Operation

Facility	Capacity（m^3/d）	Pollutant	Influent Quality (mg/L)	Pollutant Load (kg/d)	Effluent Quality (mg/L)	Pollutant Discharge (kg/d)	Concentration Decrease (mg/L)	Pollutant Load Reduction (kg/d)
Jiangnan WWTP	15,000	COD	280	4200	50	750	230	3450
		BOD	120	1800	10	150	110	1650
		SS	160	2400	10	150	150	2250
		TN	55	825	15	225	40	600
		NH_3-N	32	480	5	75	27	405
		TP	5.5	82.5	0.5	7.5	5	75

Table 5-9 indicates that operation of Jiangnan WWTP will reduce the inflow load of COD, BOD, SS, TN, NH_3-N and TP respectively by 1259.25 t/a, 602.25 t/a, 821.25 t/a， 219 t/a，147.83 t/a and 2 t/a, respectively, generating significant benefits in reduction of pollutant load.

(iii) Benefits of River Dredging

Surface substrate structure on He Riverbed will become more stable after dredging, helpful to increasing DO concentration, change redox reaction condition of bottom interface, and reduce release of nutrients. River dredging will effectively remove a considerable part of nitrogen, phosphorus and heavy metal; with wastewater intercepted along the major drainage canals, the waterfront pollution belt will be significantly reduced. The main watercourse of He River will become unobstructed and freeflowing to facilitate sand sedimentation, decrease water turbidity, and increase intensity of sunlight illumination and the growth of floating phytoplankton. Increased plankton reproduction will further increase secondary breeding of aquatic lives ranging from invertebrate to fish species. Improved water quality and assimilative capacity of He River will, to some extent, slow down water body eutrophication in this region. Animals that are adaptable to clean water will become dominating species. For example, quantity of diatom will increase over time and finally become dominating species, and blue-green algae will become less. Meanwhile, quantities of aquatic vascular plants will increase, and restoration of aquatic vascular plants has extremely important role in aquatic ecosystem. Fish species is at high tropic level in aquatic ecosystem. Restoration and multiplication of fish species rely on water quality and restoration of other aquatic biological groups at lower trophic levels. Restoration and multiplication of fish species will be achieved only when other aquatic lives are under normal growth and benign ecological cycle has been achieved. In the long run, river dredging will remove most of heavy metals and toxic substances in sediment and cut off migration and enrichment of these substances in food chain, which will increase economic value of fish. Moreover, restoration of phytoplankton and zooplankton over time will provide more attractive food and will benefit growth of chub and crucian that rely on the algae. Improved water quality, more transparent water and disappearance of odor will provide more favorable condition for growth of fish and other aquatic animal species, and will further help maintain healthy aquatic ecosystem.

5.2.1.3 Benefits of Landscaping and Ecological Environment Improvement

The landscaping construction works of the Project will be implemented in accordance with the Master Urban Plan and in association with the development of flood risk control system and the urban drainage improvement system. Urban greenbelts and ecological corridor will be constructed to increase landscaping continuity, protect animal habitat, and create natural and continuous recreational space that encourages ecological-friendly hiking and cycling. Such efforts will play a critical role in protecting the urban ecosystem structure and functions and creating an urban eco-network and planning the open urban spaces. They will help increase the value of the urban landscaping system, maintain a healthy water environment, and facilitate human-water harmony. Such landscaping efforts will be helpful to maintaining the integrity of water system and full utilization of water resources. Interaction and integration of the water and mountain systems will enable the water system to become a medium connecting all blocks and create a more stable and ecologically-sustainable system of blue water and green mountains. The rehabilitated river channels will provide the local residents and tourists with a waterfront recreational area comprising of river course, revetments and urban landscaping along He River.

Improved urban landscaping and ecological environment will set up a scientific link between the landscaping, cultural environment and the natural environment comprising of the surrounding mountains and water bodies to form an environment-friendly ecological landscaping system. This will also improve city attractiveness, increase land value, and create livable environment, and achieve co-development of city and urban residents.

5.2.1.4 Benefits of Municipal Infrastructure Construction

Flood control, wastewater and stormwater collection and drainage facilities provide physical assurance for normal urban operation and healthy urban development, and play an indispensable role in improving dwelling condition and urban capacity and increasing urban operation efficiency. Implementation of the Project will assure safe urban area against flood risk, improve regional water environment, construct high-standard and modernized municipal infrastructure and public service facilities to provide strong support and assurance for sustainable economic development of Hezhou city, increase urban development level, and achieve integration of reform and innovation.

Meanwhile, the Project will improve institutional capacity building by providing water affair management technical assistance for Hezhou Municipal Government. Institutional capacity building will establish coordination mechanism among water affair master plan agency and water resources authorities, provide concerned training, workshop and study tour, in order to improve professional capacity of Hezhou City water resources authorities and agencies and provide powerful software support and assurance for sustainable economic development of Hezhou City.

5.2.2 Adverse Environmental Impacts and Mitigation Measures

Upon the completion of the Project, adverse environmental impacts in the operation stage will mainly be generated from the Subproject of Improving Urban Drainage and Wastewater Management. Such impacts mainly include effluent, odor and noise discharged from Jiangnan WWTP in operation and noise generated stormwater pump station in operation.

5.2.2.1 Adverse Environmental Impacts associated with Jiangnan WWTP Operation and Mitigation Measures

Thanks to the operation of Jiangnan WWTP, domestic sewage in this region will be collected and treated to prevent direct discharge of untreated domestic sewage into the surface water in WWTP service area and will significantly improve water environment. However, WWTP effluent will have slight impacts on receiving water body. Additionally, odor generated by wastewater aeration and sludge storage and noise from operation of pumps and air blowers will have impact on the surrounding environment, and wastewater sludge will cause environmental pollution in case of improper disposal.

(i) Impact of WWTP Effluent

After project implementation, uncontrolled domestic sewage will be collected in associated pipeline networks and discharged to He River after treated. Therefore, wastewater discharge impact prediction is based on scenario with WWTP operation.

Jiangnan WWTP has a designed treatment capacity of 15,000 m^3/day receiving domestic sewage collected in the Jiangnan East Area of Hezhou. Outfall of the WWTP is near Zhegutou along the main watercourse of He River. Considering that urban river rehabilitation and separate wastewater and stormwater collection are included in the Project, other pollution sources that discharge into the projected river sections will be ignored during the assessment of water quality impact by WWTP effluent.

Receiving water body of Jiangnan WWTP is He River. Flow velocity, river width, river depth and gradient cited for water quality prediction are all sourced from hydrological parameters of GZAR Surface Water Environment Capacity Study Report prepared by Chinese Research Academy of Environmental Sciences and Guangxi Environmental Protection Science Research Institute. The two-dimensional steady-state mixed attenuation model of bankside discharge recommended by Environmental Impact Assessment Technical Guidelines for Surface Water Environment (HJ/T2.3-93) and the S-P model recommended in HJ/T2.3-93 are used as the prediction models for the fully mixed river sections. The prediction process is shown in Annex 2.

Prediction results show that an 11m long and 3m wide polluted mass will be formed around WWTP outfall under scenario of normal WWTP discharge, but the water quality of the other downstream sections will meet Class III of Surface Water Environment Quality Standard (GB3838-2002) along with the dilution and self-purification of He River. The predicted COD concentration at 2.8 km downstream of the WWTP outfall is almost same as baseline level upstream of the WWTP outfall, and predicted value of ammonia nitrogen at 11km downstream of the outfall will decrease to baseline level of influent from upstream of the outfall.

Prediction results show that COD concentration at 2.8 km downstream of the WWTP outfall will decrease to baseline level. The projected COD concentration in fully mixed river sections at 3.1 km downstream of the outfall is 9.9mg/L, decreased by 10% compared with existing monitoring value of 11 mg/L. The projected ammonia nitrogen concentration in fully mixed river sections is 0.314 mg/L, slightly higher than existing monitoring value of 0.313 mg/L but decreases afterwards to baseline level at 11km downstream of the WWTP outfall.

(ii) Impact of WWTP Odor and Mitigation Measures

WWTP will inevitably generate odor during operation. Odor generation concentrates in bar screen, wastewater pump chamber, grit removing tank, A^2/O reaction tank, sludge concentration tank, and dewatering facility. Odor is caused by generation of H_2S, ammonia, volatile phenol, methane, and methanol in the process of biological anaerobic and aerobic fermentation. Based on information collected of municipal WWTP odor analysis, uncontrolled H_2S and NH_3 emission has relatively higher concentration and will pollute ambient air within and outside the WWTP.

As presented in Typical Case Studies for Environmental Impact Assessment, monitored odor concentration of a WWTP with a design capacity of 40,000 m^3/day was 11.0, 4.4 and 1.1 at 100 m, 200 m, and 400 m downstream of the WWTP, respectively, under meteorological condition of breeze and air temperature of 22 degree centigrade. All these monitoring values could meet Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) Class 2 waste gas emission limit (odor concentration limit 20) within 100 m and farther. Finalized health protection distance of Hezhou municipal WWTP (capacity expanded to 30,000 m^3/day) also located in Hezhou City is 100 m, therefore this distance is also applied to Jiangnan WWTP. Based on field investigation, the nearest environmental sensitive receptor is located more than 100m away from the plant boundary and WWTP odor will have very insignificant impact on environmental sensitive receptors.

Odor capture and treatment measures can be taken for major odor-generating structures to make sure odor level could meet applicable standard at WWTP boundary. Major structures that have odor generation include inflow pump chamber, aeration tank, sludge concentration tank, and sludge dewatering chamber. Currently biological odor removing methods are adopted in most cases. Biological odor removal depends on micro-organic metabolism to degrade odor substances and is suitable for removal of WWTP odor. Biological filter is the most mature technology and is odor removing method widely applied. Under suitable condition, solid carrier (stuffing) attached by large quantity of micro-organics absorbs odor pollutants and decomposes odor pollutants to carbon dioxide and water. Bio-filter has advantages of low operation cost, high removing efficiency, and easy operation without secondary pollution, and is widely applied.

(iii) Impact of WWTP Noise and Mitigation Measures

Noise sources of WWTP include air compressor, air blower and pumps concentrating in inflow pump chamber, sludge dewatering structure, sludge circulating pump and air blower chamber. Noise intensity is shown in **Table 5-10**.

Table 5-10 Impact of Major WWTP Equipment Noise

Equipment	Noise Source Intensity dB (A)	
	With Mitigation Measures	With Mitigation Measures
Wastewater Pump	90-100	80
Sludge Pump	90-100	80
Air Compressor	95-105	85
Air Blower	80-90	80
Transportation Vehicle	75-80	--

It can be seen from Table 5-10, noise intensity can be as high as 105 dB (A) without mitigation measures being taken. When noise damper is installed and the building is enclosed, noise intensity will decrease by around 20 dB (A).

Major noise-generating equipment of WWTP includes water pump, air compressor and air blower. Noise level in air blower room ranges from 80 to 90 dB (A), and will decrease to 80 dB (A) when noise reduction measures are taken. Usually pumps are installed within buildings, in which noise level is 90 to 100 dB (A) and will decrease to 80 dB (A) after mitigation measures are taken. Further reduced by ambient air and distance, noise at WWTP boundary can meet Ambient Noise Emission Standard on the Boundary of Industrial Enterprises (GB12348-2008) Category 2, allowable maximum noise level 60 dB (A) for daytime and 50 dB (A) during night.

Noise mitigation measures include:

(1) Selection of advanced low-noise equipment and submerged wastewater and sludge pumps, and installation of air blower indoors.

(2) Firm pump foundation that can damp various vibrations and provide solid support;

(3) Proper maintenance of water pump, regular inspection of concentricity of motor and pump axle, and good lubrication of bearings to reduce abrasion of pump components and parts;

(4) Installation of acoustical material and vibration damping devices along internal wall of pump chamber, roof, floor and next to equipment to effectively control and eliminate noise transmission and reflection, such as asbestos board and vibration damper; and

(5) A greenbelt around the pump house should be constructed through inter-planting trees and bushes to improve landscaping and reduce waste gas, noise and odor impacts on surrounding environment. Tree species with strong pollution resistance should be selected.

(iv) Impact of Solid Waste during WWTP Operation and Disposal method

A^2/O micro-aeration oxidation ditch process is proposed for Jiangnan WWTP. Solid wastes generated include residual sludge and screening solid waste. Using Hezhou municipal WWTP expansion that adopts A^2/O process as reference, it is anticipated Jiangnan WWTP will generate residual sludge of 3 tons each day or 1,095 tons per year, and generate screenings of 0.1 tons each day or 36.5 tons per year. Sludge cake will be hauled to Hezhou sludge treatment facility for safe disposal.

Hezhou sludge treatment facility is located in Xinyan Village Jiuniu Community of Hezhou City Liantang Town (planned landfilling area of Hezhou municipal solid waste landfill zone 2), with designed treatment volume of 100 ton/day sludge with water content of 80%. This facility is composed of sludge receiving system, sludge treatment system, odor treatment system and wastewater treatment system. Conditioning by dilution plus deep dewatering process is adopted to dewater the sludge received with water content of 80% to dry sludge cake with moisture content 60%, and then the sludge cake is disposed of in landfill together with domestic solid waste.

Sludge generated in Jiangnan WWTP is domestic sewage sludge with high water content of 80% or more, and sludge quantity will be approximately 3 tons a day. Currently construction of Hezhou sludge treatment facility has commenced and construction will be finished before operation of Jiangnan WWTP. Hezhou sludge treatment facility has adequate capacity to accommodate sludge from Jiangnan WWTP. Therefore, disposal of Jiangnan WWTP sludge in Hezhou sludge treatment facility is feasible.

(v) Health Impact and Protective Measures

Jiangnan WWTP has a staff of around 30. Wastewater and sludge contain various pathogenic bacteria and parasitic ovum, and vapor over wastewater treatment facility could spread bacteria and virus. Exposed to micro organics in wastewater and sludge, operation staff of WWTP may be infected and catch disease. Infection may be caused by direct inhalation or indirectly by water drops sticking to skin and clothes, which occur in aeration tank, effluent weir, irrigation spraying outlet, air blower room, and dewatering room. In area with much moisture condensation, chiffon-type respirator will help reduce inhalation of toxic substances. Usually this kind of direct pathogen infection is confined to operators of the WWTP, with very low probability of occurrence in other people. However, if infection of the operators cannot be effectively controlled, disease may be spread to people outside the WWTP. Therefore, the following measures should be taken to ensure health of WWTP staff.

(1) Proper protective clothes, gloves and respiration mask should be provided for WWTP workers. Anti-skid shoes should be provided for transportation workers and steel-toe shoes should be provided for all the workers to prevent foot injury. Workers working near high-noise equipment should be provided with noise protective devices. Workers operating near heavy movable equipment, bucket, crane and transportation vehicle dumping site should be equipped with safety helmet. Guardrails should be installed around all the process containers and water tanks. Lifeline and personal floating device should be available for use when operators are working within the guardrails, to make sure life saving devices being in place in emergencies.

(2) Dangerous contact should be reduced through design and development of technical and material specifications (e.g. ventilation, air conditioning, enclosed conveyor belt, low-load and different heights, anti-skid floor, safety guardrails for stairways and aisles, spill protection and leakage prevention, noise control, dust prevention measures, gas alarm system, fire alarm and control system, and evacuation devices).

(3) Bathroom and dressing area should be provided for the operators for after-work bath and dressing, and work clothing laundry service should be provided. Additionally, frequent hand washing of WWTP staff should be encouraged.

(4) Enclosed space access plan conforming to the national requirements and internationally recognized standards should be developed for construction activities in enclosed treatment zone. Ventilation is mandatory before entering. Operators should be equipped with gas detector and valve connected with process container should be locked to prevent accidental overflow during maintenance.

(5) Eating, smoking and water drinking should be banned outside the designated area.

(6) Operators should be separated from bacteria spreading channels via mechanical overturning (e.g. use of tractor or front-end loader with enclosed air

conditioning or heating driver cab). Ventilation system should be provided in case of manual overturning.

(7) Provision and use of proper personal protection clothes and devices should be required to prevent wastewater contact, such as rubber gloves, apron and boots. Medical care should be provided in a timely manner to prevent infection, for example binding up of skin injury like cut and scrape wound. Protective clothes and glasses should be used to prevent spill contact.

(8) Instruction to use of safety devices and personal health practice should be included in safety training program for the operators to reduce exposure to pathogen and bacteria carrier.

(9) Vaccination for preventing B type hepatitis and tetanus and health monitoring should be provided for the operators, including regular health check. Persons having asthma, diabetes or weak immune function are not suitable for working in WWTP.

5.2.2.2 Impact of Stormwater Pump Station Noise and Protective Measures

Stormwater lift stations are designed for Shizigang Drainage Canal and Huang'ansi Drainage Canal. The pump stations are suspended under normal condition and are only put into operation to prevent backward flowing of river water. Major impact during operation is noise. Noise sensitive receptors are residential buildings in Xiyue Street and Mid Jiangbei Road. Short term and intermittent operation of these pump stations will have insignificant impact on environmental sensitive receptors after noise reduction by foundation and proper equipment maintenance measures are taken. Noise reduction measures to be taken are listed as below.

(1) Selection of equipment with good operation performance and low noise, and vibration damping measures are taken during equipment installation to reduce noise;

(2) Firm pump foundation that can damp various vibrations and provide solid support;

(3) Proper maintenance of water pump, regular inspection of concentricity of motor and pump axle, and good lubrication of bearings to reduce abrasion of pump components and parts; and

(4) Installation of acoustical material and vibration damping devices along internal wall of pump chamber, roof, floor and next to equipment to effectively control and eliminate noise transmission and reflection, such as asbestos board and vibration damper.

5.2.2.3 Analysis and protection measures for the operaitonal impacts of the monitoring station laboratory

Equipment and test reagent must be purchased as a part of the monitoring station construction to increase the monitoring capacity. A certain volume of wastewater and a small volume of exhaust gas and waste test reagents will be generated in the operation of the laboratory. Wastewater generated in the laboratory is mainly wastewater from washing of instruments. Although such wastewater contains little pollutants, there are relatively many types and compositions of the pollutants, including the most common organics, heavy metal ions and hazardous microorganisms as well as the less commonly seen baceria, toxins, pesticide residues, test reagent residues, etc. The wastewater containing strong acid, strong alkaline or toxic substances will generate serious enviornmental pollution if directly discharged into the natural environment. Therefore, such wastewater must be treated before discharged into the municipal pipelines. In the process of test, a small amount of exhaust gas will be generated, mainly organic exhaust gas that is ventilated outside the laboratory via the ventilation cupboard and will generate little environmental impacts. The waste drugs and test reagents are hazardous wastes and must be recovered for disposal by a qualified unit. Therefore, the wastewater, exhaust gas and solid wastes in a laboratory require reaosnable disposal, thus raising the requirements of management for the laboratory.

1. The wastewater, exhaust gas and solid wastes in the laboratories must be properly treated according to the national laws and regulations on environmental protection and random dumping, storage and discharge are prohibited.
2. Acid and alkaline waste liquid generated in the process of test and analysis and waste liquid containing highly toxic drugs must be dumped into the waste liquid cylinders for the right classification and delivered to the waste liquid storage room for centralized treatment by a qualified unit.
3. Digestion of specimens must be conducted in a ventilated cupboard and all the exhaust gas generated must be discharged at high altitude via the air duct.
4. Wastes generated in the process of testing and analysis shall be handled in such a way that intoxic wastes are dumped into the garbage bins, contaminating wastes are collected and delivered to the waste storage room for centralized treatment by a qualified unit.
5. Proper preventive measures should be taken against fire, burglary and poisoning hazards and risks. Fire protection devices and necessary poison prevention facilities should be provided in the laboratory.
6. Flammables, explosives and toxic substances must be properly stored, claimed and registered according to the respective stipulations.

7. Smoking, laundry, cooking and storage of personal food in the refrigerators are prohibited in the laboratory. Loud noises and frolic are banned during test operation.
8. The codes of operation should be strictly followed.

6. Environmental risk analysis and mitigation measures

6.1 Identification of environmental risks

The potential environmental risks in World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project will arise from the proposed Jiangnan WWTP as a part of the Urban Drainage and Wastewater Management Improvement Subproject considering the engineering features of the Project. The main environmental risks include:

(1) massive direct discharge of untreated sewage may occur in case of any events of emergency, such as power outages, natural disasters and equipment failure ;

(2) Environmental risks may arise from leakage of sewage into storm water pipe and discharge of untreated sewage into surface water caused by broken sewage pipes;

(3) Personal safety risks may arise from the accumulation of harmful gas in the course of sewage pipeline maintenance.

6.2 Analysis of potential impacts from WWTP accidents with environmental risks

6.2.1 Emergency accidents

Improper equipment maintenance or quality problem may cause failure of equipment and facilities and reduction of treatment efficiency, or even cause direct discharge of untreated sewage. Some irresistible external causes, such as power outage, natural disaster might result in equipment failure and direct discharge of untreated sewage. This is the worst case of abnormal operation. The sewage will be discharged into surface water through bypass if power outage causes facility failure.

6.2.1.1 Water quality prediction model

The effluent of Jiangnan WWTP will be discharged into He River. Considering the size of He River, the impact of discharged of untreated sewage is projected using the two-dimensional steady-state attenuation model recommended in the Technical Guideline of Environmental Impact Assessment-Surface Water (HJ/T2.3-93). The S-P mode was adopted for the full mixture section. The impact of discharge of untreated sewage (i.e. at the designed influent concentration of the WWTP) was also predicted in the scenario of accidental discharge. The details of the prediction process is described in Annex 2.

According to the prediction results, COD of the 10 m wide and 220 m long river section downstream of the outlet exceeds the discharge standard by a maximum factor of 6.46. NH_3-N of the 10m wide and 500 m long section downstream of the outlet exceeds the standard by a maximum factor of 15.10. It can thus be seen that the water quality of He River will be affected to a certain extent or even exceeds the standard at some river sections in the case of accidental discharge. Therefore, it is necessary to strengthen WWTP operation and management to prevent accidental discharge.

6.2.2 Risks of sewage pipeline leakage

In case of any leakage of sewage pipelines, collection of sewage will become unlikely. Untreated sewage will cause pollution to surface water environment. Sewage leaked from pipelines and permeated into the ground may result in pollution of not only the soil and environment in the surrounding areas and also negative impacts on ground water quality. Based on the status of operation of the existing stormwater and sewage pipelines, the probability of pipeline leakage is not high unless in the case of uncivilized construction and human damages.

6.2.3 Staff health risks from failures of WWTP system

As the WWTP system failure is always unexpected, it will cause significant damage to the working staff and endanger their life. When environmental accident occurs, the first thing affected is the health and safety of the staff in the wastewater treatment plant.

6.2.3.1 Analysis on poisoning risks and impacts caused by toxic gases

When an accident occurs in a particular structure of the sewage treatment system, maintenance workers need to enter the enclosed space, such as sewer, water collection well and wastewater tank, to repair the system immediately. In such places, high-concentration toxic gases, such as hydrogen sulfide, methane, carbon dioxide, etc. are likely to occur and accumulate. If no protective measures are taken during maintenance, the workers might inhale the toxic gases due to poor ventilation, which might result in dizziness, poor breath and other symptoms or even casualty.

According to relevant data, there have been dozens of accidents with threats personal safety in more than 20 cities caused by exposure to toxic gases in the sewers and combined pipelines or fire explosions resulted from flammable methane in the pipelines. Therefore, it is essential for the WWTP operators to take occupational safety measures to prevent damages from toxic gases. The most effective way to prevent poisoning is to take ventilation measures to disperse the poisonous and harmful gases completely and make the working space full of fresh air. If adequate ventilation is not possible, the dangerous space should be avoided and effective protective equipment must be worn during operation. Protective equipment includes gas marks, air supply masks and so on. Testing devices needed include test paper and gas detector, etc.

6.2.3.2 Analysis on health risks and impacts caused by pathogens

The wastewater and sludge contain a variety of pathogens and parasite eggs. The fog and water on the treatment facilities can spread bacteria and viruses. The WWTP workers exposed to the micro-organisms in the sewage and sludge have the risk of infection through direct inhalation of gas or caused by droplets on the skin or clothing. This kind of gas can be found at aeration tank, effluent weir, irrigation outlet, blower room, dewatering workshop and other places. In places where water vapor is highly condensed, the gauze-type respirator can reduce the inhalation of toxic substances. This type of environmental risk mainly results diseases caused by direct infection of pathogen. People outside of the plant is unlikely to be infected, but their heath will be also endangered by spread of disease due to poor control of the condition of infected workers..

6.3 Risk mitigation measures

6.3.1 Equipment safety assurance measures

The failure of pump, valve, electrical apparatus and other instrument used in the treatment facilities and system will reduce the treatment efficiency or even cause outage of the whole WWTP. This is a kind of potential risk. The emergency response actions in this regard include:

(1) A redundancy equivalent to 0.5 times of the maximum capacity is considered in the process design for the WWTP system so as to have a buffer in the event of accidents; Compatible processing equipment (reflux pump, reflow pipes, valves and meters) should be provided so that the system buffer and backflow equipment can be started to retreat the unacceptable effluent to the specified discharge standard in case of equipment failure affecting the normal operation of the system.

(2) For the vulnerable equipment, multiple standby equipment and adequate spare parts should be assured on site. All key mechanical and electrical equipment should be configured in such a way that one standby is available.

(3) Use high-quality equipment. All machinery, electrical appliances, instruments and other equipment selected should have good quality, low failure rate, good durability and be easy to maintain and repair.

(4) During operation, the operators shall strictly follow the rules and regulations of facility operation and conduct regular inspection and timely maintenance to reduce equipment failure rate.

(5) The electrical equipment should be operated in compliance with the grounding protection regulation and be equipped with automatic tripping circuit. The main equipment shall be operated under the surveillance of a computer data monitoring system and be capable of giving alarms and recording the location, time and features of accident so that the workers can organize maintenance promptly. All electrical equipment shall be installed with a protection system according to the relevant safety requirements.

(6) Dual-circuit power supply shall be used to assure normal operation of the power supply facilities and lines.

6.3.2 Protection measures for abnormal wastewater discharge

1. Emergency responses to unstable water amount caused by various factors shall be fully considered in the design to alleviate the unfavorable situations.

2. Technical management measures during WWTP operation include:

（1） Establishing a WWTP operation and management responsibility system;

（2） Organizing trainings for the management and technical staff and establishing technical appraisal records so that those failing the technical appraisal are not allowed to be on duty;

（3） Employing experienced professional and technical staff to be responsible for the technical management in the WWTP;

（4） Organizing domestic and abroad trainings for the technical staff;

（5） Strengthening inspection of pipelines and detecting and resolving problems in a timely manner;

（6） Strengthening maintenance and management of equipment and facilities. Key equipment shall have standby and dual power supply.

6.3.3 Emergency responses to unexpected wastewater discharge accident

The following measures shall be taken in the event of unexpected wastewater discharge accident in a WWTP:

(1) Ensuring the normal operation of grid and grit chamber so that the SS and COD in the influent can be reduced to certain extent;

(2) In the event of irresistible external causes, such as blackout of dual power supply and natural disaster that will lead to discharge of untreated wastewater, the wastewater shall be stored in the emergency tank and treated once the wastewater treatment system is repaired to ensure the safety of the water body;

(3) In the event of and during the handling of an accident, warning signs shall be erected in the waters near the outfall to remind all parties concerned to take precautionary measures.

6.3.4 Prevention and control measures for risks of pipeline leakage

（1） The local conditions shall be considered to select proper pipe material and ensure pipeline quality and service life. The drainage foundation shall meet the mechanical design requirements and be constructed in strict accordance with the detailed design of width, thickness and strengths of foundation to assure good construction quality.

（2） Careful inspection shall be conducted before pipeline installation. All pipe materials shall be carefully checked to avoid any cracks and leakage. On the other hand, it is necessary to check the center line and the edge of the foundation with the drawings and ensure the size and strength of all bed course satisfy the requirement. It is also necessary to check whether the manhole location, spacing and concrete strength and the preparation of anti-seepage mortar can comply with the national standard.

（3） During pipeline installation, the cement mortar shall be prepared according to the stipulated mix design. Protruded seams often occur at the pipeline connections due to squeezing during installation. If not handled in a timely manner, the water flow profile and velocity may be affected and debris accumulation and pipeline congestion may occur.

（4） The pipe base concrete and plaster mortar must reach the required strength before trench backfill. Action should be taken to avoid gravel impacts on the pipelines. Large crushed stone and hard objects should not be contained in the gravel and aggregates. Backfill and compaction should be conducted simultaneously on both sides of the pipeline and lay-by-layer on top of the pipeline so as to form an integral load-carrying mass to spread the unloading force at the pipe crest to protect the pipelines.

（5） The construction unit shall establish a complete system of pipeline monitoring and management during operation, and clear the pipe network and replace the damaged pipes in time to avoid water pollution caused by pipeline leakage.

6.3.5 Personal safety protection measures

（1） The operation and management staff shall receive safety education before formal operation. The plant shall establish a set of safety operation procedures and management system. These procedures shall be strictly enforced and the performance shall be inspected during operation.

（2） The requirements of water supply and drainage, heating and ventilation, lighting and health shall be considered in the design. Air conditioning facilities shall be provided in the places involving lengthy operation. The enclosed structure or work place with poor ventilation shall have mechanical ventilation facilities.

（3） Life jacket, life buoy, safety belt and safety helmets and other personal protective supplies shall be provided on site. The workers who have to enter the pipeline for inspection or operation shall wear the necessary protective devices, such as safety suits, gas masks, air masks, gas detection equipment, test strips, etc., to prevent poisoning and at least two persons present.

（4） The walkway of tanks shall have handrails and lighting facilities to ensure pedestrian’s safety.

（5） All electrical equipment shall have protection system that meet the relevant safety requirements and grounding protection shall be properly executed for high-voltage equipment.

（6） The hazardous parts of machinery and equipment, such as belt, gear and wheel shall be installed with protective device.

（7） It is necessary to strengthen safety management and establish a responsibility system. All dangerous areas shall have warning signs at visible positions. Platforms with a height of more than 1.2 m shall have fences. Ventilation shall be provided in the places where toxic and harmful gas might gather. The operation and maintenance unit shall set up a safety and labor protection department to be responsible for safety protection and labor protection.

（8） Sanitation room (toilets, lavatories, dressing rooms, etc.) shall be provided for the sake of actual needs and convenience. In addition to providing ventilation in the places with poor working condition and shading for the outdoor work, lounge shall also be provided. There shall be centralized bathrooms in the plant.

（9） The staff directly exposed to sludge, wastewater or domestic solid waste shall take physical examination and be vaccinated on a regular basis (such as hepatitis A, hepatitis B, etc.).

6.4 WWTP emergency response unit and its roles and responsibilities

The emergency response unit of a WWTP mainly comprises of the leading group office and the emergency response teams of different disciplines, including rescue team, liaison team, logistics team and fleet team. The roles and responsibilities of each team are as follows and shown in Figure 6-1.

1. The leading group is responsible for i) developing and implementing emergency response plans; ii) guiding and coordinating with external agencies.
2. The leading group office will assist the leading group in task allocation, supervision and inspection.
3. The rescue team is responsible for handling accidents and repair equipment under the guidance of the leading group.
4. The liaison team is responsible for communication and coordination with the rescue team, logistic team and vehicle team.
5. The logistics team is responsible for assisting in the rescue of poisoned victims and taking appropriate first aid measures, hospitalization, nursing the poisoning victims and mobilizing rescue resources.
6. The vehicle team is responsible for arranging vehicles and sending the poisoned victims to hospital and delivering rescue materials, etc.

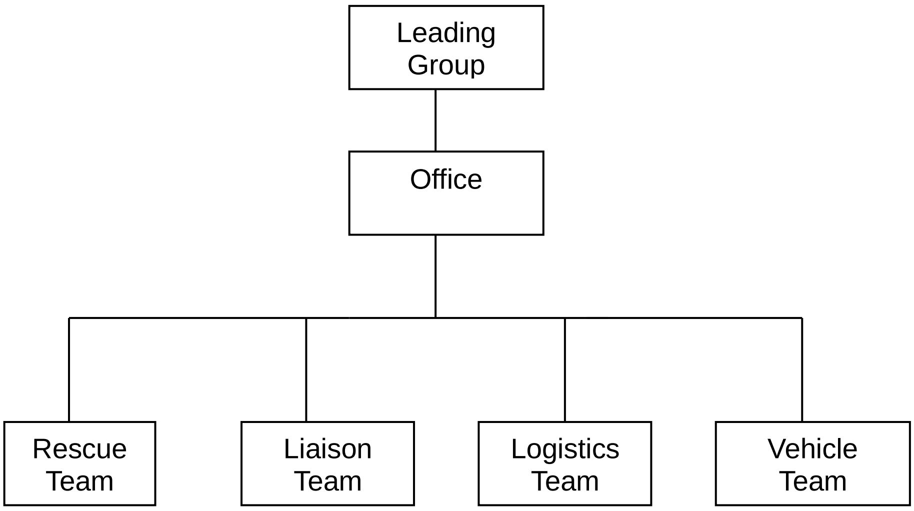


Figure 6-1: Emergency Response Mechanism of Wastewater Treatment Plants

7. Cumulative impact assessment

Hezhou Municipality was built along the He River. The urban center is on the north bank of He River. However, the terrain of the urban center is flat and depressed and the water conservancy infrastructure constructed in the past against the standard for a county town no longer match with the requirement of development of a municipal-level city. Hezhou Municipality has development a future strategy for development of the main axis along the He River, where the urban center is the most important node. In order to achieve the goal of urban development, the relevant government departments have begun to plan and construct flood control and drainage projects in recent years. On the other hand, if Hezhou's water pollution control cannot keep up with the pace of urban development, the pollution of urban inland canals in Babu old city area and tributaries of He River will become more serious and even expand to northwest and south of He River. In order to alleviate water pollution, Hezhou will make vigorous efforts in promoting the construction of drainage works, including wastewater treatment plants and the associated sewage and storm water pipelines. The relevant government departments are also planning to promote wastewater treatment in villages and towns in the territory.

Due to possible superimposition of impacts from projects already constructed, under construction or to be constructed along the main watercourse and tributaries of He River, such as flood control and drainage works, wastewater treatment plant and other infrastructures, and the impacts of the Project, cumulative impacts may arise on the valued environmental and social component (VEC) in the watershed. In such a context, with reference to IFC's Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets and through consultation with the stakeholders, the key VECs were identified and screened to determine the scope, indicators and thresholds of cumulative impact assessment. The cumulative impacts on the identified VECs were assessed. In addition, the Project and its linked projects will bring significant social benefits and certain negative impact. Therefore, the cumulative social impacts were also assessed. A series of safeguard measures were put forward on the basis of consultation with relevant departments.

7.1 Scope of cumulative impact assessment

7.1.1 Affected VEC

As discussed in Section 5.2, the long-term impacts of the Project will be mainly reflected in the reduction of water pollutants and improvement of flood control and drainage management. Upon full completion of the Project, significant positive impacts will be produced on the urban water environment in Hezhou from improvement of water quality in the tributaries of He River thanks to the construction of the sewage interception and dredging works. The proposed Jiangnan WWTP will greatly reduce pollutant load into He River. This Project will greatly reduce the flooded area and economic loss and assure urban flood safety through improvement of flood control standard and rehabilitation of the main watercourse of He River. There will be remarkable benefits from flood control. Based on desktop review and consultation with relevant departments, the activities likely to produce cumulative impacts with the long-term impacts of the Project are identified, including the existing and proposed flood control works (dikes, pumping stations, etc.) along the main watercourse of He River, river-lake connection works and water environment remediation works (urban and rural wastewater treatment facilities). The potential affected VEC, including flood control and drainage benefits, reduction of river pollutants, hydrological conditions and aquatic ecosystem, were screened at the early stage of cumulative impact assessment.

As discussed in section 5.2.1, the Project will not change the velocity, and flow of dry season and normal season and other hydrological condition of main watercourse of He River. In the event of a flood of the design level, the peak flow and velocity in the main watercourse will increase and the water will flood over the bank. During the flood period, He River erosion will be more serious. However, with various measures taken, the changes of sediment volume will be insignificant. According to the analysis, the impacts caused by the proposed dikes and drainage pump station on the main watercourse of He River will be basically similar with the Project. There will be no influence on the velocity and flow of normal season and dry season as the main watercourse will not be widened; the impact on sediment volume is negligible; the peak flow and velocity will increase during the flood period but at the same time, the floodplain area and the economic loss can be reduced. The main function of the proposed river-lake connection is to regulate peak flow in the flood period. All of these works will bring positive flood control benefits. Therefore, the cumulative impact assessment focuses on the impact in the flood period. The hydrological situation will not be significantly affected, thus not considered as important VEC, while the benefits of flood control and drainage are identified as key VECs to be assessed.

According to survey and consultation with experts, the aquatic organisms in He River are common species. There are no fish spawning grounds, feeding grounds or overwintering grounds in He River. After decades of development, there are cascade hydropower stations before He River flows into Xijiang River. There are no rare aquatic organisms or migratory fish species, or important natural habitat. Most of the fishes are economic species. As discussed in section 5.1.5, the Project has little impact on aquatic organism. The linked projects identified in the cumulative impact assessment are similar to the Project: the construction activities of dike and pump station may cause minimal disturbance to the surface water body, but the impact on aquatic organisms is temporary, minimal and reversible. Such disturbance will disappear as the construction is completed. The Project and the other linked projects will not cause long term cumulative impact on aquatic ecosystem. Therefore, it is not determined as a key VEC under this assessment.

In summary, it is finally determined that the benefits of flood control and drainage and reduction of water pollutants are determined as the key VECs under the cumulative impact assessment.

7.1.2 Temporal and spatial scope of assessment

In the course of the cumulative impact assessment, the relevant activities are screened from the four plans, i.e. Hezhou Urban Flood Control Plan, Hezhou Municipality Master Urban Plan (2016-2030) (Draft), Implementation Plan for Integrated River Rehabilitation of Urban Section of He River (2017-2020), and Hezhou Urban Ecological River System Planning (2014-2030), based on the results of consultation with Hezhou Municipal Planning Bureau, Hezhou Municipal Water Resources Bureau, Hezhou Municipal Engineering Administration Bureau, Hezhou Municipal Housing and Urban-Rural Development Bureau and Hezhou Municipal Environmental Protection Bureau. The scope of this assessment was determined on the basis of comparison with the scopes specified in each of the aforesaid plans.

Table 7-1: Plans and Scope of Impacts of the Related Development Activities

Description	Planning Period	Planning Scope	Affected VEC
WB Loan Hezhou project (the Project)	2017-2022	Main watercourse of He River: the upper Huangshi hydropower station - Downstream Jiangnan WWTP outfall Tributaries: Hejiang north branch (except for Taoyuan River)	He River: Huangshi hydropower station – 11 m downstream of Jiangnan WWTP outfall Core area of Hezhou Municipality
Hezhou Urban Flood Control Plan, Hezhou Municipality Master Urban Plan	Baseline: 2010; Short term: 2020; Long term: 2030	Main watercourse of He River: Xiwan town of Pinggui at upstream –Hejie town at downstream Planned urban center of Hezhou Municipality: east to Liantang town and Hejie town, west to Xiwan street, south to Etang town, north to the southern edge of Luo-Zhan railway	Main watercourse of He River: Xiwan town of Pinggui at upstream – Hejie town at downstream Planned urban center of Hezhou Municipality
Hezhou Municipality Master Urban Plan (2016-2030) (Draft)	Baseline: 2015; Short term:	Babu street, Xiwan street, Yangtou town, Wanggao town, Huangtian town, Hejie town, Liantang town, Etang town and surrounding villages, Fanglin	Main watercourse of He River: Pinggui WWTP at upstream-outfall of Hejie WWTP at

Table 7-1: Plans and Scope of Impacts of the Related Development Activities

Description	Planning Period	Planning Scope	Affected VEC
	2020; Long term: 2030	village of Shatian town. Hezhou urban center: east to Liantang town and Hejie town, west to Xiwan street, south to Etang town, north to south of Luo-Zhan railway Drainage planning: 1） Main watercourse of He River: Pinggui WWTP at upstream-outfall of Hejie WWTP at downstream; 2） Xiwan River: upstream to Wanggao industrial WWTP	downstream Planned urban center of Hezhou Municipality
Implementation Plan for Integrated River Rehabilitation of Urban Section of He River (2017-2020)	Baseline: 2016 Planning 2020	Main watercourse of He River: upstream Huangshi hydropower station-Xiadao power station Tributaries: northern Hejiang and Taoyuan River and Jiangnan district Wastewater treatment facilities in the surrounding villages and towns of tributaries: Etang town, Shatian town, villages surrounding the mainstream and tributaries	Main watercourse of He River: Huangshi hydropower station-outfall of Hezhou WWTP Tributaries in the Hezhou urban center and surrounding villages and towns
Hezhou Urban Ecological River System Planning	Baseline: 2014 Short term: 2020 Long term: 2030	Same as Hezhou Municipality Master Urban Plan (2016-2030) (Draft)	Planned urban center of Hezhou Municipality

Considering the impact of the Project and related planning, the scope of the cumulative impact assessment is identified and comprises of two parts, namely, main watercourse of He River and the urban center of Hezhou Municipality. As shown in the table above, the section of the main watercourse of He River to be influenced by the related planning is the section from the upstream Huangshi Hydropower Station to the downstream Hejie WWTP. The Jiangnan WWTP proposed in the Project is at the downstream. The water quality at 11 m downstream of its outfall can meet with the water environment quality standard. The effluents of Jiangnan WWTP and the Mawei River joining He River at 200 m downstream will have certain cumulative impacts. The cumulative impact of Hejie WWTP at 8 km downstream is minimal. In order to narrow the scope of assessment, the boundary of cumulative impact was set at the Duling Hydrological Station located 4.5 km downstream of the junction of Mawei River and He River. In such a context, the scope of cumulative impact assessment of the main watercourse of He River starts at the upstream Huangshi Hydropower Station and ends at the downstream Duling Hydrological Station with total length of 30 km. On the other hand, the proposed river rehabilitation works of the northern tributaries of He River and river-lake connection works will cause cumulative impact to the Project. Therefore, the northern part of the urban center is also included into the identified scope of assessment. To sum up, the spatial scope of assessment covers the main watercourse of He River (Huangshi Hydropower Station to Duling Hydrological Station) and north part of Hezhou urban center (see Figure 7-1).

The baseline year of the cumulative impact assessment is 2017; according to the schedule of the Project and timeframe of relevant planning activities, the temporal scope of the predictions and analysis will be 2018-2023 for the short term and 2030 for the long term.

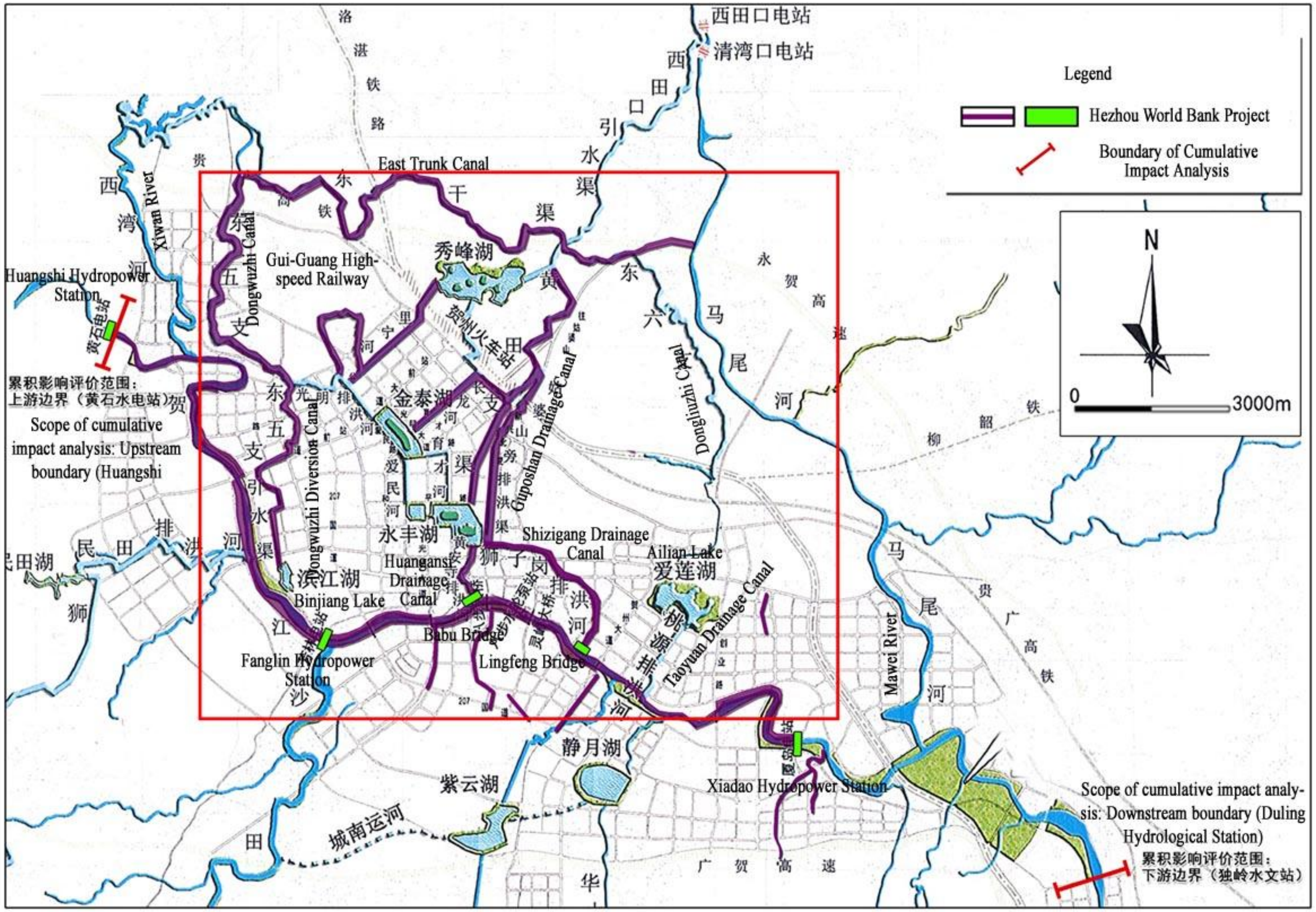


Figure 7-1: Schematic Diagram of the Scope of Cumulative Impact Analysis

7.1.3 Related development activities

As mentioned above, He River flows from northwest to southeast through Hezhou Municipality. He River will be the main axis of Hezhou Municipality in the future, with the urban center of Hezhou as the most important node. In order to achieve the goal of Hezhou urban development, the relevant departments are revising "Hezhou Municipality Master Urban Plan (2016-2030) (draft)". However, the flood control facilities of Hezhou Municipality are yet to be improved and the City is affected by floods almost every year. The existing flood control facilities in Hezhou Municipality cannot meet the needs of urban development. To this end, the relevant departments have developed the Urban Flood Control Plan of Hezhou, Guangxi, which integrated flood prevention and control measures to enhance the urban flood control capacity. On the other hand, the combined storm water and sewage system are still common in Hezhou urban area. The tributaries and drainage canals along He River receive large volume of sewage and He River is thus polluted. In order to achieve maximum collection rate of urban sewage, improve the urban drainage network, and address the problems of flooding and water pollution, the relevant departments developed a specific implementation plan in 2017, planning to implemented comprehensive river rehabilitation in 2-3 years in the urban river sections. The Hezhou Municipality Master Urban Plan (2016-2030) (draft) also develops an outlook for the urban sewage treatment facilities in the long term. Under the guidance of the Master Urban Plan, Hezhou Municipality proposed to connect as many natural rivers and lakes as possible in the future and speed up the construction of a modernized regional ecological water system relying on the projects of regulation and connection of natural rivers and lakes, medium-sized reservoirs. The Hezhou Municipality Urban Ecological Water System Planning (2014-2030) has been developed to constantly optimize configuration of water resources and further improve water resources and water environment capacity of Hezhou Municipality.

The linked projects already constructed, under construction and proposed to be constructed were identified on the basis of Hezhou Urban Flood Control Plan, Hezhou Municipality Master Urban Plan (2016-2030) (Draft), Implementation Plan for Integrated River Rehabilitation of Urban Section of He River (2017-2020) and Hezhou Municipality Ecological Water System Planning (2014-2030). The identification matrix is given in Table 7-2. The related development activities are shown in Figure 7-2.

Based on the temporal scope of the cumulative impact assessment, statistics of the expected progress of the Project and the related activities for the short-term scenario of 2018-2023 and the long-term scenario of 2023-2030 are summarized in Table 7-3 for further analysis and assessment.

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	Details	Completion Date	Flood Control Benefits	Drainage Benefits	Reduced Inflowing Pollutants
	Existing					
1.	Hezhou WWTP	Current capacity: 30,000 m^3/d; the wastewater is treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He River through 1000 m long dedicated pipeline.	Completed			Positive impact
2.	WWTP of Pinggui District	Current capacity: 30,000 m^3/d; the wastewater is treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He River.	Completed			Positive impact
3.	Jiangbeizhong Road dike	0.964 km from Jian'an Road to Shizigang; 0.764 km at downstream of Hezhou Bridge in Jiangbeidong Road.	Completed	Positive impact		Temporary and reversible negative impact during construction
4.	Jiangnan Road dike	Crest road with a length of 1.9 km	Completed	Positive impact		Temporary and reversible negative impact during construction
5.	Pinggui New District dike ((Fujiang section)	Xiwan estuary at the right bank of He River-Xiwan village, 1.28 km	Completed	Positive impact		Temporary and reversible negative impact during construction
6.	Pinggui Old Urban Area dike (Fujiang section)	Huangshi Hydropower Station-both sides of Xiwan estuary, 3.321 km	Completed	Positive impact		Temporary and reversible negative impact during

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
						construction
7.	Anju dike	Xiwan estuary at left bank of He River-Licun village, 1.445km	Completed	Positive impact		Temporary and reversible negative impact during construction
8.	Xuwan East Dike and Xiwan West Dike	Xiwan tea farm - both sides of Xiwan estuary banks, with a length of 3.475km and 3.24km respectively	Completed	Positive impact		Temporary and reversible negative impact during construction
	To be completed by end of 2023					
9.	Expansion of Hezhou WWTP	Newly built 2 A^2/O tanks and 2 high efficient sedimentation tank; build another 30,000 m^3/d capacity so that the total capacity can reach 60,000 m3/d. The ultraviolet light will be adopted for disinfection. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He River through 1000 m long dedicated pipe.	2018			Positive impact
10.	Shatian WWTP	A new WWTP will be built in Shatian town to receive domestic wastewater in west part of river south. The designed capacity is 10,000 m^3/d in short term. Total of 0.98 km sewage and storm water pipes will be installed to serve an area of 523 ha.	2020			Positive impact
11.	Etang town wastewater treatment station of Pinggui District	A set of integrated wastewater treatment facility will be constructed with a capacity of 1,000 m^3/d before connecting to Jiangnan WWTP. The wastewater is treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into Pangu River.	2018			Positive impact

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	Details	Completion Date	Flood Control Benefits	Drainage Benefits	Reduced Inflowing Pollutants
12.	Liantang town WWTP of Babu District	A WWTP with a capacity of 5,000 m^3/d and associated wastewater pipeline will be constructed. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into Mawei River.	2017			Positive impact
13.	Rural wastewater treatment facilities of Shatian town, Pinggui district	Integrated domestic wastewater treatment facilities and supporting pipes and engineering wetlands will be provided for villages with a population greater than 200 along Mintian River, Shatian River, Xuewu River and urban section of He River. Total of 33 sets of rural wastewater treatment facilities will be constructed with a capacity of 50-80 m^3/d each. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.	2019			Positive impact
14.	Rural wastewater treatment facilities of Huangtian town, Pinggui district	Integrated domestic wastewater treatment facilities and supporting pipes and engineering wetlands will be provided for villages with a population greater than 200 along flooding drainage river at Huangansi, Shizigang and urban section of He River. Total of 18 sets of rural wastewater treatment facilities will be constructed with a capacity of 50-80 m^3/d each. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.	2019			Positive impact
15.	Rural wastewater treatment facilities of Etang town, Pinggui district	Integrated domestic wastewater treatment facilities and supporting pipes and engineering wetlands will be provided for villages with a population greater than 200 along Pangu River, Huashan River and urban section of He River. Total of 10 sets of rural wastewater treatment facilities will be constructed with	2019			Positive impact

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
		a capacity of 50-80 m^3/d each. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.				
16.	Rural wastewater treatment facilities of Yangtou town, Pinggui district	Integrated domestic wastewater treatment facilities and supporting pipes and engineering wetlands will be provided f. Total of 15 sets of rural wastewater treatment facilities will be constructed with a capacity of 50-80 m^3/d each. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.	2019			Positive impact
17.	Rural wastewater treatment facilities of Xiwan street, Pinggui district	One set of integrated domestic wastewater treatment facilities with a capacity of 50-80 m^3/d and supporting pipes and engineering wetlands will be provided for villages with a population greater than 200 along urban section of He River. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.	2019			Positive impact
18.	Rural wastewater treatment facilities of Bagu street, Babu district	One set of integrated domestic wastewater treatment facilities with a capacity of 50-80 m^3/d and supporting pipes and engineering wetlands will be provided for villages with a population greater than 200 along urban section of He River. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He Rivers nearby.	2019			Positive impact
19.	Phase I Dike Construction under	Hejiang Bridge-ferry, 9.378 km; flood protection standard: P=5%	2020	Positive impact	Positive impact	Temporary and reversible

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
	Hezhou Flood Control and Drainage Improvement Project					negative impact during construction
20.	Phase II Dike Construction under Hezhou Flood Control and Drainage Improvement Project	Hejiang Bridge-Huashan River, 5.622 km; flood protection standard: P=5%	2020	Positive impact		Temporary and reversible negative impact during construction
21.	Flood control and drainage project of Taoyuan, Taibai Lake area in east new urban area	Outlet of Taibai Lake-He River, 1.618km; flood protection standard: P=5%	2020	Positive impact		Temporary and reversible negative impact during construction
22.	Flood control of the section from Yangtou town section of Fujiang River in Pinggui district (urban section)	Huangshi power station-Xiwan estuary, dike: 3.321km; flood protection level: P=2% in city urban area and P=10% in town urban area (after regulation)	2020	Positive impact		Temporary and reversible negative impact during construction
23.	Flood control of the section from Liangting village to Li village, and Pinggui Mining	Xiwan estuary-Jigong mountain, 2.725 km; flood protection level P=2% (after regulation)	2020	Positive impact		Temporary and reversible negative impact during construction

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
	Affairs Bureau to Liangting village of Fujiang River in Pinggui district					
24.	River rehabilitation of the section from Xiwan tea farm to Xiwan Bridge in Pinggui district	Xiwan tea farm-Xiwan estuary; left bank: 3.457km, right bank: 3.178km; flood protection level: P=5%	2020	Positive impact		Temporary and reversible negative impact during construction
25.	Jiangbei Dike	Hejiang Bridge-Wayaotou (including dikes of Jiangbei west road, central road and east road); dike: 6.129 km; dike: 6.999km; flood protection level: P=2% (after regulation)	2020	Positive impact		Temporary and reversible negative impact during construction
26.	Jiangnan Dike	Dike: 4.524 km; revetment: 4.387 km, including Hejiang bridge to estuary of Huashan River (dikes of Jiangnan west road, central road and south road); flood protection level: P=2% after regulation; dikes for Pangu River (Hezhou avenue to estuary of Pangu River), dikes and revetment for Huashan River(Dading village to estuary of Huashan River), flood protection level: P=2%。	2020	Positive impact		Temporary and reversible negative impact during construction
27.	Dikes of Pinggui new urban area (He River section)	Xiwan village-Shiniudu, dike: 0.87km, revetment: 0.87km; flood protection level: P=2% after regulation	2020	Positive impact		Temporary and reversible negative impact during construction
28.	Huangtian dike	Jigongtou-Dongmuyuan, dike of 3.066km, revetment of 3.512km; flood protection standard: P=2% (after regulation)	2020	Positive impact		Temporary and reversible negative

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
						impact during construction
29.	Hejie East Dike (the downtown section)	Dike: 6.688km; revetment: 4.573km, including the section of He River in Hejie; flood protection standard: P=2%	2020	Positive impact		Temporary and reversible negative impact during construction
30.	Hejie West Revetment	Planning red line of ancient city of Hejie, revetment: 0.938 km; flood protection standard: P=2%	2020	Positive impact		Temporary and reversible negative impact during construction
31.	Flood drainage works in Pinggui district, core urban area of Hezhou Municipality, Hejie town	Total of 14 pumping stations, with a capacity of 6585 kW, 121.06m^3/s; 17 sluices, with a capacity of 293.09 m^3/s; two connecting tunnel.	2020		Positive impact	Temporary and reversible negative impact during construction
32.	Expand the flood diversion channel in Zhutoudun, Xintang village and Chongtang	P=5%	2020		Positive impact	Temporary and reversible negative impact during construction
33.	River rehabilitation project	Rehabilitation of flood drainage channel in Xuewu, river dredging and channelization, cleaning river islands.	2020		Positive impact	Temporary and reversible negative impact during construction; positive impact

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	**Details**	**Completion Date**	**Flood Control Benefits**	**Drainage Benefits**	**Reduced Inflowing Pollutants**
						during operation.
34.	Demolition of flood passage obstacles	Demolition of the weir for water pump of Babu; demolition of the private fishery farm from Babu Bridge to Babu water pump on the right bank of He River; demolition of the illegal residential structures in the downstream and upstream of Babu Bridge; cleaning of the scattered dirty places from Huangshi dam to Xiadao power station.	2020		Positive impact	Temporary and reversible negative impact during construction; positive impact during operation.
35.	New flood drainage works	Construction of weirs in Liwu of Pinggui district	2020	Positive impact	Positive impact	Temporary and reversible negative impact during construction
36.	Rehabilitation of Yucai River and Aimin River	The major functions of both rivers are water recharge, flood drainage, water linkage, landscaping and navigation. The lengths of Yucai River and Aimin River are 1400 m and 1300m respectively. The maximum discharge capacity of the two rivers in 1/20 flood is 38.3 m^3/s. Maximum flood level: 106.00 m; crest height: 107.20 m; normal water level during dry season: 105.40m; river width of blue line: 22.2 to 27.4 m.	2019	Positive impact		Positive impact
37.	Rehabilitation of Taoyuan River	Taoyuan River has multi-functions such as water recharge, flood drainage, water linkage and landscaping. The total length of Taoyuan River is 4,600 m. Total of 2,946 m will be rehabilitated. Two sluices will be constructed.	2021	Positive impact		Positive impact
	To be completed by the end of 2030					
38.	Expansion of Hezhou WWTP	The ultraviolet light will be adopted for disinfection after treated by A^2/O process. The wastewater will be treated to Class 1A of	2030			Positive impact

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	Details	Completion Date	Flood Control Benefits	Drainage Benefits	Reduced Inflowing Pollutants
		Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He River through 1000 m long dedicated pipe. The capacity will be expanded to 100,000 m^3/d.				
39.	Expansion of Pinggui municipal WWTP	Construction of municipal WWTP and sewage pipeline network for Pinggui urban area with a capacity of 80,000 m^3/d in long term. The wastewater will be treated to Class 1A of Pollutant Discharge Standards for Municipal Wastewater Treatment Plants (GB18918-2002) before discharged into He River.	2030			Positive impact
40.	Shatian WWTP	Expansion of Shatian WWTP to 70,000 m^3/d in long term.	2030			Positive impact
41.	Dikes of Hezhou Institute	Zhanqian Avenue-Hejiang Bridge, dikes: 4.458 km, revetment: 4.458km. Flood protection level: P=2% after regulation.	2030	Positive impact		Temporary and reversible negative impact during construction
42.	Dikes of Fanglin High School	Zhujiadong-Hejiang Bridge, dikes: 3.42 km, revetment: 3.42km. Flood protection level: P=2% after regulation.	2030	Positive impact		Temporary and reversible negative impact during construction
43.	Embankments of Shatian	Ximuyuan-Matouling, revetment: 6.27km. Flood protection level: P=5% after regulation.	2030	Positive impact		Temporary and reversible negative impact during construction
44.	West and east dikes of Liantang town	Liantang west dike: Mawei Bridge-Xinjing Bridge, dikes: 5.51 km, revetment: 5.51km; Liantang east dike: Mawei Bridge-Xiaoshui village, dikes: 4.488	2030	Positive impact		Temporary and reversible negative

Table 7-2 Identification Matrix of Related Development Activities

SN	Related Development Activities		Identified Impacts			
	Development Activities	Details	Completion Date	Flood Control Benefits	Drainage Benefits	Reduced Inflowing Pollutants
		km, revetment: 4.488 km. Flood protection level: P=2% for mainstream after regulation, P=2% for tributary				impact during construction
45.	East and west dikes of Hejie	Hejie east dike: Planned bridge-Lijia village, dikes: 1.328 km, revetment: 1.328km. Hejie west dike: Planned bridge-Sanbuti, dikes: 5.572 km, revetment: 5.461km. Flood protection level: P=5% after regulation.	2030	Positive impact		Temporary and reversible negative impact during construction
46.	Flood drainage works in Pinggui district, core urban area of Hezhou Municipality, Hejie town	5 of flood drainage pump stations with total capacity of 总装机 4585 kW and total drainage flow of $64.31m^3/s$; 19 sluices with total flow of $315.45m^3/s$; 8 connection tunnels.	2030		Positive impact	Temporary and reversible negative impact during construction
47.	Xiufeng Lake project	New construction of Xiufeng Lake with total area of 0.3 km^2. The normal area during dry season is 0.2 km^2. During flood period, P=0.33% and water level is 119.50 m.	2030	Positive impact		
48.	Ailian Lake project	Rehabilitation of Ailian Lake (formerly Taibai Lake), covering an area of $1.21km^2$. The designed water area is $0.36km^2$.	2030	Positive impact		
49.	Renovation of east Liuzhi canal	Linking the Liuzhi canal from its starting point with upstream of Taoyuan flood drainage channel; dredging the 7,800 m length existing canal; new construction of concrete culvert to recharge Ailian Lake.	2030	Positive impact		Positive impact

*Huangansi and Shizigang pump stations under the drainage works are included in the World Bank Loan Hezhou Project.

Table 7-3 Scenarios for Cumulative Impact Assessment

Time	The Project	Flood Control and Drainage Activities	Water Environment Rehabilitation Activities
Baseline (2017)	None	No.3-8: existing dike with length of 16.389 km.	No. 1-2: two existing WWTPs
Short term (2018-2023)	All completed	No. 25-37: construction of 48.462 km bank protection; construction of 14 pump stations and 17 sluices, and 1 weir; construction of 2 river channels and rehabilitation of 2 river channels.	No. 9-24: expansion of one WWTP, construction of three new WWPTs; construction of a number of new rural wastewater treatment facilities.
Long term (2023-2030)	All completed	No. 41-49: construction of 31.046 km bank protection; construction of 5 pump stations and 19 sluices; construction of 1 new lake, and rehabilitation of 1 lake; rehabilitation of 1 canal.	No. 38-40: expansion of three WWTPs.

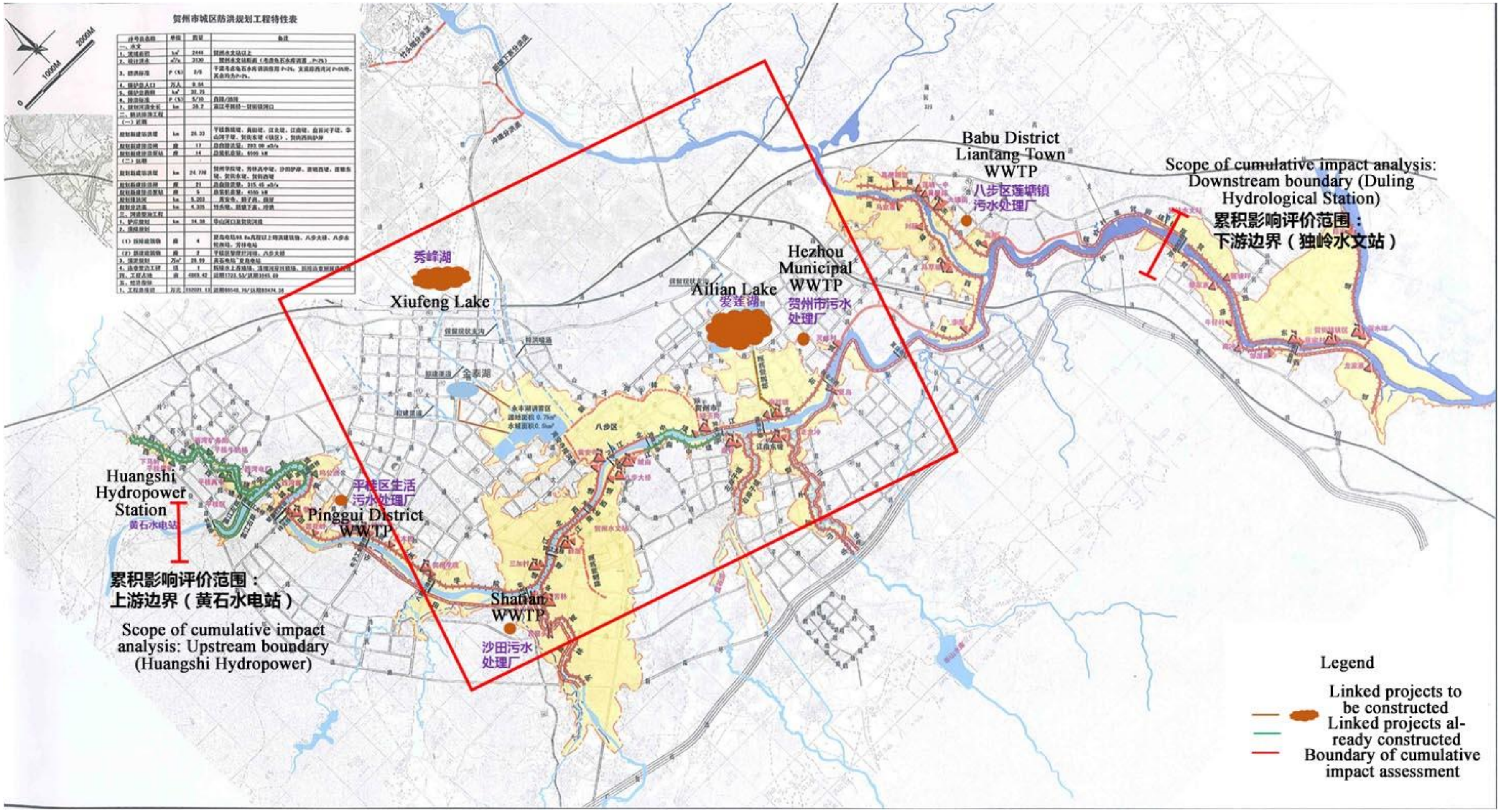


Figure 7-2: Schematic Diagram of Related Development Activities in the Cumulative Impact Analysis

7.2 Status quo of VEC

The current conditions of VEC included in the scope of cumulative impact analysis, i.e. the current conditions of flood control, flood drainage and inflowing pollutant discharge, are summarized based on analysis in the previous sections. The overall condition of the He River Watershed is that floods are frequent and the water environment is poor.

7.2.1 Status quo of flood control and drainage

The flood control system of the main watercourse of He River is not completely enclosed. Due to slow construction progress of flood control infrastructure, He River does not have a sound flood control engineering system. The hydropower stations constructed along He River lack effective regulation and management. The existing flood control infrastructures are mainly flood dikes. Except the dikes constructed in a few sections in the urban center of Hezhou against the standard for floods with a recurrence period of 20 years (with a length of about 2.8 km), no dikes or revetments are constructed in the other river sections. There is no flood control facility in Pinggui district and the fold control capacity is weak. There are two existing large reservoirs, namely Guishi Reservoir and Hemianshi Reservoir. However, the flood control function of Guishi Reservoir has not been determined. Constructed a long time ago, the other hydropower stations along He River were are aged and commissioned or transferred to other administration authorities. Therefore, flood regulation is of significant difficulty and the flood control capacity is affected.

The current drainage capacity in the watershed is very low. The flood drainage system was constructed a long time ago. Most channels were damaged seriously. Many villages and towns still don't have any flood drainage facility. Hezhou urban area is located in the karsts basin. The terrain is flat and shallow. Flash flood flows into the city during flood season and, under the effect of backwater, flood drainage becomes difficult. Most of the drainage system in old urban area are rain and sewage combined drainage system. Due to the absence of a separate drainage system, a part of the municipal domestic and industrial wastewater is discharged into Huangansi Drainage Channel, Shizigang Drainage Channel and He River together with storm water through the pipelines under the roads. Poor drainage capacity leads to waterlogging of sewage and stormwater during rainstorms. Currently, the storm water in the current scope of design is discharged into the surrounding environment freely or via the trenches. The size of the pipeline trench is normally 300×300 or d300 pipe. As the pipe is too narrow, blockage and sedimentation is serious. The urban area of Hezhou Municipality within the scope of assessment is the flood-prone area in the He River Watershed.

Since 1990, there have been significant floods in the He River Watershed, such as the floods happened in July 1994, June 1998, July 2002, and June 2005. The flood occurred in July 2002 alone resulted in the flooding 127,800 mu cultivated land and affected crops in a total area of 964,000 mu and a total population of 1.1615 million. This flood caused a direct economic loss of CNY 2.043 billion. With the poor flood protection system of He River, Guishi Reservoir, a reservoir in the watershed with an active capacity of 155 million cubic meters, has a certain buffer function to the urban area 59 km away down the stream, but its flood prevention function remains undefined. With a low flood control level, the current revetments cannot play their roles of flood control. Substantially in a state of zero protection against floods, some townships have no effective measures to resist floods from the external river. The dike construction works in Hezhou urban area have just started and the flood protection system is not yet enclosed and far from enough to meet the requirements of urban flood control. Besides, there are many structures across He River in the urban area and these structures will involve certain impact on flood passage capacity of He River channel.

7.2.2 Current status of water environment

According to the historical monitoring data[1], the fecal coliform of some locations at Pinggui section exceeded the standard. All of other parameters meet the Class III standards specified in the Surface Water Quality Standard (GB3838-2002). The non-compliance of fecal coliform is mainly caused by the domestic wastewater discharged along He River. All monitored indicators downstream of He River urban section have satisfied the requirement of Class III of Surface Water Quality Standard (GB 3838-2002)[2]. The monitoring results as shown in Section 4 indicate that the water quality of the main watercourse of He River satisfies the standard. In general, the current water quality of the main watercourse of He River is fine, but still threatened by the direct discharge of sewage along He River.

As analyzed in section 4.4, the current water quality of Lining River, Changlong River, Huangtian Branch Channel and Shizigang Drainage Channel is worse than Class V, thus no satisfying Class IV standard specified in the Surface Water Quality Standard (GB 3838-2002). In addition to the function of flood discharge, these urban inland canals and branch channels are also receptors of industrial and municipal wastewater along He River. Such wastewater is far beyond self-purification capacity of these rivers, resulting in deterioration of water quality of the urban inland canals. The key non-compliance indicators are typical pollutant of municipal wastewater, such as ammonia nitrogen, total nitrogen, total phosphorus and fecal coliform. The pollution of these urban inland canals and channels is mainly caused by municipal wastewater along He Rivers. Incorporation of the polluted water will threat the water quality of the main watercourse of He River.

[1] Referring to the EIA Report of Hezhou Pinggui WWTP and the Supporting Pipeline Project (monitoring data developed in June 2012).

[2] Referring to the EIA Report of Hezhou WWTP Expansion Project (monitoring data developed in December 2014, July and August in 2015)

7.3 VEC Cumulative impact analysis

7.3.1 VEC assessment indicator system

The VEC assessment indicator system and assessment standard or limits for this assessment are defined with reference to the flood protection and drainage objectives determined in the top planning for the He River Watershed as well as the relevant standards. See Table 7-4 for detail.

Table 7-4 Assessment Indicators of VEC

Category	Indicator	Standard/Limit	Basis
Benefits of flood control	Flood control standard of the main watercourse of He River	P=2% after regulation	Flood Control Standard (GB50201-94); Integrated Planning of He River Watershed (2010-2030); Urban Flood Control Planning of Hezhou, Guangxi
Benefits of flood drainage	Drainage capacity	Self-drainage capacity: 24-hours maximum storm under 1/20 years flood Pumping capacity: 24-hours maximum storm under 1/10 years flood	Urban Flood Control Planning of Hezhou, Guangxi
Reduction of flood losses	Annual average reduction of flood losses (10,000 CNY)	N/A	N/A
Reduction of pollutants to main watercourse of He River	Reduction of pollutant (kg/d)	N/A	N/A

7.3.2 Cumulative impact analysis

7.3.2.1 Analysis of cumulative flood control benefits

According to the analysis presented in section 5.1, the Project, especially Project

Component No. 1, will produce significant benefits of flood control upon completion. A part of the dike construction works under the Project is also included in the Master Planning of Urban Flood Control of Hezhou Municipality. Superimposition of the benefits of the Project and the other flood control works listed in Table 7-2 will lead to significant improvement of the flood control capacity of He River Watershed. See Table 7-5 for further details.

Table 7-5: Analysis of Flood Control Benefits

Item	Short-term benefits (2023)	Long-term benefits (2030)
Outcomes of the Project	The flood protection level of mainstream and tributaries of He River are respectively P=2% and P=5%; the design standards of the main watercourse dike and cofferdam are Level 2 and Level 5 respectively while that for the tributaries is Level 4.	
Outcomes of the relevant activities	With 61% of the dike construction completed for the main watercourse of He River, the flood control standard for the completed section will reach P=2% after regulation. The flood protection level of the tributaries is P=2%-5%; the design standard of dike and revetment is Level 4. The design standard of cofferdam is Level 5.	With the entire dike construction completed for the main watercourse of He River, the flood control standard for the whole He River will reach P=2% after regulation. The fully realized flood protection level of the tributaries in Jiangbei Area is P=2%-5%; the design standard of dike and revetment is Level 4. The design standard of cofferdam is Level 5.
Cumulative benefits	After the Project and other linked projects are completed in 2023, the food control capacity of the urban center of Hezhou Municipality will be significantly improved. More than 61% of the dikes along the main watercourse of He River will reach the flood control standard for floods with a recurrence period of 50 years. The flood control works of the tributaries can provide supports to the main watercourse. By then the majority part of the urban canal and branch canal rehabilitation works will be completed in Jiangbei area and most of rivers and lakes will be connected to regulate peak flow. However, some of the dikes and revetments are still unable to satisfy the flood control standard as Hezhou urban area still does not have a fully enclosed flood control system by then.	By 2030, 100% of the planned flood control works for the main watercourse of He River will be competed. The urban inland canals and canals in Jiangbei area will be connected to fully play function of peak flow regulation. Together with He River rehabilitation works under the Project, Hezhou Municipality will form a completely closed flood control system and the flood control capacity will be significantly improved. With all the projects completed and flood regulation is realized, the main water course of He River will meet the standard for floods with a recurrence period of 50 years. Superimposition of the benefits of the Project and the other linked projects will generate significant flood control benefits.

7.3.2.2 Analysis of Cumulative Drainage Benefits

Some of the flood drainage works under the Project are also part of the overall planning of flood control in Hezhou Municipality. Superimposition of the benefits of the Project and the drainage works listed in Table 7-2 will greatly improve the drainage capacity of Hezhou Municipality and the drainage capacity of the flood drainage zones in Hezhou Municipality will be significantly increased and the cumulative drainage benefits will be significant. See Table 7-6 for detail.

Table 7-6 Analysis of Drainage Benefits

Item	Drainage capacity in 2023	Drainage capacity in 2030
Outcomes of the Project	Pumping capacity of Shizigang and Huangansi pump stations: maximum 24-hours storm under 1/10 years flood	
Outcomes of the relevant activities	Upon completion of most of river rehabilitation works for urban inland canals and canals in Jiangbei area, a self-drainage capacity to withstand maximum 24-hour storm under 1/20 years flood will be achieved. The pumping capacity of the 14 pump stations to be constructed (excluding Huangansi and Shizigang pump stations) can withstand maximum 24-hour storm under 1/20 years flood.	After completion of all river rehabilitation works for urban inland canals and canals in Jiangbei area, a self-drainage capacity to withstand maximum 24-hour storm under 1/20 years flood will be achieved. The pumping capacity of the 19 planned pump stations can withstand maximum 24-hour storm under 1/20 years flood.
Cumulative benefits	By 2023, the drainage capacity of Pinggui District, the urban center of Hezhou Municipality and Hejie Town will be greatly improved. 74% of planned pumping drainage capacity will be achieved after completion of the Project and some of the linked projects.	By 2030, the drainage capacity of Pinggui district, Hezhou urban center and Hejie town will meet with planning standards if 100% of the flood drainage works as planned are completed.

7.3.2.3 Analysis of Reduction of Inflowing Pollutants

In accordance with the VEC assessment indicator system, the major assessment indicator of cumulative impacts on water environment is the reduction of pollutants of COD and NH3-N flowing into the main watercourse of He River. As a part of the assessment, a quantitative analysis was conducted over the reduction of COD and NH3-N in 2023 and 2030. The wastewater discharge standard adopted by the various WWTPs for the long term (2030) is uncertain and that currently in force is selected.

Based on the calculation in section 5.1, the reduction of pollutants flowing into He River Watershed is shown in Table 7-7.

Table 7-7: Reduction of water pollutants under the Project

Project component	Treatment capacity （m^3/d）	Pollutant	Pollutant reduction (kg/d)
Jiangnan WWTP	15000	COD	3450
		NH_3-N	405

After the completion of planned urban WWTPs and rural wastewater treatment facilities in the related development activities, the wastewater treatment capacity of Hezhou urban area and townships along He River will be greatly increased to reduce inflow pollutants. The capacity of these WWTPs is calculated based on the current size and design scale. The scale of rural wastewater treatment facility is uncertain. The designed scale is 50-80 m^3/d each set. In order to evaluate the maximum impact from the implementation of the related activities, it is assumed in this assessment that the treatment capacity is 80m^3/d each set. Expansion by 2030 is not considered. The influent concentrations of COD and NH_3-N are 280 mg/L and NH_3-N 32 mg/L respectively for the inflowing pollutants before the various WWTPs / facilities are completed. After the completion of these WWTPs and facilities, the effluent concentrations of COD and NH_3-N will reach 50mg/L and 5 mg respectively, meeting the Class 1A standard specified in the Discharge Standard of Municipal Wastewater Treatment Plant (GB18918-2002).

The reduction of COD and NH_3-N in 2023 and 2030 is estimated based on the treatment volume and concentration of pollutant as shown in Table 7-8.

It can be seen in Table 7-9 that the Project together with other urban WWTPs and rural wastewater treatment facilities will produce significant benefits of pollutant reduction. By 2023, the cumulative reduction of COD and NH_3-N will reach 17,765 kg/d and 2,085 kg/d respectively. By 2030, the cumulative reduction of COD and NH_3-N will reach 45,365 kg/d 和 5,325 kg/d respectively. If the possibility of stricter discharge standard to be enforced in the future, the benefits from reduction of pollutants will be greater.

Table 7-8: Reduction of inflowing pollutants

WWTP/facility	Reduction of inflowing pollutants by 2023 (kg/d)		Reduction of inflowing pollutants by 2030 (kg/d)	
	COD	NH3-N	COD	NH3-N
Hezhou Municipal WWTP expansion	6900	810	9200	1080
Pinggui District WWTP construction	2300	270	16100	1890
Shatian WWTP	2300	270	13800	1620
Etang wastewater treatment station of	230	27	230	27

Pinggui District				
Liantang WWTP of Babu District	1150	135	1150	135
Rural wastewater treatment facilities of Shatian town, Pinggui district	607.2	71.28	607.2	71.28
Rural wastewater treatment facilities of Huangtian town, Pinggui district	331.2	38.88	331.2	38.88
Rural wastewater treatment facilities of Etang town, Pinggui district	184	21.6	184	21.6
Rural wastewater treatment facilities of Yangtou town, Pinggui district	276	32.4	276	32.4
Rural wastewater treatment facilities of Xiwan street, Pinggui district	18.4	2.16	18.4	2.16
Rural wastewater treatment facilities of Bagu street, Babu district	18.4	2.16	18.4	2.16
Total	14315	1680	41915	4920

Table 7-9: Cumulative reduction of inflowing pollutants (Unit: kg/d)

Scenario	Item	COD	NH_3-N
	Reduction of the Project	3450	405
2023 Scenario	Reduction of related activities	14315	1680
	Cumulative reduction	**17765**	**2085**
2030 Scenario	Reduction of related activities	41915	4920
	Cumulative reduction	**45365**	**5325**

7.3.2.4 Analysis of cumulative social impacts

The Project and other linked projects will reduce the flooded area in The urban center of Hezhou Municipality and reduce the number of flooded houses, buildings, equipment and farmland, thereby reducing the economic losses of industry and agriculture caused by floods. The cumulative reduction of flood losses in 2030 is quantitatively evaluated based on the feasibility study report of Hezhou Urban Water Infrastructure and Environment Improvement Project and Guangxi Hezhou Urban Flood Control Planning. The annual average flood control benefits of the Project and other linked projects are CNY 130.32 million and 72.0533 million respectively, totaling 202.3733 million. The cumulative benefits of flood alleviation is remarkable.

The Project and other linked projects can also improve water environment, thereby improving investment environment. These projects will contribute to promotion of economic development, especially tourism and modern service industry. Therefore, theses cumulative impacts will bring social and economic benefits.

The implementation of linked projects will also produce negative social impacts similar to the Project. The dike construction, river rehabilitation and drainage pump stations construction components might involve permanent acquisition of land and the lake, river and WWTP construction works (e.g. Xiufeng Lake, Yucai River and Aimin River) to be constructed will also involve permanent land acquisition and resettlement. These social impacts might be cumulated with the Project. Total of 7 rural and 2 urban residents resettlement sites are planned under the Project. The land acquisition and house demolition shall also be properly handled during the implementation of the linked projects. The relevant government departments shall ensure that the resettlement house construction will be completed before the demolition and proper measures are implemented for the transition period from house demolition and relocation. It may affect the progress of the Project and lead to social conflicts if the resettlement issue cannot be resolved properly.

On the other hand, when the linked projects are constructed concurrently with the Project, the impacts of earth stacking and increased traffic may be cumulated. During construction period, the increased vehicles may affect traffic in the areas along the mainstream. It may lead to traffic congestion and cause cumulative social and economic impacts if the linked projects nearby are constructed at the same time. Therefore, it is necessary to take proper traffic organization and management measures to mitigate cumulative impacts during construction.

7.4 Recommended safeguard measures

As discussed in section 7.3, the cumulative impacts of the Project and the linked projects are basically positive, but land acquisition and demolition may cause certain negative impacts. As the Project and linked projects involve various government departments, the multi-departmental mitigation measures are proposed under this assessment to safeguard the cumulative benefits mentioned above and minimize negative social impacts. These measures aim to strengthen enforcement capability of the various departments and promote smooth interdepartmental communication.

1. Establishing a flood early warning system and conducting trainings to promote smart water resources management. The responsible authority is WRB.

2. Strengthening water quality monitoring and regularly tracking the water quality of He River. Hezhou EPB is responsible for setting up monitoring section at Hejie and Fulong ferry and conducting artificial monitoring on a monthly basis.

3. Taking actions to ensure the construction of resettlement houses. The Project should be properly coordinated with the construction of resettlement houses. Demolition shall be conducted only when the construction of resettlement houses is completed. If there are difficulties, a subsidy plan for the transition period should be developed and implemented in a reasonable and effective way so as to complete the construction of the resettlement houses and achieve resettlement of affected people at the earliest possible time. The departments involved include resettlement office of Hezhou urban area and Hezhou WRB.

7.5 Stakeholder participation in the cumulative impact assessment

The stakeholders, including relevant departments and APs (outside of the Project influence area) in the area of the assessment, were identified at early stage considering all activities might produce cumulative impacts with the Project. The main departments involved are Hezhou Planning Bureau, Hezhou WRB, Municipal

Engineering Administration Bureau (MEAB), EPB and resettlement office if land acquisition and demolition is involved. The stakeholder participation during the cumulative impact assessment process is conducted in the following manners:

- Collecting relevant planning and information from stakeholders to screen key VEC through consultation with relevant departments and determine the temporal and spatial scope of the assessment.
- Consulting the relevant departments and collecting their feedbacks when the draft assessment is ready.
- Consulting the relevant departments and collect their feedbacks when the safeguard measures are proposed to promote inter-departmental communications and cooperation during implementation.

In addition to consultation with relevant departments, the potential affected public (outside of the Project influence area) were also interviewed. The details of the consultation and results are given in Table 7-10.

Table 7-10 Stakeholder Participation in Cumulative Impacts Assessment

Time	Participants	Types of participation and key contents	Comments by stakeholders	EIA feedbacks
July-August 2017	WRB, EPB, MEAB	Provision of relevant documents and information: Hezhou Urban Flood Control Plan, Hezhou Municipality Master Urban Plan (2016-2030) (Draft), Implementation Plan for Integrated River Rehabilitation of Urban Section of He River (2017-2020) and Hezhou Municipality Ecological Water System Planning (2014-2030).	--	The relevant planning constitute the basis of the identification of the relevant activities under this cumulative impact assessment.
August 2017	Affected public: residents of Xiwanzhai	Interview: suggestion and expectation on the Project and linked projects.	There is no wastewater network in Xiwanzhai. The municipal wastewater is discharged into He River after treated by septic tank. The public consulted suggested improving the municipal utility network of this area.	Public's concern about the effluent discharge shows the urgency of pollutant reduction. The reduction of pollutants flowing into He River has been selected as a key VEC. The issue of wastewater treatment for Xiwanzhai area will be incorporated into the linked project of Pinggui WWTP and supporting pipeline construction.

Table 7-10 Stakeholder Participation in Cumulative Impacts Assessment

Time	Participants	Types of participation and key contents	Comments by stakeholders	EIA feedbacks
August 2017	Affected public: Hezhou Experimental Middle School	Interview: suggestion and expectation on the Project and linked projects.	Hezhou Experimental Middle School is located on the right bank of downstream of Fanglin Hydropower Station. There is no wastewater network in Fanglin village. The wastewater produced by the 3600 teachers and students is treated by on-site facility and then discharged to He River. The operation cost of wastewater treatment facility is very high. The school expects connection to the municipal wastewater treatment facility. In addition, Fanglin Junior High School and Fanglin School of Shatian town in this area also produced great amount of sewage.	Public's concern about the effluent discharge shows the urgency of pollutant reduction. The reduction of pollutants into He River has been selected as key VEC. The construction of Shatian WWTP and supporting pipeline will help addressing wastewater issue of this area. The issue of wastewater treatment for the Experimental Middle School area will be incorporated into the linked project of Shatian WWTP and supporting pipeline construction.
August 2017	Affected public: residents along Taoyuan canal	Interview: suggestion and expectation on the Project and linked projects.	The residents along Taoyuan canal expressed supports to dredging works and hope the water quality and living environment can be improved.	Public's concern about the effluent discharge shows the urgency of pollutant reduction. The reduction of pollutants into He River has been selected as key VEC. The rehabilitation works of Taoyuan canal will contribute to improvement of living environment

Table 7-10 Stakeholder Participation in Cumulative Impacts Assessment

Time	Participants	Types of participation and key contents	Comments by stakeholders	EIA feedbacks
				for the residents along the canal.
August 2017	Aquatic and livestock husbandry and veterinary: distribution of “spawning grounds” and rare aquatic organisms in main watercourse of He River.	There are no concentrated “spawning grounds”, rare aquatic organisms or migratory fish species in the main watercourse of He River.	Aquatic ecology is no longer regarded as a key VEC in this assessment.	
September 2017	WRB, EPB, MEAB	Collecting comment and feedback on this report. Questions related to the cumulative impact assessment in the questionnaire are as follows: 1. Do you think the relevant development activities listed in section 7.1.1.3 of the report are complete and accurate? If not, please add or provide your comment. 2. What is your opinion on the	EPB: please clarify the relations of the Project and Implementation Plan for Integrated River Rehabilitation of Urban Section of He River (2017-2020). WRB: Strengthening the control and management capacity of the joint operation of reservoir and hydropower station; the flood drainage benefit safeguard measures should be revised to MEAB and WRB.	The contents of linked projects were sorted out to better present the major works. A supplementary measure is added for “development of a sound flood early warning system” The corresponding responsible departments are WRB and MEAB.

Table 7-10 Stakeholder Participation in Cumulative Impacts Assessment

Time	Participants	Types of participation and key contents	Comments by stakeholders	EIA feedbacks
		results of cumulative impact assessment presented in section 7.3 of the report? 3. What is your opinion on the safeguard measures proposed in section 7.4 of the report? Please add other recommended safeguard measures if any. 4. Please add your comment on chapter 7 if any.		

Stakeholder participation has been conducted through the whole process of cumulative impact assessment. The affected public and relevant experts and departments have been consulted. Their comments and recommendations were summarized in this report. In general, the public are mainly concerned with the issue of effluent discharge. The reduction of pollutants into He River has been selected as key VEC. Through consultation with fishery experts, it was understood that there were no rare aquatic organisms or migratory fish species and no important habitat in He River. On this basis, the "aquatic ecology" is not regarded as a key VEC of this assessment. Relevant departments provided the related planning before the assessment as the basis to identify other existing and proposed projects. The draft report has been circulated to the relevant departments for consultation. The Water Resources Bureau (WRB) and Environmental Protection Bureau (EPB) have provided their comments. Relevant comments have been reflected in the report.

8. LAR social impacts and mitigation measures

8.1 Land acquisition and resettlement of the Project

Here summarized as follows is the information of LAR under the Project based on the Resettlement Plan for the proposed World Bank Loan Hezhou Urban Water Infrastructure and Environment Improvement Project prepared by Guangxi Guoye Project Management Consulting Co., Ltd., in November 2017.

The Project involves a permanent land acquisition of 3760.41 mu, including 47.13 mu state-owned land and 3713.28 mu rural collective owned land (with 2222.01mu arable land) and will affect 759 families and 4563 persons. Buildings to be demolished involve a total floor area of 164,194.71 m^2 and an affected population of 3632 of 814 households, including 93207.60 m^2 for residential houses, affecting 690 families and 3105 persons. (Rural residential houses to be demolished involve a total floor area of 55,742.29m^2 and affect 373 families and 1837 persons; urban residential houses to be demolished involve a total floor area of 37465.31m2 and affecting 317 families and 1268 persons).

Ancillary and temporary buildings to be demolished involve a total area of 49,278.64 m^2. Buildings in a total area of 14,249.54 m^2 owned by enterprises and institutions will be demolished. State-owned shops in a total area of 7,458.93 m^2 will be demolished, affecting 124 tenants. Involving a total area of 1045.67 mu, the temporary land occupation under the Project will affect 307 families and 1849 persons. The related ground attachments and infrastructures, such as fence walls, toilets, and bamboo, power and communication facilities will also be affected. The total population to be affected under the Project is 10044 persons from 1880 families, including 273 persons from 83 families identified as vulnerable groups.

8.2 Measures for mitigating social impacts under the Project

Land acquisition and resettlement represents the most significant social impact under the Project. In order to minimize the scope of land acquisition and resettlement and the impacts from the construction activities on local people, measures have been taken, such as optimizing the design proposal. In the preliminary design and feasibility study period, in order to avoid or minimize land acquisition and resettlement, the social assessment team and the design institute have conducted extensive field survey and close consultation with the local officials and residents. Measures, such as optimizing the project design, strengthening project management, improving construction technology and public consultation and participation have been taken to minimize the adverse impact of land acquisition and resettlement.

In addition to the measures to reduce land acquisition and resettlement during feasibility study and preliminary design stage, compensation and resettlement plans are developed for permanent land acquisition and resettled people. The compensation standard for permanent land acquisition is based on the relevant regulations and policies of PRC, GZAR, Hezhou city and the Environmental and Social Safeguard Policy (2016) of the World Bank. The resettlement plan is developed on the basis of consultation with local governments and APs and current practices.

Livelihood restoration program is developed for the farmers whose farmland will be acquired. Compensation and resettlement plan are developed for the rural relocated families, urban relocated families, non-residential relocated families, affected enterprises and institutions, affected ground attachments and infrastructures and affected vulnerable groups. Livelihood restoration plan is also developed for women to protect their right and interests. The specific compensation standards and measures are presented in the Resettlement Plan for the World Bank Loan Hezhou Urban Water Infrastructure and Environment Improvement Project. The LAR and social impacts and mitigation measures are summarized in Table 8-1.

Table 8-1: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
Permanent land acquisition	State-owned land: 47.13 mu Floodplain: 34.57 mu	All affected families (AFs) will receive cash compensation.	1. State-owned floodplain land involves no compensation as the implementation of the Project will not lead to any changes of the nature and ownership relationship of such land. 2. State-owned allocated land will be replaced with state-owned land of the corresponding area to be allocated in the vicinity under the Project. 3. Young crop compensation per mu of floodplain land: CNY 2100 /mu	PMO, Owner, HDAO
	3713.28 mu collective land in total, including 972.08mu for paddy field,1249.93 mu for dry land, 533.52 mu for forest land and 957.75mu for other types of land. AFs: 759; affected persons (AP): 4563.	4563 persons from 759 households	1. Land acquisition compensation: CNY 60,500 per mu of paddy field; CNY 51,800 per mu of dry land; CNY 47,000 per mu of forest land. To be prudent, the compensation criteria for other types of land is set at CNY 47,000 /mu. 2. Crop compensation: CNY 1600-2100/mu depending on the crop types. 3. Compensated land: the planned industrial land equal to 10% of acquired agricultural land will be allocated to the affected rural collective economy organizations. 4. All APs will receive: i) employment and revenue generation opportunities during project implementation; ii) free employment supports and vocational training. 5. Registered population at or above the age of 16 entitled to rural collectively-owned land contracting at the time of land acquisition will receive subsidies for rural pension insurance to the farmers who lost their land. Such subsidies will be calculated based on the number of people affected by, and the frequency and scope of land acquisition. The minimum subsidy for each land acquisition equals 60% of the average wage of workers employed by urban units in the region in the previous year times the per capita area of land acquired from local farmers. Where the per capita area of land acquired from local farmers exceeds 8 mu after one or multiple land acquisitions, the surplus part will not receive any pension insurance subsidy. Where a farmer household whose land is totally acquired and the per capita area of land acquired from the affected HHs is less than 1 mu, the subsidy will be	PMO, Owner, HDAO

Table 8-1: **Summary of LAR and Social Impacts and Mitigation Measures**

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			calculated on the basis of 1 mu.	
Temporary land occupation	Total land occupation: 1045.67 mu, including 434.96 mu paddy field, 423.58mu dry land; 187.13mu forest land; AFs: 307; AP: 1849.	1849 persons from 307 households	Compensation for temporary land occupation: CNY 3900 per mu of paddy field; CNY 3400 per mu of forest land	PMO, Owner; HDAO
Residential houses and ancillary and temporary structures	1. Demolition of urban residential houses: 37465.31m^2, brick and concrete structure; AFs: 317; APs: 1268. 2. Demolition of urban temporary houses: 18689.74 m^2.	1268 persons from 317 households	1. The PMO provides two types of resettlement for households affected by housing acquisition to choose from at free will: monetary compensation and property right replacement. 2. Monetary resettlement: monetary compensation (generally higher than the replacement price) is provided for all persons whose houses are demolished. Such compensation includes housing compensation and housing decoration compensation after assessment. Housing compensation and housing decoration compensation: The assessment is conducted by an intermediary agency with good credit-standing and good reputation commissioned under joint agreement by the demolishing party and the affected party and the compensation is effected based on the assessed price. 3. Property right replacement: built housing is provided and housing decoration is compensated. Provision of built housing in the ratio of 1:1. If the area of built housing is greater than the demolished area, the relocated family needs to buy the exceeding area at market price. Provision of housing decoration compensation. The construction unit and the relocated family will commission an independent qualified intermediaries to assess the value of decoration, based on which monetary compensation will be provided. 4. Provision of relocation subsidy and temporary housing subsidy at a rate of CNY 10 / m^2 or provision of public housing. 5. Provision of CNY 5,000/family as an one-off incentive to those who sign the LAR compensation agreement and hand over	PMO, Owner; HDAO

Table 8-1: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			the housing within the specified deadline. 6. Cash compensation will be made for urban temporary housing at a price assessed based on market price by an independent and qualified intermediary comissioned jointly by the construction unit and the relocated household.	
	1. Demolition of rural residential houses: 55742.29 m^2; brick and concrete structure; AFs: 373; APs: 1837. 2. Demolition of rural ancillary houses: 30588.89 m^2.	1837 persons from 373 households	1. The PMO provides two types of resettlement for households affected by housing acquisition to choose from at free will: monetary compensation and homestead replacement. 2. Monetary compensation is made based on the housing replacement price of CNY 1000 to 1300/m^2 for brick structure. For households choosing monetary replacement for their main houses, compensation on the main house homestead will be made at the assessed land price for reallocation of resettlement homestead. 3. Homestead resettlement: Each household is entitled to one homestead and each demolished homestead will be compensated with one resettlement homestead in an area of no more than 120m^2; the inadequate part will be compensated at the assessment price. The main house to be demolished will be compensated for at the replacement price of the same standard as for monetary compensation of CNY 1000 to 1300 for brick structures. The government will be responsible for providing water supply, power supply, access road and site leveling for the resettlement area as well as the supporting public infrastructures such as schools and hospitals; water and electricity will be delivered to the gate of each household and then connected by the household into their houses. 4. Provision of relocation subsidy and temporary housing subsidy at a rate of CNY 10 / m^2. 5. Provision of CNY 5,000/family as an one-off incentive to those who sign the LAR compensation agreement and hand over the housing within the specified deadline. 6. Monetary compensation will be provided for rural ancillary	

Table 8-1: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			housing unexceptionally at a standard of CNY 100-700/m^2 depending on the building structure. Compensation for the acquired land will be made at the standard for acquisition of rural homesteads.	
Government, public institutions and enterprises	Totally 11 government, public institutions and enterprises will be affected with a demolition area of 14249.54 m^2	Hezhou Municipal Land Resources Bureau (LRB), Health and Family Planning Commission, Hezhou WRB, Transportation Bureau of Babu District, Guangxi Guidong Electric Power Limited Company, Yingshi Primary School of Huangshi Town, Xiadao Power Station of Hezhou Pengyuan Hydropower Development Limited Company, Fanglin Hydropower Station of Hezhou Minfeng Industrial Limited Company, Hezhou Huangshi Power Station Limited Company	Relocation and reconstruction of Hezhou Health and Family Planning Commission and Babu District Transportation Bureau. Hezhou WRB and LRB choose monetary compensation for the demolished buildings. Guidong Electric Power Limited Company: monetary compensation for its office building to be demolished at assessed value and new office building will be constructed. Yingshi Primary School and Xiadao Primary School: relocation. Hezhou Minfeng Industrial Limited Company and Hezhou Huangshi Power Station Limited Company: monetary compensation for the production losses due to stoppage during project construction.	PMO, Owner; HDAO
Shops	Demolition of shops: 7458.93m^2; AFs: 124; APs: 527	527 persons from 124 affected shop tenants.	Compensation for the business losses and relocation cost to be made on the basis of replacement price ratified according to the relevant compensation standard.	PMO, Owner; HDAO

Table 8-1: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
Land attachments	Sewers: 220 m; Tombs: 53; power poles: 42; communication poles: 22; bamboo: 26489; wall: 700m^2; trees: 15162; transformer: 1 set.	All APs or owners will receive equivalent cash compensation. The land attachments planted or constructed after the cut-off date will not be compensated.	The APs will receive cash compensation. Sewage pipe: CNY 300/m; power pole: CNY 150 each; communication pole: CNY 150 each; wall: CNY 70 /m^2; bamboo: CNY 1-4 / per bamboo; trees: CNY 10-180 / tree; graves: CNY 5500 each. The trees described above will be compensated at the actual assessed value on the basis of the guiding price.	PMO, Owner; HDAO
Vulnerable group	83HH, 273 persons	All affected vulnerable groups	(1) The local Civil Affairs Bureau and the Labor and Social Security Bureau will be responsible for including these families in the social security schemes. (2) Provision of pension insurance. (3) Provision of new rural cooperative medical insurance paid by the collective unit. (4) The local rural credit cooperatives and banks can provide the vulnerable groups with small loans. (5) Provision of project-related employment opportunities. (6) Provision of project-related vocational trainings to vulnerable groups.	PMO, Owner; HDAO
Female		4148 persons	(1) Create employment and livelihood opportunities for women. (2) Ensure women participation. (3) The local government and resettlement office shall ensure the female has the same rights as male in terms of land property. (4) Gender discrimination shall be eliminated to encourage women to create their own business.	PMO, Owner; HDAO

8.3 Public participation and consultation

During preparation of the project plan and the resettlement plan, the resettlement consultant team identified all the stakeholders and conducted various interviews, meetings and consultations on the land acquisition and compensation policy. The stakeholders of the Project can be divided into three different categories, i.e. governmental departments, construction unit/contractor and APs.

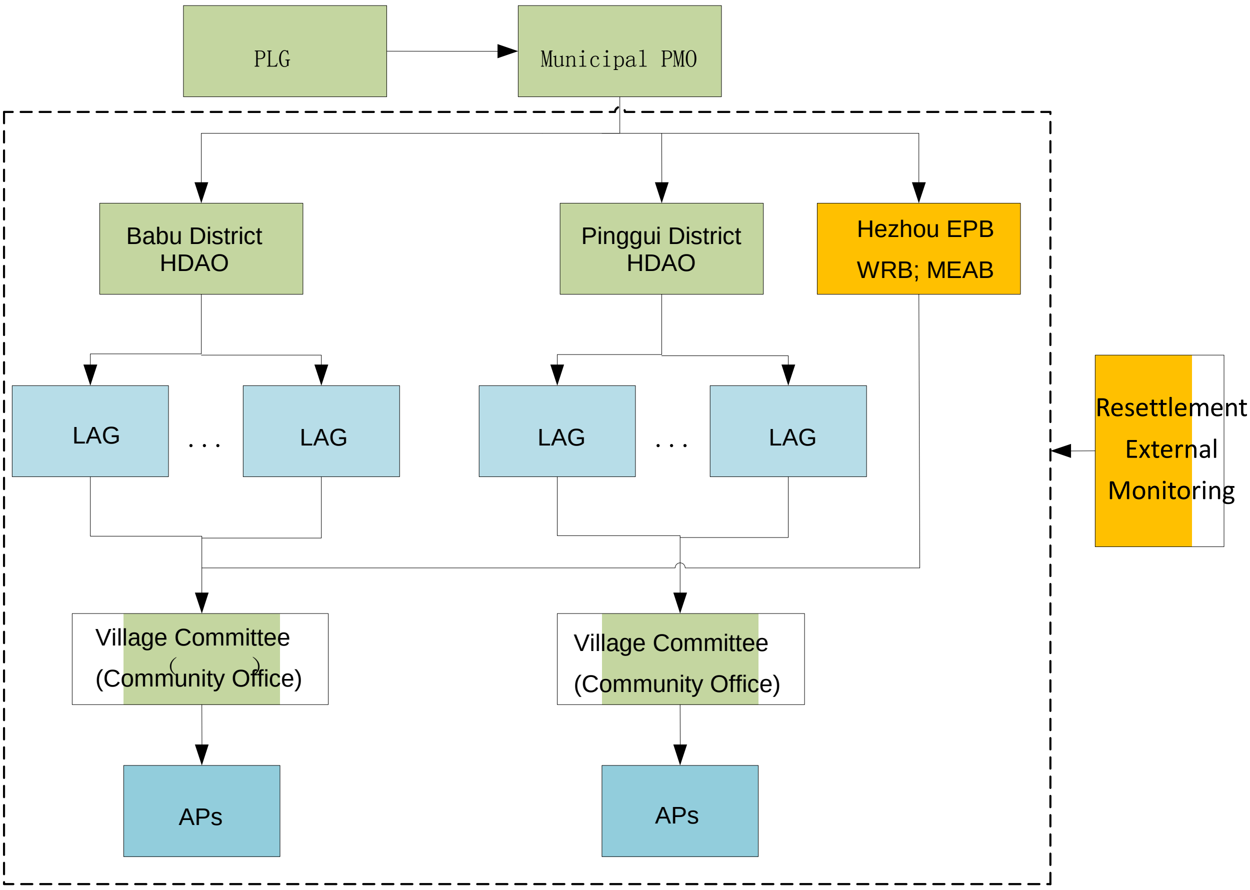
The resettlement consultant team conducted equal consultations with the APs in the project area to inform them of all aspects of the Project. 91.17% of the public are very supportive or supportive to the implementation of the Project. Only 8.83% of the consulted persons hold neutral attitude to the Project. Basically, no one expressed objection to the Project. 72.06% of respondents believe the Project would be very beneficial or beneficial. The stakeholders in the project area have understood the project information through public consultation and expressed their support to the Project. Meanwhile, concerns were also expressed over possible reduction of income and temporary impacts from the construction activities on their livelihood.

In order to properly and promptly address the issues and demands of the APs, public consultation will continue before the commencement of the project construction and implementation of the resettlement plan so that all the problems may be resolved. The implementation agencies shall organize resettlement workshops/meetings appropriately. For details, please refer to Chapter 10 for arrangements of public consultation during the implementation of the Resettlement Plan (RP).

8.4 Institutional arrangement and development

8.4.1 Resettlement-related institutions

In the implementation process of the Project, a top-down organization structure must be developed to plan, coordinate and monitor the resettlement activities. See Figure 8-1 for the organization chart.



PLG = project leading group; LAG = land acquisition group; HDAO = land acquisition and resettlement office; APs = affected persons; WRB = water resource bureau; EPB = environmental protection bureau; MEAB = municipal engineering administration bureau

Figure 8-1: Institutional Arrangements for Resettlement

8.4.2 Institutional organization and responsibilities

1. Project leading group (PLG)

The Project Leading Group of World Bank Loan Hezhou Urban Water Infrastructure and Environment Improvement Project is the highest leadership agency in the implementation of the Project to provide policy guidance and facilitate coordination at municipal level to support the implementation of the Project.

2. Project management office (PMO)

Hezhou World Bank Project Management Office is headed by Hezhou Municipal Development and Reform Commission (DRC) and fully responsible for the overall plan of and providing guidance on the land acquisition and resettlement work of the Project. Its specific duties include: providing guidance on the resettlement work in accordance with World Bank's Resettlement Policy, submitting reports on resettlement work to the World Bank, conducting preliminary review of the resettlement plan and implementation plan submitted by project owner and submitting such plans to the municipal government for approval; supervising and inspecting the status of implementation of resettlement plan and payment and use of compensation fund; supervising and reporting to the World Bank the progress of resettlement implementation; and conducting internal monitoring.

1. Urban land acquisition and resettlement office (HDAO)

The Project will involve Babu District and Pinggui District and the Urban Land Acquisition and Resettlement Office (HDAO) is responsible for the specific work of land acquisition and resettlement. Its specific responsibilities include: developing resettlement plan and implementation plan; properly carrying out the resettlement work following the plan of PMO; inspecting the status of implementation of resettlement work; iv) soliciting comments from the relevant departments and individuals and address complaints and appeals promptly; submitting timely report to World Bank on issues, comments and suggests encountered in the process of land acquisition and resettlement and assisting PMO in internal monitoring.

2. Village committee resettlement working group

The major responsibilities include participating in socio-economic and project impact survey; organizing public consultation; disseminating resettlement policy; organizing public hearings; selecting resettlement sites; allocating housing land for AFs; allocating and managing compensation fees; organizing production and training activities; delivering comments and suggestions of AFs to the higher authority; reporting the resettlement progress; and providing assistance to the vulnerable groups.

3. External independent monitoring and evaluation agency

The independent external monitoring agency is responsible for monitoring resettlement work, collecting comments and feedbacks from the affected institutions and persons in a timely manner; and reporting and submitting recommendations to the PMO and IAs. The specific duties include: investigating the social and economic conditions in the planned area and preparing and submitting social baseline survey report to the World Bank; estimating the specific impacts and progress of livelihood restoration; analyzing data collected and monitoring the whole process of implementation of the resettlement plan; preparing and submitting to the PMO and implementing agency the resettlement progress report; and preparing and submitting half-year monitoring reports to the World Bank; carry out resettlement assessment at least twice a year and reporting to the project owner and the World Bank.

8.5 Grievance redress mechanism

The APs will sign the agreement to confirm their rights and entitlements if they are satisfied with the proposed compensation. A procedure for information disclosure in the process of resettlement is helpful to increase the transparency of the Project. Through information disclosure, the APs will be informed of the multiple complaint channels (including village committees, departments, PMO, land acquisition and demolition office, external monitoring agency, government petition office, and court) and a variety of ways (such as petition and telephone) to express complaints and appeal.

In the process of development and implementation of the RP of the Project, great attention will be paid to the participation of APs and a grievance redress mechanism will be established to handle complaints and appeals from the APs in the following procedure:

Stage 1: If not satisfied with the resettlement plan, the APs can express their complaints to the village committees in oral or written form; oral complaints must be handled and recorded in writing by the village committees or street offices / town or township authorities. Such complaints shall be addressed within one week by the project group at village level, village committee, or street / township authorities.

Stage 2: If the APs are still not satisfied with the resolutions made in Stage 1, an appeal can be filed to the PMO after such resolution is received and the PMO shall make a further resolution within 2 weeks.

Stage 3: If the APs are still not satisfied with the resolutions made in Stage 2, an appeal can be filed to the HDAO after such resolution is received and the HDAO shall make a further resolution within 2 weeks.

Stage 4: If the APs are still not satisfied with the resolutions made in Stage 3, an appeal can be filed to the External Monitoring Agency after such resolution is received and the External Monitoring Agency shall make a further resolution within 2 weeks. All the complaints and appeals (in oral o written form) shall be reported to the World Bank in the resettlement monitoring report.

Stage 5: If the APs are still not satisfied with the resolution made in Stage 4, an appeal may be filed to the government petition office after such resolution is received. The petition office shall make a further resolution within 2 weeks.

The APs may directly file a lawsuit to the civil court if he / she is not satisfied with the existing GRM procedures or resolutions made in any of the above stages.

8.6 Monitoring and evaluation arrangements

In order to ensure the smooth implementation of land acquisition and resettlement work and proper resettlement of the APs, the resettlement progress will be monitored and evaluated regularly in strict accordance with the terms specified in World Bank's Operation Policy (OP 4.12) of Involuntary Resettlement and Guidance on Resettlement Monitoring and Evaluation for Business in PRC. Such monitoring shall comprises of two parts, namely the internal monitoring carried out by the resettlement agency and the external independent monitoring.

The internal monitoring will be conducted by the PMO to ensure the resettlement activities are carried out in accordance with the principles and timetable specified in the Resettlement Plan. The purpose of internal monitoring is to enable the resettlement institutions to maintain excellent functions during implementation.

The external monitoring refers to the regular monitoring and evaluation on resettlement activities conducted by the independent monitoring agency (IMA). This external monitoring shall be undertaken by a competent IMA.

After the completion of the project, post-project evaluation will be conducted on the basis of monitoring and evaluation results to evaluate the experiences and lessons for reference in terms of land acquisition and resettlement for future projects. The owner of subproject will commission the external monitoring agency to conduct post-project evaluation. The post-project evaluation agency will develop a terms of reference and evaluation indicator system for the post-evaluation, conduct social and economic survey and preparing and submitting the LAR post evaluation report to the PMO and World Bank.

9. Alternative Analysis

9.1 Purpose and principles

The purpose of alternative analysis is to minimize the environmental impact by optimizing the project design from environmental perspective through comparative analysis of a number of alternatives that may be selected for the Project.

The general principles for alternative analysis include:

1. Quantitative comparison: quantifying the environmental impact from project implementation as much as possible for each alternative;
2. Comprehensive comparison: conducting a multi-dimension comparison and analysis of the alternatives from the environmental, technical, economic, and social perspectives;
3. Compatibility comparison: The selected alternative shall be compatible with relevant development planning and standards and the local conditions.

9.2 With-/Without-project analysis

Without-project alternative refers to the scenario where the project will not be implemented. Analysis was conducted from the perspectives of environmental benefits and costs and social and economic development, with results summarized in Table 9-1.

Table 9-1 With-/Without- Project Comparison

Category	With-Project	Without-Project
Advantages	(1) Improved urban safety, improved flood risk control capacity. The flood control standard of He River main watercourse is improved to floods with a recurrence period of 50 years; flooded area is reduced by 13.1 km^2. The avoided economic loss amounts to CNY 2044 million. The flood control standard for the inner urban rivers is improved to floods with a recurrence period of 20 years. Flooded area is reduced by 3.1 km^2. The avoided economic loss amounts to CNY 248.74 million. (2) Reduced pollutant load to rivers, improved water environment; load reduction thanks to development of Jiangnan WWTP includes: COD 1259.25t/a, BOD 602.25t/a, SS 821.25t/a, TN 219t/a, NH_3-N 147.83t/a, and TP 2t/a; sewage interception along Huangtian Branch Canal, Guposhan Drainage canal, Huangansi Drainage canal, Shizigang Drainage canal helps	(1) The current status can be maintained, i.e. the vegetation will remain intact; (2) No change on land value (no land occupation); the permanent land acquisition is reduced by 3760.41mu; the temporary land occupation is reduced by 1045.67 mu; the house demolition is reduced by 93207.60 m^2; impact on the 1880 families or 10044 people can be avoided. (3) No environmental impacts in terms of noise pollution and vegetation damage will be generated during the construction stage.

Table 9-1 With-/Without- Project Comparison

Category	With-Project	Without-Project
	to achieve a load reduction of 15000 m^3/day and the reduction of COD 1888.88 t/a and NH_3-N 221.75 t/a discharged into He River in an uncontrolled way. (3) Improved hydrology and municipal infrastructure.	
Disadvantages	(1) Land occupation and house demolition will happen. The project will involve permanent land acquisition of 3760.41 mu and temporary land occupation of 1045.67 mu; the Project will also involving demolition of buildings in a total area of 93207.60 m^2, affecting 1880 families or 10044 people. (2) During construction there will be vegetation damage, and noise and flying dust issues. (3) During construction there will be impacts on traffic and daily travel of local residents.	(1) Flood control dikes are incomplete. At the discharging points of drainage system the elevation is low. When the water river in the He Rive is high, backflow occurs easily. In the event of a flood with a recurrence period of 50 years, the consequences will be a flooded area of 13.1 km^2 and an economic loss of CNY 2044 million. (2) Covered-up inner urban rivers, increasing use of impermeable pavement and the decreasing storm water storage capacity in the city would end up with a flooded area of 3.1 km^2 and an economic loss of CNY 248.74 million in the event of a flood with a recurrence period of 20 years. (3) The Shizigang, Huangansi and Taoyuan Drainage Canals are narrow and have difficulty of flood passage. In addition, domestic sewage from local residents are discharged into the canals, resulting in poor water quality in dry seasons featuring in high turbidity and strong odor. Pollutants such as ammonia and TP are worse than Class V standards, making He Rivers “black and stinky water bodies”. Without sewage interception along the He River, sewage is discharged into He River without proper treatment, causing deteriorating water quality.
Summary	From social and environmental perspectives, the with-project alternative is more preferable than the without-project alternative.	

It is shown from Table 9-1 that, although the without-project scenario does not generate additional environmental impacts from project construction, problems of poor flood dike, discharge outlets of low elevation, covered-up urban inland canals and decreasing flood storage capacity still exist. A flood with a recurrence period of 50 years in He River would end up with a flooded area of 13.10 km2 and a total economic loss of CNY 2044 million. A flood with a recurrence period of 20 years in He River would end up with a flooded area of 3.1 km2 and a total economic loss of CNY 248.74

million. The narrow urban inland canals restrict their flood carrying capacities and continuous discharge of domestic sewage from residents along He Rivers without any treatment would end up with deterioration of water quality in He River.

For the with-project alternative, although implementation of the Project will bring some environmental impacts, most of these impacts, except the irreversible ones from permanent land acquisition, can be avoided or mitigated through proper environmental protection measures. Implementation of the Project will end up with improved flood management capacity of He River and help reducing the economic loss by CNY 204.4 million in the event of a flood with a 50-year recurrence period. In addition, it will also be helpful to improving Hezhou's city appearance and protecting the people's health and protect the water quality of He River and promote integrated rehabilitation of the He River and the urban inland canals. The amount of COD and NH3-N discharged into He River will be reduced by 1259.25 t/a and 47.83 t/a. The amount of sewage interception along Huangtian Branch Canal, Guposhan Drainage Canal, Huangansi Drainage Canal and Shizigang Drainage Canal may reach 15,000 m^3/d and the amount of COD and NH3-N discharged in an uncontrolled way into He River will be reduced by 1888.88t/a and 221.75t/a, contributing remarkably to rehabilitation of black and odor urban waters. Therefore, this alternative will be helpful to protection of ecological safety and improvement of Hezhou's urban environment. Polluted rivers will be converted into livable landscaping areas and value of local land will be increased. In addition, the Project can also facilitate the urban and rural economic and social development and generate significant social, environmental and economic benefits. Therefore, from the perspective of promoting social and economic development and environmental protection, the with-project alternative is better than the without-project alternative and the project implementation is necessary.

9.3 Dredging alternatives

The Project involves dredging of various rivers and drainage canals. Four different dredging methods were considered as shown in Table 9-2.

Table 9-2 Comparisons of dredging methods

<table>
<tr><th colspan="2">Contents</th><th>Method 1</th><th>Method 2</th><th>Method 3</th><th>Method 4</th></tr>
<tr><td colspan="2">Description of methods</td><td>Cutter suction dredgers (boat)</td><td>Grab dredger (boat)</td><td>Direct digging</td><td>Suction dredging</td></tr>
<tr><td rowspan="5">Technical</td><td>Technical difficulties and feasibility</td><td>With certain technical difficulties</td><td>With certain technical difficulties</td><td>Low technical difficulties</td><td>Low technical difficulties</td></tr>
<tr><td>Construction conditions</td><td>Fit for rivers with wide surface and certain depth</td><td>Fit for rivers with wide surface and certain depth</td><td>Fit for rivers with wide surface and certain depth</td><td>Fit for rivers with wide surface and certain depth</td></tr>
<tr><td>Construction difficulties</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td>Construction duration</td><td>High efficiency and short duration</td><td>High efficiency and short duration</td><td>Low efficiency and long duration</td><td>High efficiency and short duration</td></tr>
<tr><td>Temporary storage of sediments dredged</td><td>Requiring a temporary de-watering site</td><td>Requiring a temporary de-watering</td><td>Requiring temporary storage and</td><td>Requiring a temporary de-watering</td></tr>
</table>

Table 9-2 Comparisons of dredging methods

Contents		Method 1	Method 2	Method 3	Method 4
			site	temporary de-watering site	site
	O&M cost	CNY 100-150 / m^3 dry sediment	CNY 100-150 / m^3 dry sediment	CNY 60-100 / m^3 dry sediment	CNY 100-120 / m^3 dry sediment
Environmental impacts	Impacts on sensitive receptors	Insignificant	Insignificant	Insignificant	Insignificant
	Water environment impact	Insignificant disturbance	Significant disturbance	Insignificant disturbance	Negligible disturbance
	Odor impact	Limited odor impact during dredging. The odor impact distance from de-watering site is approximately 30 m.	Certain degree of odor impact during dredging and de-watering. The impact distance is approximately 30 m.	Significant odor impact during dredging and de-watering. The impact distance is approximately 100 m.	Limited odor impact during dredging. The odor impact distance from de-watering site is approximately 30 m.
	Noise impact	Mainly from boat and pump operation. Noise impact limited, 70-80dB(A)	Mainly from boat and grabber operation. Noise impact limited, 70-80dB(A)	Limited noise from manpower operation. 60-70dB(A)	Some degree of noise impact from submersible pumps, 75-85dB(A)
Social impacts	Temporary land acquisition	Dewatering site needs land1500m^2	Dewatering site needs land1500m^2	Storage site need land 50m^2, Dewatering site needs land1500m^2	Dewatering site needs land1500m^2

Table 9-2 Comparisons of dredging methods

Contents	Method 1	Method 2	Method 3	Method 4
Main advantage / disadvantages	Advantage: Fast speed and high efficiency in construction. Fit for wide rivers with large dredging load. Disadvantage: technically difficult. Requiring sediment dewatering site.	Advantage: Fast speed and high efficiency in construction. Fit for wide rivers with large dredging load. Disadvantage: Significant disturbance to river and significant odor impact. Requiring sediment dewatering site.	Advantage: simple method； Fit for narrow space such as ditches and buried culverts. Disadvantage: low efficiency. Requiring not only sediment de-watering site, but also temporary storage site. Significant odor impact.	Advantage: simple method； Fit for narrow space such as ditches and buried culverts. Using submersible pumps can reduce some odor problems. Disadvantage : some noise problem s during dredging. Requiring sediment dewatering site.
Conclusions	Recommended alternatives	For He River main channel, Alternative 1 is recommended. For the Huangansi Drainage canal, and Shizigang Drainage canal, Alternative 4 is recommended. For Huangtian Branch Canal, Guposhan Drainage canal,and East Trunk Canal, Alternative 3 + Alternative 4 is recommended as the construction space is available.		

For different rivers and drainage canals, different dredging methods can be used. Involving huge dredging load, He River, with wide river surface and favorable depth, have the conditions needed for operation of large dredging vessels. Alternative dredging methods include cutter suction dredgers or grab dredger. The recommended option is the cutter suction dredgers because of its higher dredging efficiency, shorter dredging duration, insignificant disturbance to water body and the reduction of duration of impacts from the sediment dewatering site.

For Huangtian Branch Canal, Guposhan Drainage Canal, Huangansi Drainage Canal and Shizigang Drainage Canal, due to work space restrictions, large dredging vessels cannot be used. The alternatives include direct digging or suction dredging. Because the urban inland canals have poor water quality and stinky sediments due to perennial reception of sewage; in addition, located in the densely-populated urban area, in-water suction method is recommended in order to reduce the odor impacts on the environmentally sensitive sites. For Huangtian Branch Canal, Guposhan Drainage canal and the upstream section of East Trunk Canal, Alternative 3 + Alternative 4 is recommended, i.e. construction plant dredging plus suction dredging, as these construction sites are located far away from the residential areas and mostly farmland and unused land.

9.4 Alternatives for hydropower station improvement

In the feasibility study stage, several alternatives are proposed and compared for improvement of Huangshi Hydropower Station, Fanglin Hydropower Station and Xiadao Hydropower Station. The results of such comparison are summarized in Tables 9-3 to 9-5.

Table 9-3 Comparison of upgrading alternatives for Huangshi Hydropower Station

Content		Alternative 1: Upgrading the hydropower station	Alternative 2: Upgrading the hydropower station after buy-back	Alternative 3: Demolishing the hydropower station after buy-back
Description		Keeping the power station; upgrading the existing water gate to a hydraulic lift gate.	After buy-back, keeping the power station and upgrading the existing water gate to a hydraulic lift gate.	After buy-back, demolishing the workshops, turbine, sluice gate and associated structures of the hydropower station.
Engineering cost		CNY 24.03 million (CNY 0.45 million for demolishing existing water gate; CNY 22 million for installing a new gate; CNY 1.58 million as compensation for temporary shut-down of the station during construction)	CNY 28.45 million (CNY 6 million for buy-back; CNY 22 million for new gate and CNY 0.45 million for demolishing existing gate)	CNY 7.00 million (CNY 6 million for buy-back and 1 million for demolishing).
Construction duration		Long	Long	Short
Flood control benefits		Backwater upstream the gate reduced from 1.6 m to 0.64 m in terms of water level and 7.8 km to 3.1 km in terms of length.	Backwater upstream the gate reduced from 1.6 m to 0.64 m in terms of water level and 7.8 km to 3.1 km in terms of length.	He River section will be restored to its original natural status.
Environmental impact	Impact on sensitive sites	Limited	Limited	Limited
	Water environment impact	Requiring both demolition of existing concrete gate and installation of a new adjustable hydraulic lift gate; the duration of both construction and disturbance on	Requiring both demolition of existing concrete gate and installation of a new adjustable hydraulic lift gate; the duration of	Requiring only demolition of existing concrete gate, the duration of disturbance on water quality is short.

Table 9-3 Comparison of upgrading alternatives for Huangshi Hydropower Station

Content		Alternative 1: Upgrading the hydropower station	Alternative 2: Upgrading the hydropower station after buy-back	Alternative 3: Demolishing the hydropower station after buy-back
		water quality are long.	both construction and disturbance on water quality are long.	
Social impact	Land acquisition and resettlement	No	No	No
	Benefits from power generation	Compensation in an amount of CNY 1.58 million for production suspension during construction.	The government becomes the owner after buy-back. Compensation is not needed.	CNY 1.58 million / year as economic loss of power generation
	Placement of staff	To be re-opened after temporary shut-down for one year. Nobody loses job.	To be re-opened after temporary shut-down for one year. Nobody loses job.	15 people losing their jobs.
Main advantage/disadvantages		Advantage: enabling adjustment of flood control through the adjustable hydraulic lift gate, and the creation of a waterfront landscape in the upstream and improved environmental benefit. Disadvantage: longer construction duration and greater investment needed.	Advantage: enabling adjustment of flood control through the adjustable hydraulic lift gate and the creation of a waterfront landscape in the upstream and improved environmental benefit. No need of compensation for the suspension of power generation during construction. Disadvantage: longer construction duration and more investment needed. Long implementation duration leading	Advantage: He River course will be restored original natural condition; no impact on flood carrying capacity; Disadvantage: No upstream waterfront landscape will be created.

Table 9-3 Comparison of upgrading alternatives for Huangshi Hydropower Station

Content	Alternative 1: Upgrading the hydropower station	Alternative 2: Upgrading the hydropower station after buy-back	Alternative 3: Demolishing the hydropower station after buy-back
		to too much uncertainty.	
Conclusions	Alternative 1 is recommended.		

Based on the above comparisons, Alternative 1 will reduce the impact of the gate dam on the flood carrying capacity, reduce the upstream flooding loss (which increases by approximately CNY 0.5 million each year), and avoid difficulties in flood control. At the same time, with the gate dam of the hydropower station upgraded, an upstream waterfront landscape will be created and the flood regulating capacity will be improved. The environmental benefits will be improved thanks to improvement of flood carrying capacity. The disadvantages are that the long construction duration will lead to loss of revenue from power generation and generate some environmental impacts, most of which are temporary. In Alternative 2, the government becomes the owner after buy-back, therefore only the buy-back cost will be needed and compensation to losses due to power generation suspension is not needed. However, this alternative has the disadvantage of too much uncertainty due to long implementation time. In Alternative 3, the construction period is very short. However, after the removal of the gate dam, power generation will be permanently terminated, resulting in a yearly loss of approximately 1 million KW in power generation and 15 jobless employees of the hydropower station. These are permanent impacts and can cause greater social impacts than Alternative 1. After the comprehensive comparison, Alternative 1 is recommended (upgrading the hydropower station gate dam).

Table 9-4　Comparison of upgrade alternatives for Fanglin Hydropower Station

Alternatives	Alternative1: (1) keeping Fanglin Bridge; (2) removing the slider gate on the dam	Alternative 2: (1) demolishing the power station; (2) demolishing and reconstructing Fanglin Bridge as planned (half-width to be constructed in short term and second half-width after the power station is demolished according to the road planning); (3) removing the gate dam.	Alternative 3: (1) keeping the power station; (2) demolishing and reconstructing Fanglin Bridge as planned (half-width to be constructed in short term and second half-width after the power station is demolished according to the road planning); (3) removing the gate dam and building another gate dam at

Table 9-4 Comparison of upgrade alternatives for Fanglin Hydropower Station

			a different location downstream.
Scope	(1) Demolition of slider gate of Fanglin Hydropower Station; (2) Keeping Fanglin Bridge;	(1) Demolition of Fanglin Hydropower station; (2) Demolition of Fanglin Bridge and construction of a new bridge with 226 m span and 15 m width (half-width).	(1) Demolition of the bridge and gate dam and keeping the power station; (2) Construction of a new 84m gate dam with water retention height of 4.5 m; (3) construction of a new Fanglin Bridge with 226 m span and 15 m width.
Water gate design	/	/	The new water gate is located between the two power stations in the downstream and will adopt the continuous hydro-lifting water gate design, totally having 12 holes with a single-hole width of 7m. After upgrading, the hydraulic dam will be sized 12 m * 7 m * 4.5 m.
Bridge design	/	The approach bridges on both ends will adopt 3-span 20m prefabricated hollow slab beam structure with a beam height of 0.95 m. The main bridge will adopt 30+40+30m cast-in-place pre-stressed concrete continuous box girder with a beam height of 2.0m. The navigation requirements for Class 4 navigation canal with a net width of 30m and a net height of 7m will be satisfied.	The approach bridges on both ends will adopt 3-span 20m prefabricated hollow slab beam structure with a beam height of 0.95 m. The main bridge will adopt 30+40+30m cast-in-place pre-stressed concrete continuous box girder with a beam height of 2.0m. The navigation requirements for Class 4 navigation canal with a net width of 30m and a net height of 7m will be satisfied.
Impact on flood control	There will be some back water from the old bridge and the water gate bottom.	No impact	The back water effect is relatively smaller with 2.56 km back water length.

Table 9-4 Comparison of upgrade alternatives for Fanglin Hydropower Station

	The back water length is 6.8 km. The elevation of upstream dike needs be increased.		The elevation of upstream dike needs be increased.
Additional area of LAR	No	128m^2 brick house	128m2 brick house
Placement of unemployed	79 employees need reemployment	79 employees need reemployment	Nobody gets unemployed
Impact on irrigation	A new small irrigation pumping station needs to be built as compensation for the affected farmland of 1600 mu.	A new small irrigation pumping station needs to be built as compensation for the affected farmland of 1600 mu.	1600 mu paddy field and dry land to be affected. No compensation measures.
Impact on environmentally sensitive sites	No environmentally sensitive sites	No environmentally sensitive sites	No environmentally sensitive sites
Impact on water environment	Involving only the demolition of the existing water gate, the duration of both the construction activities and disturbance on water quality will be short.	Since the construction activities will be carried out in two stages including both demolition of existing water gate and construction of a new road, the duration of both the construction period and the disturbance to water quality will be long.	Since both demolition of existing water gate and construction of a new road will be involved, the duration of both the construction period and the disturbance to water quality will be long.
Engineering cost	CNY 28.02 million (including CNY 15.02 million for buy-back, CNY 1 million for water gate demolition, CNY 8.9 million for new dike and CNY 4 million for new small irrigation pumping station to be constructed.)	54.50 million RMB (including 15.02 million for buy-back, 4.32 million for the power station demolishing, 6 million for Fanglin Bridge and water gate demolishing, 25 million bridge construction, 16.64 million for land acquisition and resettlement, and 4 million for additional irrigation pumping station.) CNY 54.50 million (including CNY 15.02 million for buy-back,	CNY 102.32 million (including CNY 6 million for Fanglin Bridge and water gate demolition, CNY 25 million for bridge construction, CNY 67.2 million for new water gate construction, CNY 2.8 million for additional dike, CNY 1.15 million for compensation for temporary power generation suspension during construction, and CNY 16.64 million for land acquisition

Table 9-4 Comparison of upgrade alternatives for Fanglin Hydropower Station

		CNY 4.32 million for power station demolition, CNY 6 million for Fanglin Bridge and water gate demolition, CNY 25 million for bridge construction, CNY 16.64 million for land acquisition and resettlement, and CNY 4 million for additional irrigation pumping station.)	and resettlement.
Existing problems	No	Transportation and planning authorities need to be consulted on the feasibility of the half-width construction of Fanglin Bridge.	Will planning, construction and approval of the navigation channel be considered upon construction of the new water gate? Safety assessment on the hydropower station workshops and structures is needed to determine whether the structural safety will affect the construction of the water gate?
Advantages	(1) The back water effect of the power station is reduced; (2) no need of land acquisition and demolishing; (3) the environmental impact from Fanglin Bridge upgrade is eliminated.	(1) Bridge safety issue resolved; (2) Traffic jam pressure is alleviated; (3) back water effect basically removed with no impact on flood control and (4) no LAR is involved.	(1) Bridge safety issue resolved; (2) environmental impacts on both banks mitigated; (3) normal power generation assured; (4) irrigation needs satisfied.
Disadvantages	(1) High cost for power station buy-back; (2) some impacts will be generated on irrigation and a new small irrigation pumping station is needed; (3) the bridge safety issue remains not resolved; (4) the back water effect	(1) High cost for power station buy-back; (2) Construction of the Fanglin Bridge will generate significant impacts on traffic (traffic diversion at 2km upstream of Mintian Bridge and 1km downstream of Hezhou Bridge may be considered to	(1) There will still be some back water effect; therefore upstream dike is needed; and (2) construction of Fanglin Bridge will generate significant impact on traffic (traffic diversion at 2km upstream of Mintian Bridge and 1km downstream of

Table 9-4 Comparison of upgrade alternatives for Fanglin Hydropower Station

	from the bridge remains significant; and (5) need to increase the dike height in upstream.	relieve traffic pressure); and (3) some impacts will be generated on irrigation on both banks; therefore, a new small irrigation pump station is needed;	Hezhou Bridge may be considered to relieve traffic pressure).
Reasons for recommendation	Reduced backwater effect from the power station and savings on cost; consideration of navigational plan and transportation plan is not needed. Project implementation is easier.	Backwater effect from the power station is substantially eliminated, the engineering cost is higher. Coordination with transportation plan is needed. Project implementation is more difficult.	Backwater effect from the power station is substantially eliminated, the engineering cost is very high. Coordination with transportation plan is needed. Project implementation is more difficult.
Recommended alternatives	Alternative 1		

In Alternative 1 for Fanglin Hydropower Station upgrading, the length of upstream back water is reduced through demolition of the existing concrete water gate. Compared with the other alternatives, Alternative 1, with no requirement of resettlement, features the best savings on investment, shortest construction period and relatively insignificant environmental impacts from construction. Its disadvantages include the high buy-back cost, the loss of power generation and the need of reemployment of unemployed power plant staff, and the impact on upstream irrigation leading to the addition of a new irrigation pumping station, the unresolved bridge safety issue, and the remaining back water effect from the bridge making necessary the increase of downstream dike elevation. However, compared with Alternative 2 and 3, this alternative is advantageous in its significant savings on investment, zero need of resettlement, and shortest construction duration and can generate some flood control benefits. Therefore, Alternative 1 is recommended for its highest cost-effectiveness and best price performance.

Table 9-5 Comparison of alternatives for Xiadao Hydropower Station

Content	Alternative 1: Keeping the power station and increasing the upstream dike height	Alternative 2: keeping the power station after the buy-back and increasing the upstream dike height	Alternative 3: Keeping the power station and building additional flood channel	Alternative 4: Keeping the power station after buy-back and building additional flood channel	Alternative 5: Upgrading the power station	Alternative 6: Upgrading the power station after buy-back
Description	Keeping the power station: increasing the upstream dike height and keeping the power station	Power station buy-back: increasing the upstream dike height as in Alternative 1	Keeping the power station: building an additional flood channel to remove backwater and then keeping the power station	Power station buy-back: increasing the upstream dike height as in Alternative 3.	Keeping the power station: reducing the crest elevation of gate dam to reduce backwater; changing gate type from flap gate to flat gate	After power station buy-back, upgrading the hydropower station as in Alternative 3
Engineering cost	CNY 10.1 million (including CNY 2.6 million for new dike, CNY 7.5 million for compensation of power generation shut-down during construction)	CNY 57.4 million RMB (including CNY 53.5 million for buy-back and CNY 2.6 million for new dike)	CNY 64.1 million (including CNY 4.6 million for land acquisition, CNY 52 million for additional flood channel, CNY 7.5 million for compensation of power generation shut-down during construction)	CNY 110.1 million (including CNY 53.5 million for buy-back, CNY 4.6 million for land acquisition and CNY 52 million for additional flood channel)	CNY 39.35 million (including CNY 0.5 million for gate demolishing, CNY 30 million for gate upgrade, CNY 1.35 million for additional dike, and CNY 7.5 million for compensation of power generation shut-down during construction)	CNY 85.35 million (including CNY 53.5 million for buy-back, CNY 0.5 million for gate demolishing, CNY 30 million for gate upgrade, CNY 1.35 million for additional dike)
Flood control benefit	Due to backwater effect, it is necessary to increase the height of a 4.0m long dike by 0-1.0m.	Due to backwater effect, it is necessary to increase the height of a 4.0m long dike by 0-1.0m.	No backwater from the water gate. Upstream dike is still needed.	No backwater from the water gate. Upstream dike is still needed.	Due to backwater effect, it is necessary to increase the height of a 1.8km long dike by 0-0.37m.	Due to backwater effect, it is necessary to increase the height of a 1.8km long dike by 0-0.37m.
Impact on sensitive sites	Limited to the area around the dike	Limited to the area around the dike	Limited to the area around the	Limited to the area around the additional	Limited to the area around the flap gate	Limited to the area around the

Table 9-5 Comparison of alternatives for Xiadao Hydropower Station

Content	Alternative 1: Keeping the power station and increasing the upstream dike height	Alternative 2: keeping the power station after the buy-back and increasing the upstream dike height	Alternative 3: Keeping the power station and building additional flood channel	Alternative 4: Keeping the power station after buy-back and building additional flood channel	Alternative 5: Upgrading the power station	Alternative 6: Upgrading the power station after buy-back
	construction site	construction site	additional flood channel construction site	flood channel construction site	upgrade site	additional flood channel construction site
Water environment impact	No impacts	No impacts	No impacts	No impacts	The disturbance to water body is limited to the flap gate construction period. The duration is not long.	No impacts
Land acquisition and resettlement	No	No	$47360m^2$	$47360m^2$	No	No
Benefit from power generation	CNY 7.5 million as compensation for power generation suspension during construction.	After the buy-back the government becomes the owner, therefore no need for compensation.	CNY 7.5 million as compensation for power generation suspension during construction.	After the buy-back the government becomes the owner, therefore no need for compensation.	CNY 7.5 million as compensation for power generation suspension during construction.	After the buy-back the government becomes the owner, therefore no need for compensation.
Placement of staff	No	No	No	No	No	No
Main advantages / disadvantages	Advantage: limited impact on the power station. Easy construction; low cost. Disadvantages: Increased dike height may increase flooding risk on both banks.	Advantage: limited impact on the power station. Easy construction; low cost. Disadvantage: Increased dike height may increase flooding risk on both banks.	Advantage: back water effect removed. Disadvantage: Long construction duration; land acquisition and resettlement needed; greater impacts on the environment and local residents' life.	Advantage: back water effect removed. Disadvantage: Long construction duration; land acquisition and resettlement needed; greater impacts on the environment and local residents' life. Higher cost.	Advantage: back water effect reduced. Disadvantage: Long construction duration and high cost for gate upgrading.	Advantage: back water effect reduced. Disadvantage: Long construction duration and high cost for gate upgrading.

Table 9-5 Comparison of alternatives for Xiadao Hydropower Station

Content	Alternative 1: Keeping the power station and increasing the upstream dike height	Alternative 2: keeping the power station after the buy-back and increasing the upstream dike height	Alternative 3: Keeping the power station and building additional flood channel	Alternative 4: Keeping the power station after buy-back and building additional flood channel	Alternative 5: Upgrading the power station	Alternative 6: Upgrading the power station after buy-back
			Higher cost.			
Conclusions	Alternative 1 is recommended.					

In Alternative 1 for Xiadao Power Station Upgrading, upstream dike height is increased to satisfy flood control requirements in the upstream areas. Increase of dike height involves relatively low cost. Advantages in reduced upstream flooding loss and avoided flood regulation difficulties assure the feasibility and implementability of the alternative. The upstream area of Xiadao Power Station is dominated by low hills and features in higher planned land elevation. Increasing the dike height will have little impact on local flood drainage and control and involves a very low cost. With the impacts from water construction activity on water environment avoided and with no land acquisition and resettlement required, Alternative 1 for Xiadao Power Station Upgrading features in the biggest savings on investment and is therefore recommended.

9.5 WWTP Alternatives

Different alternatives for the proposed Jiangnan WWTP are compared in terms of siting, treatment process and outlet locations. Results of such comparison are shown in Table 9-6 to 9-10 as follows.

Table 9-6 Comparison of siting alternatives for the Jiangnan WWTP

Content		Site alternative 1	Site alternative 2
Description		Mid-west of Jiangnan District, south bank of the He River. Near the Taoyuan Road and Shengping Road.	East of planned Jiangnan district. East of the Luo-Zhan Railway, south of the He River, and west of the Gubo Village Songbaizhai Village.
Technical	Site condition	Flat terrain, favorable for WWTP layout	Flat terrain with limited earthwork needs, favorable for WWTP layout
	Sewage collection	Located in the planned areal convenient for sewage collection	Low elevation, favorable for sewage collection.
	Flooding risk	Little possibility of flooding	Little possibility of flooding
	Discharge outlet	Pressurized flow. Construction and installation cost for pumping station is CNY 8.4515 million	Pressurized flow. Construction and installation cost for pumping station is CNY 9.5782 million
	Sewer network cost	Construction and installation cost is CNY 9.8738 million	Construction and installation cost is CNY 11.6406 million
Environmental impact	Impacts on environmentally	Some sensitive sites are in the protection	Distance to the nearest sensitive site is larger

Table 9-6 Comparison of siting alternatives for the Jiangnan WWTP

Content		Site alternative 1	Site alternative 2
	sensitive sites	area	than 100 m
	Impacts on water environment	Discharged into He River; a pollutant flume is formed within 5 m from the outlet.	Discharged into He River; a pollutant flume is formed within 5 m from the outlet..
	Odor impacts	Involving impact on sensitive sites nearby	No sensitive sites in the affected area.
	Noise impacts	Involving impact on sensitive sites nearby	No sensitive sites in the affected area.
Social impact	Resettlement	Demolition of residential houses and extensive resettlement is needed.	Insignificant need of demolition, thus insignificant cost of LAR
Main advantages / disadvantages		Advantage: Its location in the middle of the urban area of Jiangnan District and in the vicinity of residential areas allows easy transportation and easy sewage collection. Flooding risk is low thanks to its location in the inner side of the planned urban area. Disadvantage: More significant environmental impacts as it is located in the downtown center. The protection distance to surrounding area is not sufficient.	Advantage: Convenient transportation, easy sewage collection and effluent discharge. Insignificant need of house demolition and low cost of land acquisition; the flat terrain allows easy sewage collection and requires little earthwork quantity. Located at the leeward of prevailing wind direction, impacts on residents in the leeward direction are small. Disadvantage: some filling works are needed as the terrain is low and flat.
Conclusion		Alternative 2 is recommended.	

From the comparison above, Alternative 2 is better because it allows easy sewage collection; although pipeline investment is relatively higher, Alternative 2 involves little house demolishing and resettlement and no impacts on environmentally sensitive sites as there are no sensitive sites in the protection area. Therefore the site described in Alternative 2 east of planned Jiangnan district and Luo-Zhan Railway, south of He River and west of Gubo Village and Songbaizhai Village is recommended as the WWTP site.

Table 9-7 Comparison of WWTP treatment processes

Content	Process 1	Process 2
Description	A2/O Micro-pore	MBR

Table 9-7 Comparison of WWTP treatment processes

Content		Process 1	Process 2
		aeration oxidation process	
Technical	Special features	1. Conventional biological denitrification and dephospheration method with stable performance. 2. Use of Micro-pore aeration pipes, easy installation and maintenance, easy management, little maintenance, much smaller energy consumption than the conventional oxidation ditch method	1. Low residual sludge production 2. solid-liquid separation is achieved requiring no secondary settling tank
	Equipment	Involving fewer equipment types and quantities and less strict requirements of equipment quality and maintenance.	Involving more equipment types and quantities and more complicated requirements of management and maintenance.
	Operational management	Automated control system involving little workload of programming, low cost of PLC hardware, but high labor intensity. Less strict requirements on operator qualifications; Low overall equipment cost.	Automated control system involving strong workload of programming, high cost of PLC hardware, but lower labor intensity. more strict requirements on operator qualifications; high overall equipment cost.
	Construction and installation cost	CNY 34.4758 million	CNY 51.2855 million
	Operational cost	CNY1.41 / ton	CNY 2.55 / ton
Environmental impact	Water environment impact	Easy O&M. Stable effluent quality	Difficult O&M lead to poorer stability of effluent quality.
	Odor impact	Structures with odor problem including aeration tank, sludge condensing tank and sludge room. Certain odor impacts will be generated.	Structures with odor problem including screens, sludge condensing tank. Scope of odor impact is relatively small.
	Noise impact	Major noisy equipment is the air compressor	No high-noise equipment.
	Sludge production	0.31kg sludge/kg BOD	0.1kg sludge/kg BOD
Social impact	Land	1.65 hm2	1.28 hm2

Table 9-7 Comparison of WWTP treatment processes

Content		Process 1	Process 2
	acquisition		
Main advantage/disadvantage		Advantage: 1. Conventional biological denitrification and dephospheration method with stable performance; 2. Use of Micro-pore aeration pipes, easy installation and maintenance, easy management, little maintenance, much smaller energy consumption than the conventional oxidation ditch method; 3. Stable effluent quality Disadvantage: Involving larger area of land occupation	Advantage 1. Low residual sludge production; 2. solid-liquid separation is achieved requiring no secondary settling tank Disadvantage High investment cost. Stricter qualification requirements for operators ensure stable performance. More equipment types and quantities are needed, implying greater complexity in management and maintenance and greater possibility in unstable effluent quality.
Conclusion		Alternative 1 is recommended.	

It can be seen from the above comparison that, compared with the MBR process, the A2/O micro-pore aeration and oxidation process involves a low process investment, less difficulty in operational management, greater savings on operational cost and more stable effluent quality. Although it will generate some odor impacts and noise impacts, such impacts can be contained within the plant area if appropriate measures are taken. Therefore, Alternative 1, i.e. the A2/O micro-pore aeration and oxidation process, is recommended as the treatment process for the WWTP under the Project.

Table 9-8 Comparison of alternative locations of discharge outlet of Jiangnan WWTP

Content		Alternative 1	Alternative 2
Description		Jingyue Lake	Downstream He River
Technical Environmental impact	Installation depth of associated pipelines	Shallow	Deep
	Pipeline cost	CNY 9.8738 million	CNY 11.6406 million
	Technical difficulty and feasibility	Technically feasible	Technically feasible
	Construction condition	Available	Available
	Construction difficulty	Minor	Major
	Construction period	Short	Long
	O&M	Convenient	Fairly convenient
Technical	Water environment impact	Mid-stream He River, greater environmental impacts	He River downstream, downwind direction of the prevailing wind direction. Greater environmental benefits.
	Receiving water body self-purifying capacity	Still water, difficult for pollutant diffusion. Poor self-purifying capacity	Flowing water. Easy for pollutant diffusion. Good self-purifying capacity

Table 9-8 Comparison of alternative locations of discharge outlet of Jiangnan WWTP

Content		Alternative 1	Alternative 2
	Odor impact	Surrounded in the urban area. Odor impact is significant.	In the suburban area and downwind direction. Odor impact is insignificant.
	Noise impact	Significant	Insignificant
	Land acquisition	Significant	Insignificant
Engineering cost	Construction cost	Significant	Insignificant
	Operational cost	Similar	Similar
Main advantages / disadvantages		Advantage: Convenient sewage collection and lower sewer network cost; Disadvantage: located in the urban center; involving impacts on surrounding area. Extensive demolition is needed.	Advantage: Greater environmental benefits and insignificant demolition demand; Disadvantage: Bigger pipeline length and depth involved.
Conclusion		Alternative 2 is recommended	

It can be seen from the above comparison that Alternative 2 for the location of the discharge outlet of Jiangnan WWTP requires installation of longer sewer pipelines and greater buried depth. Despite of the construction difficulty, this alternative involves greater long-term environmental benefits because the discharge outlet is located at the lower reaches of He River and downwind direction of residential areas in the suburb. Pollutant load from the effluent can be quickly diluted and purified once it enters He River. In the other alternatives, diffusion and self-purification of pollutant in the effluent are difficult. Therefore, the outlet at the lower reaches of He River is recommended as the discharge outlet of Jiangnan WWTP.

10. Public Participation and Information Disclosure

10.1 Purpose of public participation

The purpose of public participation is to improve the quality of EIA, to provide more information and advice, and to make the EIA process more open and public so as to enable all the people with direct or indirect connection with the Project to participate in the EIA process to ensure transparency and credibility of the EIA results and to bring forward their own views and opinions to make the EIA process better and fairer.

Public participation is an important part of EIA process and an effective way to improve scientific decision-making. Public participation for construction projects is an important means of enhancing the two-way communications between project construction units, EIA consultants and the public. Through extensive public participation, the public directly or indirectly affected by the construction project can have a full understanding of the potential environmental impacts, mitigation measures and the economic and social benefits brought by the project construction, and can provide feedback opinions and actively offer suggestions to jointly find a solution for potential problems. Thus the impact of project implementation on the environment can be minimized, potential pollution induced conflicts can be avoided, and environmental protection and economic development can be better coordinated. The main purposes of public participation include:

(1) Summarizing and analyzing public opinions, so that they can be included in the environmental protection measures. Public opinions should also be used as the work guidelines in the implementation stage of the Project.

(2) Conducting two-way communication between the public and the construction unit, introducing project overview, potential pollution, control measures, EIA prediction results, etc., to the public in detail and collecting public opinions and suggestions, etc. and giving feedback to the construction unit so that the project design can be properly modified to bridge the public and the construction unit for mutual understanding.

(3) Soliciting, through public participation, public views and opinions of the Project, finding a basis for safeguarding public interest, fully adopting the feasibility suggestions in the EIA process to ease public concerns induced by lack of communications between the construction unit and the public, and mitigating as much as possible the adverse impacts on and making necessary compensation for public interests.

(4) The post-EIA assessment mainly relies on public supervision. Public participation is an important part of environmental management mechanism, which is conducive to protecting the ecological environment, improving the environmental and economic benefits of the Project, and improving environmental quality, and ensuring the implementation of sustainable development strategies.

10.2 Scoping and stakeholder identification

Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project plans to apply for a loan from the World Bank to further accelerate infrastructure development under the Project, and create conditions for coordinated social and economic development in the region. Implementation of the Project will facilitate improvement of water environment in He River Watershed and Hezhou Municipality, watershed ecological function and city style and quality as well as local peoples' livelihood and lay a solid foundation for sustainable development in Hezhou. However, during project construction and operation, there will be some environmental impacts on the surrounding area concerning the personal interests of local people. Such impacts will cover individual residents and organizations within the range of red lines (RoRL) and in the affected areas of the Project.

In the project-affected area, all individuals or organizations that are directly or indirectly benefiting from or adversely impacted by the Project are the stakeholders of the Project. At the same time, project-related government agencies or experts in the related disciplines are also stakeholders. Stakeholders of the Project are identified based on the subprojects defined in the feasibility study report and are summarized in Table 10-1.

Table 10-1 Summary of project stakeholders

S.N	Subproject	Subproject component	Stakeholders	
			Affected people	Related government agencies and experts
1	**Improving Flood Risk Resilience of He River**	A-1 He River integrated rehabilitation (Huangshi Hydro-Power station to Guangming Bridge)	Residents along the watershed (Shangsong Village, Xiwan Village, Xiwanzhai Village, Jigongzhou village, Xibenyuan Village, Gongqiaotou Village, Longjiangdu Village, Hezhou Institute, Shizigang Village, Sanjiacun Village, Fanglin Village, Fanglin Village, Laoxuewo Village, Laozengwo Village), Hezhou Experimental Middle School	HWRB, HAAHB, HFoB, HLRB, HPB, HTPD
		A-2 He River integrated rehabilitation (Guangming Bridge to Lingfeng Bridge)	Residents along the watershed (Babuxi South No.2 Alley residential house, Xiyue Street residential house, Jiangbeizhong Road residential house, Xialiang Village)	HWRB, HAAHB, HFoB, HLRB, HMEAB (river widening might involve infrastructure), HCPPRFTB (Office of Historical Cultural City Application), HPB, HTPD
		A-3 He River integrated rehabilitation (Lingfeng Bridge to Xiadao Hydropower Station)	Residents along the watershed (Jiangbeizhong Road residential house, Diandengzhai Village, Pinganzhai Village, Laiwu Village, Chetianzhai Village, Yazhai Village, Duchuantou Village, Chushuitang Village, Xiadaozhai Village, Jichitan Village), Xiadao Primary School.	HWRB, HAAHB, HFoB, HLRB, HPB, HTPD
		A-4 East Trunk Drainage Canal rehabilitation and Mawei River connectivity	Residents along the watershed (Huangtianzhai Village, Dabanqiao Village, Fengfeiling Village and Xianghuadao Village).	HWRB, HPB, HAAHB, HLRB
		A-5 Xiadao Hydropower Station integrated improvement	Residents along the watershed (Jichitan Village, Niulanpai Village, Hydropower station owner and operator)	HWRB, HPB
		A-6 Fanglin Hydropower Station	Residents along the watershed (Sanjia Village, Fanglin Street; Hydropower station owner and operator)	HWRB, HPB, HTPD

Table 10-1 Summary of project stakeholders

S.N	Subproject	Subproject component	Stakeholders	
			Affected people	Related government agencies and experts
		integrated improvement		
		A-7 Huangshi Hydropower Station integrated improvement	Residents along the watershed (Shangsong Village; Hydropower station owner and operator)	HWRB, HPB
		A-8 He River dredging (Huangshi Hydropower Station to Xiadao Hydropower Station)	Same as A-1, A-2, and A-3	HWRB, HMEAB (garbage, in-situ treatment for sand and stones), HPB and HAAHB
2	**Improving Urban Drainage and Wastewater Management**	B-1 Huang'ansi Drainage Canal pumping station	Xiyue Street residential house	HWRB, HPB and HCPPRFTB
		B-2 Shizigang Drainage Canal pumping station	Jiangbeizhong Road residential house	HWRB and HPB
		B-3 Lining River rehabilitation	Residents along the watershed (Pingjing Village, Baimenlou Village, Lijiatang Village, Lining Village, Daninggang Village, Jizishi Village, Laozhaishan Village, Xiangjiayuan Village) and Yingshi Primary School	HWRB, HLRB, HPB and Railway Authority
		B-4 Changlong River rehabilitation	Residents along the watershed (Huangtianzhen township, Sanqiqiao Village, Douxing Village, Tianjingnao Village, Yatanggang Village, Changlong Village)	HWRB, HLRB, HPB and Railway Authority
		B-5 Huangtian Branch Canal rehabilitation	Residents along the watershed (Ershiao Village, Sanqiqiao Village, Huangtian Township, Huangtian Village, Anshan Village), Hezhou Pinggui No.3 Junior High School.	HWRB, HMEAB, HPB, HLRB and Railway Authority
		B-6 Guposhan Drainage Canal rehabilitation	Residents along the watershed (Huangtian Township, Huangtian Village, Anshan Village, Benyuanna Village, Baijiazhai Village and Shizigang Village)	HWRB, HMEAB, HLRB, HPB and authorities involved in utility pipelines: water, sewer, gas, telecommunication and

Table 10-1 Summary of project stakeholders

S.N	Subproject	Subproject component	Stakeholders	
			Affected people	**Related government agencies and experts**
				electricity
		B-7 East No. 5 Branch Canal rehabilitation	Residents along the watershed (Tianchongzhai Village, Tangpingzhai Village, Xiwan Village, Xiwan Township, Guanyingyan Village)	HWRB, HMEAB, HPB, HLRB, and authorities involved in utility pipelines: water, sewer, gas, telecommunication and electricity
		C-1 Huang'ansi Drainage Canal rehabilitation	Residents along the watershed (residential buildings at Badaxi Road, Qianjin Road, Jianshezhong Road, Youxingxiang Alley, Xinan No.1 Alley, Xiyue Street).	HWRB, HMEAB, HPB, HLRB and HTPD
		C-2 Shizigang Drainage Canal rehabilitation	Residents along the watershed (residential buildings at Wanquan Street, Zhushan Road, Longxing alley, Yinhe Street, Wangjiao Alley, Longshan Road, Xingguang Road, Pinganxi Road, Jiangbeizhong Road)	HWRB, HMEAB, HPB, HLRB and HTPD
		C-3 Jiangnan WWTP and associated sewer system and road improvement	Residents along the watershed (Fanglin Village, Laoxuewu Village, Laozengwu Village, Xinxuewu Village, Zhegutou Village, Chaan Village, and residential buildings at Guangming Avenue, Nanhuan Road, Binjiangnan Road, Xinxingnan Road, Xiadao Village, Xiadaozhai Village, and Tongluozhou Village.)	HWRB, HLRB, HPB, and HMEAB
3	**Institutional Strengthening, Capacity Building and Project Management**	Hydraulic monitoring station	Responsible person of relevant agency	HWRB, and HPB
		Environmental monitoring station	Responsible person of relevant agency	HWRB, HEPB, and HPB
		Ecological monitoring station	Responsible person of relevant agency	HLRB, and HPB

HAAHB: Municipal Aquatic & Animal Husbandry Bureau; HCPPRFTB: Hezhou Municipal Culture, Press, Publication, Radio, Film & TV Bureau; HMEAB: Hezhou Municipal Engineering Administration Bureau; HFoB: Hezhou Municipal Forestry Bureau; HFB: Hezhou Financial Bureau; HLRB: Hezhou Municipal Land and Resources Bureau; HPB: Hezhou Municipal Planning Bureau; HWRB: Hezhou Municipal Water Resource Bureau; HEPB: Hezhou Municipal Environmental Protection Bureau; HTPD: Hezhou Municipal Traffic Police Department.

10.3 Public consultation

10.3.1 Executive arrangements

The implementation of the Project will be helpful for the water environment improvement in the project related watershed and urban area, effectively improve the ecological functions of the basin and enhance the city's style and taste, improve the quality of people's life, and provide a solid basis for sustainable development of Hezhou in the future. As the construction and operation of the Project involves land acquisition, resettlement, and possibly local environmental changes, two rounds of public participation were carried out for the Project according to the requirements of domestic laws and regulations for environmental protection and the World Bank Safeguard Policy (OP4.01). The first round was in the preparation phase, or during the preparation of the EIA outline; the second round was after the draft EIA report was finalized. The public participants mainly include residents in the project area or project-affected area, i.e., the residents near the sections of He River and urban inland canals to be rehabilitated and the WWTP to be built. In addition, the public participants also include representatives and experts from government agencies related to the Project

The first round was conducted in the project preparation phase or during the preparation of the EIA outline. The main purpose was to introduce the basics of the Project so that the public could have a basic understanding of the Project and make comments or suggestions for project implementation.

During this round, the EIA consultant solicited comments and suggestions from the public through online information disclosure, poster disclosure, interviews, questionnaires survey and seminars. Such comments and suggestions were delivered as feedbacks to the Project EA and feasibility study designer to provide references for the project design as this EIA.

The second round of public participation was implemented after the first draft of the EIA Report was completed. The main purpose was to provide feedbacks on comments and suggestions solicited during the first round, and solicit comments and suggestions on the proposed mitigation measures.

During the second round, the EIA consultant also solicited comments and suggestions from the public through expert consultation, online disclosure, poster disclosure, interviews and seminars. At the same time, the draft EIA report was made available at places of public accessibility including offices of the PMO, HEPB, relevant village committees, or street committees, etc.

Details of the public participation are summarized in the Table 10-2 and Table 10-3. The process is illustrated in Figure 10-1 and Figure 10-2.

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
First Round						
2016.4.14	HDRC	Seminar	Government agencies, village committee leader and villager representatives involved in the Project	Introducing basic information and potential environmental impacts of the Project, soliciting public opinions and suggestions	The design should be optimized to avoid land acquisition and resettlement. Resettlement activities should be well implemented to achieve land resource balance.	Timely communication will be assured with the FSR design institute to provide feedback to them so that land acquisition and resettlement can be avoided as much as possible. Relevant national and local regulations for land acquisition, resettlement and compensation will be respected and relevant measures and requirements will be included in the ESMP.
2016.4.15	Gonghe Village, Sanjia Village	Site visit, Questionnaires survey	Village committee and villager in Gonghe Village; Village committee and villager in Sanjia Village;	Introducing basic information and potential environmental impacts of the Project, soliciting public opinions and suggestions	Villagers' opinions should be fully respected to ensure all lands acquired are fully compensated and the life and work of villagers who lose their lands will be restored.	The resettlement and compensation plan should not lead to negative impacts on the livelihood of land-losing villagers. Measures to be taken should comply with relevant national laws and regulations so that they are acceptable to people and make sure that everybody has a job and lives a good life in the end instead of only compensated financially.
2016.4.16	Lining Village and Changlong Village	Site visit, Questionnaires survey	Village committee and villager in Lining Village; Village committee and villager in Changlong Village	Introducing basic information and potential environmental impacts of the Project, soliciting public opinions and suggestions	Stronger efforts should be made in water quality monitoring and improvement to protect the ecological environment. Local construction labor force may be hired for the project construction to create job opportunity for local residents.	1. The Project EIA proposed different environmental protection measures based on the nature of each component to make sure the impact on water environment and ecological environment from construction is minimized. Detailed measures include: (1) Enhance the environmental training for construction workers to improve their environmental awareness, and forbid random littering and dumping; (2) Arrange construction in non-wet seasons or sunny days to reduce the impact on water quality in He River; (3) Implement soil erosion control based on the soil erosion control plan, and improve the ecological revetment. The detailed measures are also summarized in Chapter 5. 2. The contractor should hire local labor where possible provided that the construction requirements are satisfied.
2016.4.17	Babu Street	Site visit, Question	Babu Street Office, the	Introducing basic information and	Proper arrangements should be made to the construction works to	For the comments raised by the public, the EIA proposed the following measures: (1) selecting

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	Office, the project areas in the city	naires survey	project areas in the city	potential environmental impacts of the Project, soliciting public opinions and suggestions	avoid noise disturbance to residents.	advanced low-noise equipment; (2) prohibiting construction activities at noon (12:00-14:00) or at night (22:00 – 6:00 next day); (3) Using vibration damping foundation or vibration damping support with damping material for noisy machinery or equipment; (4) erecting noise-reduction fences around construction sites with a distance of less than 5 m from residential buildings and schools; temporary sound barriers with effective noise attenuation should be erected for construction sites close to schools; (5) all machinery and equipment should be maintained and repaired effectively and periodically to stay in good conditions for the final purpose of noise reduction and longer service life; and (6) stricter requirements should be raised for management of construction intensity, machinery or vehicle operator and codes of operation, etc.
2017.2.20	HWRB	Seminar	HWRB, HAB, HTB, HLRB, HFoB, HAAHB, HCPPRFTB, Eco-city management committee, village committee representatives, design institute representative and project owner representatives.	Introducing the basic information and scope of the Project. Each agency should identify its key responsibilities. A coordination mechanism at different levels should be established to explore potential environmental impacts during construction and operation stages.	1. Whether the project area involves the historic famous trees. If any, they should be protected during construction. 2. The historic scenery and ecological environment on both sides of He River, especially the ancient ferry, pier and dike, should be protected. 3. Before construction a traffic management plan needs to be prepared to ensure smooth traffic and safety. 4. Due diligence should be conducted for associated facilities.	1. The EIA proposed the following protection measures for historical famous trees: (1) minimizing the construction area and shorten the construction duration; (2) prohibiting tree felling, transplanting, bark peeling, root digging, or injection of hazardous or toxic materials to the historic famous trees; (3) prohibiting construction of buildings or structures, laying pipelines, erecting cables, digging borrow areas, mining and sand excavation, flooding or sealing ground, emitting fumes and dumping wastewater or solid wastes, stockpiling or dumping flammables, explosives or other hazardous substances on sites with a horizontal distance of less than 5 m of from the projected shades of crowns of historic famous trees ; (4)prohibiting activities including carving, nailing, winding, hanging on the trees or piling material against the tree trunk (5) prohibiting rolling and compaction by construction vehicles or plant in areas with a distance of 5m outside the vertical projection of the crowns of ancient and famous trees. 2. The EIA proposed the following protection measures for cultural heritage: (1) the project design should avoid construction in the protection area of the

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
						existing historic culture street; (2) before commencement of construction works under the Project, the relevant authorities should be consulted to develop an effective cultural relics protection plan; 3) construction camps, temporary top soil stockpiling sites are not allowed to be located in the protection area; and (4) A Physical Cultural Resources Management Plan should be developed to regulate and standardize the constriction operations. 3. (1) Construction works should be carried out on a section-by-section basis to enable early excavation and backfill; (2) A bulletin board should be erected at construction site to inform the public of project background, construction duration, etc. and seek the public understanding on the inconvenience brought about by the Project; information on contact person and complaint hot line number should also be disclosed; (3) the pipeline construction should avoid the peak hours or traffic police guide should be utilized in peak hours to divert traffic and ensure smooth pedestrian and motorized vehicle to minimize traffic jam and reduce impact on local residents' travel; and (4) construction management and trainings on environmental protection for construction workers should be strengthened. 4. The associated projects identified for the Project include Guangxi He River Rehabilitation Project, Hezhou Domestic Solid Wastes Landfill Project, Hezhou Jintai Lake Rehabilitation Project, Hezhou Yongfeng Lake Rehabilitation Project, Hezhou WWTP Project, Hezhou Sludge Harmless Disposal Project etc. The status of these associated projects is detailed in Chapter 3, Due diligence of associated projects.
2017.2.25	HCPPRFTB	Questionnaires survey	HCPPRFTB	Basic information about Xiyue Street and its protection	1. Wherever possible, the project design should avoid the national level historic famous city and its protection area, and avoid the ancient ferry, dike, bridge and trees to protect the cultural heritage in	1. Based on the protection area of the Xiyue Cultural Street, the design institute optimized the RoRL for the Project. In-situ protection will be used to protect the ancient dike and ferry with no further upgrade except filling the outside with compressed soil to improve the stability of the dike. 2. Relevant authorities should be consulted to

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					Hezhou. 2. The planning and design for Xiyue Street should follow the suggestions of Hezhou National Historic Cultural Famous City Application Office and be submitted to the municipal government for approval prior to the commencement of any construction works. Buildings close to or within the famous city should have the same style with the existing historic cultural street. 3. Lessons and experiences from the other cities such as Yongzhou in Hunan Province, Wuzhou in Guangxi Province, should be used as references and the dikes to be constructed should be located as close to He River as possible; the original dike and ancient ferries should be protected; antique water-front bridge gallery should be built to cover up the sewer pipelines along He River to enhance the aesthetics of the city as a whole. 4. It is suggested that Wuzhou and Guilin's model in the dike design should be followed to exhibit the Hezhou mining culture, Qianjiang culture, and red culture in the form of embossment on the dike. The water environment rehabilitation should be integrated with the urban development to create a new leisure space in Hezhou and revitalize the historic and old communities.	develop an effective cultural heritage protection plan; 3. Education and training should be strengthened during construction to raise construction workers' awareness of cultural heritage protection. If a cultural heritage is identified in the construction process, the construction unit or construction supervising unit should suspend the construction activity immediately, and report the cultural heritage authority for proper handling. The construction can only be resumed at the cultural heritage authority's approval. 4. For the historical street protection section at the estuary of He River and Huangansi Drainage Canal, a dual-function dike combining landscaping with flood control may be constructed outside the existing Babu Minguo Dike as a part of the flood control component to manifest the prosperity of shipping culture in ancient Hezhou while hide the vertical-moving flood gate inside the dike relying on the corridor support structures. 5. Management and maintenance in the operation stage should be strengthened.
2017.3.2	HEPB	Site	HEPB EIA division and	Consulting and identifying the EIA	1. The EIA for He River Rehabilitation Project has been	EIAS have been prepared and approved for the associated facilities. Hezhou WWTP is operating

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
		interview	Pollution Control Division.	approval process and progress of associated facilities, and the pollutant discharge points in the city.	approved. Currently the Pinggui New District Dike, Huangtian Dike and Jiangbei Dike have been completed and the Jiangnan Dike is not yet started and is estimated to complete in 2018. 2. The EIA for the Hezhou Jintai Lake Integrated Rehabilitation Project has been approved. Currently, construction of the project subcomponent has not commenced and is anticipated to complete by September 2019. 3. The EIA for the Hezhou Yongfeng Lake Integrated Rehabilitation Project has been approved. Currently, construction of the project subcomponent has not commenced and is anticipated to complete by September 2019. 4. The EIA for Hezhou WWTP (Phase I) has been approved and the plant has passed the acceptance test and is in stable operation. The effluent water quality can meet relevant discharge standards. The EIA for Phase II expansion has been approved and current Phase II is under construction. 5. The EIA for the Hezhou Sludge Disposal Center has been approved. The facility is currently under trial operation. The EP acceptance test will be conducted later. 6. The EIA for the Hezhou Landfill has been approved, and the landfill have been built and put into operation. Currently it is undergoing	smoothly with effluent quality meeting relevant standards. Currently it is undergoing Phase II expansion. Once Phase II is completed, it can accommodate the sewage intercepted in the Project. The current sludge treatment project has a designed treatment capacity of 100 tons/day. The current load is 33 tons/day, therefore there is still room for more load. When the Jiangnan WWTP is completed, it will produce 3 tons/day of sludge, within the acceptable range for the Hezhou Sludge Disposal Center for handling. After dewatering, the moisture content can be reduced to 50%. After negotiating with the HMEAB, the dredged sediments can be send to Hezhou Landfill for disposal after dewatering process. The details of the associated facilities are summarized in Chapter 3. Based on the survey results for the associated facilities, appropriate environmental protection measures should be proposed and effectively implemented causing no secondary pollution. Detailed measures are introduced in Chapter 5, Environmental Impact Analysis and Mitigation Measures, of the report.

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					a technological upgrade on its leachate treatment station.	
2017.7	HMEAB	Site interview	HMEAB Utilities Division leader	Consulting and identifying the development and operation status of the Hezhou Sludge Disposal Center, and the operation status of the Hezhou Landfill. Discussing and confirming whether the disposal center can accept the sediment dredged from He River rehabilitation component.	Hezhou Sludge Disposal Center is already built and put in operation. The treatment capacity is 100 tons/day. It can accept sludge with a moisture content of 80%. After treatment the moisture content can be reduced to 60%. The treated sludge can then be sent to landfill for disposal.	The dredged sediment from He River rehabilitation component has a moisture content of approximately 95%. It is planned to use the integrated solidification method for sediment treatment and reduce the moisture content to less than 80% (60-70%) so as to meet the acceptance requirement of Hezhou Sludge Disposal Center. After discussion among different parties, the sediment disposal plan was adjusted. The integrated solidification method can reduce the moisture content of the sediment to 50% and achieve the required moisture content（of less than 60%）of the solid waste landfill for direct landfill rather than having to be treated in the sludge disposal center. After the Project becomes operational, sludge from Jiangnan WWTP will be dewatered at the disposal center before being sent to the landfill for disposal.
2017.8.31	HHCB	Site interview	Leader of the Urban Development Management Division of HHCB	Consulting and identifying the layout of underground utilities	The Hezhou municipal pipeline survey is still being constantly updated and improved. Some of the pipelines are too old to have track record. In the construction stage, contractors should be very careful about underground pipelines.	Based on the Hezhou municipal pipeline survey results, a number of pipelines are identified in the construction area, for which the EIA report proposes the following protection measures: (1) Coordinating with relevant agencies including the HMEAB, HHURB to acquire underground pipeline survey data and basic information of the pipelines including pipeline type, alignment, buried depth, etc.; establishing a pipeline coordination team. Excavation activities involving underground pipelines should be pre-approved by the authorities, such as HMEAB, HHURB; (2) developing a construction plan and an emergency response plan based on the pipeline alignment and buried depth to avoid underground pipelines where possible; and (3) before commencement of excavation activities involving underground pipelines, reporting the construction area and construction time to relevant authorities before excavation so as to get prepared for emergency

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
						responses.
2017.9.1	HAAHB	Phone interview	Leaders in Fishery Administration Division of HAAHB	Consulting and confirming whether the project area involves fishery site or rare species, and discussing the potential impacts on the aquatic ecological system in He River	1. There are no concentrated feeding areas or spawning area in the urban section of He River. In addition, as Hezhou is located in the southern part of China, wintering area is not needed. Furthermore, there are many power stations blocking the urban section of He River, therefore there are no migratory channel in this section. 2. Dredging will cause impact on aquatic plants or animals using He River bottom as habitat. But they are not rare species, and will recover after a certain period of time.	1. In the EIA it is clarified that the project area does not involve fishery site or rare species. Dredging will have some impact on plants and animals living in He River bottom, however they are not rare species and can recover after a certain period of time. 2. The fishery department is doing proliferation at the dam for Guishi Water Reservoir Power Station to restore the aquatic culture. This can effectively help protect the aquatic environment. 3. The EIA also proposed the following measures: (1) the construction will be arranged at low-water seasons as much as possible; (2) the construction activities will be limited within minimized area and in shortest duration.
2017.9.7	Temporary de-watering site	Site visit, Questionnaires survey	Residents in the area surrounding the temporary de-watering site	Introducing the basic information and scope of the Project, disclosing information on the potential environmental impacts and associated measures for the temporary dewatering site.	The public expressed their understanding and support. The site should be located away from residential area. The construction should be conducted in autumn and winter. It is desirable to commence and complete the construction works as early as possible at one go to minimize the impact on local residents.	The Project will further improve the design and preparation work to enable early commencement. The construction activities will strictly follow the design and construction plan; pollution control measures should be well developed to avoid repetitive construction. In addition, this Report proposes the following measures for the dredging process: (1) Dredging will be arranged in low-water seasons with shortest duration to minimize disturbance to water body; (2) The dredged sediments will be dewatered into sludge cakes and then transported in enclosed vehicles to Hezhou Domestic Solid Waste Landfill for disposal; (3) Temporary dewatering site should be equipped with temporary storage and sedimentation tanks. The wastewater from dewatering process is treated in the sedimentation tank before being discharged; (4) Fencing, covering and intercepting measures will be taken for the dewatering sites and lime and deodorant will be made available for disinfection and odor removal.
2017.9.8	Hezhou Experimental Middle	Site visit, Questionnaires	Responsible persons of Hezhou	Introducing the project scope and overview,	1. The project area is limited outside the boundary wall of the school, therefore the school is not	1. This issue has been discussed with the design institute. The RoRL will be adjusted to exclude the roads.

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	School	survey	Experimental Middle School	discussing the potential impact of the Project on the school and the potential control measures.	involved. However the Project RoRL covered the main entrance roads for the school. Therefore, traffic jam will become inevitable to affect the teaching activities. 2. The Project RoRL are close to the student and faculty dormitory buildings. Therefore the construction should not be conducted during the resting time. 3. Currently sewage produced in the school is sent to its own treatment facility for treatment to the discharge standard before being discharged. The operation cost is very high. Therefore, the school anticipates that sewage can be accepted by the city sewer network.	2. The EIA proposed the following measures for the construction noises: (1) no construction activities are allowed during noon time (12:00 - 14:00) or night time (22:00 - 6:00); (2) fences or temporary sound barriers should be erected around construction sites; (3) management should be strengthened over construction intensity, machinery or vehicle operators, and codes of operation, etc. following the detailed measures described in Chapter 5. 3. The wastewater management system of Hezhou is being continuously improved. The sewage from Fanglin district will be sent to the planned Shatian Township WWTP (not under the Project).
2017.9.8	Yingshi Primary School	Site visit, Questionnaires survey	Headmaster of the Yingshi Primary School	Introducing the project scope and overview, discussing the potential impact of the Project on the school and the potential control measures.	1. A new multi-functional office building (3-storey reinforced concrete structure) and school public toilets (brick and concrete structure for both sides) are within the RoRL. The school currently has more than 500 teachers and students with limited space for teaching or offices. If these lands are occupied, it will seriously affect the school's teaching activities. 2. In order to avoid the impact of construction noise on the school's teaching activities, it is recommended that the construction should be carried out during the vacations.	The Yingshi Primary School will be relocated. Currently the local government has included in the planning a 50 mu site at the intersection of Xinyuan Road and Minle Road in the New Eco-city for the relocation of the school. The new campus is planned to complete by the end of 2018. In order not to affect the regular teaching activities, it is planned to conduct the relocation during the winter break in 2018 and then the old campus will be demolished. After the relocation the school will not be affected by the Project.
2017.9.11	Pinggui No.3 Middle	Site visit, Questionnaires	Headmaster of the Pinggui No.3 Middle	Introducing the project scope and overview,	It is suggested to adjust the red line to exclude the school so that the Project will not involve the school	1. The comments have been sent to design institute and adjustment has been made to the RoRL, which are now outside the fencing wall of the school, thus no

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	School	survey	School	discussing the potential impact of the Project on the school and the potential control measures.	campus and not affect the regular teaching activities.	school land will be involved. 2. The Project borders on the eastern fencing wall of the school. Within the wall is the sports ground. The classrooms and the dormitory buildings are relatively far from the project area, thus the project construction will have little impact on school teaching.
2017.9.11	Xiadao Primary School	Site visit, Questionnaires survey	Headmaster of Xiadao Primary School	Introducing the project scope and overview, discussing the potential impact of the Project on the school and the potential control measures.	There is a memorial museum for a special branch of CCP in the project-affected area which has special educational significance.	1. It has been confirmed with HCPPRFTB that the Babu CCP Special Branch in Xiadao Primary School is a cultural heritage site, which should be protected on its original site. The following protection measures are to be taken: (1) The project design and construction should avoid the protection area of the current Babu Special Branch Historic Site in Xiadao Primary School, and to keep the historical cultural heritage intact. (2) Before the construction commencement, the relevant authorities should be consulted to develop effective cultural relics protection plans. (3) Detailed construction plan should be developed prior to construction commencement and warning signs should be erected on site for cultural heritage protection to provide information on the nature, significance, protection area, protection measures for the historical and cultural heritage, and contact person and contact information for the management entity. (4) Construction activity should not be allowed within the cultural heritage protection area. Use of excavator or piling machines is prohibited and manpower excavation should be used instead to minimize vibration impact on the cultural heritage. (5) Training should be provided for construction workers to enhance their awareness of cultural heritage protection so that the cultural heritage can be avoided in construction activities and artificial damage to the cultural heritage can be prevented. 2. The EIA proposed the following measures for the construction noises: (1) no construction activities are allowed during noon time (12:00 - 14:00) or night time (22:00 - 6:00); (2) Fences and temporary sound barriers should be erected around the construction

Table 10-2 Summary of comments and feedbacks for the first round of public consultation

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
						sites when necessary; (3) Strict requirements should be proposed on management of construction intensity, machinery or vehicle operators, and codes of operation, etc. See Chapter 5 of the report for details regarding such measures.
2017.9.11	Pinggui District CNRTB	Site interview	Director of Pinggui District CNRTB, Cultural, Director of CHMI	Consulting and confirming whether the CCP Special Branch Memorial Hall in Xiadao Primary School is an object of preservation as physical cultural resources, and the level of protection and requirements	The Babu Special Branch of CCP in Xiadao Primary School has not submitted the declaration for object of preservation as physical cultural resources. Whether it will be treated as an object of preservation as physical cultural resources needs to be further confirmed with the municipal bureau because it has a long history.	After confirmation with the HCPPRFTB, it is concluded that the Babu Special Branch of CCP in Xiadao Primary School is a cultural heritage site. The detailed protection measures can be referred to the above.
2017.9.12	Hezhou Museum	Site visit, Questionnaires survey	Museum curator	Consulting and confirming whether the CCP Special Branch Memorial Hall in Xiadao Primary School is an object of preservation as physical cultural resources, and the level of protection and requirements.	This place was registered and became a provincial object of preservation as physical cultural resources in Guangxi in 1989. It is suggested to conduct in-situ protection and convert the surrounding area to a cultural park. In addition there are some historic sites in Diandengzhai Village. If these sites are involved in-situ protection should be conducted.	The comments have been sent to the design institute. The dike protection plan has been adjusted from T-shaped revetment to vertical retaining wall to reduce the construction affected area so that the cultural heritage can be avoided and the in-situ protection can be conducted. The detailed protection measures for this site are included in the ECOP for management of physical cultural resources. Based on the site investigation, the historic sites in the Diandengzhai Village are not involved in the Project.

CCP: Chinese Communist Party; CPPRFTB: Cultural, Press, Publication and Radio, Film & TV Bureau; CHMI: Cultural Heritage Management Institute; HAB: Hezhou Municipal Agricultural Bureau; HAAHB: Municipal Aquatic & Animal Husbandry Bureau; HCPPRFTB: Hezhou Municipal Cultural, News and Radio & TV Bureau; HDRC: Hezhou Municipal Development and Reform Commission; HMEAB: Hezhou Municipal Engineering Administration Bureau; HFoB: Hezhou Municipal Forestry Bureau; HFB: Hezhou Financial Bureau; HHCB: Hezhou Municipal Housing and Construction Bureau; HLRB: Hezhou Municipal Land Resource Bureau; HPB: Hezhou Municipal Planning Bureau; HWRB: Hezhou Municipal Water Resource Bureau; HEPB: Hezhou Municipal Environmental Protection Bureau; HTPD: Hezhou Municipal Traffic Police Department.

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
2017.9.13	Changlong Village, Anshan Village, Yingshi Village, and Lining Village.	Site visit, Questionnaires survey	Village committee and villagers from Changlong Village, Anshan Village, Yingshi Village, and Lining Village.	Public consultation for key contents and conclusions for the draft EIA to seek public understanding and support for the Project and the mitigation measures proposed	The public support the Project and approve the proposed environmental protection measures.	The Project will strictly follow the ESMP to implement relevant environmental protection measures.
2017.9.13	Residents along Diandengzhai, Huangansi Temple, Shizigang, Xialiang	Site visit, Questionnaires survey	Villagers from Diandengzhai Village, residents along Huangansi Temple and Shizigang, village committee and villagers	Public consultation for key contents and conclusions for the draft EIA to seek public understanding and support for the Project and the mitigation measures	1. The public support the Project and approve the proposed environmental protection measures. 2. The public It is suggested that the construction to be commenced and completed as soon as	The Project will strictly follow the ESMP to implement relevant environmental protection measures. Initiate the project construction as soon as possible, and strictly follow the design requirements and the construction plan. Implement the pollution control measures accordingly and try to complete by one take. Complete the construction as soon as possible so that the facilities can be

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	Village		from Xialiang Village, and Babu District Chengdong Street Office	proposed	possible.	put in operation early.
2017.9.14	Meiyi Village and Gubai Village	Site visit, Questionnaires survey	Village committee and villagers from Meiyi Village and Gubai Village	Public consultation for key contents and conclusions for the draft EIA to seek public understanding and support for the Project and the mitigation measures proposed	The public support the Project and approve the proposed environmental protection measures.	The Project will strictly follow the ESMP to implement relevant environmental protection measures.
2017.9.14	Sanjia Village, Mintian Village, Xialiang Village, and	Site visit, Questionnaires survey	Village committee and villagers from Sanjia Village, Mintian Village,	Public consultation for key contents and conclusions for the draft EIA to seek public understanding	1. The public support the Project and approve the proposed environmental protection measures.	1. The Project will strictly follow the ESMP to implement relevant environmental protection measures. 2. The area where the Laozenwu in Xialiang Village and Laoxuewu in Fanglin Village are in involves He River section

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	Fanglin Village		Xialiang Village, and Fanglin Village	and support for the Project and the mitigation measures proposed	2. Representatives from Laozenwu in Xialiang Village and Laoxuewu in Fanglin Village raised an issue. Because of the demolishing of the Babu Bridge water gate, the water level will decrease and the groundwater level and the drinking water in the area will be affected. They hope their drinking water supply can be improved by installing water supply pipeline and connecting tap water to the villages.	from Fanglin Hydropower Station to Xiadao Power Station. For the Xiadao Power Station, the project design is limited to the upgrade of the building surface, thus it will not affect the upstream water level. Therefore the Project will not affect the groundwater level in the area where the representatives are living in. the water supply pipelines will be installed gradually as the urban area develops.
2017.9.15	Xiwan Street Office, Xiwan	Site visit, Questionnaires	Xiwan Street Office, Village committee and villagers	Public consultation for key contents and conclusions for	1. The public support the Project and accept the proposed	1. The Project will strictly follow the ESMP to implement relevant environmental protection measures. 2. The Xiwanzhai area is within the

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
	Village, Gonghe Village and Gongqiao Village	survey	from Xiwan Village, Gonghe Village and Gongqiao Village	the draft EIA to seek public understanding and support for the Project and the mitigation measures proposed	environmental protection measures. 2. The residents in Gonghe Village Xiwanzhai area hope that their sewer can be accepted in the city sewer system.	service area of the Pinggui District WWTP which has already been constructed and put into operation. The sewer network for the area is gradually being constructed.
2017.9.14	/	Questionnaires survey	HHCB	Soliciting comments on the potential impact on underground pipelines and mitigation measures to be taken	1. The representatives are supportive to the Project and consider the Project very important and necessary. 2. Accepting the environmental protection measures to be taken. 3. It is suggested that the project owners and constrictors should	The Project will strictly follow the ESMP to implement relevant environmental protection measures.

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					prepare relevant emergency plans.	
2017.9.14	/	Questionnaires survey	HTB	Soliciting comments on the potential impact on traffic and mitigation measures to be taken	1. Fully supportive to the Project; 2. Accepting the environmental protection measures to be taken; 3. Further assessment should be conducted on flood carrying capacity of small-scaled Hydropower stations and on the dimensions of the navigation channel, reserve ship passage facilities to ensure safe bridge operation; 4. It is suggested that comments should	1. The Project will strictly follow the ESMP to implement relevant environmental protection measures. 2. The design institute provide supplement assessment to clarify that the Project will not change the overall structure of the Xiadao Power Station, thus the ship passage facility will not be involved. In addition, the water level of He River will remain largely unchanged, thus no impact on navigational environment will be caused. 3. During the project design, many coordination have been conducted with the management committee of the new eco-city and reached agreement. 4. Tried to solicit comments from the railway authorities, however no response have been received.

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					be solicited from the Eco-city management committee on the implementation He River Embankment component. 5. It is suggested that the IAs should conduct further assessment on flood carrying capacity and navigation channel dimensions of the bridge for safety assurance; 6. He River rehabilitation might cause safety issue for Gui-Guang Express Railway. Therefore, it is suggested that comments be solicited from the municipal railway	

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					authority.	
2017.9.15	/	Questionnaires survey	HCPPRFTB	Soliciting comments on the potential impact on the Historic cultural street (Xiyue Street) and mitigation measures to be taken	1. The representatives all support the Project and consider the Project very important and necessary. 2. Accepting the environmental protection measures to be taken. 3. Suggesting to add "the protection of the historic buildings in Xiyue Street (historic cultural street) should follow relevant requirements on cultural heritage protection" in the proposed protection measures.	The Project will strictly follow the ESMP to implement relevant environmental protection measures. In addition to original proposed protection measures, add a new measure: "the protection of the historic buildings in Xiyue Street (historic cultural street) should follow relevant cultural heritage protection requirement."
2017.9	/	Comme	HEPB	Soliciting	1. It is suggested	1. The Report is further improved based

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
.14		nts soliciting		comments on the Chapter of Accumulative Impact Analysis.	that the Project should be further coordinated with relevant documents such as the Hezhou He River Urban Section Integrated Rehabilitation Implementation Plan. 2. For technical issues such as the project impact and measures to be taken, refer to WB environmental specialist's comments as final decision.	on Hezhou He River Urban Section Integrated Rehabilitation Implementation Plan. 2. The Report is further improved based on WB environmental specialist's comments.
2017.9.18	/	Comments soliciting	HMEAB	Soliciting comments on the Chapter of Accumulative Impact Analysis.	No further comments	/
2017.9	/	Comme	HWRB	Soliciting	Suggesting to change	Accepted

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
.18		nts solicitin g		comments on the Chapter of Accumulative Impact Analysis.	the responsible entity to HMEAB and HWRB	
2017.9 .19	/	Questio nnaires survey	HMEAB	Soliciting comments on the project impact from dredging, or on the underground utility pipelines, famous and historic trees, and mitigation measures to be taken	1. Fully supportive to the Project 2. Accepting the environmental protection measures to be taken. 3. Suggesting to request relevant underground pipelines data from HHURDB. Establishing a pipeline coordination team and designate special liaison person. Developing a construction plan based on actual	1. The underground utilities pipelines documents have been collected. 2. The following measures will be taken when underground utilities pipelines are involved: (1) Coordinate with relevant agencies including the municipal engineering administration departments and housing and urban-rural development authority to acquire underground pipeline survey material, understand the basic information including pipeline type, alignment, buried depth, etc., establish coordination team for pipeline. Excavation activities involving underground pipelines should be pre-approved by the authorities, such as the municipal engineering administration departments and the housing and urban-rural development authority; (2) develop construction plan

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					pipeline conditions. When the excavation involves existing pipelines, informing relevant property owners to supervise and prepare emergency plans. For excavation in municipal roads, relevant approval documents should be prepared at relevant authorities. 4. The protection measures for historic famous trees should be strictly implemented.	and emergency plan based on the pipeline alignment and buried depth, to avoid underground pipelines as much as possible; and (3) before commencement of excavation activities involving underground pipelines, report the construction area and construction time to relevant authorities before excavation so that necessary preparation of emergency plans can be made. 3. The following measures will be taken when historic famous trees are involved: (1) minimize the construction area and shorten the construction duration; (2) prohibit cutting, moving, bark peeling, root digging, or infection of hazardous or toxic materials to the historic famous trees; (3) prohibit activities within 5 meters of horizontal distance from the crowns of historic famous trees include developing buildings or structures, laying pipelines, establishing cable lines, excavation for borrowing pit, ground inundation or sealing, fume discharging,

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
						sewage dumping, or stacking and dumping flammable, explosive, toxic or hazardous materials; (4)prohibit activities including carving, stapling, winding, hanging or leaning against and piling against; (5)prohibit running over with construction vehicles or equipment within 5 meters of horizontal distance from the crown.
2017.9.20	/	Questionnaires survey	HPB	Soliciting comments on the project impact on Xiyue Street and mitigation measures to be taken	1. Fully supportive to the Project and cooperative in relevant planning service. 2. Suggesting to coordinate with drainage and water way system planning, especially the planning under preparation, such as the sponge city planning, the downtown area style	1. The Project will strictly follow the ESMP to implement relevant environmental protection measures. 2. During the project design, relevant plans including the drainage plans and water way system plans have been taken into consideration. During the project implementation, the planning authorities will be further coordinated for further optimization of the project design based on the city master plan.

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					guideline, and the controlling plans for each district, to ensure the implementation of each plans and the Project.	
2017.9.20	HWRB	Seminars and Questionnaires survey	Owners and operators of Huangshi, Fanglin, Xiadao power stations. Representatives from traffic police department	Exploring the project impact on power stations owners and operators and mitigation measures to be taken	1. All participants are supportive for the Project. 2. Accepting the environmental protection measures to be taken. 3. The upgrades of Huangshi Power Station and Fanglin Hydropower Station will impact on the upstream irrigation of large area of farm lands. 4. The traffic police	1. The Project will strictly follow the ESMP to implement relevant environmental protection measures. 2. The EIA consultant and the water resource departments conducted survey on the farm lands affected. Irrigation in areas upstream of Huangshi Power Station will not be affected. The Fanglin Hydropower Station will have some irrigation functions. As the water gate will be removed under the Project, the back water level will fall, causing certain impact on the irrigation of farm land on the right bank in a total area of 1600 mu. The Project proposed to build a new irrigation pumping station

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
					department suggested: (1) before construction commencement, relevant preparation should be done including campaign, coordination with transportation authorities, and re-routing of bus lines, etc. (2) construction vehicles should not speed or overload. They should be sealed and cleaned regularly to mitigate environmental impacts.	to pump He River water from He River to safeguard supply of irrigation water. 3. The comments from the traffic police department have been incorporated into the ESMP.
2017.9.20	Hezhou DRC	Seminars	Representatives from HPB, HEB, HCPPRFTB,	Negotiating and confirming the plan for the Babu Special Branch	It is confirmed that the Babu Special Branch Historic Site in Xiadao Primary School is a	The following protection measures are to be taken: (1) For the current Babu Special Branch Historic Site in Xiadao Primary School, the dike protection plan

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
			HPDG, Pinggui District EPB, and Pinggui District CNRTB	Historic Site in Xiadao Primary School	cultural heritage protection unit. It is an important existing “red culture” heritage in Hezhou, and a base for promoting patriotism education and red culture-based tourism. Therefore it has high value and should have in-situ protection.	has been adjusted from T-shaped revetment to vertical retaining wall to reduce the construction affected area so that the cultural heritage can be avoided and the in-situ protection can be conducted (2) Before the construction commencement, negotiate with the relevant authorities to develop effective cultural relics protection plans. (3) Develop detailed construction plan prior to construction commencement, place warning signs on site for cultural heritage protection, in which information provided will include the nature, significance, protection area, protection measures for the heritage, and contact person and contact information for the management entity. (4) Do not allow construction activity within the cultural heritage protection area. Do not use excavator or piling machines, instead use manpower excavation to minimize the vibration impact on the cultural heritage. (5) Conduct cultural heritage protection

Table 10-3 Summary of second round of public participation and feedbacks

Time	Venue	Method	Objects	Contents	Public comments/opinions	Feedback to public comments
						awareness training for construction workers, so that they can avoid the cultural heritage in construction activities and avoid man-made damage to the cultural heritage.

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Figure 10-1: Photos taken at the seminars

Figure 10-2: Photos taken during public participation surveys

10.3.2 Public Participation Outcomes and Discussions

The 5 key issues concerned by the affected people and relevant authorities during the public participation process and the corresponding feedbacks are summarized as follows:

1st Issue: Land acquisition and resettlement, and replacement of resettled farmers losing their lands

Feedback: (1) The design will be optimized to minimize land acquisition and resettlement and thus minimize the number of resettled people in the Project; (2) the relevant national and local laws and regulations will be strictly followed to develop a reasonable compensation standard to compensate people affected in the land acquisition and resettlement; (3) for the rural labors who lose their land, aids will be provided to get employed in non-agricultural industries by means of targeted recommendation and in-person communications, etc.

2nd Issue: Expectations on early commencement and early completion of the Project and actions to avoid repetitive construction.

Feedback: Improvements will be made to the project design and preparation to enable early commencement of the construction works. The construction will strictly follow the design and construction plan and the pollution control measures. The contractors should make all efforts to complete the construction works at one go as soon as possible and avoid repetitive construction.

3rd Issue: Arrangement of sewage discharge in the surrounding area. Currently there are no complete sewage collection system in Xiwanzhai and Fanglin Villages (Hezhou Experimental Middle School). The sewage is discharged to He River after treatment in septic tanks or small-scaled treatment facilities. The performance of these small-scaled facilities is not stable and the operational cost is very high. Therefore it is suggested to improve the drainage system for these areas, so that the sewage can be collected and sent to WWTPs for treatment to avoid river pollution.

Feedback: The Xiwanzhai Village is within the service area of Pinggui District WWTP already in operation. The sewer system for the WWTP is being improved and will cover Xiwanzhai Village very soon. The sewage from Fanglin Village will be sent to the planned Pinggui District WWTP.

4th Issue: Mitigation measures for construction noise. There are four schools (Hezhou Experimental Middle School, Pinggui No.3 Middle School, Yingshi Primary School and Xiadao Primary School) in the close neighborhood of the project area. Will the teaching activities in these schools be affected?

Feedback: For Hezhou Experimental Middle School, temporary sound barrier will be established. For Yingshi Primary School, the entire school will be relocated. For Pinggui No.3 Middle School and Xiadao Primary School, the construction area will be separated by the sport grounds from the schools teaching buildings and dormitory buildings, therefore the construction activities will have no impact on regular teaching activities.

5th Issue: The protection plan for the Babu Special Branch of CCP in Xiadao Primary School.

Feedback: It is confirmed that the Babu Special Branch Historic Site in Xiadao Primary School is a cultural heritage protection unit. It is an important existing “red culture” heritage in Hezhou, and a base for promoting patriotism education and red culture-based tourism. Therefore it has high value and should have in-situ protection. It is planned to adjust the original dike protection plan from T-shaped revetment to vertical retaining wall to reduce the construction area and avoid this cultural relics site.

Public comments and suggestions are summarized in Table 10-2, which have been taken into account by the EIA consultant and feasible adjustment suggestions and pollution control measures were proposed on such a basis.

10.3.3 Statistics of Public Participation Questionnaire Survey

The targets of the survey are the residents in the affected area. Site visits were conducted and universal and representative samples were taken from the different subproject areas. Results of such survey are summarized as follows:

(1) Statistics of basic information of respondents

For the first public consultation survey a total of 170 individual questionnaires were distributed with a 100% recovery rate. 158 out of the 170 recovered questionnaires were valid, with a validity ratio of 92.9%. For the second public consultation survey a total of 180 individual questionnaires were distributed with a 100% recovery rate. 171 out of the 180 recovered questionnaires were valid, with a validity ratio of 95.0%. The survey visits and seminars are illustrated in the Figure 10-1 and Figure 10-2. The profile of the questionnaire respondents is summarized in Table 10-4.

Table 10-4 Profile of the public consultation questionnaire respondents

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">First Round</th><th colspan="2">Second Round</th></tr>
<tr><th>No. of people</th><th>Percentage (%)</th><th>No. of people</th><th>Percentage (%)</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Gender</td><td>Male</td><td>111</td><td>70.3</td><td>113</td><td>66.1</td></tr>
<tr><td>Female</td><td>47</td><td>29.7</td><td>58</td><td>33.9</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Education</td><td>College or above</td><td>48</td><td>30.4</td><td>13</td><td>7.6</td></tr>
<tr><td>Diploma</td><td>17</td><td>10.8</td><td>13</td><td>7.6</td></tr>
<tr><td>Junior diploma</td><td>6</td><td>3.8</td><td>10</td><td>5.8</td></tr>
<tr><td>Senior High School</td><td>15</td><td>9.5</td><td>26</td><td>15.2</td></tr>
</table>

Table 10-4 Profile of the public consultation questionnaire respondents

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">First Round</th><th colspan="2">Second Round</th></tr>
<tr><th>No. of people</th><th>Percentage (%)</th><th>No. of people</th><th>Percentage (%)</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Junior High School</td><td>27</td><td>17.1</td><td>64</td><td>37.4</td></tr>
<tr><td>Primary School and less</td><td>32</td><td>20.3</td><td>17</td><td>9.9</td></tr>
<tr><td rowspan="6">4</td><td rowspan="6">Age</td><td>20 or less</td><td>0</td><td>0</td><td>2</td><td>1.2</td></tr>
<tr><td>21-30</td><td>22</td><td>13.9</td><td>26</td><td>15.2</td></tr>
<tr><td>31-40</td><td>50</td><td>31.6</td><td>38</td><td>22.2</td></tr>
<tr><td>41-50</td><td>29</td><td>18.4</td><td>44</td><td>25.7</td></tr>
<tr><td>51-60</td><td>32</td><td>20.3</td><td>35</td><td>20.5</td></tr>
<tr><td>Above 60</td><td>20</td><td>12.7</td><td>24</td><td>14.0</td></tr>
<tr><td rowspan="8">5</td><td rowspan="8" colspan="2">Units or groups covered during the questionnaire survey</td><td colspan="2">HDRC</td><td colspan="2">Pinggui District Huangtian Township Lining village committee</td></tr>
<tr><td colspan="2">Hezhou Pinggui District LARO</td><td colspan="2">Huangtian Township Anshan village committee</td></tr>
<tr><td colspan="2">Hezhou Pinggui District WRB</td><td colspan="2">Pinggui District Huangtian Township Lining village committee</td></tr>
<tr><td colspan="2">Hezhou Pinggui District Huangtian Township Gonghe Village Committee</td><td colspan="2">Pinggui District Huangtian Township Yingshi Village Committee</td></tr>
<tr><td colspan="2">Hezhou Institute</td><td colspan="2">Pinggui District Huangtian Township Chonglong Village</td></tr>
<tr><td colspan="2">Hezhou Babu District Babu Street Sanjia Village Committee</td><td colspan="2">Xiadao Village Committee</td></tr>
<tr><td colspan="2">Hezhou Babu District Jiangnan Street Xialiang Village Committee</td><td colspan="2">Hezhou Babu District Chengdong Street Office</td></tr>
<tr><td colspan="2">Hezhou Babu District Babu Street Office</td><td colspan="2">Meiyi Village Committee</td></tr>
</table>

Table 10-4 Profile of the public consultation questionnaire respondents

No.	Item	First Round		Second Round	
		No. of people	Percentage (%)	No. of people	Percentage (%)
		Babu District Land acquisition and Resettlement Office		Xialiang Village Committee	
		Hezhou Babu District People's Government Office		Lingfeng Village on Chengdong Street	
		Hezhou Pinggui District Huangtian Township Lining Village Committee		Liantang Township Gubai Village Committee	
		Hezhou Pinggui District Huangtian Township Qingmian Village Committee		East district management station	
		Hezhou Babu District Liantang Township Government		Fanglin Village Committee	
		Hezhou Pinggui District Huangtian Township Changlong Village Committee		Pinggui District Xiwan Street Shangsong Village Committee	
		HLRB		Pinggui District Xiwan Street Xiwan Village Committee	
		HTB		Pinggui District Xiwan Street Office	
		Babu District LARO		Gonghe Village Committee	
		HCPPRFTB		Mintian Village Committee	
		HFoB		Hezhou Babu District Babu Street Sanjia Village Committee	
		Guidong Power Group Company		HWRB	
		Hezhou Pinggui District No.3 Junior High School		HPB	
		Hezhou Pinggui District Huangtian Township		Guangxi Zhengyou Group	

Table 10-4 Profile of the public consultation questionnaire respondents

No.	Item	First Round		Second Round	
		No. of people	Percentage (%)	No. of people	Percentage (%)
		Yingshi Primary School		Company	
		Etang Township Xiadao Primary School		Hezhou HMEAB	
		Hezhou Experimental High School			

HCPPRFTB: Hezhou Municipal Culture, Press, Publication, Radio, Film and TV Bureau; HFoB: Hezhou Municipal Forestry Bureau; HMEAB: Hezhou Municipal Engineering Administration Bureau; HLRB: Hezhou Municipal Land Resource Bureau; HPB: Hezhou Municipal Planning Bureau; HTB: Hezhou Municipal Transportation Bureau; LARO: Land Acquisition and Resettlement Office; WRB: Water Resource Bureau;

(2) Survey results analysis

The survey results are summarized in Table 10-5 and Table 10-6.

Table 10-5 Public Survey Results (Individual)

Content	Chosen answer	First round		Second round	
		No. of people	Percentage (%)	No. of people	Percentage (%)
1. Are you familiar with the Hezhou Urban Water Infrastructure and Environment Improvement Project	A. Familiar	134	84.8	132	77.2
	B. Not familiar	24	15.2	39	22.8
2. Are you satisfied with the current conditions of water environmental and urban flood control in Hezhou?	A. Satisfied	23	14.6	37	21.6
	B. Fair	70	44.3	68	39.8
	C. Not satisfied	65	41.1	66	38.6
3. What do you think are the impacts that the Project will bring upon you?	A. Environmental impact	19	12.0	31	18.1
	B. Job (income)	8	5.1	9	5.3

Table 10-5 Public Survey Results (Individual)

Content	Chosen answer	First round		Second round	
		No. of people	Percentage (%)	No. of people	Percentage (%)
	C. Residential land (farm land) being occupied	31	19.6	40	23.4
	D. Other	8	5.1	6	3.5
	E. No impacts	99	62.7	91	53.2
4. What do you think is the biggest impact on environment in the project implementation?	A. Air pollution	18	11.4	26	15.2
	B. Water pollution	36	22.8	54	31.6
	C. Noise	27	17.1	55	32.2
	D. Solid Waste	26	16.5	23	13.5
	E. No impacts	68	43.0	23	13.5
5. Which of these areas do you think should be strengthened in terms of environmental pollution control (multiple choices).	A. Air pollution	36	22.8	45	26.3
	B. Water pollution	85	53.8	85	49.7
	C. Solid Waste	51	32.3	50	29.2
	D. Noise	35	22.2	48	28.1
	E. Ecological protection	76	48.1	51	29.8
6. How will the Project affect your daily work and life after completion?	A. Positive	93	58.9	109	63.7
	B. Negative	2	1.3	13	7.6
	C. Negative but acceptable	9	5.7	18	10.5
	D. No impact	52	32.9	30	17.5
7. What kind of impact do you think the Project will have	A. Very positive	125	79.1	121	70.8
	B. Fair	22	13.9	43	25.1

Table 10-5 Public Survey Results (Individual)

Content	Chosen answer	First round		Second round	
		No. of people	Percentage (%)	No. of people	Percentage (%)
on the coordinated economic and social development?	C. Negative	1	0.6	2	1.2
	D. No impact	5	3.2	4	2.3
8. Based on above, what is your attitude towards the Project?	A. Support	158	100	171	100
	B. Oppose	0	0	0	0

Table 10-6 Public Survey Results (Group)

SN	Content	Chosen answer	First round		Second round	
			Person	%	Person	%
1	Before this survey, have you received any information about the Project and what is the source?	A. News	1	4.2	3	13
		B. Government meetings	20	83.3	19	82.6
		C. Construction unit	0	0	2	8.7
		D. Public discussion	1	4.2	0	0
		E. Other means	4	16.7	3	13.0
		F. Do not know	0	0	0	0
2	In your opinion how are the current conditions on water environmental and urban flood control in Hezhou?	A. Very good	2	8.3	4	17.4
		B. Fairly good	5	20.8	7	30.4
		C. Fair	7	29.2	10	43.5
		D. Poor	5	20.8	2	8.7
		E. Very poor	5	0	0	0
3	What do you think is the biggest impact on environment in the project implementation?	A. Air pollution	2	8.3	2	8.7
		B. Water pollution	5	20.8	13	56.5
		C. Noise	11	45.8	8	34.8
		D. Solid Waste	6	25.0	3	13.0
		E. No impacts	5	20.8	3	13.0
4	In your opinion which of these areas should be strengthened in	A. Air pollution	8	33.3	6	26.1
		B. Water pollution	15	62.5	12	52.2
		C. Solid Waste	11	45.8	7	30.4

Table 10-6 Public Survey Results (Group)

SN	Content	Chosen answer	First round		Second round	
			Person	%	Person	%
	terms of environmental pollution control (multiple choices).	D. Noise	11	45.8	7	30.4
		E. Ecological protection	18	75.0	13	56.5
5	Do you think the Project will have positive effect on the coordinated economic and social development?	A. Positive	24	100	23	100
		B. Negative	0	0	0	0
6	What do you think is the impact of the Project on your organization?	A. Positive	12	50.0	15	65.2
		B. Negative	2	8.3	1	4.3
		C. No impacts	6	25.0	6	26.1
		D. Negative but acceptable	3	12.5	1	4.3
7	Considering the local economic development and environmental protection, what is your attitude towards the Project?	A. Supportive	24	100	23	100
		B. Not supportive	0	0	0	0

According to the statistical results, 100% of the residents surveyed favored the Project. The public are very supportive to the project implementation.

10.4 Information Disclosure

According to requirements in the Interim Measures for Public Participation in Environmental Impact Assessment, the Environmental Information Disclosure Measures (Trial) and the World Bank OP / BP4.01 (Environmental Assessment), BP 17.50 (Information Disclosure), the Project disclosed relevant information by means of online disclosure and field posters, and distributed the EIA report and ESMP report at places with easy public access, including the PMO office, the municipal EPB, the EIA consultant, and offices of village committees.

The preparation progress of EIA and ESMP and the information disclosure status are summarized in Table 10-7.

Table 10-7 Time, Location and Methods of Information Disclosure

Round	Time	Method	Location	Title and content of disclosed information
First Round	April 2016	Online disclosure	Official website for HEPB: http://hezhou.gxepb.gov.cn/xxgk/ztfl/xzsp/gsgg/201604/t20160420_10202723.html, and official website for HDRC	1. Title of the document: First round information disclosure for the EIA for Hezhou Urban Water Infrastructure and Environment Improvement Project. 2. Content: (1) Project overview; (2) EIA procedure and content; (3) Channels and deadlines for public access to the ESIA report; (4) Deadlines for public comments; (5) Contact information, including mailing address, postal code, phone number, fax number, contact person and email address etc. for the construction unit and the EIA consultant.
	February 2017	Poster	Bulletin boards for Babu District Government, Pinggui District Government, Huangtian Township Government, and village committees or street offices for Shangsong Village, Xiwan Village, Xiwan Street, Mintian Village, Fanglin Village, Gonghe Village, Lining Village, Changlong Village, Yingshi Village, Huangtian Village, Anshan Village, Sanjia Village, Gubai Village, Xiadao Village, Xialiang Village, Lingfeng Village, Chengdong Street, Babu Street and Jiangnan Street.	
	June 2017	Online disclosure	Official website for HEPB: http://www.hzsepb.gov.cn/xxgk/jgfl/hpk/201706/t20170628_33576.html	
Second Round	October 9, 2017	Online disclosure	Official website for HEPB and official website for HDRC	1. Title of the document: First round information disclosure for the EIA for Hezhou Urban

Table 10-7 Time, Location and Methods of Information Disclosure

Round	Time	Method	Location	Title and content of disclosed information
	October 9, 2017	Poster	Bulletin boards for Babu District Government, Pinggui District Government, Huangtian Township Government, and village committees or street offices for Shangsong Village, Xiwan Village, Xiwan Street, Mintian Village, Fanglin Village, Gonghe Village, Lining Village, Changlong Village, Yingshi Village, Huangtian Village, Anshan Village, Sanjia Village, Gubai Village, Xiadao Village, Xialiang Village, Lingfeng Village, Chengdong Street, Babu Street and Jiangnan Street.	Water Infrastructure and Environment Improvement Project. 2. Content: (1) Project background; (2) Potential environmental impacts; (3) Measure for avoiding or mitigating the impacts; (4) Main conclusions of EIA; (5) Channels and deadlines for public access to the ESIA report; (6) Scope and items for public consultation; (7) methods for public comments; (8) Contact information; and (9) the full reports of the EIA and ESMP.

Photos of First Round Online Disclosure

Photos of First Round Field Posters

Photos of 2nd Round Online Disclosure

Photos of 2nd Round Field Posters

10.5 Public Participation for Social Impact Assessment

10.5.1 Public participation and community consultation activities

Since March 2016, a series of public participation and community consultation activities (see Table 10-8) have been carried out for the preparation of the Resettlement Plan by the consultants and the World Bank experts. These include:

(1) In March 2016, the World Bank dispatched its first Pre-Identification Mission to conduct its preliminary project identification. The Mission also provided guidance for the social safeguard related works and provided detailed requirements. During the land acquisition and resettlement survey conducted between March 2016 and April 2017, representatives from agencies of different levels in charge of land acquisition and resettlement, and representatives from villages and shops all participated in the survey. During the survey, the female representatives were all present and examined closely the indicators for final survey results.

(2) During the periods from April 16 to April 26 in 2016, July 21 to July 27 in 2016, August 10 to August 20 in 2016, January 20 to January 24 in 2017, February 20 February 23 in 2017, March 2017, March 17 to March 21 in 2017, April 24 to April 29 in 2017, the consultants, PMO, IAs, and the Resettlement Office organized a number of meetings among representatives from different agencies and the affected people. These agencies include the land resource bureaus, planning bureaus, and housing and urban-rural development bureaus for Babu District and Pinggui District. At these meetings, information was disclosed on the existing policies on land acquisition and resettlement compensation standards at national, regional or municipal levels, and the World Bank policy document (OP/BP4.12). From the participants, comments have been solicited on mitigating project impacts, confirming compensation standards, and resettlement and livelihood restoration plans etc. Based on these comments, the design institute has adjusted the project design several times to minimize the impact of resettlement. Through extensive consultation, it is all agreed that the loss on the affected people’s side will be compensated with cash compensation or physical placement following relevant national laws and regulations.

(3) During the preparation of the Resettlement Plan from March 2016 to June 2017, the resettlement consultants, PMO, IAs, design institute and other relevant agencies visited various villages and villagers, held meetings with participating village leaders and villagers' representatives, interviewed representatives of participating units and shops, to solicit their opinions on land acquisition, resettlement policies and standards, resettlement plans and restoration methods. The meeting and surveys have been helpful to the resettlement issues, compensation policies, compensation eligibilities, and restoration plans. Other topics of discussion include the siting of office buildings for resettled units, self-owned buildings or concentrated compounds for resettled farmers.

(4) In order to raise the project awareness, PMO, IAs, and the Resettlement consultant conducted a questionnaire survey on the affected communities and affected people during the period from March 2016 to April 2017. The survey covered all affected villages and tenants, as well as units and shops. Therefore the sampling is representative, structurally reliable, and can truly reflect the wishes of the affected people.

(5) Seminars on environmental and resettlement were held between November 2016 and February 2017.

The consultation concluded that the affected people do not want further adjustment on land related issues. For the loss of income due to loss of land, the affected people demanded for cash compensation and provision of employment opportunities, required the government to solve the permanent homestead issue as soon as possible and build the foundation with full cash compensation in place. Compared with the house demolition, the affected people cared less about land acquisition. This is because the project area is along He Rivers and main channels. The lands to be acquired are basically those lands that can be useful only when inundation is not a problem. And because these affected people are near the city, they are not willing to be working on agricultural or salt production. Therefore they hope that the Project can bring about economic transformation and new employment opportunities, and that they can get the homestead for house building, or get fully compensated in cash. All the questionnaire respondents expressed their wishes to use the compensation to rebuild the house, and most of them also want to use the compensation to start some business, or master some skills through training, or even be employed in big enterprises, instead of going back to land farming business. They want to use the cash compensation for their land loss to restore their livelihoods and income, such as: 1) the purchase of social insurance; 2) self-owned business in the tertiary industry, i.e. clothing stores, grocery stores, transport, freight, community services, repair shop, hairdressing, salon, dry cleaners, entertainment, catering and hotel services, and tourism service, etc.; 3) investment in their children's education. They hope that through training they can find jobs in other institutions, business units and business organizations. Affected people are satisfied with the compensation arrangement and the resettlement measures. However, they also expressed their concern about fair and timely payment of compensation.

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
Morning of March 24, 2016	Conference room at HDRC	Explain the importance of the Project. Campaign and mobilization	PMO	Representatives from PMO, District Governments, Street Offices, Village committees, and Resettlement Consultant	60	15	Conduct front end campaign
March 25, 2016	Conference room at HDRC	Discuss the resettlement impact within the scope of project design RoRL.	Project owner and resettlement consultant	Representatives from PMO, Project owners, design institutes, Municipal Planning Bureau, Municipal Housing and Construction Bureau, Offices of Land Acquisition and Resettlement for Babu District and Pinggui District, and Resettlement Consultant	20	0	Sort out and discuss issues on reducing land acquisition and resettlement in the project-affected area
April 13, 2016	Conference room at HDRC	Understand the project awareness of District Governments, Village Committees and villagers within the preliminarily determined affected area.	District LAROs	Representatives from PMO, District Governments, Street Offices, Village committees, villagers representatives and Resettlement Consultant	56	12	Further understand the attitude of affected people to the Project
April 14 – 18, 2016	Village committee of	Resettlement social economic survey,	Resettlement consultant	Related village committee and affected people, and	210	60	Clarify the social economic

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
	affected villages, and affected units	project-affected area and attachment survey		Resettlement Consultant			conditions in the project area and impacts from the Project
April 28, 2016	Conference room at HDRC	Understanding WB Social Safeguard policies	PMO	PMO consultant, representatives from project owners, District Governments, Street Offices, Village committees, and Resettlement Consultant	52	15	The implementation parties understand relevant WB social safeguard policies.
April 29 to May 8, 2016	15 affected villages and affected units.	Soliciting resettlement opinions	Resettlement Consultant	Relevant township governments, street offices, village committees, affected people and Resettlement Consultant	13	6	Negotiate on land acquisition compensation methods and standards.
Morning of July 22, 2016	Mintian Village Committee, village and project site	Conduct willingness survey on land acquisition and resettlement related issues with the representatives from Mintian Village Committee and village groups.	Mintian Village Committee	Representatives of Mintian Village committee and village groups, villagers and Resettlement Consultant	30	6	Follow recent compensation policies. During project implementation, reduce excavation. Restore road surface promptly after surface breaking.
Afternoon of July 22, 2016	Fanglin Village Committee, village and	Conduct willingness survey on land acquisition and resettlement related	Fanglin Village Committee	Representatives of Fanglin Village committee and village groups, villagers and	23	6	Try best to solve the sewer problems and the tap water pipeline problems

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
	project site	issues with the representatives from Fanglin Village Committee and village groups.		Resettlement Consultant			for the village
Morning of July 23, 2016	Gonghe Village Committee, village and project site	Conduct willingness survey on land acquisition and resettlement related issues with the representatives from Gonghe Village Committee and village groups.	Gonghe Village Committee	Representatives of Gonghe Village committee and village groups, villagers and Resettlement Consultant	29	13	The compensation standards should be publicly disclosed. The compensation should be directly paid to individual account.
Morning of July 25, 2016	Sanjia Village Committee, village and project site	Conduct willingness survey on land acquisition and resettlement related issues with the representatives from Sanjia Village Committee and village groups.	Sanjia Village Committee	Representatives of Sanjia Village committee and village groups, villagers and Resettlement Consultant	32	5	The compensation will be used to improve the housing conditions. It is hoped that the house building approval process can be simplified.
Morning of July 26, 2016	Huangtian Village Committee and village	Interview with Huangtian Village Committee	Huangtian Village Committee	Huangtian Village Committee and Resettlement Consultant	22	6	Follow recent compensation policies; make payment in a timely manner; Make no unattainable promises..

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
Afternoon of July 26, 2016	Xiwan Village Committee and village	Visit Xiwan Village Committee	Xiwan Village Committee	Xiwan Village Committee and Resettlement Consultant	28	8	Follow recent compensation policies; make payment in a timely manner; Make no unattainable promises..
Morning of July 27, 2016	Shangsong Village Committee and Lining Village Committee	Interview with Fanglin and Sanjia Village Committee	Fanglin and Sanjia Village Committee	Fanglin and Sanjia Village Committee, and Resettlement Consultant	10	4	Follow recent compensation policies; make payment in a timely manner; Make no unattainable promises..
Morning of January 22, 2017	Conference room at HDRC	Seminar with affected village committee representative due to design changes	PMO and Resettlement Consultant	Affected village committee, villagers and Resettlement Consultant	45	15	Communication on project scope change. The changes are believed as beneficial to environmental improvement and thus supported.
January 23, 2017	Xialiang Village	Focus group discussion about	PMO and Resettlement	Representatives from street offices, project owners and	21	6	The houses to be demolished are

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
	Committee	resettlement hospital	Consultant	affected people			urban residential buildings, should follow urban residents resettlement policies to settle the affected people.
January 24, 2017	HAB office	Focus group discussion on shops and resettlement hospital	Resettlement Consultant	Representatives from HAB, HWRB and shops along the Yinhe Street	25	10	Shops are transitional housing that emerged under special historical conditions. It has no property rights but only tenure rights. People all know that they need to move when the government wants us to move, but they should be compensated following the most recent policy and standards.
Morning of February 23, 2017	Conference room at Babu District Government	Consultation on women's rights	HWU and Resettlement Consultant	2-3 women representatives from affected villages in Babu District		27	Women are also entitled to be informed the resettlement arrangement and have equal rights in

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
							terms of compensation money.
Morning of February 23, 2017	Conference room at Pinggui District Government	Consultation on women's rights	HWU and Resettlement Consultant	2-3 women representatives from affected villages in Pinggui District		26	Women are also entitled to be informed the resettlement arrangement and have equal rights in terms of compensation money.
March 18, 2017	Conference room at HDRC	project-affected area and attachment survey feedback meeting	Resettlement Consultant	Representatives from PMO, Project owners, LAROs of Babu District and Pinggui District, 9 affected township (including Huangtian, Shatian, Babu Street, etc.) and major affected villages	46	18	Fully understand affected people's attitude towards the Project. Develop an information communication and feedback mechanism. Let affected people fully understand their rights.
Morning of April 25, 2017	Conference room at Municipal Government Education Center	Coordination between resettlement implementation organization and relevant agencies.	World Bank Senior Social Safeguard Specialist	PMO, Project owner, Resettlement Consultant, HLRB, HHCB, HPB, District LAROs, District Government leaders and township government leaders.	22	6	Relevant agencies expressed their support to the Project. Clarified their responsibilities in the resettlement process and

Table 10-8 Record of public participation process of affected people

Time	Venue	Agenda (topics)	Organizer	Participants	No. of participants	No. of female participants	Results of negotiation
							relevant agencies should prepare emergency plan for potential issues.
Morning, Sept. 5, 2017	DRC Conference Room	Discussing about ownership of flood plains on river banks; training on national river management law; negotiating about resettlement compensation plan.	Resettlement consultant team	PMO, LRB, DI, Resettlement consultant team. Urban district government leader, relevant village committees, villager representatives	35	9	Understanding lawsand regulations, supporting project construction, willing to abide by laws and regulations, hoping to get paid of the young crop compensation according to the standard

HAB: Hezhou Municipal Agricultural Bureau; HDRC: Hezhou Municipal Development and Reform Commission; HHCB: Hezhou Municipal Housing and Construction Bureau; HLRB: Hezhou Municipal Land Resource Bureau; HPB: Hezhou Municipal Planning Bureau; HWU: Hezhou Municipal Woman's Union: HWRB: Hezhou Municipal Water Resource Bureau; LARO: Land Acquisition and Resettlement Offices; PMO: Project Management Office.

10.5.2 Public participation plan during project implementation

In order to properly and promptly address the difficulties and needs of the affected people on land acquisition and resettlement, public consultation will continue after the commencement of the project implementation and before the implementation of Resettlement Plan, so that all problems can be resolved. The implementation unit shall arrange the meeting properly on the issue of land acquisition and resettlement. Each AF will have the opportunity to negotiate a compensation contract with the Office of Land Acquisition and Resettlement. The public consultation plans and processes are summarized in Table 10-9.

Table 10-9 Public Consultation Plan and Process for Land Acquisition and Resettlement

Purpose	Form	Time	Implementation unit	Target participants	Notes
1. Introducing the Project and Resettlement Plan to affected people for their opinions	Village representative conference and Unit staff representative conference	December 2017 to February 2018	PMO, EA, IAs, design institute, District Governments, Village Committees and units.	All affected people involved in LAR of the Project	The meetings will be held in each affected village and unit.
2. Disclosing the resettlement information brochure	Public village committee and enterprise meeting, and discussion among concerned group	November 2017	PMO, EA, IAs, District Governments, Village Committees, units, HLRB and HLARO	All affected people involved in LAR of the Project	Disclosing resettlement information brochure, discussing concerned issues and suggestions on resettlement
3. Submitting the final draft of Resettlement Plan to affected people	Public and community meeting, unit meeting, focus group discussion	September 2017	PMO, EA, IAs, District Governments, Village Committees, enterprises	All affected people involved in LAR of the Project	Disclosing the final draft of Resettlement Plan to affected people and discussing relevant questions, accepting comments and suggestions from different parties
4. Conducting detailed survey	Site survey and family interview	January 2018 to May 2018	PMO, IAs, District Governments, Village Committees, units, HLRB, District LAROs	All affected people involved in LAR of the Project	Conducting full-range survey for land acquisition and property indicator, and collection social economic data
5. Advising the affected people of rights and	Public meeting	March 2018 to July 2018	PMO, IAs, District Governments, Village	All affected people and beneficiaries	Holding AF and staff meetings to cover

Table 10-9 Public Consultation Plan and Process for Land Acquisition and Resettlement

Purpose	Form	Time	Implementation unit	Target participants	Notes
payment deadlines			Committees, units	involved in LAR of the Project	compensations and rights
6. Disclosing details of Resettlement Plan to affected people before being approved by WB	Public and community meeting, unit meeting, focus group discussion	November 2017	PMO, IAs, and LAROs	All involved parties, beneficiaries and affected people of the Project	Meeting with beneficiaries and affected people
7. Monitoring the affected people and beneficiaries	Family interview	January 2018 to December 2022	PMO, IAs, District Governments, Township Governments, Village Committees, units, HLARO, independent monitoring agency	Random sampling	Providing Resettlement Plan and Implementation Monitoring Plan

LARO: Land Acquisition and Resettlement Office; HLRB: Hezhou Municipal Land Resource Bureau

In order to successfully implement the Resettlement Plan, the affected people will be encouraged to participate actively in various LAR activities. The Project will have certain impacts on the local residents. To ensure that the affected people can benefit from the Project, the local residents and workers are encouraged to actively participate in the project construction. It is necessary to consider local residents and workers in terms of employment of labor force and provide them with the necessary assistance.

11. Environmental & Social Management Plan

11.1 Environment and Social Management System

Hezhou Municipal Environmental Protection Bureau is responsible for the review and approval of the various subprojects of the Project according to the administrative authority stipulated in the Law of the People's Republic of China on Environmental Protection and the Regulations on Environmental Protection Management of Construction Projects. As the environment management agency of the Project, Hezhou Municipal Environmental Protection Bureau is mainly responsible for proposing environmental protection requirements based on the contents of the EIA Report of the Project, coordinating the environment management work of the various departments and organizing the "three-simultaneousness" acceptance of the environmental protection facilities. The World Bank Loan Project Management Office is responsible for managing the implementation of the entire Project while the Project Owner is responsible for implementing the various specific activities under the general administration framework of the Project as well as the leadership of Hezhou Municipal Government. In order to assure smooth implementation of the environment management activities of the Project, a number of full-time or part-time environment management personnel are assigned in the PMO, the Project Owner, the Contractor and the Operator to implement the Environmental & social management plan.

11.1.1 Environment Management Agency

As the environment management activities of the Project in the construction stage are significantly different from those in the operation stage and such activities are either short-term or long-term in terms of their deadlines, the Contractor and the Operator should set up separate organizations to take the responsibility for different stages. As the construction stage ends, the management organization of the construction stage will be cancelled while that of the operation stage will start to operate, with a certain overlapping period allowed based on the progress of the specific management activities.

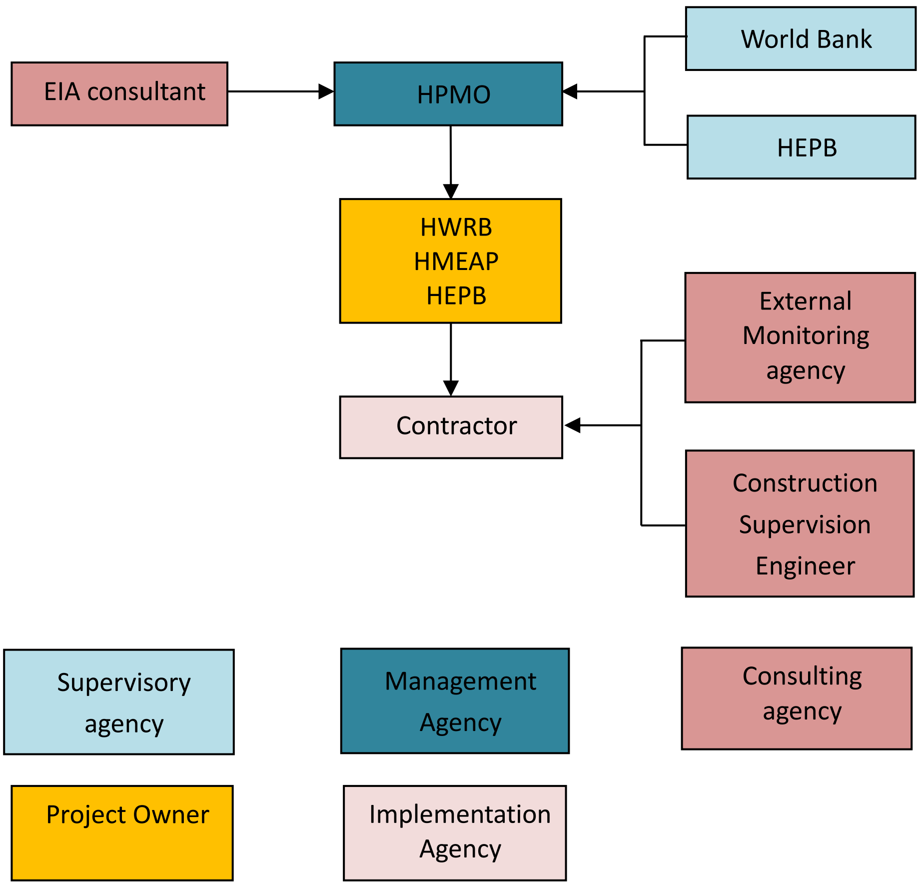

Figure 11-1: Schematic Diagram of the Environment Management Agencies in the Construction Stage of the Project

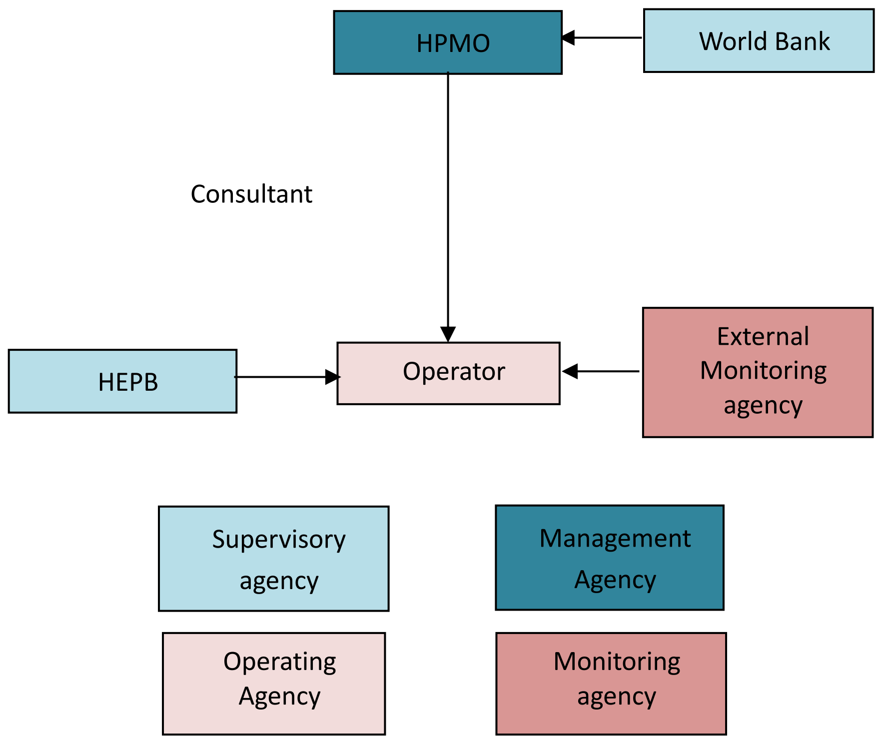

Figure 11-2: Schematic Diagram of Environment Management Agencies in the Operation Stage of the Project

11.1.2 Responsibilities and Contents of Environment Management

The contents of environment management in the construction stage are remarkably different from those in the operation stage of the Project and the ESMP is implemented by different responsible departments. Table 11-1 shows the contents and staffing of each environment management agency for environment management work in different stages.

Table 11-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Contents of Environment Management	Staffing
Design and preparation	PMO	Contacting and coordinating with the competent government department of environment management for implementation of the environment management matters;	2
	Project Owner	1. Responsible for a series of environmental protection management work in the design and preparation stage of the Project; 2. Securing the fund needed for the environmental protection work; 3. Responsible for coordinating with the competent government department of environment management for implementation of the environment management matters; 4. Recruiting supervision engineer and collecting records.	3
	Designer	1. Incorporating the environmental protection measures into the design program and budget; 2. Incorporating the ESMP mitigation measures into the technical specifications of the bidding documents.	3
	EIA consultant	1. Providing technical support to the environmental protection work included in the project design; 2. Preparing the EIA documents of the Project; 3. Development ESMP.	5
	Municipal EPB	1. Responsible for review and approval of EIA Report of the Project; 2. Providing guidance to the urban and county EPBs on proper implementation of the routine environment supervision and management work of the Project.	2
Construction stage	Project Owner	1. Responsible for a series of environmental protection management work in the construction stage of the Project and securing the fund needed for the environmental protection work; 2. Managing and supervising the environmental protection work in the construction stage and investigating into and handling problems of public disturbance or pollution arising in the construction process; 3. Responsible for coordinating with the competent government department of environment protection for implementation of the environment management matters; 4. Following up with the execution status of the ESMP and reporting on a periodical basis to the competent government department of the same level, the provincial PMO and the World Bank ;	3

Table 11-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Contents of Environment Management	Staffing
		5. Accepting and handing public complaints.	
	Contractor	1. Implementing the environmental protection measures and the various activities in the construction stage based on the bidding documents, the construction contract and this ESMP; 2. Accepting guidance and supervision by the environment management personnel of the Project Owner, the construction supervision engineer and the related government departments; 3. Accepting technical supports provided by the environmental protection consulting agency; 4. Implementing safety protection measures, e.g. erecting signs and fences on the boundary of construction sites, setting up channels of public communication and assuring construction safety; 5. Executing the ESMP.	3
	Construction Supervision Engineer	1. Supervising the contractor's execution of the ESMP and carrying out the environment mitigation measures in the construction contract; 2. Carrying out site supervision of the implementation status of the Contractor; 3. Assisting the EA in carrying out the environment management work; 4. Keeping records of and developing and submitting to the Project Owner on a periodical basis ESMP execution status reports.	5
	Environmental Monitoring Agency	1. Carrying out the environmental monitoring work of the construction stage and operation stage of the Project based on the authorization of the Project Owner and the environmental monitoring plan included in this EIA report; 2. Conducting the monitoring activity under the authorization of the Project Owner in case of any abnormalities in the construction process.	Depending on the scope of authorized assignment
	Local EPB	1. Supervising and inspecting the environmental protection measures of the Project Owner and the Contractor; 2. Receiving ESMP execution reports submitted by the Project Owner and the PMO and performing the administration functions based on such reports; 3. Arranging emergency response actions in the event of any abnormal environmental conditions in the construction process; 4. Accepting and coordinating the handling process of public complaints.	2
	Technical Assistance / Consultant	1. Providing technical supports to the environmental protection work in the construction stage of the Project according to the authorization of the Project Owner and this EIA Report as well as the environmental protection design outcomes; 2. Providing the contractor with technical guidance on the environmental protection work and properly carrying out the environmental protection training work in the construction stage of the Project.	Unlimited

Table 11-1 Contents of Environment Management in Different Stages

Stage	Project stakeholders	Key Contents of Environment Management	Staffing
Operation stage	Project Owner or Operator	1. Responsible for the post-operation management work of environmental protection and implementing the mitigation measures and monitoring of the ESMP in the operation stage; 2. Responsible for contacting and coordinating with the competent government department about the implementation of the environment management matters; 3. Making emergency responses to environmental accidents; 4. Providing periodical staff training to enhance their competence and actively organizing activities for exchange of environmental protection technology and experiences to further improve the management work of environmental protection.	3
	Environmental Monitoring Agency	1. Carrying out the environmental monitoring work of the operation stage of the Project as authorized by the Project Owner and required in the environmental monitoring plan; 2. Carrying out the routine monitoring activities related to the Project on a periodical basis.	Depending on the scope of authorized assignment
	Municipal EPB	1. Responsible for the final acceptance of the environmental protection work of the Project; 2. Guiding the county EPB to properly carry out the routine environment supervision and management work of the Project.	2
	Local EPB	1. Managing and supervising the status of compliance with the environmental protection standards in the operation stage; 2. Carrying out routine supervision and inspection of the operation status of the built environmental protection facilities.	2
	Public or organizations	Public supervision	Not limited

11.1.3 Environmental protection supervision plan

Based on the characteristics of the Project, the implementation status of the environmental protection work of the Project is not only subject to the supervision of Hezhou Municipal EPB, but also the relevant department of the World Bank. Construction supervision engineers should be employed to assist the EA in site supervision and inspection in the construction stage of the Project and an environmental protection division should be set up to supervise the Project in the operation stage.

See Table 11-2 for the environmental protection supervision plan of the Project.

Table 11-2 Environmental Protection Supervision Plan of the Project

Stage	Agency	Content of Supervision	Purpose of Supervision
FS stage	Municipal EPB, WB	1. Reviewing EIA Outlines; 2. Reviewing EIA Report; 3. Reviewing EAP	1. To make sure the EIA Report has complete content, well-selected topics and clear focus; 2. To make sure that any significant and potential issues likely to arise in the Project are reflected; 3. To make sure that a specific and feasible implementation plan is available for the mitigation measures of the environmental impacts.
Design and construction stage	Municipal Government Municipal EPB Babu District EPB Pinggui District EPB Municipal Culture & Tourism Bureau	1. Reviewing the preliminary environmental protection design and ESMP; 2. Inspecting the restoration of temporarily occupied land, and vegetation and environment affected by the construction works; 3. Inspecting measures for control of dust and noise pollution and deciding construction time; 4. Inspecting emission of air pollutants; 5. Inspecting discharge and treatment of domestic sewage and waste engine oil on the construction sites; 6. Inspecting restoration and treatment of borrow areas and waste disposal sites; 7. Inspecting disposal of sludge; 8. Inspecting and determining whether there any underground cultural relics.	1. To strictly enforce the “three-simultaneousness” policy of the Project; 2. To assure that all the construction sites satisfy the environmental protection requirements; 3. To reduce the impacts on the surrounding environment in the construction stage and enforce the relevant laws and regulations and standards of environmental protection; 4. To make sure that the water quality of He River and Inner River are not polluted; 5. To make sure that the landscape and land resources are not seriously damaged to avoid soil erosion; 6. To make sure that the sludge is properly disposed; 7. To protect the cultural resources from damages.
Operation stage	Municipal EPB Babu District EPB Pinggui District EPB Municipal public security and fire protection authorities	1. Inspecting the implementation of EAP in the operation stage; 2. Inspecting the implementation of the monitoring plan; 3. Inspecting sensitive sites where further environmental protection measures are needed (and where unanticipated environmental problems may arise); 4. Inspecting whether the environment quality at the environmentally-sensitive sites satisfies the requirements of	1. To implement EAP; 2. To implement monitoring plan; 3. To protect environment in the true sense; 4. To strengthen environment management and actually safeguard personal health; 5. To assure that the pollutant emission satisfies the emission standards.

Table 11-2 Environmental Protection Supervision Plan of the Project

Stage	Agency	Content of Supervision	Purpose of Supervision
		the corresponding quality standard; 5. Strengthening supervision to prevent unanticipated incidents and developing emergency response plans so that the environmental risks can be eliminated in time in the event of any accidents.	

11.2 Environmental and Social Impacts and their Mitigation Measures

The Project Components include He River Flood Risk Resilience Improvement Subproject and Urban Drainage and Wastewater Management Subproject. In accordance with the relevant laws and codes of China and Guangxi and in association with the World Bank General Environment, Health and Safety (EHS) Guidelines, EHS Guidelines for Water Supply and Drainage, general and special countermeasures and mitigation measures are proposed for the preparation stage, the construction stage and the operation stage of different types of subprojects. For the general countermeasures and mitigation measures, three ECOPs and 1 MP are developed as annexes to the ESMP, namely Annex 1: ECOP for Embankment Construction Component, Annex 2: ECOP for Small Waterworks Construction Component, Annex 3: ECOP for Road and Pipeline Network Construction Component and Annex 4: Management Plan of Physical Cultural Resources. Table 11-3 shows the ECOPs and MP applicable to the respective subprojects while Tables 11-4 to 11-13 present a summary of the environmental and social impacts as well as the mitigation measures. Table 11-14 summarizes the LAR and social impacts and their mitigation measures while Table 11-15 presents the Dam Safety Action Plan.

Table 11-3 ECOP and ESMP applicable to each subproject

S.N	Name of subproject	Applicable ECOP
I	**Flood risk control**	
A-1	He River Integrated Rehabilitation Subproject (Huangshi Hydropower Station – Guangming Bridge)	ESMP Annex 1: ECOP for Embankment Construction Component
A-2	He River Integrated Rehabilitation Subproject (Guangming Bridge --- Lingfeng Bridge)	ESMP Annex 1: ECOP for Embankment Construction Component; Annex 4: Physical Cultural Resources Management Plan
A-3	He River Integrated Rehabilitation Subproject (Lingfeng Bridge – Xiadao Hydropower Station)	ESMP Annex 1: ECOP for Embankment Construction Component
A-4	East Trunk Canal Integrated Rehabilitation and Mawei River Connection Subproject	ESMP Annex 2: ECOP for Small Waterworks Construction Component
II	**Urban drainage improvement**	
B-1	Huangansi Drainage Pump Station	ESMP Annex 2: ECOP for Small Waterworks Construction Component; Annex 4: Physical

Table 11-3 ECOP and ESMP applicable to each subproject

S.N	Name of subproject	Applicable ECOP
		Cultural Resources Management Plan
B-2	Shizigang Drainage Pump Station	ESMP Annex 2: ECOP for Small Waterworks Construction Component
B-3	Lining River Rehabilitation	ESMP Annex 2: ECOP for Small Waterworks Construction Component
B-4	Changlong River Rehabilitation	ESMP Annex 2: ECOP for Small Waterworks Construction Component
B-5	Huangtian Branch Canal Rehabilitation	ESMP Annex 2: ECOP for Small Waterworks Construction Component ; Annex 3: ECOP for Road and Pipeline Network Construction Component
B-6	Guposhan Drainage Canal Rehabilitation	ESMP Annex 2: ECOP for Small Waterworks Construction Component
B-7	East No. 5 Branch Canal Rehabilitation	ESMP Annex 2: ECOP for Small Waterworks Construction Component
III	**Water quality improvement**	
C-1	Huangansi Drainage Canal Integrated Rehabilitation	ESMP Annex 1: ECOP for Embankment Construction Component; Annex 4: Physical Cultural Resources Management Plan
C-2	Shizigang Drainage Canal Integrated Rehabilitation	ESMP Annex 1: ECOP for Embankment Construction Component
C-3	Jiangnan WWTP and associated pipeline construction	ESMP Annex 3: ECOP for Road and Pipeline Network Construction Component
IV	Institutional Capacity Building and Project Management	
E-1	River supervisor system + Internet Smart Management System	ESMP Annex II: ECOP for Small Waterworks Construction Component

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
Main Watercourse Widening for Flood Discharge: A-1 He River Rehabilitation (Huangshi Hydropower Station to Guangming Bridge); A-2 He River Rehabilitation (Guangming Bridge to Lingfeng Bridge); A-3 He River Rehabilitation (Lingfeng Bridge to Xiadao Hydropower Station)	Design	Technical design	Residents on the right bank of He River downstream from Huangshi Hydropower Station, ancient buildings in Xiyue Street Historical and Cultural Quarter, The Old Site of CCP Babu Special Branch within Xiadao Primary School	Original technical design requires demolition of large quantities of residential buildings on the right bank of He River downstream from Huangshi Hydropower Station, occupation of part of land of Hezhou Municipality High School, demolition of The Old Site of CCP Babu Special Branch, and occupation of protected area of Xiyue Street Historical and Cultural Quarter.	1. He River (Huangshi Hydropower Station to Guangming Bridge, GL20+800~GL21+485), 685 m in length. Embankment width of the right bank is narrowed by 40 m and glass retaining wall will be built to avoid relocation of residents downstream from Huangshi Hydropower Station. 2. He River (Huangshi Hydropower Station to Guangming Bridge, GL10+545~GL10+940), 395 m in length. Technical design is optimized by changing earth dike to glass retaining wall to narrow land area occupied and avoid impact to Hezhou High School on the right bank. 3. He River (Huangshi Hydropower Station to Guangming Bridge, GL2+760~GL2+800), 40 m in length. T-shaped revetment slope is changed to vertical retaining wall to narrow land area occupied and avoid demolition of The Old Site of CCP Babu Special Branch. 4. Construction area boundary is changed to avoid protected area of Xiyue Street Historical and Cultural Quarter.	/	Design Institute	/
	Construction	Watercourse widening, civil work construction, construction material and soil/stone	Shangsong Village, shanty town of Xiwan Village, Xiwan Town residents, Pinggui District Government,	Operation noise of excavator, bulldozer, loader, vibrator and dump truck during construction will have certain impact	As specified in Annex 1 of the ESMP, ECOP for Embankment Construction, temporary sound barrier with height not lower than 2 m should be set for construction sites near Hezhou College, Hezhou Pilot Middle School and Xiadao	30	Contractor	Hezhou Municipal EPB

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
		transportation, construction camp, and temporary construction site access road	Xiwan Community, houses of Jinshuiwan Community by He River (not delivered for use), Jigongzhou, Songmuji Community of Gonghe Village, Longjiangdu, Hezhou College, Sanjia Village, Fanglin Street, Hezhou Municipality Pilot Middle School, Fanglin Village, Loacengwu, residential buildings of Wenyuanhuadu Community by He River, residents in No.2 Xinan Alley of Babu Street, Xiyue Street residents, Xialiang Village, Diandengzhai, Chushuitang, Xiadao Primary School, Xiadao Village, Jichitan	on sensitive receptors within 30 m around the construction site. Earth excavation, onsite storage, backfilling, people and vehicle moving, and leakage and spill of earth transportation vehicles will have impact on sensitive receptors within 50 m around construction site. Construction solid waste generated from demolition of buildings acquired and waste soil/stone from construction of new buildings/structures will have environmental impact, if not well managed.	Primary School, and construction activities should be scheduled to avoid normal school time.			
			Land area permanently and temporarily occupied by the Project	Soil erosion area of 166.09 hm^2 and soil loss of 24,350 tons caused by construction activities	① He River Rehabilitation (Huangshi Hydropower Station to Guangming Bridge) Reusable surface soil in disturbed area should be removed and stored in designated area before construction.	15.6	Contractor	Hezhou Water Resources Bureau

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 227900m^3 surface soil, 227900m^3 surface soil backfill, and construction of 15123 m long bio-swale (included in technical design). Greening measures: 330031 m^2 embankment slope covered with grass, 30246 m^2 planting of trees, bush and grass, and 60 m^2 vertical greening (included in technical design).Temporary measures: temporary covering by 10,000m^2 dense-mesh net (new). ② He River Rehabilitation (Guangming Bridge to Lingfeng Bridge) Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 31300 m^3 surface soil, 31300 m^3 surface soil backfill, and construction of 450 m long bio-swale, 3795m^2 for permeable bricks (included in technical design). Greening measures: 31924 m^2 embankment slope covered with grass, 750 m^2 planting of trees, bush and grass, 944m^2 vertical landscaping, 1145m^2 key area landscaping, 137998m^2 landscaping (included in			

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					technical design).Temporary measures: temporary covering by 1,000 m^2 dense-mesh net (new). ③ He River Rehabilitation (Lingfeng Bridge to Xiadao Hydropower Station) Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 35,100 m^3 surface soil, 35,100 m^3 surface soil backfill, and construction of 3040 m long ecological swale (included in technical design).Greening measures: 209926 m^2 embankment slope covered with grass, 3,040 m^2 planting of trees, bush and grass, 64441m^2 landscaping (included in technical design).Temporary measures: temporary covering by 7,000 m^2 dense-mesh net (new).			
		Watercourse widening, and dike construction	He River water quality	Without good management, construction material such as asphalt, fuel, chemicals and domestic sewage of construction workers may enter surface water and cause water environment pollution.	1. Construction should be scheduled in dry season as much as possible. 2. Construction area should be minimized and construction period should be shortened. 3. Vegetation should be restored as early as possible to minimize impact. 4. ECOP for dike construction, included as Annex 1 of the ESMP should be followed.	10	Contractor	Hezhou Municipal EPB
		Watercourse widening, civil	Ancient buildings in Xiyue Street	There are no protected ancient	Physical and cultural resources management plan as included in Annex	10	Contractor	Hezhou Culture and Press and

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
		work construction, construction material and soil/stone transportation	Historical and Cultural Quarter, The Old Site of CCP Babu Special Branch within Xiadao Primary School	buildings or relics within construction area, but uncontrolled construction activities may lead to damage to ancient buildings and the relics and pollution, and the damage may be irremediable.	4 of the ESMP should be strictly followed by construction activities.			Publications Bureau
		civil work construction, construction material and soil/stone transportation	4 banyan in Xialiang Community, 2 hackberries, 1 banyan and 1 Cinnamomun camphor in Mid Jiangbei Road	Ancient and rare trees are not within construction area of the Project, but quite near the construction site, approximately 50 m away from the site. Normal growth of these trees will possibly be affected by earth taking and disposal, storage of construction solid waste, moving of construction vehicles and transportation of construction equipment.	6. Construction scope should be minimized and construction period should be shortened as possible; 7. It is prohibited to chop down the trees, transplant without being permitted, peel the bark, dig out the root and inject toxic and harmful substance to the trees; 8. It is not allowed within 5 meters outside crown shadow of the trees for construction of buildings or structures, laying of pipelines, laying of power cables, pit excavation and earth taking, sand and stone taking, inundation or paving ground surface, fume emission, wastewater discharge and solid waste dumping, storage or dumping of flammable and combustible or toxic and harmful substances; 9. It is not allowed for carving, nailing, winding, hanging on the trees or piling material against the tree trunk; and 10. Entry of construction vehicles and equipment is not allowed within 5	/	Contractor	Hezhou Urban Administration Bureau

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					meters outside crown shadow of the trees.			
		Road occupation by construction activity, construction material and soil/stone transportation	Hezhou College, Hezhou Municipality Pilot Middle School, and Xiadao Primary School	Occupation of school access road will cause access difficulties of students, school staff and parents and may affect access safety of the students and disturb normal school activities.	7. For construction activities that will affect public traffic, construction program should be provided to public traffic authority in advance for arrangements for adjusting public traffic route, and construction cannot commence until permission is obtained. 8. Signs should be set on construction site before construction indicating construction description and schedule, requesting public understanding of inconvenience caused by construction activities, and disclosing contact information and complaint hotline. This information could be disclosed in advance through media, micro-blog and wechat, as possible. 9. Excavation and backfilling should be done by zone. 10. Temporary access path should be built when construction site is near public facilities like bus stop. Material transportation should be scheduled to avoid peak hours to reduce peak traffic volume. 11. Traffic diversion and adjustment should be done by traffic police in peak school hours and temporary traffic lights and other signs should be set. 12. Training on construction management and environmental protection should be strengthened.	2	Contractor	Hezhou Transport Bureau, Hezhou Traffic Police Group
		Civil work construction, and	Water supply pipeline located 23	Interruption of existing	4. The contractor should further coordinate with municipal and	/	Contractor	Hezhou Housing and Urban and

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
		watercourse widening	m upstream from Sanjia Bridge	underground pipelines due to poor construction management	urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment and depth, and establish pipeline coordination team. Prior approval should be obtained from municipal and urban development authorities for excavation interfering with underground pipelines. 5. Construction plan and emergency responsive program should be developed based on pipeline alignment and depth to avoid interference with existing underground pipelines as much as possible. 6. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities, and emergency responsive program should be in place.			Rural Development Bureau
		Earth borrow, and waste soil disposal	2 borrow areas located at 1.25 km east to Xiadao Bridge in eastern Hezhou Municipality and west to Hezhou Municipality electronic technology ecological industrial park; the disposal site located in construction solid waste landfill in Huangtian Town	Soil erosion area of 87.72 hm^2 and soil loss of 100058 tons caused by earth borrow and disposal for temporary land use, construction access road, construction camp, etc.	① Temporary Construction Path Surface soil should be removed and be stored in temporary storage site in The main watercourse of He River rehabilitation zone, and temporary drainage and sedimentation structures should be built along both sides of the road. The site should be restored in late construction stage. Structural measures: removal of 41600 m^3 surface soil, 41600 m^3 surface soil backfill and 20.82 hm^2 land restoration (new). Greening measures: 5.12 hm^2 forest restoration and 7.04 hm^2 grass land	1491.16	Contractor	Hezhou Water Resources Bureau

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
			Gonghe Village of Hezhou Municipality		restoration (new). Temporary measures: 138660 m temporary earth drainage canal, and 139 temporary sedimentation tanks (new). ② Construction Site and Camp Surface soil should be removed and be stored in designated storage site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary material storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: removal of 9,000 m^3 surface soil, 9,000 m^3 surface soil backfill and 4.50 hm^2 land restoration (new). Greening measures: 0.11 hm^2 garden plot restoration and 2.71 hm^2 grass land restoration (new). Temporary measures: 4,685 m temporary earth drainage canal, and 26 temporary sedimentation tanks, and 7,700 m^2 dense-mesh net (new). ③ Temporary Soil Storage Site Straw bag stuffed with soil will be put surrounding the site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: 18.05 hm^2 land restoration (new). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm^2 garden restoration and 2.22 hm^2 grass land			

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					restoration (new). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (new). ④ Borrow Area Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 11,080 m^3 surface soil, 11,080 m^3 surface soil backfill, 36.95 hm^2 land restoration, 3,800 m long brick drainage canal, and 15 brick sedimentation tanks (new). Greening measures: 36.95 hm^2 grass planting, planting of 46,187 pines and 92,375 bushes (new). Temporary measures: 1,000 m retaining wall for temporary storage site and			

Table 11-4 Environment Impacts and Mitigation Measures of Main Watercourse Widening Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					36,000 m^2 dense-mesh net (new). ⑤ Disposal Site Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should built around the site. The disposal site should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 22,200 m^3 surface soil, 22,200 m^3 surface soil backfill, 7.4 hm^2 land restoration, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick sedimentation tanks (new). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (new). Temporary measures: installation of 2,000 m^2 dense-mesh net (new). ⑥Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches.			

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
Water Diversion (A-4 East Trunk Canal Rehabilitation and Connection with Mawei River)	Construction	Watercourse widening, civil work construction, construction material and earth transportation, construction camp, temporary construction path	Xianghuadao	Noise of exactor, bulldozer, loader, vibrator and dump truck during construction will have certain impact on sensitive receptors within 30 m. Dust from earth exaction, onsite storage and backfilling, moving of construction workers and vehicles, and leakage and spill of transportation vehicles will have impact on sensitive receptors within 50 m of the construction site. Demolition of buildings acquired and construction of new buildings/structures will generate construction solid waste and waste soil, which will have environmental impact without proper management.	ECOP for small waterworks as included in Annex 2 of the ESMP should be followed.	1	Contractor	Hezhou Municipal EPB
			Land area permanently and temporarily occupied by the Project	Soil erosion area and soil loss caused by construction of the Project will be 26.10 hm^2 and 2,368 tons, respectively.	Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. East Trunk Canal Rehabilitation Structural measures: removal of 20,100 m^3 surface soil, 20,100	18	Contractor	Hezhou Water Resources Bureau

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					m^3 surface soil backfill， 12300 permeable bricks (included in technical design). Greening measures: 62424m^2 turfing, 16343m^2 greenbelt, 99492m^2 landscaping (included in technical design). Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (new). Flood Diversion Canal of East Trunk Canal Structural measures: removal of 5,500 m^3 surface soil, 5,500 m^3 surface soil backfill, 5386m ecological swale, 5386m^2 permeable bricks (included in technical design). Greening measures: 24267 m^2 three-dimensional geo-technical net embankment slope with grass, 5386 m^2 greening belt, 4200 m^2 landscaping and greening (included in technical design). Temporary measures: temporary covering by 3,000 m^2 dense-mesh net (new).			
		Operation of dredging equipment and dewatering facility	Water quality of East Trunk Canal, area along sediment transportation route	Dredging will have temporary disturbance to water body, cause increase of suspended solids, and possibly have odor emission. Without strict management, transportation process may have secondary pollution.	1. Information of construction schedule, environmental impact and sediment transportation route should be disclosed to the public in a timely manner. 2. Dredging should be scheduled in dry season as possible and construction	2	Contractor	Hezhou Municipal EPB

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					period should be shorted to minimize disturbance to water body. 3. Mechanical excavation supplemented by manual excavation is adopted for East Trunk Canal, and movable vehicular dewatering equipment is used for onsite dewatering. Dredging effluent is discharged to the canal. Interception and diversion + dry dredging method may be used for dredging provided that the construction condition permits (with the required operation space available for inner river interception and diversion) and a sound regional intercepting pipeline network is in place. 4. Sediment is dewatered to sludge cake with moisture content less than 50%, and is hauled through enclosed vehicle to Hezhou solid waste landfill for disposal. 5. Strict equipment inspection should be done during dredging to prevent oil leakage. Wastewater and solid waste should be collected with other construction waste, and is			

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					not allowed to enter surface water.			
		Watercourse widening, dike construction	Water quality of East Trunk Canal and Mawei River	Without appropriate management, construction material (asphalt, oil, chemicals), oily construction wastewater and domestic sewage of construction workers may enter surface water and cause water pollution.	1. Construction should be scheduled in dry season as possible. 2. Construction area should be minimized as possible and construction period should be shortened. 3. Vegetation should be restored as early as possible to minimize impact on local environment. 4. ECOP for small waterworks as included in Annex 2 of the ESMP should be followed.	1	Contractor	Hezhou Municipal EPB
		Earth borrow and disposal	Two borrow areas located 1.25 km east to Xiadao Bridge in eastern Hezhou and west to Hezhou Municipality electronic technology ecological industrial park; disposal site located in construction solid waste landfill in Gonghe village.	Soil erosion area and soil loss caused by earth borrow and disposal for temporary land use, construction access road and construction camps will be 87.72 hm^2 and 100058 tons, respectively.	① Temporary Construction Path Surface soil should be removed and be stored in temporary storage site in The main watercourse of He River rehabilitation zone, and temporary drainage and sedimentation structures should be built along both sides of the road. The site should be restored in late construction stage. Structural measures: removal of 41600 m^3 surface soil, 41600 m^3 surface soil backfill and 120.82 hm^2 land restoration (new). Greening measures: 5.12 hm^2	1491.16	Contractor	Hezhou Water Resources Bureau

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					forest restoration and 7.04 hm^2 grass land restoration (new). Temporary measures: 138660 m temporary earth drainage canal, and 139 temporary sedimentation tanks (new). ② Construction Site and Camp Surface soil should be removed and be stored in designated storage site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary material storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: removal of 9,000 m^3 surface soil, 9,000 m^3 surface soil backfill and 4.50 hm^2 land restoration (new). Greening measures: 0.11 hm^2 garden plot restoration and 2.71 hm^2 grass land restoration (new). Temporary measures: 4,685 m temporary earth drainage canal, and 26 temporary sedimentation tanks, and 7,700 m^2 dense-mesh net (new). ③ Temporary Soil Storage Site Straw bag stuffed with soil will be put surrounding the site, and temporary drainage and			

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: 18.05 hm^2 land restoration (new). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm2 garden restoration and 2.22 hm^2 grass land restoration (new). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (new). ④ Borrow Area Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done			

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 11,080 m^3 surface soil, 11,080 m^3 surface soil backfill, 36.95 hm^2 land restoration, 3,800 m long brick drainage canal, and 15 brick sedimentation tanks (new). Greening measures: 36.95 hm^2 grass planting, planting of 46,187 pines and 92,375 bushes (new). Temporary measures: 1,000 m retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (new). ⑤ Disposal Site Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures			

Table 11-5 Environmental Impacts and Mitigation Measures of Water Diversion Subcomponent

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should built around the site. The disposal site should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 22,200 m^3 surface soil, 22,200 m^3 surface soil backfill, 7.4 hm^2 land restoration, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick sedimentation tanks (new). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (new). Temporary measures; installation of 2,000 m^2 dense-mesh net (new). ⑥ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches.			

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
Waterworks Improvement: A-5 Xiadao Hydropower Station Upgrade; A-6 Fanglin Hydropower Station Upgrade; A-7 Huangshi Hydropower Station Upgrade	Construction	Water-related construction, transportation of construction material and earth, construction camp, and temporary construction path	Jichitan	Operation noise of exactor, bulldozer, loader, vibrator and dump truck during construction will have certain impact on sensitive receptors within 30 m. Dust from earth exaction, onsite storage and backfilling, moving of construction workers and vehicles, and leakage and spill of transportation vehicles will have impact on sensitive receptors within 50 m of the construction site. Demolition of buildings acquired and construction of new buildings/structures will generate construction solid waste and waste soil, which will have environmental impact without proper management.	ECOP for small waterworks as included in Annex 2 of the ESMP should be followed.	1	Contractor	Hezhou Municipal EPB
			Water quality of He River	Without appropriate management, construction material (asphalt, oil, chemicals) , oily construction wastewater and domestic sewage of construction workers may enter surface water	1. Construction should be scheduled in dry season as possible. 2. Construction area should be minimized as possible and construction period should be shortened. 3. Vegetation should be restored as early as possible to minimize impact on local environment. 4. ECOP for dike construction as included	1	Contractor	Hezhou Municipal EPB

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
				and cause water pollution.	in Annex 1 of the ESMP should be followed.			
		Removal of Huangshi Hydropower Station and Fanglin Hydropower Station gate dams.	Residents of Fanglin Street and Tianchang Village	Traffic interruption and travel inconvenience during construction	1. For construction activities that will affect public traffic, construction program should be provided to public traffic authority in advance for arrangements for adjusting public traffic route, and construction cannot commence until permission is obtained. 2. Signs should be set on construction site before construction indicating construction description and schedule, requesting public understanding of inconvenience caused by construction activities, and disclosing contact information and complaint hotline. This information could be disclosed in advance through media, micro-blog and wechat, as possible. 3. Excavation and backfilling should be done by zone. 4. Temporary access path should be built when construction site is near public facilities like bus stop. Material transportation should be scheduled to avoid peak hours to reduce peak traffic volume. Separate construction access road should be built for construction in rural area to avoid use of rural road and damage of rural road by oversize equipment and vehicle. 5. Training on construction management and environmental protection should be strengthened. 6. During construction of Fanglin Hydropower Station improvement, travel from Fanglin Street and	1	Contractor	Hezhou Transport Bureau, Hezhou Traffic Police Group

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					Tianchang Village to area north to He River will be re-routed along Fanglin Road, G207 and Sanjia Bridge or through Mintian rural road and Bahuang Class 2 road. Traffic re-routing plan is subject to approval of traffic police and road closing and re-routing signs will be posted.			
		Removal of Fanglin Hydropower Station river flashboard	400 mu dry and paddy field in Tianchang Village, 200 mu farmland in Mintian Village and 1,000 mu farmland in Fanglin Village	Fanglin Hydropower Station has irrigation function. Relying on high water level contributed by barrage, river water can flow to irrigation channels through diversion culverts by gravity. As flashboard is removed, existing irrigated area will be affected.	A small-sized pump station will be built. River water will be lifted by three pumps with designed delivery head of 30 m and distance of 800 m and diverted to irrigated area in Tianchang, Fanglin and Mintian villages through existing water diversion culverts and channels.	400	Contractor	Hezhou Water Resources Bureau
		Earth borrow and disposal	Two borrow areas located 1.25 km east to Xiadao Bridge in eastern Hezhou and west to Hezhou Municipality electronic technology ecological industrial park; disposal site located in construction solid waste landfill in Gonghe village.	Soil erosion area and soil loss caused by earth borrow and disposal for temporary land use, construction access roads and construction camps will be 87.82 hm^2 and 10058 tons, respectively.	① Temporary Construction Path Surface soil should be removed and be stored in temporary storage site in The main watercourse of He River rehabilitation zone, and temporary drainage and sedimentation structures should be built along both sides of the road. The site should be restored in late construction stage. Structural measures: removal of 41600 m^3 surface soil, 41600 m^3 surface soil backfill and 20.82 hm^2 land restoration (new). Greening measures: 5.12 hm^2 forest restoration and 7.04 hm^2 grass land restoration (new). Temporary measures: 138660 m temporary earth drainage canal, and 139 temporary sedimentation tanks (new). ② Construction Site and Camp	1491.16	Contractor	Hezhou Water Resources Bureau

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					Surface soil should be removed and be stored in designated storage site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary material storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: removal of 9,000 m^3 surface soil, 9,000 m^3 surface soil backfill and 4.50 hm^2 land restoration (new). Greening measures: 0.11 hm^2 garden plot restoration and 2.71 hm^2 grass land restoration (new). Temporary measures: 4,685 m temporary earth drainage canal, and 26 temporary sedimentation tanks, and 7,700 m^2 dense-mesh net (new). ③ Temporary Soil Storage Site Straw bag stuffed with soil will be put surrounding the site, and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during construction. The site should be restored in late construction stage. Structural measures: 18.05 hm^2 land restoration (new). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm2 garden restoration and 2.22 hm^2 grass land restoration (new). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m temporary earth drainage canal, and 47 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (new).			

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					④ Borrow Area Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 11,080 m^3 surface soil, 11,080 m^3 surface soil backfill, 36.95 hm^2 land restoration, 3,800 m long brick drainage canal, and 15 brick sedimentation tanks (new). Greening measures: 36.95 hm^2 grass planting, planting of 46,187 pines and 92,375 bushes (new). Temporary measures: 1,000 m retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (new). ⑤ Disposal Site Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage			

Table 11-6 Environmental Impacts and Mitigation Measures of Waterworks Improvement

Subcomponent	Period	Activity	Environmental Sensitive Receptor	Potential Impact	Mitigation/Prevention Measures	Cost CNY 10,000	Implemented By	Supervised By
					site before construction. Retaining wall, masonry drainage canal and various drainage structures should built around the site. The disposal site should be restored in late construction stage through surface soil backfill and vegetation replanting. Structural measures: removal of 22,200 m^3 surface soil, 22,200 m^3 surface soil backfill, 7.4 hm^2 land restoration, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick sedimentation tanks (new). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (new). Temporary measures: installation of 2,000 m^2 dense-mesh net (new). ⑥ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m^3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches.			

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
River dredging (A-8 He	Design stage	Schematic design	Hezhou Institute, Hezhou Experimental	Odor generated in dredging	1. With heavy load of dredging, wide water surface and a certain water depth,	/	FS unit	

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
River Dredging Subproject (Huangshi Hydropower Station – Xiadao Hydropower Station)			Middle School, areas along sludge transportation route	process, odor and leachate generated from temporary sludge storage, tail water generated from sludge dewatering and impacts from sludge transportation route, etc.	He River has the conditions required for operation of large dredgers. In the optimized design proposal, cutter suction dredger known for its high dredging efficiency is selected to significantly shorten the construction period, reduce disturbances to water systems and correspondingly reduce the time of impacts of the sludge dewatering sites. 2. As the optimum choice, No. 1 dewatering site (river shores on the right bank of He River approximately 100m upstream from Lingfeng Bridge) and No. 2 dewatering site (river shore on the left bank of He River approximately 100m upstream from Fanglin Bridge) are selected, both located more than 100m away from the closest sensitive spot, helpful to avoid impacts on the environmentally sensitive sites from temporary storage and dewatering of sludge. 3. Optimization of sludge transportation routes: The			

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					transportation route from No. 1 sludge dewatering site to the solid waste landfill is from Lingfengnan Road to National Highway 207, Gongye Avenue, National Highway 323 and then the access road to the solid waste landfill, involving a haulage of approximately 14km; The transportation route from No. 2 sludge dewatering site to the solid waste landfill is from Fanglin Road to Guangming Avenue, National Highway 207, Gongye Avenue, National Highway 323 and then the access road to the solid waste landfill, involving a haulage of approximately 18km. Such a selection of the sludge transportation routes has considered the need for avoiding densely populated residential areas, shortening haulage to the best possibility and reducing the environmental impacts.			
	Construction stage	Operation of dredging	Hezhou Institute, Hezhou Experimental	The dredging process will generate	1. Information on the construction plan, the environmental impact	5	Construction contractor	Municipal EPB

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
		vessel, operation of integrated sludge treatment facility, sludge dewatering and onsite dewatering	Middle School, water quality of He River	temporary disturbances to water systems and result in increased SS concentration and possibly fugitive odor in a small amount. Improper management of sludge dewatering or transportation process may cause secondary pollution.	descriptions, dredger operation route and sludge transportation route should be disclosed in time to the public. 2. The dredging operation should be conducted in the low-water season and the construction time should be shortened, if possible, to reduce disturbances to water systems. 3. Cutter suction dredger is selected for the dredging operation of the main watercourse of He River and the sludge is delivered to dewatering facilities on No. 1 and No. 2 dewatering sites along He River and dewatered into sludge cakes with a moisture content of less than 50%, which are then transported in enclosed vehicles to Hezhou Municipal Domestic Solid Waste Landfill for disposal. 4. Construction plants and vessels involved in the dredging process must be subject to strict inspection to prevent oil leakage. Sewage,			

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					solid wastes and oily wastewater from vessel cabins must not be cast into the water systems and should, instead, be collected and treated together with the other construction wastes. 5. Flood interception ditches should be excavated around the temporary sludge storage tanks on the dewatering site and connected to the wastewater sedimentation tanks. 6. Stormwater, tail water from sludge dewatering collected by the flood interception ditches should be discharged into the wastewater sedimentation tank for sedimentation before finally discharged into He River. 7. The sludge should be dewatered and transported out of site in a timely manner to avoid the generation of leachate due to excessive storage. 8. Quick lime and deodorants should be provided for sterilization and deodorization			

Table 11-7 Environmental impacts of He River Dredging Subproject and their mitigation measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					of the dewatering site and labor protection devices such as masks should be provided to the construction workers.			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
Water conservancy infrastructure construction (B-1 Huangansi Drainage Canal Pump Station, B-2 Shizigang Drainage Canal Pump Station)	Design stage	Schematic design	Xiyue Street Historical and Cultural Quarter, residential buildings on Xiyue Street, residential buildings and staff dormitory of Transportation Bureau on Jiangbeizhong Road	Flood risks for the Xiyue Street Historical and Cultural Quarter, noise impacts from the operation of pump stations along Huangansi Drainage Canal and Shizigang Drainage Canal	1. The optimized design takes account of the preservation of the historical and cultural relics of Xiyue Street and aims to assure that the cultural relics protection zone is not flooded and not relocated, land use difficulty is addressed through capacity minimization of drainage pump stations and selection of existing watercourses needing no widening and full diversion of regional flood via Shizigang Drainage	/	FS unit	/

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Canal. 2. In order to reduce the impacts of noises generated in the operation of the drainage pump stations, well-designed and low-noise mechanical equipment is selected and vibration insulation and control measures are adopted where possible during installation and operation to reduce noise; the robust structure and evenly grouted bases of the pump equipment can absorb vibrations and provide a solid support to the base plate. Through reasonable arrangement of sound absorbing materials and vibration reduction devices, e.g. asbestos boards and shock absorbers, on the inner walls, ceilings, floors and beside the equipment in the pump station helps to effectively control and eliminate spread and reflection of noises.			
	Construction	Civil works	Residential	Noises	Requirements included in	5	Construction	Municipal

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
	stage	construction, construction material and earth and aggregate transportation, construction camps, access roads	buildings on Xiyue Street, residential buildings and staff dormitory of Transportation Bureau on Jiangbeizhong Road	generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction stage will generate certain impacts on sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork transportation vehicles in the construction stage will generate	ESMP Annex 2: World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Small Waterworks Construction Component will be implemented.		contractor	EPB

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				certain impacts on sensitive sites within a distance of 50m in the neighborhood. Poor management of construction wastes and debris, waste soil generated in the demolition of acquired buildings and construction of new buildings will cause impacts on the environment.				
			Right of way and temporary land use for the Project	Construction activities will result in additional soil erosion of $0.37hm^2$ and 20t.	(1) Huangansi Drainage Pump Station Cut slope and ground with vegetation being removed should be covered with dense-mesh net during construction, and temporary drainage canals and structures should be built on construction site.	24.95	Construction contractor	Municipal WRB

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Structural measures: 20 m long stormwater pipelines (already included in the technical design) Temporary measures: 42 m long temporary earth drainage canal, 2 temporary sedimentation tanks, and temporary covering of dense-mesh net of 100 m^2 (newly included in the technical design)。 (2) Shizigang Drainage Pump Station Cut slope and ground with vegetation being removed should be covered with dense-mesh net during construction, and temporary drainage canals and structures should be built on construction site. Structural measures: 150 m long stormwater pipelines (already included in the technical design) Temporary measures: 150 m long temporary earth drainage canal, 2 temporary sedimentation			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					tanks, and temporary covering of dense-mesh net of 500 m^2 (newly included in the technical design)。			
		Construction of civil works, transportation of construction materials and earth and stone materials	Ancient buildings in the Xiyue Street Historical and Cultural Quarter	No preserved ancient buildings are distributed in the construction area. However, poor construction management and uncivilized construction behaviors may lead to irrevocable consequences such as damage, contamination and even destruction of the preserved ancient buildings and sites.	The construction activities will be carried out in strict accordance with the requirements included in ESMP Annex 4: World Bank Financed Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project Management Plan of Physical Cultural Resources.	2	Construction contractor	Municipal CPPRFTB
		Construction	2 camphor trees	No famous or	1. Construction scope	/	Construction	Municipal

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
		of civil works, transportation of construction materials and earth and stone materials	and 1 banyan tree at Xinaner Street, 1 camphor tree at Xiyue Street	ancient trees are found in the project implementation area, but temporary borrow and dump of soil, stockpiling of construction wastes and movement of construction vehicles and plants on the construction sites may affect the normal growth of such trees in the vicinity with a distance of less than 50m.	should be narrowed and construction period should be shortened as much as possible; 2. Tree felling, unlicensed transplanting, bark peeling, root digging and injection of toxic and hazardous substances to trees should be prohibited; 3. It is not allowed to construct buildings or structures, lay pipelines, install power cables, excavate borrow areas, mine sand and stone, flood or seal the ground, emit fumes, discharge wastewater and dump solid wastes, stockpile or dump flammables, explosives or toxic and hazardous substances in the area with a distance of less than 5m from the outer edge of the crown shadow of		contractor	MEB

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					trees. 4. It is not allowed to engrave, nail, wind, hang or support or stack articles on or around tree trunks; and 5. Construction vehicles and plants are not permitted to enter or roll the area with a distance of less than 5m from the outer edge of the crown shadow of trees.			
		Excavations during civil works construction	Pipelines at the intersection between Shizigang Drainage Canal and the Transportation Bureau on Jiangbeizhong Road	Poor construction management may lead to interruption of underground pipelines.	1. The contractor should further coordinate with municipal and urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment and depth, and establish a pipeline coordination team. Prior approval should be obtained	/	Construction contractor	Municipal HURB

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					from municipal and urban development authorities for excavation interfering with underground pipelines. 2. Construction plan and emergency response plan should be developed based on pipeline alignment and depth to avoid interference with existing underground pipelines as much as possible. 3. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities to be prepared for emergency responses.			
		Borrow fill and waste oil	Borrow area located 1.25km	Borrow fill and waste soil for	(1) Construction access roads	1491.16	Construction contractor	Municipal WRB

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			east of Xiadao Bridge in the eastern part of Hezhou Municipality, borrow area located at Hezhou Electronic Technology Ecological Industry Park and the construction waste disposal site located at Gonghe Village, Huangtian of Hezhou Municipality	temprary land use, construction access road and construction camps will result in soil erosion in a total area of 87.72hm^2 and an additional soil erosion of 100058t.	Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 41600m^3, top soil backfill in a total volume of 41600 m^3 and land rehabilitation in a total area of 20.82hm^2 (newly included in the technical design); Greening measures: 5.12hm^2 for forest land restoration, 7.04hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 138660m for temporary			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					earth drainage gutter; 139 temporary sedimentation tanks (newly included in the technical design). （2）Construction production and domestic activity areas Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 9000m^3, top soil backfill in a total volume of 9000 m^3 and land rehabilitation in a total area of 4.50hm^2 (newly included in the technical design); Greening measures:			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					$0.11hm^2$ for garden land restoration, $2.71hm^2$ for grassland restoration (newly included in the technical design); Temporary measures: 4685m for temporary earth drainage gutter; 26 temporary sedimentation tanks; $7700m^2$ for dense-mesh net (newly included in the technical design). (3) Temporary soil storage site Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored through land rehabilitation and cut-over land restoration at the end of the construction stage. Structural measures: 18.05 hm^2 land rehabilitation (newly included in the technical design).			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Greening measures: 4.31 hm^2 forest land restoration, 1.38hm2 for garden restoration and 2.22 hm^2 grass land restoration (newly included in the technical design). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m long temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (newly included in the technical design). ① Borrow sites Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting Structural measures: 11,080 m^3 for surface soil removal, 11,080 m^3 for surface soil backfill, 36.95 hm^2 for land rehabilitation, 3,800 m long brick masonry drainage canal, and 15 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 36.95			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					hm^2 for grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design). Temporary measures: 1,000 m long retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design). (4) Waste disposal sites Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should be built around the site. The disposal site should be restored at the end of the			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					construction stage through surface soil backfill and vegetation replanting. Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3 for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (newly included in the technical design). Temporary measures: installation of 2,000 m^2 dense-mesh net (newly included in the technical design). ⑥ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m^3 for earthwork excavation and backfill; 861m^3 for fencing			

Table 11-8 Environmental Impacts of the Water Conservancy Infrastructure Construction Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and demolition of earth-filled woven bags; 495m for temporary drainage ditches.			
	Operation stage	Operation of drainage pump station	Residences on Xiyue Street and Jiangbeizhong Road and staff dormitory of Transportation Bureau	Noise impacts from operation of drainage pump station of Huangansi Drainage Canal and Shizigang Drainage Canal	Maintenance and servicing of water pumps should be strengthened by means of periodical inspection of electric motor and pump axle concentricity and assuring excellent lubrication of axles so as to reduce wearing of pump parts and reduce noise.	1	Operator	Municipal EPB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
River-lake connection (B-3 Lining River Rehabilitation, B-4 Changlong River Rehabilitation, B-5 Huangtian Branch Canal Rehabilitation, B-6 Guposhan Drainage Canal Rehabilitation, B-7 East No. 5 Branch Canal Rehabilitation)	Construction stage	Watercourse widening, Civil works construction, construction material and earth and aggregate transportation, construction camps, access roads	Pingjing, Lijiatang, Lining Village, Daninggang, Xiangjiayuan, Taipingzhai, Yingshi Primary School, Huangtian Town, Pinggui No. 3 Middle School, Douhang, Bantanggang, Xinzhai, Huangtian Village, Muyuanna, Baijiazhai, Shizigang	Noises generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction stage will generate certain impacts on sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork	Requirements included in ESMP Annex 2: World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Small Waterworks Construction Component will be implemented. Temporary sound barriers with a height of no less than 2m and high effectiveness of noise reduction should be provided for construction sites around Yingshi Primary School and Pinggui No. 3 Middle School and the construction activities should be scheduled in such a way that the teaching periods are avoided.	25	Construction contractor	Municipal EPB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				transportation vehicles in the construction stage will generate certain impacts on sensitive sites within a distance of 50m in the neighborhood. Poor management of construction wastes and debris, waste soil generated in the demolition of acquired buildings and construction of new buildings will cause impacts on the environment.				
			Right of way and temporary land use for the Project	Construction activities will result in additional soil erosion of	(1) Lining River Rehabilitation Reusable surface soil in disturbed area	60	Construction contractor	Municipal WRB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				$67.73hm^2$ and 6040t.	should be removed and stored in designated area before construction. Cut slope and surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 28,600 m^3 surface soil, 28,600 m^3 surface soil backfill (already included in the technical design). Greening measures: 56146 m^2 three-dimensional			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					geo-technical net embankment slope covered with grass, 9310 m^2 greening belt, 35,020 m^2 landscaping and greening (already included in the technical design). Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design). (2) Changlong River Rehabilitation Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 22,600 m^3 surface soil, 22,600 m^3 surface soil backfill, 6306m ecological swale (already included in the technical design). Greening measures: 47113m^2 three-dimensional geo-technical net embankment slope covered with grass, 7966 m^2 greening belt, 29,630 m^2 landscaping and greening (already included in the			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					technical design). Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design). (3) Dongwu Branch Canal Rehabilitation Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and surface with vegetation removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage.			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Structural measures: removal of 45,000 m^3 surface soil, 45,000 m^3 surface soil backfill, 4270m ecological swale, 18675m^2 permeable bricks (already included in the technical design). Greening measures: 113930 m^2 bush planting and 7685m^2 greening (already included in the technical design). Temporary measures: temporary covering by 15,000 m^2 dense-mesh net (newly included in the technical design). (4) Huangtian Branch Canal Rehabilitation Reusable surface soil			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: removal of 24,400 m^3 surface soil, 24,400 m^3 surface soil backfill, 18750m^2 permeable bricks (already included in the technical design). Greening measures: 54260m^2			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					three-dimensional geo-technical net embankment slope covered with grass and 14880 m^2 greenbelt, 45000m^2 landscaping (already included in the technical design). Temporary measures: temporary covering by 10,000 m^2 dense-mesh net (newly included in the technical design). (5) Guposhan Drainage Canal Rehabilitation Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction. Greening measures:			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					6000 m^2 landscaping and greening (already included in the technical design). Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).			
		Watercourse widening, dike construction, etc.	Water quality of Lining River, Changlong River, Huangtian Branch Canal, Guposhan Branch Canal and East No. 5 Branch Canal	Improper management of construction materials such as asphalt, oils, chemical substances and oily construction wastewater, domestic sewage of construction workers may result in their discharge into the surface water and cause pollution	1. The construction works should be arranged in the low-water season where possible; 2. The scope of the construction activities should be narrowed and the construction period should be shortened as much as possible. 3. The construction works should be implemented according to the requirements included in ESMP Annex 1: ECOP for the Embankment	10	Construction contractor	Municipal EPB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				of the water environment.	Construction Component of World Bank Financed Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project.			
		Operation of dredging plants, operation of integrated sludge treatment facility	Water systems of Huangtian Branch Canal, Guposhan Branch Canal and areas along the sludge transportation routes	The dredging process will generate temporary disturbances to water systems and result in increased SS concentration and possibly fugitive odor in a small amount. Improper management of transportation process may cause secondary pollution.	1. Information on the construction plan, the environmental impact descriptions and sludge transportation route should be disclosed in time to the public. 2. The dredging operation should be conducted in the low-water season and the construction time should be shortened, if possible, to reduce disturbances to water systems. 3. Dredging for Huangtian Branch Canal and Guposhan Branch Canal is conducted through mechanical dredging assisted with artificial operation. Dewatering is achieved on site using the movable vehicle-mounted integrated drying facility	4	Construction contractor	Municipal EPB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and the residual water is discharged into Huangtian Branch Canal and Guposhan Branch Canal in the vicinity. Interception and diversion + dry dredging method may be used for dredging provided that the construction condition permits (with the required operation space available for inner river interception and diversion) and a sound regional intercepting pipeline network is in place. 4. The sludge is dewatered into sludge cakes with a moisture content of less than 50%, which are then transported in enclosed vehicles to Hezhou Municipal Domestic Solid Waste Landfill for disposal. 5. Construction plants involved in the dredging process must be subject to strict inspection to prevent oil leakage. Sewage and solid wastes must not be cast into the water systems			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and should, instead, be collected and treated together with the other construction wastes.			
		Occupation of local roads by the construction activities, transportation of earth and aggregates	Pinggui No. 3 Middle School	School access roads are occupied, resulting in travelling difficulty for students, school faculty and parents and possibly affecting traffic safety of students and order of school teaching.	1. A construction plan should be submitted to the transportation authority for construction activities with impacts on public transit and re-routing of public transit must be well planned and permit must be obtained before proceeding with such construction activities. 2. A bulletin board should be erected on the construction site before the construction works commences to introduce the project components and construction time to obtain public understanding of inconveniences generated in the construction process. Contact information	1	Construction contractor	Municipal Transportation Bureau Municipal Traffic Police Brigade

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and complaint hotlines should be also disclosed. If possible, such prior announcement may be achieved via the news media, micro blog, wechat, etc. 3. The construction works should be implemented on a section-by-section or zone-by-zone basis and excavation and backfill should be carried out in the shortest possible time. 4. Temporary access roads should be provided for construction works close to bus stops and other public facilities. Material transportation should be time in such a way that the traffic peak hours are avoided to alleviate pressure on urban traffic. 5. Traffic police guiding and dispatching should			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					be needed during school peak hours and temporary signal lights and other signs should be provided. 6. Stronger efforts should be made in construction management and environmental protection training for construction workers.			
		Civil works construction, watercourse widening, etc.	Pipelines at the intersection of Lining River with Zhanqian Avenue, the intersections of Changlong River with Guangming Avenue and Guposhan Avenue and the intersection of East No. 5 Branch Canal with National Highway No. 207	Poor construction management may lead to interruption of underground pipelines.	1. The contractor should further coordinate with municipal and urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment	/	Construction contractor	Municipal HURDB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and depth, and establish a pipeline coordination team. Prior approval should be obtained from municipal and urban development authorities for excavation interfering with underground pipelines. 2. Construction plan and emergency response plan should be developed based on pipeline alignment and depth to avoid interference with existing underground			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					pipelines as much as possible. 3. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities to be prepared for emergency responses.			
		LAR involved in Changlong River Integrated Rehabilitation	53 recently constructed private tombs	Improper implementation of LAR may affect the progress of the Project.	Requirements included in ESMP Annex 4: World Bank Financed Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project Management Plan of	/	Construction contractor	Resettlement external monitoring agency

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Physical Cultural Resources			
		Earthwork and stonework construction at the intersections of East Trunk Canal and Lining River with Gui-Guang Express Railway	Gui-Guang Express Railway	Improper construction measures and management may affect the foundation stability and safe operation of railway		/	Construction contractor	Nanning Railway Bureau
		Borrow fill and waste oil	Borrow area located 1.25km east of Xiadao Bridge in the eastern part of Hezhou Municipality, borrow area located at Hezhou Electronic Technology Ecological Industry Park and the construction	Borrow fill and waste soil for temporary land use, construction access road and construction camp will result in soil erosion in a total area of 87.72hm^2 and an additional soil erosion of 100058t.	(1) Construction access roads Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the	1491.16	Construction contractor	Municipal WRB

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			waste disposal site located at Gonghe Village, Huangtian of Hezhou Municipality		road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of $41600m^3$, top soil backfill in a total volume of 41600 m^3 and land rehabilitation in a total area of $20.82hm^2$ (newly included in the technical design); Greening measures: $5.12hm^2$ for forest land restoration, $7.04hm^2$ for grassland restoration (newly included in the technical design); Temporary measures: 138660m for temporary earth drainage gutter; 139temporary sedimentation tanks (newly included in the technical design). (2) Construction			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					production and domestic activity areas Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 9000m^3, top soil backfill in a total volume of 9000 m^3 and land rehabilitation in a total area of 4.50hm^2 (newly included in the			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					technical design); Greening measures: 0.11hm^2 for garden land restoration, 2.71hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 4685m for temporary earth drainage gutter; 26 temporary sedimentation tanks; 7700m^2 for dense-mesh net (newly included in the technical design). (3) Temporary soil storage site Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored through land rehabilitation and			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					cut-over land restoration at the end of the construction stage. Structural measures: 18.05 hm^2 land rehabilitation (newly included in the technical design). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm^2 garden restoration and 2.22 hm^2 grass land restoration (newly included in the technical design). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m long temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (newly included in the technical design). (4) Borrow sites Water and soil			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					area should be restored in late construction stage through surface soil backfill and vegetation replanting Structural measures: 11,080 m^3 for surface soil removal, 11,080 m^3 for surface soil backfill, 36.95 hm^2 for land rehabilitation, 3,800 m long brick masonry drainage canal, and 15 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 36.95 hm^2 for grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design). Temporary measures: 1,000 m long retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design).			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					(5) Disposal sites Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should be built around the site. The disposal site should be restored at the end of the construction stage through surface soil backfill and vegetation replanting. Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (newly included in the technical design). Temporary measures: installation of 2,000 m^2 dense-mesh net (newly included in the technical design). ⑥ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m^3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary			

Table 11-9 Environmental impacts of He River-lake connection Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					drainage ditches.			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
Huangansi Drainage Canal Integrated Rehabilitation (C-1 Huangansi Drainage Canal Integrated Rehabilitation)	Design stage	Schematic design	Xiyue Street Historical and Cultural Quarter, residential buildings on Badaxi Road, Qianjin Road, Jiangbeizhong Road, Youxing Street and Xiyue Street	Flood risk to the Xiyue Street Historical and Cultural Quarter; impacts of river dredging odor on the residential buildings on Badaxi Road, Qianjin Road, Jiangbeizhong Road, Youxing Street and Xiyue Street	1. The design boundary is optimized based on the scope of preservation of the Xiyue Street Historical and Cultural Quarter and the area needed to be preserved is avoided. 2. Due to the perennial reception of domestic sewage along He River, Huangansi Drainage Canal is known for its poor water quality and odor sediments. Since the drainage canal is located in the urban center that is densely populated with limited space for operation, the optimized program chooses the underwater dredging method with suction sludge	/	FS unit	/

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					pump assisted with artificial operation. Water sealing plays a significant role in reducing odor emission and reducing the amount of odor generated from sludge agitation. 3. As the optimum choice, No. 1 dewatering site (river shores on the right bank of He River approximately 100m upstream from Lingfeng Bridge) is selected. It is located more than 100m away from the closest sensitive spot, helpful to avoid impacts on the environmentally sensitive sites from temporary storage and dewatering of sludge.			
	Construction stage	Civil works construction, construction material and earth and aggregate transportation, construction camps, access roads	Residential buildings at Badaxi Road, Qianjin Road, Jianshezhong Road, Youxing Street and Xiyue Street	Noises generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction	Requirements included in ESMP Annex 1: World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Embankment Construction Component	3	Construction contractor	Municipal EPB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				stage will generate certain impacts on sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork transportation vehicles in the construction stage will generate certain impacts on sensitive sites within a distance of 50m in the neighborhood. Poor management of				

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				construction wastes and debris, waste soil generated in the demolition of acquired buildings and construction of new buildings will cause impacts on the environment.				
			Right of way and temporary land use for the Project	Construction activities will result in additional soil erosion of 4.13hm^2 and 143t.	Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and land surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: 6,500 m^3 surface soil backfill (already included in the technical design).	3.6	Construction contractor	Municipal WRB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Greening measures: 21,528 m^2 greening, and 1,920 m^2 wetland planting (already included in the technical design). Temporary measures: temporary covering by 3,000 m^2 dense-mesh net (newly included in the technical design).			
		Operation of dredging vessel, operation of integrated sludge treatment facility, sludge dewatering and onsite dewatering	Water system of Huangansi Drainage Canal, areas along the sludge transportation routes	The dredging process will generate temporary disturbances to water systems and result in increased SS concentration and possibly fugitive odor in a small amount. Improper management of sludge dewatering or transportation process may cause secondary	1. Information on the construction plan, the environmental impact descriptions and sludge transportation route should be disclosed in time to the public. 2. The dredging operation should be conducted in the low-water season and the construction time should be shortened, if possible, to reduce disturbances to water systems. 3. The dredging method selected for Huangansi Drainage Canal is suction sludge pump plus artificial	5	Construction contractor	Municipal EPB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				pollution.	operation. The dredged sludge with a moisture content of 95% are conveyed through fecal suction truck to No. 1 dewatering site along He River. Interception and diversion + dry dredging method may be used for dredging provided that the construction condition permits (with the required operation space available for inner river interception and diversion) and a sound regional intercepting pipeline network is in place 4. Sludge is dewatered into sludge cakes with a moisture content of less than 50%, which are then transported in enclosed vehicles to Hezhou Municipal Domestic Solid Waste Landfill for disposal. 5. Construction plants involved in the dredging process must be subject to strict inspection to prevent oil leakage. Sewage and solid wastes must not be			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					cast into the water systems and should, instead, be collected and treated together with the other construction wastes. 6. Flood interception ditches should be excavated around the temporary sludge storage tanks on the dewatering site and connected to the wastewater sedimentation tanks. 7. Stormwater, tail water from sludge dewatering collected by the flood interception ditches should be discharged into the wastewater sedimentation tank for sedimentation before finally discharged into He River. 8. The sludge should be dewatered and transported out of site in a timely manner to avoid the generation of leachate due to excessive storage. 9. Quick lime and deodorants should be provided for sterilization			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					and deodorization of the dewatering site and labor protection devices such as masks should be provided to the construction workers.			
		Construction of civil works, transportation of construction materials and earth and stone materials	Ancient buildings in the Xiyue Street Historical and Cultural Quarter	No preserved ancient buildings are distributed in the construction area. However, poor construction management and uncivilized construction behaviors may lead to irrevocable consequences such as damage, contamination and even destruction of the preserved ancient buildings and sites.	The construction activities will be carried out in strict accordance with the requirements included in ESMP Annex 4: World Bank Financed Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project Management Plan of Physical Cultural Resources.	2	Construction contractor	Municipal CPPRFTB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
		Construction of civil works, transportation of construction materials and earth and stone materials	2 camphor trees and 1 banyan tree at Xinaner Street, 1 camphor tree at Xiyue Street	No famous or ancient trees are found in the project implementation area, but temporary borrow and dump of soil, stockpiling of construction wastes and movement of construction vehicles and plants on the construction sites may affect the normal growth of such trees in the vicinity with a distance of less than 50m.	1. Construction scope should be narrowed and construction period should be shortened as much as possible; 2. Tree felling, unlicensed transplanting, bark peeling, root digging and injection of toxic and hazardous substances to trees should be prohibited; 3. It is not allowed to construct buildings or structures, lay pipelines, install power cables, excavate borrow areas, mine sand and stone, flood or seal the ground, emit fumes, discharge wastewater and dump	/	Construction contractor	Municipal MEB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					solid wastes, stockpile or dump flammables, explosives or toxic and hazardous substances in the area with a distance of less than 5m from the outer edge of the crown shadow of trees. 4. It is not allowed to engrave, nail, wind, hang or support or stack articles on or around tree trunks; and 5. Construction vehicles and plants are not permitted to enter or roll the area with a distance of less than 5m from the outer edge of the crown shadow of trees.			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
		Excavations during civil works construction	Pipelines at the intersection between Huangansi Drainage Canal and Badaxi Road and Jianshezhong Road	Poor construction management may lead to interruption of underground pipelines.	1. The contractor should further coordinate with municipal and urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment and depth, and establish a pipeline coordination team. Prior approval should be obtained from municipal and urban development authorities for excavation interfering with underground pipelines. 2. Construction plan and emergency response	/	Construction contractor	Municipal HURB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					plan should be developed based on pipeline alignment and depth to avoid interference with existing underground pipelines as much as possible. 3. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities to be prepared for emergency responses.			
		Borrow fill and waste oil	Borrow area located 1.25km east of Xiadao Bridge in the	Borrow fill and waste soil for temporary land use,	(1) Construction access roads Prior to construction, top soil in the right of way will	1491.16	Construction contractor	Municipal WRB

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			eastern part of Hezhou Municipality, borrow area located at Hezhou Electronic Technology Ecological Industry Park and the construction waste disposal site located at Gonghe Village, Huangtian of Hezhou Municipality	construction access road and construction camp will result in soil erosion in a total area of 87.72hm^2 and an additional soil erosion of 100058t.	be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 41,600m^3, top soil backfill in a total volume of 41,600 m^3 and land rehabilitation in a total area of 20.82hm^2 (newly included in the technical design); Greening measures: 5.12hm^2 for forest land restoration, 7.04hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 138660m for temporary			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					earth drainage gutter; 139 temporary sedimentation tanks (newly included in the technical design). (2) Construction production and domestic activity areas Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 9000m^3, top soil backfill in a total volume of 9000 m^3 and land rehabilitation in a total area of 4.50hm^2 (newly included			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					in the technical design); Greening measures: 0.11hm^2 for garden land restoration, 2.71hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 4685m for temporary earth drainage gutter; 26 temporary sedimentation tanks; 7700m^2 for dense-mesh net (newly included in the technical design). (3) Temporary soil storage site Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored through land rehabilitation and cut-over land restoration at the end of the construction stage.			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Structural measures: 18.05 hm^2 land rehabilitation (newly included in the technical design). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm2 garden restoration and 2.22 hm^2 grass land restoration (newly included in the technical design). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758m long temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (newly included in the technical design). (4) Borrow areas Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting Structural measures: 11,080 m^3 for surface soil removal, 11,080 m^3 for surface soil backfill, 36.95 hm^2 for land rehabilitation,			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					3,800 m long brick masonry drainage canal, and 15 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 36.95 hm^2 for grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design). Temporary measures: 1,000 m long retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design). (5) Waste disposal sites Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should be built around the site. The disposal site should be restored at the end of the construction stage through surface soil backfill and vegetation replanting. Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3 for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (newly			

Table 11-10 Environmental Impacts of Huangansi Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					included in the technical design). Temporary measures: installation of 2,000 m^2 dense-mesh net (newly included in the technical design). ⑦ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
Shizigang Drainage Canal Integrated Rehabilitation	Design stage	Schematic design	Residential buildings at Wanquan Street, Zhushan Road, Longxing Road,	Dredging odor will generate impacts on residential buildings at	1. Due to the perennial reception of domestic sewage along He River, Shizigang Drainage Canal is known for its poor water	/	FS unit	/

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
(C-2 Shizigang Drainage Canal Integrated Rehabilitation)			and Yinhe Street; office building of Hezhou Land and Resources Bureau, office building and staff dormitory building of Guidong Electricity Bureau, residential buildings at Wangjiao Road, Jianshe Road, Longshan Road, Xingguang Road; shops and swimming pool of Hezhou Water Resources Bureau, residential building at Pinganxi Road, office building of Hezhou Health and Family Planning Committee, office building and staff	Wanquan Street, Zhushan Road, Longxing Road, and Yinhe Street; office building of Hezhou Land and Resources Bureau, office building and staff dormitory building of Guidong Electricity Bureau, residential buildings at Wangjiao Road, Jianshe Road, Longshan Road, Xingguang Road; shops and swimming pool of Hezhou Water Resources Bureau,	quality and odor sediments. Since the drainage canal is located in the urban center that is densely populated with limited space for operation, the optimized program chooses the underwater dredging method with suction sludge pump assisted with artificial operation. Water sealing plays a significant role in reducing odor emission and reducing the amount of odor generated from sludge agitation. 2. As the optimum choice, No. 1 dewatering site (river shores on the right bank of He River approximately 100m upstream from Lingfeng Bridge) is selected. It is located more than 100m away from the closest sensitive spot, helpful to avoid impacts on the environmentally sensitive sites from temporary storage and dewatering of sludge. 3. Upon transformation of			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			dormitory building of Babu District Transportation Bureau, residential buildings at Jiangbeizhong Road	residential building at Pinganxi Road, office building of Hezhou Health and Family Planning Committee, office building and staff dormitory building of Babu District Transportation Bureau, residential buildings at Jiangbeizhong Road. Blind-to-open canal transformation will generate impacts travelling convenience of residential buildings at Yinhe Street, office building	blind canal to open canal, the optimized program considers the construction of one small overbridge each at Yinhe Street, the Land & Resources Bureau and Guidong Electricity Bureau to mitigate impacts on travelling of local residents due to such transformation.			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				of Hezhou Land & Resources Bureau, office building and staff dormitory building of Guidong Electricity Bureau.				
	Construction stage	Civil works construction, construction material and earth and aggregate transportation, construction camps, access roads	Residential buildings at Wanquan Street, Zhushan Road, Longxing Road, and Yinhe Street; office building of Hezhou Land and Resources Bureau, office building and staff dormitory building of Guidong Electricity Bureau, residential buildings at Wangjiao Road, Jianshe Road, Longshan Road,	Noises generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction stage will generate certain impacts on sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork	Requirements included in ESMP Annex 1: World Bank Financed Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Embankment Construction Component.	10	Construction contractor	Municipal EPB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			Xingguang Road; shops and swimming pool of Hezhou Water Resources Bureau, residential building at Pinganxi Road, office building of Hezhou Health and Family Planning Committee, office building and staff dormitory building of Babu District Transportation Bureau, residential buildings at Jiangbeizhong Road	excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork transportation vehicles in the construction stage will generate certain impacts on sensitive sites within a distance of 50m in the neighborhood. Poor management of construction wastes and debris, waste soil generated in the demolition of acquired buildings and construction of new buildings				

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				will cause impacts on the environment.				
			Right of way and temporary land use for the Project	Construction activities will result in additional soil erosion of 13.62hm^2 and 1045t.	Reusable surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and land surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Structural measures: 3,990 m long bio-swale, 2,247 m long covered drainage canal, and 9,000 m^3 surface soil backfill (already included in the technical design). Greening measures:	6	Construction contractor	Municipal WRB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					23,340m^2 three-dimensional geo-technical net embankment slope covered with grass, 30,057 m^2 greening, and 3,990 m^2 wetland planting (already included in the technical design). Temporary measures: temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).			
		Operation of dredging vessel, operation of integrated sludge treatment facility, sludge dewatering and onsite dewatering	Water system of Shizigang Drainage Canal, areas along the sludge transportation route	The dredging process will generate temporary disturbances to water systems and result in increased SS concentration and possibly fugitive odor in a small	1. Information on the construction plan, the environmental impact descriptions, dredger operation route and sludge transportation route should be disclosed in time to the public. 2. The dredging operation should be conducted in the low-water season and	5	Construction contractor	Municipal EPB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				amount. Improper management of sludge dewatering or transportation process may cause secondary pollution.	the construction time should be shortened, if possible, to reduce disturbances to water systems. 3. The dredging method selected for Shizigang Drainage Canal is suction sludge pump plus artificial operation. The dredged sludge with a moisture content of 95% are conveyed through fecal suction truck to No. 1 dewatering site along He River. Interception and diversion + dry dredging method may be used for dredging provided that the construction condition permits (with the required operation space available for inner river interception and diversion) and a sound regional intercepting pipeline network is in place. 4. Sludge is dewatered into sludge cakes with a moisture content of less than 50%, which are then transported in enclosed vehicles to			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Hezhou Municipal Domestic Solid Waste Landfill for disposal. 5. Construction plants and vessels involved in the dredging process must be subject to strict inspection to prevent oil leakage. Sewage, solid wastes and oily wastewater from vessel cabins must not be cast into the water systems and should, instead, be collected and treated together with the other construction wastes. 6. Flood interception ditches should be excavated around the temporary sludge storage tanks on the dewatering site and connected to the wastewater sedimentation tanks. 7. Stormwater, tail water from sludge dewatering collected by the flood interception ditches should be discharged into the wastewater sedimentation			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					tank for sedimentation before finally discharged into He River. 8. The sludge should be dewatered and transported out of site in a timely manner to avoid the generation of leachate due to excessive storage. 9. Quick lime and deodorants should be provided for sterilization and deodorization of the dewatering site and labor protection devices such as masks should be provided to the construction workers.			
		Blind-to-open canal transformation	Residential building at Yinhe Street, office building of Hezhou Land & Resources Bureau, office and staff dormitory buildings of Guidong Electricity Bureau	Interrupted operation of shops at Yinhe Street will generate impacts on income of business owners. Some parking spaces in Hezhou Land & Resources	1. Impacts on the normal operation of shops at Yinhe Street, Hezhou Land & Resources Bureau and Guidong Electricity Bureau will be mitigated mainly through implementation of LAR and compensation measures detailed in the RP. 2. Impacts on the parking lot of the Land & Resources Bureau may be mitigated	/	Construction contractor	MEB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				Bureau will become no longer usable, imposing pressure on office parking for this unit.	through diversion of traffic, restricting access of vehicles of other organizations, which may be diverted to the parking lots in the vicinity.			
		Excavations during civil works construction	Pipelines at the intersection between Shizigang Drainage Canal and Guposhan Avenue, Wanquan Street, Zhushan Road, Badaxi Road, Yinhe Street, Jianshezhong Road, Pinganxi Road, Longshan Road, Anshanxi Road, Xingguang Road, Pinganxi Road and the Transportation Bureau at Jiangbeizhong Road	Poor construction management may lead to interruption of underground pipelines.	1. The contractor should further coordinate with municipal and urban development authorities during construction for collection of underground pipeline information including pipeline type, alignment and depth, and establish a pipeline coordination team. Prior approval should be obtained from municipal and urban development authorities for	/	Construction contractor	Municipal HURDB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					excavation interfering with underground pipelines. 2. Construction plan and emergency response plan should be developed based on pipeline alignment and depth to avoid interference with existing underground pipelines as much as possible. 3. In the event of interference with existing pipelines, the concerned authority should be informed of particular construction location and schedule of excavation activities to be prepared for emergency responses.			
		Borrow fill and	Borrow area	Borrow fill and	(1) Construction access	1491.16	Construction	Municipal

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
		waste oil	located 1.25km east of Xiadao Bridge in the eastern part of Hezhou Municipality, borrow area located at Hezhou Electronic Technology Ecological Industry Park and the construction waste disposal site located at Gonghe Village, Huangtian of Hezhou Municipality	waste soil for temporary land use, construction access road and construction camp will result in soil erosion in a total area of 87.72hm^2 and an additional soil erosion of 100058t.	roads Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 41,600m^3, top soil backfill in a total volume of 41,600 m^3 and land rehabilitation in a total area of 20.82hm^2 (newly included in the technical design); Greening measures: 5.12hm^2 for forest land restoration, 7.04hm^2 for grassland restoration (newly included in the technical design);		contractor	WRB

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Temporary measures: 138660m for temporary earth drainage gutter; 139 temporary sedimentation tanks (newly included in the technical design). (2) Construction production and domestic activity areas Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 9000m^3, top soil backfill in a total volume of 9000 m^3 and land rehabilitation in a total			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					area of 4.50hm^2 (newly included in the technical design); Greening measures: 0.11hm^2 for garden land restoration, 2.71hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 4685m for temporary earth drainage gutter; 26 temporary sedimentation tanks; 7700m^2 for dense-mesh net (newly included in the technical design). (3) Temporary soil storage site Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored through land rehabilitation and cut-over land restoration at the end of the construction stage.			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Structural measures: 14.75 hm^2 land rehabilitation (newly included in the technical design). Greening measures: 4.31 hm^2 forest land restoration and 2.42 hm^2 grass land restoration (newly included in the technical design). Temporary measures: installation and removal of 6,985 m long temporary straw bag stuffed with soil, 7,085 m long temporary earth drainage canal, and 47 temporary sedimentation tanks, and 173,800 m^2 dense-mesh net (newly included in the technical design). (4) Borrow areas Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage through surface soil backfill and vegetation replanting Structural measures: 11,080 m^3 for surface soil removal, 11,080 m^3 for surface soil backfill, 36.95 hm^2 for land rehabilitation, 3,800 m long brick masonry drainage canal, and 15 brick masonry sedimentation tanks (newly			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					included in the technical design). Greening measures: 36.95 hm^2 for grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design). Temporary measures: 1,000 m long retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design). (5) Disposal sites Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					wall, masonry drainage canal and various drainage structures should be built around the site. The disposal site should be restored at the end of the construction stage through surface soil backfill and vegetation replanting. Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3 for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500 bushes (newly included in the technical design). Temporary measures: installation of 2,000 m^2 dense-mesh net (newly			

Table 11-11 Environmental Impacts of Shizigang Drainage Canal Integrated Rehabilitation Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					included in the technical design). ⑧ Mud transfer tank: Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
Drainage system improvement (C-3 Jiangnan WWTP and associated pipeline and road construction	Design stage	Schematic design	Sensitive sites around the WWTP, water quality of He River	Impacts on the environmentally sensitive sites from operation of WWTP; impacts on water quality of He River from accidental discharge of WWTP	1. The WWTP siting should be optimized and the area east of the planned Jiangnan District of Hezhou, east of Luo-Zhan Railway, south of He River and west of Songbozhai of Gubai Village is recommended as the WWTP site to reduce resettlement and avoid impacts on environmentally sensitive sites. 2. In order to reduce the impacts of noises generated in the operation of the pumps and equipment in the WWTP, well-designed and low-noise mechanical equipment is selected and vibration insulation and control measures are adopted where possible during installation and operation to reduce noise; the robust structure and evenly grouted bases of the pump equipment can absorb vibrations and provide a solid support to the base	/	FS unit	/

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					plate. Through reasonable arrangement of sound absorbing materials and vibration reduction devices, e.g. asbestos boards and shock absorbers, on the inner walls, ceilings, floors and beside the equipment in the pump station helps to effectively control and eliminate spread and reflection of noises. 3. A certain allowance will be considered in the WWTP design to keep a certain buffer in accident state and avoid impacts on the water quality of He River from accidental discharge.			
	Construction stage	Construction of civil works, transportation of construction materials and earth and aggregates, construction camps, access roads, etc.	Residential buildings at Niupailan	Noises generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction stage will generate certain impacts on	Requirements included in ESMP Annex 3: World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Road and Pipeline Construction Component will be implemented.	5	Construction contractor	Municipal EPB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork transportation vehicles in the construction stage will generate certain impacts on sensitive sites within a distance of 50m in the neighborhood. Poor management of construction wastes and debris, waste soil generated in the demolition of				

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				acquired buildings and construction of new buildings will cause impacts on the environment.				
			Right of way and temporary land use for the Project	Construction activities will result in soil erosion in a total area of 34.12hm^2 and an additional soil erosion of 2949t.	(1) Jiangnan WWTP and Associated pipeline networks Surface soil in disturbed area should be removed and stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Temporary drainage canals and other drainage structures should be built on	38.36	Construction contractor	Municipal WRB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					site. Structural measures: removal of 5,000 m^3 surface soil, 5000 m^3 surface soil backfill and 800 m long stormwater pipelines (already included in the technical design). Greening measures: 0.96 hm^2 landscaping and greening (already included in the technical design). Temporary measures: 880 m long temporary earth drainage canal, 4 temporary sedimentation tanks, and temporary covering by 1,000 m^2 dense-mesh net (newly included in the technical design). (2) Binjiangnan Road Surface soil in disturbed area should be removed and			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					stored in designated area before construction. Cut slope and ground surface with vegetation being removed should be covered with dense-mesh net for protection during construction and restored through soil covering and greening in later stage. Temporary drainage canals and other drainage structures should be built on site. Structural measures: removal of 99500 m^3 surface soil, 99500 m^3 surface soil backfill and 5,560 m long stormwater pipelines (already included in the technical design). Greening measures: 146126m^2 embankment			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					greening and21770m^2 road greening (already included in the technical design). Temporary measures: 11,120 m temporary earth drainage canal, 20 temporary sedimentation tanks, and temporary covering by 5,000 m^2 dense-mesh net (newly included in the technical design).			
		Borrow fill and waste oil	Borrow area located 1.25km east of Xiadao Bridge in the eastern part of Hezhou Municipality, borrow area located at Hezhou Electronic Technology Ecological Industry Park and the	Borrow fill and waste soil for temporary land use, construction access road and construction camps will result in soil erosion in a total area of 87.72hm^2 and an additional soil erosion of 100058t.	(1) Construction access roads Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will	1491.16	Construction contractor	Municipal WRB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
			construction waste disposal site located at Gonghe Village, Huangtian of Hezhou Municipality		be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 41,600m^3, top soil backfill in a total volume of 41,600 m^3 and land rehabilitation in a total area of 20.82hm^2 (newly included in the technical design); Greening measures: 5.12hm^2 for forest land restoration, 7.04hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 138660m for temporary earth drainage gutter; 139 temporary sedimentation tanks (newly included in the technical design). (2) Construction production and domestic activity areas Prior to construction, top soil in the right of way will be removed and stockpiled on a temporary stockpiling site in the construction area of the main stream rehabilitation works of He River. In the			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					meanwhile, temporary drainage and sedimentation measures will be taken on both sides of the road and land rehabilitation and cut-over land restoration will be conducted in the late stage of the Project. Structural measures: top soil removal in a total volume of 9000m^3, top soil backfill in a total volume of 9000 m^3 and land rehabilitation in a total area of 4.50hm^2 (newly included in the technical design); Greening measures: 0.11hm^2 for garden land restoration, 2.71hm^2 for grassland restoration (newly included in the technical design); Temporary measures: 4685m for temporary earth drainage gutter; 26 temporary sedimentation tanks; 7700m^2 for dense-mesh net (newly included in the technical design). (3) Temporary soil storage site			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					Straw bag stuffed with soil will be placed and temporary drainage and sedimentation structures should be built around the site before construction. Temporary soil storage site should be covered during and restored through land rehabilitation and cut-over land restoration at the end of the construction stage. Structural measures: 18.05 hm^2 land rehabilitation (newly included in the technical design). Greening measures: 4.31 hm^2 forest land restoration, 1.38hm^2 garden restoration and 2.22 hm^2 grass land restoration (newly included in the technical design). Temporary measures: installation and removal of 8658 m long temporary straw bag stuffed with soil, 5758 m long temporary earth drainage canal, and 53 temporary sedimentation tanks, and 206250 m^2 dense-mesh net (newly			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					included in the technical design). (4) Borrow sites Water and soil conservation measures for borrow area are not included in project technical design, which should be a comprehensive system composed of structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Excavation during construction should be done from top to bottom and bench by bench to form stable cut slope. Retaining wall of soil bags should be built along slope bottom and bare ground surface should be covered with dense-mesh net. Temporary drainage canals and structures should be built around the site. The borrow area should be restored in late construction stage			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					through surface soil backfill and vegetation replanting Structural measures: 11,080 m^3 for surface soil removal, 11,080 m^3 for surface soil backfill, 36.95 hm^2 for land rehabilitation, 3,800 m long brick masonry drainage canal, and 15 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 36.95 hm^2 for grass planting, planting of 46,187 pines and 92,375 bushes (newly included in the technical design). Temporary measures: 1,000 m long retaining wall for temporary storage site and 36,000 m^2 dense-mesh net (newly included in the technical design). (5) Waste disposal sites Water and soil conservation measures for disposal site are not included in project technical design, which should be a comprehensive system composed of			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					structural measures, planting measures and temporary measures. Surface soil should be removed and be stored in temporary storage site before construction. Retaining wall, masonry drainage canal and various drainage structures should be built around the site. The disposal site should be restored at the end of the construction stage through surface soil backfill and vegetation replanting. Structural measures: 22,200 m^3 for surface soil removal, 22,200 m^3 for surface soil backfill, 7.4 hm^2 for land rehabilitation, 150 m long masonry retaining wall, 1,100m long masonry interception/drainage canal, and 4 brick masonry sedimentation tanks (newly included in the technical design). Greening measures: 7.4 hm^2 grass planting, planting of 9,250 pines and 18,500			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					bushes (newly included in the technical design). Temporary measures: installation of 2,000 m^2 dense-mesh net (newly included in the technical design). Mud transfer tanks: Temporary measures: 21 mud transfer tanks to be provided; 11193m3 for earthwork excavation and backfill; 861m^3 for fencing and demolition of earth-filled woven bags; 495m for temporary drainage ditches.:			
	Operation stage	WWTP operation	WWTP site and its neighborhood	Impacts generated by odor, noise and sludge generated in the operation of the WWTP	1. Measures of odor collection and biological deodorization will be taken for the key odor-generating structures such as influent pump station, aeration tank, sludge concentration tank, and sludge dewatering workshop. 2. A health protection distance of 100m is set on the periphery of the major odor-generating structures such as influent pump house, aeration tank, sludge concentration tank and sludge dewatering workshop.	30	Operator	Municipal EPB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					3. Maintenance and servicing of water pumps should be strengthened by means of periodical inspection of electric motor and pump axle concentricity and assuring excellent lubrication of axles so as to reduce wearing of pump parts. 4. A greenbelt around the pump house should be constructed through inter-planting trees and bushes to improve landscaping and reduce waste gas, noise and odor impacts on surrounding environment. Tree species with strong pollution resistance should be selected. 5. Sludge generated from Jiangnan WWTP is transported to Guangxi Hezhou Sludge Harmless Treatment Project for dewatering and then to Hezhou Solid Waste Landfill for disposal.			
			WWTP staff	In the operating environment,	1. Proper protective clothes, gloves and respiration mask	20	Operator	Municipal

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				staff of Jiangnan WWTP is extensively exposed to wastewater or sludge containing various pathogenic bacteria and parasitic ovum. Mist and vapor generated by wastewater treatment facility could spread bacteria and virus. Exposed to microorganisms in wastewater and sludge, operation staff of WWTP may be infected and catch disease.	should be provided for WWTP workers. Anti-skid shoes should be provided for transportation workers and steel-toe shoes should be provided for all the workers to prevent foot injury. Workers working near high-noise equipment should be provided with noise protective devices. Workers operating near heavy movable equipment, bucket, crane and transportation vehicle dumping site should be equipped with safety helmet. Guardrails should be installed around all the process containers and water tanks. Lifeline and personal floating device should be available for use when operators are working within the guardrails, to make sure life saving devices being in place in emergencies. 2. Dangerous contact should be reduced through design and development of			Occupational Disease Prevention and Control Center

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					technical and material specifications (e.g. ventilation, air conditioning, enclosed conveyor belt, low-load and different heights, anti-skid floor, safety guardrails for stairways and aisles, spill protection and leakage prevention, noise control, dust prevention measures, gas alarm system, fire alarm and control system, and evacuation devices). 3. Bathroom and dressing area should be provided for the operators for after-work bath and dressing, and work clothing laundry service should be provided. Additionally, frequent hand washing of WWTP staff should be encouraged. 4. Enclosed space access plan conforming to the national requirements and internationally recognized standards should be developed for construction activities in enclosed treatment zone. Ventilation			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					is mandatory before entering. Operators should be equipped with gas detector and valve connected with process container should be locked to prevent accidental overflow during maintenance. 5. Eating, smoking and water drinking should be banned outside the designated area. 6. Operators should be separated from bacteria spreading channels via mechanical overturning (e.g. use of tractor or front-end loader with enclosed air conditioning or heating driver cab). Ventilation system should be provided in case of manual overturning.			
		Accidental discharge of WWTP	Water quality of He River	In the event of an accidental discharge from Jiangnan WWTP, a 10 m wide and 220 m long area	1. Emergency response measures against instable water supply caused by various factors should be fully considered in the design to mitigate the adverse conditions.	20	Operator	Municipal EPB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				downstream of the outlet will experience non-compliant COD discharge higher than the standard by a factor of 15.10. In such an event, the water quality of He River will be affected to a certain extent and such event may even lead to non-compliance in a certain area in the downstream section.	2. A WWTP operation management and accountability system should be set up. 3. Management and operation staff training should be organized and technical examination files developed. Those who fail such examination shall not be allowed to take the post. Experienced technical professionals should be employed to be responsible for internal technical management work; professional and technical personnel should be selected to take part in domestic or international technical training. 4. Inspection of water conveyance pipelines should be strengthened so that problems are identified and addressed in a timely manner. 5. Multiple stand-by equipment should be provided for vulnerable equipment and adequate spare parts required for			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					maintenance and upgrading should be assured. The mechanical and electronic equipment in the treatment system should at least have one in operation and one stand-by. 6. High quality equipment should be selected. The various machines, electrical appliances and instruments in the treatment facilities should be products of high quality and low fault rate that satisfy the design requirements and are suitable to long-term operation and easy maintenance. 7. During operation, the on-duty operators must operate in strict accordance with the rules and regulations of the treatment facilities, conduct frequent inspections and carry out timely maintenance and servicing to reduce the fault rate. 8. The electrical equipment should follow the requirements of grounding protection specifications and			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					be equipped with automatic tripping circuit. Operation of key equipment is subject to computer digital monitoring to enable timely alarms and recording of location, nature and time of occurrence of accidents so that timely repair can be organized. The installation protections for all electrical equipment must satisfy the relevant safety requirements for electrical equipment. 9. Dual feed electricity supply should be adopted to assure normal operation of the electricity supply facilities and lines.			
		Accidental leakage due to broken sewage pipeline	Surface water, ground water and soil around the pipelines	As a result of leakage of sewage pipelines, collection of wastewater will become unlikely and untreated wastewater will be discharged into surface waters, causing	1. Upon pipeline design, suitable pipe material should be selected based on the specific conditions and characteristics of the city where they are located and actions should be taken to assure pipeline quality and service life. The groundwork of pipeline drainage works must satisfy the mechanical design requirements, with	10	Operator	Municipal EPB

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
				impacts on surface water environment. Wastewater leaked from pipelines will permeate into the ground, not only polluting the soil and sanitation environment, but also generating adverse impacts on water quality of ground water.	corresponding actions taken where such requirements are failed. Such groundwork should be constructed in strict accordance with the width, thickness and strength required in the design drawing for quality assurance. 2. Inspections should be carried out accordingly before pipeline laying. On one hand, pipes delivered to site should be carefully inspected to avoid situations where pipes with cracks or voids are laid in the trenches; on the other hand, centerlines and side lines of pipeline foundation and size and strength of manhole foundation should be carefully checked against the drawings; finally, location and distance of manholes, concrete strength at all locations and mix ratio of waterproof mortar at all junctions must be checked against the national standards. 3. Upon pipeline installation, cement mortar needed for			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					plaster band should be prepared according to the specified mix ratio. Stand-up seams often occur due to pressing upon the installation of junctions between two drainage pipelines. In order to assure smooth flow of the drainage pipelines, the stand-up seams at the junctions should be handled in time to avoid reduction of flow section, impacts on flow speed and even accumulation of debris in and even obstruction of pipelines. 4. Trench backfill should not be conducted until the cradle concrete and plaster band mortar reach a certain strength and direct impact by aggregates on the pipes should be avoided. Large rocks, bricks and hard substances should not be present in the aggregates. Backfill and compaction on both sides of the pipeline should be conducted simultaneously while that on the top should be conducted			

Table 11-12 Environmental Impacts of the Drainage System Improvement Subproject and their Mitigation Measures

Name of subproject	Stage	Activity	Environmentally sensitive spot	Potential impact	Mitigation / control measures	Environmental protection investment (CNY10000)	EA	Supervision agency
					in layers to form a mass of integral stress which can disperse and discharge the stress over the crest to protect pipeline safety. 5. In the operation stage of the Project, the EA should set up a sound pipeline management system to enable timely dredging and renewal of pipelines and avoid possible contamination of surrounding waters and ground water from sewage leakage.			

Table 11-13: Environmental impacts and mitigation measures for the Technical Assistance Management Subproject

Sbuproject	Period	Activity	Environmentally sensitive site	Potential impact	Mitigation/prevention measures	Environmental protection investment (CNY10000)	EA	Supervisory agency
Technical assistance management (E-1: River governor system + Internet intelligent management and control system)	Construction stage	Hydrological station construction	/	Noises generated in the operation of excavators, bull dozers, dump trucks and other construction plants used in the construction stage will generate certain impacts on sensitive sites within a distance of 30m in the neighborhood. Dust generated in earthwork excavation, stockpiling, backfill, pedestrian and motor vehicle movement, spillage from earthwork transportation vehicles in the construction stage will generate certain impacts on sensitive sites within a distance of 50m in the neighborhood.	Requirements included in ESMP Annex 2: World Bank Loan Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project ECOP for Small Waterworks Construction Component will be implemented.	1	Construction contractor	HEPB

				Poor management of construction wastes and debris, waste soil generated in the demolition of acquired buildings and construction of new buildings will cause impacts on the environment.				
Technical assistance management (E-2: He River Watershed water environment monitoring, early warning and integrated management system)	Operation stage	Laboratory operation	Around the laboratory	The wastewater containing strong acid, strong alkaline or toxic substances will generate serious enviornmental pollution if directly discharged into the natural environment. Exhaust gas will cause hazard to laboratory staff while the waste drugs and test reagents are hazardous wastes to the environment if not properly disposed.	1. The wastewater, exhaust gas and solid wastes in the laboratories must be properly treated according to the national laws and regulations on environmental protection and random dumping, storage and discharge are prohibited. 2. Acid and alkaline waste liquid generated in the process of test and analysis and waste liquid containing highly toxic drugs must be dumped into the waste liquid cylinders for the right classification and delivered to the waste liquid storage	/	Owner	HEPB

					room for centralized treatment by a qualified unit. 3. Digestion of specimens must be conducted in a ventilated cupboard and all the exhaust gas generated must be discharged at high altitude via the air duct. 4. Wastes generated in the process of testing and analysis shall be handled in such a way that intoxic wastes are dumped into the garbage bins, contaminating wastes are collected and delivered to the waste storage room for centralized treatment by a qualified unit. 5. Proper preventive measures should be taken against fire, burglary and poisoning hazards and risks. Fire protection devices and necessary poison prevention facilities should be provided in the laboratory. 6. Flammables, explosives and toxic substances must be properly stored, claimed			

					and registered according to the respective stipulations. 7. Smoking, laundry, cooking and storage of personal food in the refrigerators are prohibited in the laboratory. Loud noises and frolic are banned during test operation. 8. The codes of operation should be strictly followed.			

Table 11-14: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
Permanent land acquisition	State-owned land: 47.13 mu Floodplain: 34.57 mu	All affected families (AFs) will receive cash compensation.	1. State-owned floodplain land involves no compensation as the implementation of the Project will not lead to any changes of the nature and ownership relationship of such land. 2. State-owned allocated land will be replaced with state-owned land of the corresponding area to be allocated in the vicinity under the Project. 3. Young crop compensation per mu of floodplain land: CNY 2100 /mu	PMO, Owner, HDAO
	3713.28 mu collective land in total, including 972.08mu for paddy field,1249.93 mu for dry land, 533.52 mu for forest land and 957.75mu for other types of land. AFs: 759; affected persons (AP): 4563.	4563 persons from 759 households	1. Land acquisition compensation: CNY 60,500 per mu of paddy field; CNY 51,800 per mu of dry land; CNY 47,000 per mu of forest land. To be prudent, the compensation criteria for other types of land is set at CNY 47,000 /mu. 2. Crop compensation: CNY 1600-2100/mu depending on the crop types. 3. Compensated land: the planned industrial land equal to 10% of acquired agricultural land will be allocated to the affected rural collective economy organizations. 4. All APs will receive: i) employment and revenue generation opportunities during project implementation; ii) free employment supports and vocational training. 5. Registered population at or above the age of 16 entitled to rural collectively-owned land contracting at the time of land acquisition will receive subsidies for rural pension insurance to the farmers who lost their land. Such subsidies will be calculated based on the number of people affected by, and the frequency and scope of land acquisition. The minimum subsidy for each land acquisition equals 60% of the average wage of workers employed by urban units in the region in the previous year times the per capita area of land acquired from local farmers. Where the per capita area of land acquired from local farmers exceeds 8 mu after one or multiple land acquisitions, the surplus part will not receive any pension insurance subsidy. Where a farmer household whose land is totally acquired and the per capita area of land acquired	PMO, Owner, HDAO

Table 11-14: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			from the affected HHs is less than 1 mu, the subsidy will be calculated on the basis of 1 mu.	
Temporary land occupation	Total land occupation: 1045.67 mu, including 434.96 mu paddy field, 423.58mu dry land; 187.13mu forest land; AFs: 307; AP: 1849.	1849 persons from 307 households	Compensation for temporary land occupation: CNY 3900 per mu of paddy field; CNY 3400 per mu of forest land	PMO, Owner; HDAO
Residential houses and ancillary and temporary structures	1. Demolition of urban residential houses: 37465.31m^2, brick and concrete structure; AFs: 317; APs: 1268. 2. Demolition of urban temporary houses: 18689.74 m^2.	1268 persons from 317 households	1. The PMO provides two types of resettlement for households affected by housing acquisition to choose from at free will: monetary compensation and property right replacement. 2. Monetary resettlement: monetary compensation (generally higher than the replacement price) is provided for all persons whose houses are demolished. Such compensation includes housing compensation and housing decoration compensation after assessment. Housing compensation and housing decoration compensation: The assessment is conducted by an intermediary agency with good credit-standing and good reputation commissioned under joint agreement by the demolishing party and the affected party and the compensation is effected based on the assessed price. 3. Property right replacement: built housing is provided and housing decoration is compensated. Provision of built housing in the ratio of 1:1. If the area of built housing is greater than the demolished area, the relocated family needs to buy the exceeding area at market price. Provision of housing decoration compensation. The construction unit and the relocated family will commission an independent qualified intermediaries to assess the value of decoration, based on which monetary compensation will be provided. 4. Provision of relocation subsidy and temporary housing subsidy at a rate of CNY 10 / m^2 or provision of public housing.	PMO, Owner; HDAO

Table 11-14: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			5. Provision of CNY 5,000/family as an one-off incentive to those who sign the LAR compensation agreement and hand over the housing within the specified deadline. 6. Cash compensation will be made for urban temporary housing at a price assessed based on market price by an independent and qualified intermediary comissioned jointly by the construction unit and the relocated household.	
	1. Demolition of rural residential houses: 55742.29 m^2; brick and concrete structure; AFs: 373; APs: 1837. 2. Demolition of rural ancillary houses: 30588.89 m^2.	1837 persons from 373 households	1. The PMO provides two types of resettlement for households affected by housing acquisition to choose from at free will: monetary compensation and homestead replacement. 2. Monetary compensation is made based on the housing replacement price of CNY 1000 to 1300/m^2 for brick structure. For households choosing monetary replacement for their main houses, compensation on the main house homestead will be made at the assessed land price for reallocation of resettlement homestead. 3. Homestead resettlement: Each household is entitled to one homestead and each demolished homestead will be compensated with one resettlement homestead in an area of no more than 120m^2; the inadequate part will be compensated at the assessment price. The main house to be demolished will be compensated for at the replacement price of the same standard as for monetary compensation of CNY 1000 to 1300 for brick structures. The government will be responsible for providing water supply, power supply, access road and site leveling for the resettlement area as well as the supporting public infrastructures such as schools and hospitals; water and electricity will be delivered to the gate of each household and then connected by the household into their houses. 4. Provision of relocation subsidy and temporary housing subsidy at a rate of CNY 10 / m^2. 5. Provision of CNY 5,000/family as an one-off incentive to those	

Table 11-14: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
			who sign the LAR compensation agreement and hand over the housing within the specified deadline. 6. Monetary compensation will be provided for rural ancillary housing unexceptionally at a standard of CNY 100-700/m^2 depending on the building structure. Compensation fo the acquired land will be made at the standard for acquisition of rural homesteads.	
Government, public institutions and enterprises	Totally 11 government, public institutions and enterprises will be affected with a demolition area of 14249.54 m^2	Hezhou Municipal Land Resources Bureau (LRB), Health and Family Planning Commission, Hezhou WRB, Transportation Bureau of Babu District, Guangxi Guidong Electric Power Limited Company, Yingshi Primary School of Huangshi Town, Xiadao Power Station of Hezhou Pengyuan Hydropower Development Limited Company, Fanglin Hydropower Station of Hezhou Minfeng Industrial Limited Company, Hezhou Huangshi Power Station Limited Company	Relocation and reconstruction of Hezhou Health and Family Planning Commission and Babu District Transportation Bureau. Hezhou WRB and LRB choose monetary compensation for the demolished buildings. Guidong Electric Power Limited Company: monetary compensation for its office building to be demolished at assessed value and new office building will be constructed. Yingshi Primary School and Xiadao Primary School: relocation. Hezhou Minfeng Industrial Limited Company and Hezhou Huangshi Power Station Limited Company: monetary compensation for the production losses due to stoppage during project construction.	PMO, Owner; HDAO
Shops	Demolition of shops: 7458.93m^2; AFs: 124; APs: 527	527 persons from 124 affected shop tenants.	Compensation for the business losses and relocation cost to be made on the basis of replacement price ratified according to the relevant compensation standard.	PMO, Owner; HDAO

Table 11-14: Summary of LAR and Social Impacts and Mitigation Measures

Type of impact	Degree of impact	Eligible beneficiary of compensation	Compensation policy and standard	Responsible agency
Land attachments	Sewers: 220 m; Tombs: 53; power poles: 42; communication poles: 22; bamboo: 26489; wall: 700m^2; trees: 15162; transformer: 1 set.	All APs or owners will receive equivalent cash compensation. The land attachments planted or constructed after the cut-off date will not be compensated.	The APs will receive cash compensation. Sewage pipe: CNY 300/m; power pole: CNY 150 each; communication pole: CNY 150 each; wall: CNY 70 /m^2; bamboo: CNY 1-4 / per bamboo; trees: CNY 10-180 / tree; graves: CNY 5500 each. The trees described above will be compensated at the actual assessed value on the basis of the guiding price.	PMO, Owner; HDAO
Vulnerable group	83HH, 273 persons	All affected vulnerable groups	(7) The local Civil Affairs Bureau and the Labor and Social Security Bureau will be responsible for including these families in the social security schemes. (8) Provision of pension insurance. (9) Provision of new rural cooperative medical insurance paid by the collective unit. (10) The local rural credit cooperatives and banks can provide the vulnerable groups with small loans. (11) Provision of project-related employment opportunities. (12) Provision of project-related vocational trainings to vulnerable groups.	PMO, Owner; HDAO
Female		4148 persons	(5) Create employment and livelihood opportunities for women. (6) Ensure women participation. (7) The local government and resettlement office shall ensure the female has the same rights as male in terms of land property. (8) Gender discrimination shall be eliminated to encourage women to create their own business.	PMO, Owner; HDAO

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
1	Guishi Reservoir Dam in Hezhou City	Reservoir risk elimination and rehabilitation was inspected and accepted by Guangxi Autonomous Region Water Resources Department in 2015. The reservoir has gone through extremely heavy flood in 2015 and is under safe operation. Issues include unclear responsibility allocated for auxiliary dam management, lack of observation data processing and analysis capacity by dam safety monitoring staff, and need for landslide mass treatment at Wugong Mountain. Follow-up action plan is required.	(8) Diversion of seepage collected from gallery top drain to discharge channel to keep gallery dry; (9) Closer coordination with Fuchuan Water Resources Bureau for clear responsibility allocation for safety management of auxiliary dam; (10) Provision of professional training on observation data analysis for dam safety monitoring staff; (11) Analysis of observation data of the last 5 years; (12) Development of automatic dam safety monitoring system; (13) Study on extent of impact on facility safety by scouring pit behind overflow dam; and (14) Special geo-investigation and design necessary for treatment of Wugong Mountain landslide mass. Completion time: 31 December 2021 Cost estimate： CNY 13 million
2	Chayuan Reservoir Dam in Zhongshan County	Technical design of Chayuan Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include 3m wide dam crest not in compliance with criteria and artificial damage to right retaining wall of discharge culvert channel. Follow-up action plan is required.	(3) Restoration/new construction of channel connecting with discharge culvert; (4) Adding dam seepage monitoring facilities; (3) Change of existing drainage channel downstream from draining prism to seepage collection channel and construction of measuring weir for seepage observation;

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
			(4) Increasing the thickness of downstream slope of the dam to widen the dam crest to 4 meters. （5）Improving the flood control emrgency response plan. Completion time: 31 December 2021 Cost estimate： CNY 2.5 million
3	Junchong Reservoir Dam in Zhongshan County	Technical design of Junchong Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include 3m wide dam crest not in compliance with criteria and absence of seepage interception channel next to the draining prism. Follow-up action plan is required.	(1) Removing/trimming of weed on downstream slope and downstream draining structure as early as possible; (2) Adding dam seepage monitoring facilities; (3) Change of existing drainage channel next to draining prism to seepage collection channel for seepage observation; and (4) Widening downstream slope of the dam to widen dam crest to 4 meters. (5) Improving the flood control emrgency response plan. Completion time: 31 December 2021 Cost estimate： CNY 2 million
4	Luojiu Reservoir Dam in Zhongshan County	Technical design of Luojiu Reservoir risk elimination and rehabilitation in 2014 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 3 years. Issues include absence of reservoir water level observation, and absence of seepage collection channel downstream from the	(1) Installation of reservoir water gauge for water level observation; and (2) Adding dam seepage monitoring facilities; (3) Construction of seepage collection channel next to draining prism and installation of measuring weir for seepage observation;

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		draining prism. Follow-up action plan is required.	(4) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 30,000
5	Hongshuiping Reservoir Dam in Fuchuan County	Technical design of Hongshuiping Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality met design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, weed growing at right jetty head, and inadequate facilities. Follow-up action plan is required.	(1) Enhancement of daily operation management, and weeding on right jetty head; and (2) Installation of water gauge for reservoir. (3) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 100,000
6	Shalongchong Reservoir Dam in Fuchuan County	Technical design of Shalongchong Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of upstream and downstream slope clean-up and maintenance for a long time, and damage of dam top road. Follow-up action plan is required.	(1) Weeding on upstream and downstream slope, restoration of dam top road as early as possible to restore dam appearance. (2) Adding dam seepage monitoring facilities; (3) Improving the flood control emrgency response plan. Completion time: 31 December 2019 Cost estimate： CNY 300,000
7	Shidong Reservoir Dam in Pinggui District	Technical design of Shidong Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include absence of seepage collection channel	(3) Improving seepage collection channel next to the draining prism for seepage observation; (4) Provision of professional training on use of dam safety monitoring equipment and preliminary information processing;

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		downstream from the draining prism, absence of monitoring capacity of reservoir staff, and absence of emergency response program. Follow-up action plan is required.	and (3) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 200,000
8	Huashan Reservoir Dam in Pinggui District	Technical design of Huashan Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include dam crest width of around 3.5 m that is not in compliance with criteria, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Construction of seepage collection channel next to draining prism for seepage observation; (2) Adding dam seepage monitoring facilities; (3) Widening downstream slope of the main and auxiliary dam to widen dam crest to 4 meters to meet criteria requirement; (4) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (5) Improving flood control emergency response program. Completion time: 31 December 2021 Cost estimate：CNY 3 million
9	Pangu Reservoir Dam in Pinggui District	Technical design of Pangu Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 7 years. Issues include dam top width of 3.5 m that is not in compliance with criteria, absence of seepage collection channel downstream from the draining prism, and absence of emergency	(1) Construction of seepage collection channel next to slope draining structure for seepage observation; (2) Adding dam seepage monitoring facilities ; (3) Improving flood control emergency response program; and (4) Widening downstream slope of the dam to widen dam crest to 4 meters. Completion time: 31 December 2021

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		response program. Follow-up action plan is required.	Cost estimate： CNY 2 million
10	Dachong Reservoir Dam in Pinggui District	Technical design of Dachong Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(6) Installation of reservoir water gauge for water level observation; construction of seepage collection channel next to draining prism for observation of dam seepage; (7) Adding dam seepage monitoring facilities ; (8) Extension of new discharge culvert pipe, and new construction of diversion channel; (9) Improving flood control emergency response program; and (10) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. Completion time: 31 December 2019 Cost estimate： CNY 400,000
11	Dayao Reservoir Dam in Pinggui District	Technical design of Dayao Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of reservoir water level observation, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (4) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 300,000
12	Guishan Reservoir Dam in Pinggui	Technical design of Guishan Reservoir risk elimination and rehabilitation in 2010 generally meets requirements of applicable standards and the construction quality meets the design	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ;

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	District	requirements. The reservoir has been under normal operation for 7 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(3) Weeding within 20 m of the dam, improvement of seepage collection channel next to draining prism for observation of dam seepage; (4) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (5) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 300,000
13	Changtang Reservoir Dam in Pinggui District	Technical design of Changtang Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of reservoir water level observation, absence of seepage collection channel downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities (3) Improvement of seepage collection channel next to draining prism for observation of dam seepage; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year; and (4) Improving flood control emergency response program. Completion time: 31 December 2019 Cost estimate： CNY 350,000
14	Luoxi Reservoir Dam in Pinggui District	Technical design of Luoxi Reservoir risk elimination and rehabilitation in 2011 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 6 years. Issues include absence of seepage collection channel	(1) Change of drainage ditch next to draining prism of main dam to seepage collection channel; installation of long culvert pipe linking auxiliary dam discharge culvert pipe and channel, and change of existing drainage ditch to seepage collection channel; observation of main and auxiliary dam seepage.

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
		downstream from the draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(2) Adding dam seepage monitoring facilities ; (3) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. (4) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 400,000
15	Huimiandu Reservoir Dam in Pinggui District	Dam safety assessment was done by design institute hired by Pinggui District Water Resources Bureau in February 2014. Design for reservoir risk elimination and rehabilitation was approved by Guangxi Autonomous Region Water Resource Bureau in November 2015. Construction commenced in August 2016 and is in progress. Technical design meets requirements of applicable standard, and construction quality will be assessed once finished. Currently no follow-up actions are required.	
16	Guangming Reservoir Dam in Pinggui District	Technical design of Guangming Reservoir risk elimination and rehabilitation in 2013 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 4 years. Issues include absence of seepage collection channel next to draining prism, inaccuracy of dam top elevation, and absence of emergency response program. Follow-up action plan is required.	(1) Change of drainage channel to seepage collection channel for seepage observation of the dam; (2) Adding dam seepage monitoring facilities ; (3) Confirmation of dam top elevation and dam crest width; and (4) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 300,000

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
17	Guanyawo Reservoir Dam in Pinggui District	Technical design of Guanyawo Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of seepage collection channel next to draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Adding dam seepage monitoring facilities ; (2) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. (2) Construction of seepage collection channel for seepage observation of the dam and the closed old culvert; (3) Improving flood control emergency response program; Completion time: 31 December 2019 Cost estimate: CNY 300,000
18	Zhemu Reservoir Dam in Pinggui District	Technical design of Zhemu Reservoir risk elimination and rehabilitation in 2012 generally meets requirements of applicable standards and the construction quality meets the design requirements. The reservoir has been under normal operation for 5 years. Issues include absence of reservoir water level observation, absence of seepage collection channel next to draining prism, absence of reservoir staff on duty in non-rainy season, and absence of emergency response program. Follow-up action plan is required.	(1) Installation of reservoir water gauge for water level observation; (2) Adding dam seepage monitoring facilities ; (3) Change of drainage ditch downstream from the draining prism to seepage collection channel, and installation of measuring weir for dam seepage observation; (4) Improving flood control emergency response program; (5) Widening downstream slope of the dam to widen dam crest to 4 meters; and (6) Arrangement of reservoir staff in non-flood season and making sure reservoir staff on duty throughout the year. Completion time: 31 December 2021 Cost estimate： CNY 1.5 million
19	River Dam of	Dam safety specialists have been employed for safety assessment	(4) A dam and workshop safety monitoring system will be constructed in

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	Xiadao Power Station in Hezhou City	of hub facility, and safety assessment report is expected to be available by the end of October.	accordance with the requirements of the "Technical Specifications on Safety Monitoring of Concrete Damsd (DL/T5178-2003) and in association with the actual situations of the Project so as to monitor the gate dam and horizontal and vertical displacement, inclination, pier joint and crack opening and closing degree and foundation uplift pressure, leakage. (5) A separate circuit breaker and protection circuit will be added to ensure the safe operation of booster station. (6) The left gate of the overflow gate dam will be repaired to assure safe opratoin of the barrage dam. Pier joint and crack opening and closing degree Uplift pressure of foundation Leakage volume Completion time: 31 December 2021; Cost estimate: CNY 500,000
20	River Dam of Fanglin Hydropower Station/Hejiang Power Station in Hezhou City	Dam safety specialists have been employed for safety assessment of hub facility, and safety assessment report is expected to be available by the end of October.	
21	River Dam of Huangshi Power	Dam safety specialists have been employed for safety assessment of hub facility, and safety assessment report is expected to be	

Table 11-15 Dam Safety Action Plan and Rehabilitation Program

SN	Reservoir/Dam	Requirement for Follow-up Actions	Rehabilitation Program
	Station in Hezhou City	available by the end of October.	

11.3 Environmental Monitoring Plan

11.3.1 Objectives of Environmental Monitoring

Environmental monitoring covers the construction stage and the operation stage of the Project and aims to acquire full and timely information on the pollution conditions of the proposed project, the degree of changes made and scope of impacts brought by the project construction to and on the environment quality of the project area as well as the status of environmental quality in the operation stage so as to give timely feedbacks to the competent authority and provide a scientific basis for the environment management work of the Project.

11.3.2 Environment Monitoring Agency

Environmental monitoring in the construction stage and the operation stage is undertaken by a qualified monitoring agency entrusted by and on behalf of the project contractor or operator. The undertaking agency should be certified in the national environmental quality certification program, have complete equipment and strong technical competence and are able to carry out the respective environmental monitoring task in a satisfactory manner.

Sensitive and concerned spots that probably involve significant pollution as shown in the prediction results of environment impacts are chosen as the monitoring spots to follow up with the pollution status of the monitored items in the construction stage and the operation stage. Noise, ambient air and surface water that involve significant environmental impacts are chosen as the monitoring contents. The monitoring factors are determined based on the pollution characteristic factors of the Project. The monitoring and analysis method for the respective items specified in the Technical Specifications on Environmental Monitoring promulgated by MoEP is chosen and the national standards confirmed in the EIA of each subproject are adopted as the assessment standard.

11.3.3 Environmental Monitoring Plan and Budget

The environmental monitoring plan and budget for the construction stage and operation stage of each subproject is shown in Table 11-13 in detail. The requirements of the monitoring plan of the linked projects are shown in Table 11-14 while the water and soil conservation monitoring program is shown in Table 11-15.

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring （CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
Construction stage	Ambient air	TSP	A-1He River Integrated Rehabilitation (Huangshi Hydropower Station - Guangming Bridge)	Shangsong Village, Hezhou Institute, Hezhou Experimental Middle School, Laozengwu	2 periods / year，2 days / period， 1 time / day. The aforesaid frequency should be followed throughout the construction stage.	2400	2.88	Qualified monitoring agency	Construction contractor	“Ambient air quality standard” （GB3095-2012）; Class II
			A-2He River Integrated Rehabilitation (Guangming Bridge - Lingfeng Bridge)	Xialiang Village		600	0.72			
			A-3 He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower Station)	Diandengzhai, Xiadao Primary School		1200	1.44			
			A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection	Xianghuadao		600	0.72			
			A-5 Xiadao Hydropower Station Integrated Rehabilitation	Jichitan		600	0.72			
			B-1 Huangansi Drainage Canal Pump Station	Residential building at Xiyue Street		600	0.72			
			B-2 Shizigang Drainage	Dormitory		600	0.72			

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring（CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
			Canal Pump Station	building of Transportation Bureau						
			B-3 Lining River Integrated Rehabilitation	Lining Village, Yingshi Primary School		1200	1.44			
			B-4 Changlong River Integrated Rehabilitation	Changlong Village		600	0.72			
			B-5 Huangtian Branch Canal Integrated Rehabilitation	Pinggui No. 3 Middle School, Huangtian Town		1200	1.44			
			B-6 Guposhan Drainage Canal Integrated Rehabilitation	Baijiazhai		600	0.72			
			B-7 East No. 5 Branch Canal Integrated Rehabilitation	Xiwanzhen		600	0.72			
			C-1 Huangansi Drainage Canal Integrated Rehabilitation	Residential buildings at Badaxi Road and Youxing Street		1200	1.44			
			C-2 Shizigang Drainage Canal Integrated Rehabilitation	Residential buildings at Wanquan Street and Yinhe Street		1200	1.44			
			C-3 Jiangnan WWTP associated pipeline	Residential buildings at		600	0.72			

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring (CNY)	Total cost (CNY 10000)	Monitoring agency	Client agency	Applicable standards and specifications
			networks and road improvement	Niupailan						
		H_2S, NH_3, odor concentration	C-1 Huangansi Drainage Canal Integrated Rehabilitation	Residential buildings at Badaxi Road, Youxing Street and Xiyue Street along Huangansi Drainage Canal	4 periods / year, 1 day / period, 4 times / day, The aforesaid frequency should be followed throughout the dredging stage.	7920	3.17	Qualified monitoring agency	Construction contractor	Design hygiene standard for industrial enterprises (TJ 36-79); maximum allowable concentration for residential areas; “Odor Pollutant Emission Standard” （GB14554-93）
			C-2 Shizigang Drainage Canal Integrated Rehabilitation	Residential buildings at Wanquan Street, Yinhe Street and Xingguang Street and Jiangbeizhong Road along Shizigang Drainage Canal		10560	4.22			
		COD, BOD_5, SS, petroleum, NH3-N, TP	A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection	Cross sections at the starting and ending points of East Trunk Canal Rehabilitation Section, cross section 500m ahead of the confluence point	2 periods / year, 2 days / period, 1 time / day The aforesaid frequency should be followed throughout	3000	3.6	Qualified monitoring agency	Construction contractor	”Surface Water Environmental Quality Standard” （GB3838-2002）; Class Ⅲ for Mawei River and Class IV for East Trunk Canal

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring （CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
				of Mawei River and East Trunk Canal	the construction stage.					
			A-5 Xiadao Hydropower Station Integrated Rehabilitation	He River Xiadao Hydropower Station cross section		1000	1.2			“Surface Water Environmental Quality Standard” （GB3838-2002）; Class Ⅲ
			A-6 Fanglin Hydropower Station Integrated Rehabilitation	He River Fanglin Hydropower Station cross section		1000	1.2			
			A-7　Huangshi Hydropower Station Integrated Rehabilitation	He River Huangshi Hydropower Station cross section		1000	1.2			
			A-8　He River (Huangshi Hydropower Station - Xiadao Hydropower Station) Dredging Works	Wastewater discharge outlets of sediment dewatering sites at Fanglin Bridge and Lingfeng Bridge		1000	1.2			GB 8978-1996　”Integrated wastewater discharge standard”　Class I
			B-3 Lining River Rehabilitation	Lining River Rehabilitation Section starting and ending cross		2000	2.4			“Surface Water Environmental Quality Standard” （GB3838-2002）;

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring (CNY)	Total cost (CNY 10000)	Monitoring agency	Client agency	Applicable standards and specifications
				sections						Class Ⅳ
			B-4 Changlong River Rehabilitation	Changlong River Rehabilitation Section starting and ending cross sections		2000	2.4			
			B-5 Huangtian Branch Canal Rehabilitation	Huangtian Branch Canal Rehabilitation Section starting and ending cross sections		2000	2.4			
			B-6 Guposhan Drainage Canal Rehabilitation	Guposhan Drainage Canal Rehabilitation Section starting and ending cross sections		2000	2.4			
			B-7 East No. 5 Branch Canal Rehabilitation	East No. 5 Branch Canal Rehabilitation Section starting and ending cross sections		2000	2.4			
			C-1 Huangansi Drainage Canal Rehabilitation	Huangansi Drainage Canal Rehabilitation Section starting		2000	2.4			

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring（CNY）	Total cost（CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
				and ending cross sections						
			C-2 Shizigang Drainage Canal Rehabilitation	Shizigang Drainage Canal Rehabilitation Section starting and ending cross sections		2000	2.4			
	Noise	dB（A）	A-1 He River Integrated Rehabilitation (Huangshi Hydropower Station - Guangming Bridge)	Shangsong Village, Hezhou Institute, Hezhou Experimental Middle School, Laozengwu	2 periods / year，2 days / period，2 times / day(one time each day and night) The aforesaid frequency should be followed throughout the construction stage.	960	0.29	Qualified monitoring agency	Construction contractor	“Sound environment quality standard”（GB3096-2008）; Class II
			A-2 He River Integrated Rehabilitation (Guangming Bridge - Lingfeng Bridge)	Xialiang Village		240	0.58			
			A-3 He River Integrated Rehabilitation (Lingfeng Bridge – Xiadao Hydropower Station)	Diandengzhai, Xiadao Primary School		480	0.29			
			A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection	Xianghuadao		240	0.29			
			A-5 Xiadao Hydropower Station Integrated Rehabilitation	Jichitan		240	0.29			

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring（CNY）	Total cost（CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
			B-1 Huangansi Drainage Canal Pump Station	Residential building at Xiyue Street		240	0.29			
			B-2 Shizigang Drainage Canal Pump Station	Dormitory building of Transportation Bureau		240	0.58			
			B-3 Lining River Integrated Rehabilitation	Lining Village, Yingshi Primary School		480	0.29			
			B-4 Changlong River Integrated Rehabilitation	Changlong Village		240	0.58			
			B-5 Huangtian Branch Canal Integrated Rehabilitation	Pinggui No. 3 Middle School, Huangtian Town		480	0.29			
			B-6 Guposhan Drainage Canal Integrated Rehabilitation	Baijiazhai		240	0.29			
			B-7 East No. 5 Branch Canal Integrated Rehabilitation	Xiwan Town		240	0.58			
			C-1 Huangansi Drainage Canal Integrated Rehabilitation	Residential buildings at Badaxi Road and Youxingxiang Street		480	0.58			
			C-2 Shizigang Drainage	Residential		480	0.29			

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring （CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
			Canal Integrated Rehabilitation	buildings at Wanquan Street and Yinhe Street						
			C-3 Jiangnan WWTP associated pipelines and road improvement works	Residential building at Niupailan		240	0.29			
	Sludge dewatering cake	Moisture content	A-4 East Trunk Canal Integrated Rehabilitation and Mawei River Connection	Sludge dewatering site	Once a week during dredging; 5 samples per monitoring	20	1.0	Qualified monitoring agency	Construction contractor	The moisture content should be lower than 50%.
			A-8 He River (Huangshi Hydropower Station – Guangming Bridge) Dredging							
			B-5 Huangtian Branch Canal Rehabilitation							
			B-6 Guposhan Drainage Canal Integrated Rehabilitation							

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring （CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
			C-1 Huangansi Drainage Canal Integrated Rehabilitation							
			C-2 Shizigang Drainage Canal Integrated Rehabilitation							
Operation stage	Exhaust gas	H_2S, NH_3, odor concentration	C-3 Jiangnan WWTP associated pipelines and road improvement works	Upwind and downwind of the boundary of Jiangnan WWTP	4 periods / year，1 day / period，4 times / day; until project account closure	5280	10.56	Qualified monitoring agency	Project Owner	“Pollutant Discharge Standards for Municipal Wastewater Treatment Plants” （GB18918-2002）
	Surface water	COD, BOD_5, SS, petroleum, NH3-N, TP	C-1 Huangansi Drainage Canal Integrated Rehabilitation	200m ahead of the confluence of Huangansi Drainage Canal into He River	4 periods / year，2 days / period，1 time / day; until project account closure	1000	2	qualified monitoring agency	Project Owner	“Surface Water Environmental Quality Standard” （GB3838-2002）; Class Ⅳ
			C-2 Shizigang Drainage Canal Integrated Rehabilitation	200m ahead of the confluence of Shizigang Drainage Canal into He River		1000	2			
			C-3 Jiangnan WWTP associated pipelines and	500m upstream and downstream		2000	4			“Surface Water Environmental Quality

Table 11-13 Environment Monitoring Plan

Period	Monitoring object	Monitoring item	Subproject	Monitoring site	Monitoring frequency	Cost per monitoring （CNY）	Total cost （CNY 10000）	Monitoring agency	Client agency	Applicable standards and specifications
			road improvement works	of the discharge outlet of Jiangnan WWTP into He River						Standard” （GB3838-2002）; Class III
	Wastewater	COD, BOD_5, SS, petroleum, NH3-N, TP	C-3 Jiangnan WWTP associated pipelines and road improvement works	Discharge outlet of Jiangnan WWTP	4 periods / year，2 days / period，1 time / day; until project account closure	1000	2			“Pollutant Discharge Standards for Municipal Wastewater Treatment Plants” （GB18918-2002）; Class 1A
	Site boundary noise	dB（A）	C-3 Jiangnan WWTP associated pipelines and road improvement works	On the eastern, southern, western and northern boundaries of Jiangnan WWTP	4 periods / year，2 days / period，2 times / day(one time each day and night); until project account closure	960	1.92	Qualified monitoring agency	Project Owner	“Ambient Noise Emission Standard on the Boundary of Industrial Enterprises” （GB12348-2008）; Class II

Table 11-14 Environment monitoring plan of linked projects

Linked projects	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client agency	Applicable standard
Hezhou WWTP	Wastewater	COD, NH3-N	Discharge outlet of Hezhou WWTP	Surveillance monitoring, 2 periods / year，1 day / period，4 times / day	Qualified monitoring agency	Project Owner	“Pollutant Discharge Standards for Municipal Wastewater Treatment Plants”（GB18918-2002）; Class 1A
		pH value, COD, BOD-5, NH3-N, SS, animal and vegetable oils, petroleum, anionic surfactants, total nitrogen, total phosphorus, chrome, fecal coliform, total mercury, alkyl mercury, total cadmium, total chromium, hexavalent chromium, total arsenic, total lead					
		COD, NH3-N	Discharge outlet of Hezhou WWTP	Online monitoring comparison, 4 periods / year，1 day / period，3 times / day	Qualified monitoring agency		
	Exhaust gas	hydrogen sulfide, ammonia, odor concentration	Upwind and downwind of the site boundary of Hezhou WWTP	2 periods / year，2 days / period，4 times / day	Qualified monitoring agency		“Pollutant Discharge Standards for Municipal Wastewater Treatment Plants”（GB18918-2002）
	Site boundary noise	dB（A）	On the eastern, southern, western and northern boundaries of Hezhou WWTP	2 periods / year，2 days / period，2 times / day(one time each day and night)	Qualified monitoring agency		“Ambient Noise Emission Standard on the Boundary of Industrial Enterprises”（GB12348-2008）; Class II

Table 11-14 Environment monitoring plan of linked projects

Linked projects	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client agency	Applicable standard
Hezhou Sludge Harmless Treatment	Exhaust gas	hydrogen sulfide, ammonia, odor concentration	Upwind of the site of Hezhou Sludge Harmless Treatment Project, outlet of the exhaust pipe of the deodorization workshop	2 periods / year，2 days / period，4 times / day	Qualified monitoring agency	Project Owner	“Odor Pollutant Emission Standard”（GB14554-1993）; Class II
	Wastewater	COD, BOD-5, NH3-N, SS	Outlet of self-built wastewater treatment system of Hezhou Sludge Harmless Treatment Project	2 periods / year，2 days / period，4 times / day	Qualified monitoring agency		“Integrated wastewater discharge standard”（GB8987-1996）; Class I
	Site boundary noise	dB（A）	On the eastern, southern, western and northern boundaries of Hezhou Sludge Harmless Treatment Project	2 periods / year，2 days / period，2 times / day(one time each day and night)	Qualified monitoring agency		“Ambient Noise Emission Standard on the Boundary of Industrial Enterprises”（GB12348-2008）; Class II
	Ground water	pH value, turbidity, Permanganate index, nitrate nitrogen, nitrite nitrogen, NH3-N, chloride, lead, mercury, cadmium, hexavalent chromium, arsenic, total coliform, total bacteria	1 observation well in and 2 observation wells downstream the site of Hezhou Sludge Harmless Treatment Project	2 periods / year，2 days / period，1 time / day, for a monitoring period of 2 years	Qualified monitoring agency		“Ground water quality standard”（GB/T 14848-93）; Class III
	Soil	Cadmium, mercury, arsenic, copper, lead, chromium, zinc, nickel	Farmland downstream of the flow direction of ground water inside the site and area of Hezhou Sludge Harmless Treatment Project	1 period / year，1 day / period	Qualified monitoring agency		“Soil Environment Quality Standard”（GB1518-1995）; Class II
Hezhou Domestic Solid Waste	Exhaust gas	Total SS, hydrogen sulfide, ammonia, odor concentration	Upwind and downwind of Hezhou Domestic Solid Waste Landfill	2 periods / year，2 days / period，4 times / day	Qualified monitoring agency	Project Owner	“Odor Pollutant Emission Standard”（GB14554-1993）; Class II

Table 11-14 Environment monitoring plan of linked projects

Linked projects	Monitoring element	Monitoring item	Monitoring site	Monitoring frequency	Monitoring agency	Client agency	Applicable standard
	Wastewater	pH value, chrome, COD, BOD-5, SS, NH3-N, total phosphorus, total nitrogen, fecal coliform, total mercury, total cadmium, total chromium, hexavalent chromium, total arsenic, total lead	Outlet of leachate treatment station	2 periods / year，2 days / period，4 times / day	Qualified monitoring agency		“Standard for Pollution Control on the Landfill Site of Municipal Solid Waste”（GB16889-2008）; Class II
	Site boundary noise	dB（A）	On the eastern, southern, western and northern boundaries of Hezhou Domestic Solid Waste Landfill	2 periods / year，2 days / period，2 times / day(one time each day and night)	Qualified monitoring agency		“Ambient Noise Emission Standard on the Boundary of Industrial Enterprises”（GB12348-2008）; Class II
	Groundwater	pH value, Total hardness, permanganate index, NH3-N, nitrate, nitrite, sulfate, chloride, volatile phenols, cyanide, fluoride, arsenic, mercury, hexavalent chromium, copper, zinc, lead , Cadmium, iron, manganese, total coliform	5 upstream and downstream monitoring wells of ground water	2 periods / year，2 days / period，1 time / day	Qualified monitoring agency		“Ground water quality standard”（GB/T14848-1993）; Class III
The monitoring plan required in the EIA of the linked projects should be incorporated into this ESMP and its monitoring report should be submitted on a periodical basis as one of the reports due under the Project.							

Table 11-15 Water and soil conservation monitoring plan

<table>
<tr><th>Period</th><th>Monitoring area</th><th>Monitoring contents and monitoring methods</th><th>Monitoring frequency</th><th>Total cost (CNY 10000)</th><th>Monitoring agency</th><th>Client agency</th></tr>
<tr><td rowspan="3">Construction stage</td><td>Flood risk control subproject area</td><td>(1) Pre-construction soil erosion status and background value;
(2) Using survey method and remote sensing method to monitor changes of terrain and landform, disturbance of surface and vegetation and number of damaged water and soil conservation facilities;
(3) Using survey method to monitor volume of earthwork excavation and fill and transportation under the Project;
(4) Using sedimentation tank method to monitor volume of soil erosion;
(5) Using survey method to monitor status of protection and effectiveness of operation of the water and soil conservation measures.</td><td rowspan="3">Monitoring period:
The monitoring period starts in June 2018 in the construction preparation stage and ends in December 2024 in the year of design level.
Monitoring frequency:
Stockpiling volume of the temporary stockpiling sites in use and the implementation status of the water and soil conservation measures in effect shall be monitored and recorded at least once every 10 days; area of disturbed surface, retaining and fencing effect of water and soil conservation measures shall be monitored and recorded at least once every month; Since rainfall in the Project area mainly occurs in the months of April to</td><td>15</td><td>Qualified monitoring agency</td><td>Construction contractor</td></tr>
<tr><td>Urban drainage Rehabilitation subproject area</td><td>(1) Pre-construction soil erosion status and background value;
(2) Using survey method and remote sensing method to monitor changes of terrain and landform, disturbance of surface and vegetation and number of damaged water and soil conservation facilities;
(3) Using survey method to monitor volume of earthwork excavation and fill and transportation under the Project;
(4) Using sedimentation tank method to monitor volume of soil erosion;
(5) Using survey method to monitor status of protection and effectiveness of operation of the water and soil conservation measures.</td><td>24</td><td>Qualified monitoring agency</td><td>Construction contractor</td></tr>
<tr><td>Water quality</td><td>(1) Pre-construction soil erosion status and background</td><td>10</td><td>Qualified</td><td>Construction</td></tr>
</table>

Table 11-15 Water and soil conservation monitoring plan

Period	Monitoring area	Monitoring contents and monitoring methods	Monitoring frequency	Total cost (CNY 10000)	Monitoring agency	Client agency
	improvement subproject area	value; (2) Using survey method and remote sensing method to monitor changes of terrain and landform, disturbance of surface and vegetation and number of damaged water and soil conservation facilities; (3) Using survey method to monitor volume of earthwork excavation and fill and transportation under the Project; (4) Using sedimentation tank method to monitor volume of soil erosion; (5) Using survey method to monitor status of protection and effectiveness of operation of the water and soil conservation measures, and survival rate, coverage and growth status of trees and grass for water and soil conservation.	September, routine monitoring should be conducted in these months at the monitoring frequency indicated in the previous table. In the months of October to March the next year, no fixed site monitoring shall be conducted and only site inspections will be arranged. The other monitoring activities shall be conducted once every 3 months. In the event of any rain storms or heavy winds, 1 to 2 additional monitoring should be arranged in time.		monitoring agency	contractor
	Temporary works area	(1) Using survey method and remote sensing method to monitor changes of terrain and landform, and the height, slope length and land occupation of stockpiles of the temporary stockpiling sites; (2) Using sedimentation tank method to monitor volume of soil loss; (3) Using survey method to monitor the implementation status and benefits of temporary measures.		7	Qualified monitoring agency	Construction contractor

11.4 Capacity Development and Training

11.4.1 Capacity Development and Training Requirements

The key objects of environmental capacity development are the environment managers and construction supervision engineers, training for whom is one of the key component of technical supports under the Project. In order to assure smooth and effective implementation of the ESMP, it is necessary to provide training on ESMP and other relevant knowledge and skills to the staff of the Project Owner / EA, the operator, the contractor, the supervision engineer, the local PMOs and other stakeholders and also provide different training to staff on different job positions. Training on social issues should also be organized for public subject to social impacts from land acquisition and resettlement, etc.

11.4.2 Contents and Cost Estimate of Capacity Development and Training

（1） Environment Managers and Construction Supervision Engineer

The training will be organized by the PMO and conducted by the Environment Technology Specialist one year before the implementation of the Project for the full-time environment management personnel of the PMO, the full-time environment management coordinators of the subprojects and the construction supervision engineers.

（2） Contractor and Construction Workers

The training will be organized by the PMO or the subproject contractors in the project area prior to the implementation of the Project and may be specifically implemented by the Environment Management Specialist or trained full-time environment management staff of the enterprises.

（3） Operator

The training will be organized by the PMO or the Employer in the project area before the Project is put into operation and may be specifically implemented by the Environment Management Specialist or trained full-time environment management staff of the enterprises.

（4） Groups involved in the LAR process

The training will be organized by the PMO or the Employer in the project area before the LAR process comences and may be specifically implemented by the PMO or the Social Specialist employed by the PMO.

（5） Vulnerable groups such as women, children and poor households

The training will be organized by the PMO or the Employer in the project area before the Project is put into operation and may be specifically implemented by the PMO or the Social Specialist employed by the PMO.

Details of the contents, trainees, time table and estimated budget of the training are shown in Table 11-1 and Table 11-2.

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Table 11-14 Sample Training Schedule for Environmental Training

Subproject	Training stage	Training objects	No. of trainees	Training duration	Training time	Total cost (*CNY10000)	IA	Supervision Agency
1. He River Flood Risk Resilience Improvement Subproject								
Main Watercourse Widening and Flood Discharge A-1 – A-3	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	3	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
Trunk Canal Flood Diversion A-4	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	3	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
Water Conservancy Infrastructure Improvement A-5 – A-7	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	9	3 days	Prior to implementation of the construction plan	1.35	PMO and its Environment Specialist	World Bank
	Operation stage	Operation agency	3	2 days	Prior to official operation of the Project	0.3	PMO and its Environment Specialist	World Bank
Dredging Works A-8	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	9	3 days	Prior to implementation of the construction plan	1.35	PMO and its Environment Specialist	World Bank
2. Urban Drainage and Sewage Management Subproject								

Table 11-14 Sample Training Schedule for Environmental Training

Subproject	Training stage	Training objects	No. of trainees	Training duration	Training time	Total cost (*CNY10000)	IA	Supervision Agency
Water Conservancy Infrastructure Development B-1 – B-2	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	3	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
	Operation stage	Operation agency	3	2 days	Prior to official operation of the Project	0.3	PMO and its Environment Specialist	World Bank
River-lake Connection B-3 – B-9	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	24	3 days	Prior to implementation of the construction plan	3.6	PMO and its Environment Specialist	World Bank
Huangansi Drainage Canal Integrated Rehabilitation C-1	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	6	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
Shizigang Drainage Canal Integrated Rehabilitation C-2	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	6	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
Drainage System Improvement	Construction stage	Full-time environment management personnel,	6	3 days	Prior to implementation	0.6	PMO and its Environment	World Bank

Table 11-14 Sample Training Schedule for Environmental Training

Subproject	Training stage	Training objects	No. of trainees	Training duration	Training time	Total cost (*CNY10000)	IA	Supervision Agency
C-3		full-time environment management coordinator, construction supervision engineer			of the construction plan		Specialist	
	Operation stage	Operation agency	3	2 days	Prior to official operation of the Project	0.3	PMO and its Environment Specialist	World Bank
Ecological Landscaping Improvement D-2	Construction stage	Full-time environment management personnel, full-time environment management coordinator, construction supervision engineer	3	3 days	Prior to implementation of the construction plan	0.6	PMO and its Environment Specialist	World Bank
3. Institutional Capacity Building and Project Management								
Hydrological Monitoring Station E-1	Construction stage	Full-time environment management personnel, full-time environment management coordinator	2	2 days	Prior to implementation of the Project	0.2	PMO and its Environment Specialist	World Bank
	Operation stage	Operation agency	2	2 days	Prior to official operation of the Project	0.2	PMO and its Environment Specialist	World Bank
Environmental Monitoring Station Development E-2	Construction stage	Full-time environment management personnel, full-time environment management coordinator	2	2 days	Prior to implementation of the Project	0.2	PMO and its Environment Specialist	World Bank
	Operation stage	Operation agency	2	2 days	Prior to official operation of the Project	0.2	PMO and its Environment Specialist	World Bank

Table 11-2 Sample Training Schedule for Social Training

Content	Trainees	Number of persons	Training duration	Training time	Total cost (CNY10000)）	Implementation body	Supervisory body
Training on LAR policies	Groups affected by LAR	100	1 day	Before LAR	3	PMO and its social specialist	World Bank
Knowledge training on water environment protection and urban development	Vulnerable groups such as women, children in the project area	50	1 day	Before formal operation of the Project	2	PMO and its social specialist	World Bank
Employment skill training for vulnerable groups	Vulnerable groups such as women and poor households	50	3 days	Before formal operation of the Project	5	PMO and its social specialist	World Bank

11.5 Reporting Mechanism

11.5.1 Information Exchange

Environment management requires necessary exchange of information among the PMO, the Project Owner, the Contractor, the Operator and the different departments and jobs in the organization and also requires disclosure of relevant information to the external parties (stakeholders, general public, etc.).

Internal information exchange may be implemented in diversified forms, such as meetings, internal briefings, but at least 1 formal meeting must be organized each month. All information exchange should be recorded and archived. External information exchange is implemented on a half-year or one-year basis. For information exchange with the cooperative units, meeting minutes shall be developed and put into archives.

11.5.2 Record Mechanism

In order to assure the effective operation of the environment management system, the organization must set up a sound record system and keep records in the following aspects:

（1） Laws and regulations;

（2） Government permits;

（3） Environmental factors and the relevant EIA documents and ESMP reports;

（4） Training records;

（5） Records of inspections, calibrations and maintenance activities;

（6） Monitoring data;

（7） Effectiveness of corrective and preventive measures;

（8） Information of stakeholders; grievance redress procedure and records of results;

In addition, the aforesaid records shall be subject to necessary control, including identification, collection, cataloging, archiving, storage, management, maintenance, inquiry, retention life and disposal of records.

11.5.3 Reporting Mechanism

The Contractor, the Operator, the Monitoring Agency, the construction supervision engineer and the PMO shall keep records of project progress, ESMP execution status, environmental monitoring results throughout the implementation of the Project and report in a timely manner to the concerned departments. Monitoring records of the operation status of the solid waste landfills and WWTPs involved in the linked projects and the due diligence study shall also be acquired and collected on a periodical basis. The relevant requirements shall be incorporated into the monitoring plan, which mainly consist of the six aspects as follows:

（1） The construction supervision engineer of the Project shall keep detailed records of the execution status of the ESMP on a monthly basis and submit the monthly report to the Project Owner and the Municipal PMO in a timely manner. The weekly and monthly reports should include information on the execution status of the environmental protection measures, and the progress and data of environmental monitoring.

（2） The Contractor and Operator shall keep detailed records of the progress of the Project and the execution status of the ESMP on a quarterly basis and submit the quarterly report to the PMO in a timely manner, with a copy to Hezhou Municipal EPB.

（3） The Monitoring Agency shall submit the monitoring report to the Contractor (Operator) and the construction supervision engineer in a timely manner after the monitoring assignment is carried out.

（4） The Contractor and the Operator shall submit the Environmental Monitoring Report of the Project to Hezhou Municipal EPB, Babu District EPB and Hezhou Municipal PMO in a timely manner. Hezhou Municipal PMO shall submit the monthly report, the quarterly report and the yearly report on the progress and effectiveness of the execution of the ESMP of the Project to Hezhou Municipal EPB and the relevant organizations and, when necessary, to the World Bank.

（5） In the event of any specific non-compliances in terms of environmental protection, the construction supervision engineer and the PMO shall submit a report to the local competent authority of environmental protection and to the superior levels if necessary.

（6） 2 ESMP Execution Reports should be submitted each year to the World Bank. The ESMP Execution Report may include the following contents:

a. Project implementation progress, e.g. construction progress and length of sections completed in the dike construction works, He River rehabilitation works, the pavement works and the pipeline works;

b. Execution status of the environmental protection measures of the Project;

c. Implementation status and key results of environmental monitoring;

d. Implementation status of the training program;

e. Information of continuous public participation; public complaints and the records of key contents, solution and public satisfaction of such complaints, if any;

f. Existing problems and solutions;

g. ESMP Execution Plan for the second half of the year.

11.6 Grievance Redress Mechanism

The grievance redress mechanism of the Project covers all stages of implementation of the Project, including resettlement, resident disturbance in the construction stage and supervision of the operation stage.

（1） Public grievances on resettlement: Any problems arising in the resettlement process may be appealed according to Section VIII: Grievance Redress Procedure.

（2） Public grievances in the construction period: The Contractor of the Project and the Municipal PMO and Municipal EPB shall follow up with the progress of the Project in a timely manner to learn about inconveniences brought to the local people in the construction of the Project. The construction contractor shall make public the responsible person’s name and contact information for the sake of public supervision and complaint. The Municipal PMO and the Municipal EPB shall set up a special reception window and assign special personnel to collect the public opinions in a timely manner. Public opinion books should be provided so that records are kept of telephone calls or personal visits, including the name and contact information of the callers and visitors, impacts from project implementation and their opinions. Such records shall be archived and reported in a timely manner and questions raised by the public shall be replied within three working days and a solution shall be proposed and implemented within 10 to 15 working days depending on the level of difficulty. The final results of the process of implementation and coordination and resolution shall be added into the Public Opinion Book. In order to better address the inconveniences brought by the construction of the Project to the daily life of local people, the Contractor and the external monitoring agency are required to submit the Public Opinion Book to Hezhou Municipal EPB at the end of each month so that such opinions are handled in time under the supervision of Hezhou Municipal EPB. If the complainant remains dissatisfied with the resolution made the Municipal PMO or EPB, he / she may, upon receipt of such resolutions, file a lawsuit at the local people's court according to the Civil Procedure Law of the People's Republic of China.

（3） Operation stage supervision: The public may raise any questions in the operation stage directly to the Municipal PMO or Hezhou Municipal EPB (EP complaint hotline: 12369), which shall record, study and discuss and respond to such questions within 3 working days and propose and implement a solution within 10 to 15 working days depending on the level of difficulty. If the complainant remains dissatisfied with the resolution made the Municipal PMO or EPB, he / she may, upon receipt of such resolutions, file a lawsuit at the local people's court according to the Civil Procedure Law of the People's Republic of China.

The aforesaid channels of grievance redress shall be made public via meetings or by other means to enable the public to be fully aware of their rights to complain. In addition, the public media shall be utilized for extensive advertisement. The grievance redress institution shall handle the complaints free of charge and all expenses incurred there from shall be disbursed as a part of the contingency fee by the Municipal PMO.

11.7 Investment Estimation for Environmental Protection

Table 11-15 shows the estimated investment required for the aforesaid additional environmental measures needed in the design stage, construction stage and operation stage of the Project.

Table 11-15: Investment Estimation for Environmental Protection of the Project

SN	Stage	Cost description	Estimated investment (CNY10000)
1	Design stage	EIA	200
	Subtotal		**200**
2	Construction stage	Additional environmental protection measures	141
3		Additional water and soil conservation measures	1657.67
4		Environment monitoring	56
5		Water and soil conservation monitoring and supervision	91
6		Implementation of Dam Safety Action Plan	2655
7		Operation of external monitoring agency	24
8		Staff training in the construction stage	11
		Training on LAR policies	3
	Subtotal		**4638.67**
9	Operation stage	Final acceptance of environmental protection	80
10		Environment monitoring	23
11		Operation of external monitoring agency	20
12		Staff training in the operation stage	2
		Knowledge training on water environment protection and city development	3
		Training on employment skills of vulnerable groups	5
	Subtotal		**133**
	Total		**4970.67**

12. EIA Conclusions and Recommendations

The following conclusions may be drawn from the comprehensive environmental impact assessment of the Project:

（1） The Project aims to implement integrated improvement of water environment and construction of urban infrastructure under the guidelines of development, livelihood and innovation and following the standards of “green water service, eco-friendly water service and storm and flood safety”. The Project will be helpful to safeguarding regional flood protection and waterlogging drainage, improving regional water environment and building high-standard and modernized urban infrastructure and public facilities; it will provide powerful support and assurance to the sustainable economic development of Hezhou Municipality to promote the level of sustainable urban development and realize the integration of reform and innovation.

Identified from the perspectives of task demand and target realization, the key design elements of the Project comprise of five engineering systems of flood risk control, urban drainage improvement, water environment improvement, ecological landscape improvement and technical assistance and management.

Flood risk control --- Through improvement of the flood discharge capacity of the mainstream and tributaries, flood risks will be prevented and put under control by means of assured discharge of flood. The flood control status of the main watercourse of He River and its urban tributaries will be analyzed and an enclosed flood control system will be constructed to bring the flood control capacity of the urban area of Hezhou to the respective standard.

Urban drainage improvement --- Through improvement of the storage capacity, the stormwater retention capacity will be increased for the purpose of reducing the pumping and drainage volume. The terrain and topographical condition of the urban area and the existing urban drainage system will be analyzed and measures of storage regulation and pumping will be taken to assure flood discharge safety and reduce waterlogging risks in the urban area of Hezhou Municipality.

Water environment improvement --- Improvement of the water diversion and exchange system and the wastewater collection and treatment system will help improving the water quality of He River channels and lay a foundation for improvement of ecological environment in He River Watershed and final realization of the targets of water quality and ecological safety of the water systems in the region.

Ecological landscape improvement --- Construction of the urban green ring and ecological corridor will be helpful to the improvement of landscape continuity, preservation of animal habitats, establishment of continuous leisure and entertainment network close to nature, encouragement of walking and bicycle travelling and protection of natural ecology. The urban green ring and ecological corridor will become the center for protecting the urban ecological structure and functions and developing the urban ecological network and urban open space planning and will promote the value of the urban landscape system, maintain the health and life of the water environment of the water systems and facilitate human-water harmony.

Technical assistance and management --- The management capacity of the various functional departments and the smart water management level of Hezhou Municipality as a whole will be promoted through construction of the water quality monitoring station and the flood warning system as well as training of the full-time staff.

Upon the implementation of the Project, the main watercourse of He River will reach a flood control standard of 1 in 50 years while the urban river system will achieve a 20-year recurrence period in terms of waterlogging hazard. Effective collection and treatment of wastewater in Jiangnan District will contribute to improved water quality of the urban water system and improved urban environment quality and drive the sustainable development of Hezhou Municipality. He River shores and other low-impact development facilities will be fully utilized to reduce energy consumption, save land and alleviate pressure of water environment. Upon completion, the Project will play an extremely important role in safeguarding social stability and economic prosperity in the region and generate huge social, economic and environment benefits, making it an important project serving multiple purposes.

（2） The construction of the Project complies with the national laws and regulations and the master urban plan and environmental protection plan of the project area, which are the policy and legal foundation for the implementation of the Project.

（3） The implementation of the Project may involve some environmental protection objects (sensitive sites), such as residential areas, schools and physical cultural resources, etc. In the feasibility study, the Project is reasonably sited to avoid the aforesaid environmental protection objects. In the Environment Assessment, optimization of design program is achieved through analysis of the siting alternatives to mitigate impacts on the environmental protection objects.

（4） Some adverse impacts are likely to arise from the implementation of the Project on the surrounding environment. Such impacts may come from the construction stage and may also occur in the operation stage.

1） Adverse impacts in the construction period mainly include soil erosion caused by excavation, exhaust gas and noise from transportation of earth and construction material on construction site and access roads, and wastewater discharged from construction camps and sediment dewatering facilities and odor from dredging and temporary storage of dredged sediment. Additionally, social impacts include disturbance to local traffic by construction vehicles and Fanglin Hydropower Station improvement, impact by He River rehabilitation to the physical cultural resources of Xiyue Historical and Cultural Street and the site of CCP Babu Special Branch, interference with railway from He River-lake connection works, and impact on existing farmland irrigation by Fanglin Hydropower Station improvement.

2） Upon completion of the Project, the urban flood risk control capacity of Hezhou will be enhanced, the black and odorous urban waters will be eliminated and the landscape value, ecological environment and municipal infrastructure will be improved. However, adverse environmental impacts will arise, mainly including effluent, odor and noise generated in the operation of Jiangnan WWTP and noise generated by stormwater pump stations in operation. Nevertheless, the positive benefits of the Project as a whole will be far more significant than its adverse impacts.

（5） The level and scope of the adverse impacts likely to arise from the Project will be controlled within the scope permitted by the national laws and regulations and standards and codes by means of alternatives, mitigation measures, ESMP implementation, public participation and consultation, involuntary resettlement, and implementation of the dam safety action plan, etc.

In conclusion, the Project is feasible if the alternatives, mitigation measures, ESMP, public consultation, involuntary resettlement plan, dam safety action plan and other countermeasures proposed under the Project are executed.

Annex 1:Monitoring data of environmental quality conditions in the project area

Table 1 Ambient Air Quality Weekly Report in Hezhou City (for Period No. 24)

Date of monitoring	SO_2（ug/m^3）	NO_2（ug/m^3）	PM_{10}（ug/m^3）	AQI	Air quality level	Air quality status
2017.6.11	12	19	46	46	I	Excellent
2017.6.12	12	22	48	65	II	Fine
2017.6.13	9	17	39	44	I	Excellent
2017.6.14	14	19	34	34	I	Excellent
2017.6.15	6	16	26	40	I	Excellent
2017.6.16	8	12	24	27	I	Excellent
2017.6.17	6	11	26	36	I	Excellent

Table 2 Ambient Air Environment Monitoring Results and Statistical Analysis at the Proposed WWTP Location

Monitoring site	Date of monitoring	H2-S（mg/m^3）	Ammonia（mg/m^3）
A11 Proposed site of Jiangnan WWTP	2017.05.16	ND	0.03
	2017.05.17	ND	0.02~0.03
	Standard	0.01	0.20
	Pi	0.05	0.1~0.15
	Rate of noncompliance	0	0

Table 3 Monitoring Results of Odor Concentration along the River Basin

Location	Monitoring time	Monitoring result (dimensionless)
A1 Riverside residence at Qiaodong Street south of He River dredging section	First monitoring	13
	Second monitoring	12
	Third monitoring	12
	Fourth monitoring	11
A2 Riverside residence at Nanshan Road south of He River dredging section	First monitoring	13
	Second monitoring	15
	Third monitoring	14
	Fourth monitoring	17
A3 Riverside residence at Sanqi Bridge of Huangtian Branch Canal dredging section	First monitoring	19
	Second monitoring	16
	Third monitoring	16
	Fourth monitoring	15
A4 Riverside residence at Shizigang of Guposhan Drainage Canal dredging section	First monitoring	10
	Second monitoring	12
	Third monitoring	<10
	Fourth monitoring	11
A5 Riverside residence at Xinduzhai of Taoyuan Drainage Canal dredging section	First monitoring	<10
	Second monitoring	<10
	Third monitoring	<10
	Fourth monitoring	<10
A6 Riverside residence at Fumin Street of Huangan Temple Drainage Canal dredging section	First monitoring	<10
	Second monitoring	<10
	Third monitoring	<10
	Fourth monitoring	<10
A7 Riverside residence at Xiyue Street of Huangan Temple Drainage Canal dredging section	First monitoring	**87**
	Second monitoring	**88**
	Third monitoring	**82**
	Fourth monitoring	**88**
A8 Riverside residence at Zhushan Road of Shizigang Drainage Canal dredging section	First monitoring	**20**
	Second monitoring	**23**
	Third monitoring	**21**
	Fourth monitoring	**23**
A9 Riverside residence at Wangjiao Street of Shizigang Drainage Canal dredging section	First monitoring	19
	Second monitoring	16

Table 3 Monitoring Results of Odor Concentration along the River Basin

Location	Monitoring time	Monitoring result (dimensionless)
	Third monitoring	15
	Fourth monitoring	16
A10 Riverside residence at Yinhe Street of Shizigang Drainage Canal dredging section	First monitoring	17
	Second monitoring	16
	Third monitoring	15
	Fourth monitoring	16
A11 Proposed site of Jiangnan WWTP	First monitoring	12
	Second monitoring	11
	Third monitoring	13
	Fourth monitoring	11

Table 4 Surface Water Environment Quality Monitoring Results

Location / Monitoring item	Date of sampling	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	W8 Cross section of Jianshezhong Road of Huangansi River	W9 Cross section at the origin of Shizigang River
pH	2016.6.6	7.85	7.91	7.85	7.76	8.05	8.03	7.76	7.62	7.98
	2016.6.7	7.69	7.88	7.64	7.81	7.89	7.69	7.79	7.54	7.62
	2016.6.8	7.82	7.69	7.67	7.59	7.96	8.05	7.75	7.47	7.81
Dissolved oxygen	2016.6.6	5.5	6.4	5.5	5.1	7.0	5.1	5.8	5.4	7.2
	2016.6.7	5.7	6.6	5.4	5.6	6.8	5.5	6.1	5.2	7.2
	2016.6.8	5.6	5.9	5.2	5.5	6.7	5.4	6.0	5.3	6.9
Permanganate index	2016.6.6	1.6	1.4	2.2	3.2	1.9	5.1	2.6	2.5	1.8
	2016.6.7	1.7	1.6	2.2	3.2	2.0	5.2	2.6	2.4	1.8
	2016.6.8	1.7	1.5	2.1	3.2	2.0	5.1	2.4	2.3	1.8
BOD5	2016.6.6	3.6	1.6	1.1	1.7	ND	3.8	2.1	3.3	1.7
	2016.6.7	3.3	1.7	1.1	1.9	ND	3.7	2.2	3.0	1.6
	2016.6.8	3.5	1.6	1.3	1.7	ND	3.9	2.2	3.1	1.6
COD	2016.6.6	8	7	9	12	10	16	11	12	14
	2016.6.7	9	8	10	14	11	17	12	13	15
	2016.6.8	7	6	8	11	9	15	10	11	13
SS	2016.6.6	7	ND	6	5	7	9	10	6	5
	2016.6.7	8	4	6	5	6	8	ND	5	6
	2016.6.8	7	ND	4	6	6	8	ND	5	6
NH3-N	2016.6.6	0.105	0.088	0.102	1.508	0.191	6.468	2.754	2.848	0.541
	2016.6.7	0.110	0.091	0.102	1.519	0.177	5.788	2.0809	2.787	0.491

Table 4 Surface Water Environment Quality Monitoring Results

Location / Monitoring item	Date of sampling	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	W8 Cross section of Jianshezhong Road of Huangansi River	W9 Cross section at the origin of Shizigang River
	2016.6.8	0.099	0.080	0.113	1.463	0.185	6.135	2.837	2.798	0.477
TP	2016.6.6	0.03	0.06	0.08	0.45	0.05	0.53	0.38	0.31	0.13
	2016.6.7	0.03	0.06	0.09	0.43	0.05	0.55	0.37	0.32	0.13
	2016.6.8	0.03	0.06	0.08	0.44	0.06	0.54	0.38	0.31	0.14
Petroleum	2016.6.6	0.01	0.01	0.01	0.03.	0.02	0.03	0.03	0.02	0.02
	2016.6.7	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.01	0.01
	2016.6.8	0.01	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.01
Volatile phenol	2016.6.6	0.0033	0.0016	0.0013	0.0041	0.0031	0.0045	0.0040	0.0020	0.0022
	2016.6.7	0.0031	0.0014	0.0011	0.0038	0.0033	0.0041	0.0038	0.0023	0.0025
	2016.6.8	0.0029	0.0014	0.0012	0.0038	0.0029	0.0039	0.0038	0.0020	0.0021
Cyanide	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anionic surfactant	2016.6.6	0.10	0.12	0.14	0.15	0.14	0.13	0.12	0.11	0.10
	2016.6.7	0.11	0.12	0.14	0.15	0.14	0.13	0.12	0.10	0.11
	2016.6.8	0.10	0.11	0.15	0.13	0.13	0.12	0.10	0.11	0.11
Sulfide	2016.6.6	0.012	ND	ND	ND	0.013	0.005	ND	0.013	0.013
	2016.6.7	0.011	ND	ND	ND	0.011	0.006	ND	0.012	0.013
	2016.6.8	0.012	ND	ND	ND	0.012	0.007	ND	0.013	0.013
Copper （Cu）	2016.6.6	0.00096	0.00018	ND	0.00041	0.00088	0.00694	0.00090	0.00112	0.00206
	2016.6.7	0.00108	0.00024	ND	0.00053	0.00101	0.00638	0.00076	0.00099	0.00181

Table 4 Surface Water Environment Quality Monitoring Results

Location / Monitoring item	Date of sampling	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	W8 Cross section of Jianshezhong Road of Huangansi River	W9 Cross section at the origin of Shizigang River
	2016.6.8	0.00122	0.00021	ND	0.00066	0.00079	0.00583	0.00101	0.00090	0.00156
Zinc (Zn)	2016.6.6	ND	0.00091	ND	ND	ND	ND	0.00130	ND	0.00091
	2016.6.7	ND	0.00108	ND	ND	ND	ND	0.00102	ND	0.00080
	2016.6.8	ND	0.00123	ND	ND	ND	ND	0.00099	ND	0.00109
Plumbum（Pb）	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic（As）	2016.6.6	0.0050	0.0034	0.0023	0.0065	0.0070	0.0038	0.0085	0.0053	0.0063
	2016.6.7	0.0049	0.0035	0.0023	0.0062	0.0066	0.0039	0.0084	0.0060	0.0062
	2016.6.8	0.0048	0.0034	0.0023	0.0064	0.0069	0.0038	0.0084	0.0054	0.0060
Cr6+	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4 Surface Water Environment Quality Monitoring Results （Continued）

Monitoring item \ Location	Date of sampling	W10 Wangjiao cross section of Shizigang River	W11 Dawodu cross section of Taoyuan River	W12 Nanshetang cross section of Guishidong No. 6 Branch Canal	W13 Cross section of Guishidong Trunk Canal	W14 Cross section at the origin of Guishidong No. 5 Branch Canal	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River
pH	2016.6.6	7.45	7.96	8.08	8.12	8.00	8.02	8.01	8.00
	2016.6.7	7.50	7.74	7.93	7.91	7.93	7.86	7.77	7.89
	2016.6.8	7.31	7.99	8.01	8.06	8.04	7.86	7.92	7.87
Dissolved oxygen	2016.6.6	5.1	8.8	8.9	6.8	7.0	7.6	7.9	7.6
	2016.6.7	5.2	8.8	8.9	6.8	7.0	7.6	7.9	7.6
	2016.6.8	5.3	8.6	8.8	7.0	7.1	7.7	8.0	7.8
Permanganate index	2016.6.6	4.0	2.9	1.4	1.4	1.8	1.6	1.6	1.7
	2016.6.7	3.8	3.0	1.5	1.4	1.9	1.6	1.7	1.7
	2016.6.8	3.7	3.0	1.4	1.3	1.8	1.6	1.7	1.7
BOD5	2016.6.6	3.8	1.9	0.8	ND	3.8	ND	1.4	1.3
	2016.6.7	3.4	2.0	0.9	ND	3.5	0.8	1.6	1.4
	2016.6.8	3.4	1.7	0.9	ND	3.5	0.7	1.3	1.3
COD	2016.6.6	18	13	12	11	10	9	8	10
	2016.6.7	17	13	11	10	9	10	9	11
	2016.6.8	15	12	11	10	9	8	7	9
SS	2016.6.6	ND	ND	ND	6	7	8	6	4
	2016.6.7	5	6	4	5	5	9	7	6
	2016.6.8	4	5	4	5	6	7	7	5
NH3-N	2016.6.6	7.274	0.505	0.083	0.177	0.258	0.263	0.288	0.313
	2016.6.7	6.829	0.483	0.080	0.155	0.274	0.260	0.305	0.313
	2016.6.8	6.663	0.477	0.088	0.171	0.338	0.277	0.258	0.296

Table 4 Surface Water Environment Quality Monitoring Results （Continued）

Location / Monitoring item	Date of sampling	W10 Wangjiao cross section of Shizigang River	W11 Dawodu cross section of Taoyuan River	W12 Nanshetang cross section of Guishidong No. 6 Branch Canal	W13 Cross section of Guishidong Trunk Canal	W14 Cross section at the origin of Guishidong No. 5 Branch Canal	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River
TP	2016.6.6	0.74	0.51	0.03	0.05	0.06	0.06	0.08	0.08
	2016.6.7	0.72	0.49	0.03	0.05	0.07	0.06	0.07	0.09
	2016.6.8	0.73	0.47	0.03	0.05	0.07	0.06	0.07	0.09
Petroleum	2016.6.6	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.02
	2016.6.7	0.03	0.3	0.02	0.01	0.01	0.01	0.02	0.02
	2016.6.8	0.03	0.03	0.01	0.01	0.01	0.02	0.02	0.02
Volatile phenol	2016.6.6	0.0025	0.0017	0.0028	0.0031	0.0019	0.0035	0.0031	0.0022
	2016.6.7	0.0028	0.0014	0.0021	0.0024	0.0020	0.0038	0.00034	0.0020
	2016.6.8	0.002	0.0014	0.0022	0.0024	0.0020	0.0032	0.0030	0.0020
Cyanide	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND
Anionic surfactant	2016.6.6	0.11	0.12	0.09	0.09	0.15	0.15	0.13	0.13
	2016.6.7	0.11	0.12	0.09	0.09	0.14	0.16	0.13	0.12
	2016.6.8	0.13	0.09	0.10	0.13	0.15	0.14	0.13	0.13
Sulfide	2016.6.6	0.009	0.014	ND	0.013	0.006	0.007	0.007	0.005
	2016.6.7	0.010	0.013	ND	0.012	0.006	0.006	0.007	0.007
	2016.6.8	0.011	0.013	ND	0.013	0.007	0.007	0.006	0.006
Copper（Cu）	2016.6.6	0.00049	0.00429	0.00049	ND	0.00644	0.00048	0.00052	0.00035
	2016.6.7	0.00038	0.00464	0.00052	ND	0.00575	0.00041	0.00060	0.000029
	2016.6.8	0.00041	0.00399	0.00043	ND	0.00609	0.00053	0.00072	0.00041
Zinc (Zn)	2016.6.6	0.00192	0.00205	ND	ND	ND	ND	0.00101	ND

Table 4 Surface Water Environment Quality Monitoring Results （Continued）

Location / Monitoring item	Date of sampling	W10 Wangjiao cross section of Shizigang River	W11 Dawodu cross section of Taoyuan River	W12 Nanshetang cross section of Guishidong No. 6 Branch Canal	W13 Cross section of Guishidong Trunk Canal	W14 Cross section at the origin of Guishidong No. 5 Branch Canal	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River
	2016.6.7	0.00169	0.0173	ND	ND	ND	ND	0.00093	ND
	2016.6.8	0.00222	0.00186	ND	ND	ND	ND	0.00099	ND
Plumbum（Pb）	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic（As）	2016.6.6	0.0055	0.0020	0.0016	0.0075	0.0020	0.0036	0.0031	0.0029
	2016.6.7	0.0055	0.0016	0.00144	0.0074	0.0019	0.0035	0.0032	0.0029
	2016.6.8	0.0058	0.0015	0.0014	0.0072	0.0018	0.0035	0.0030	0.0028
Cr6+	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND
Hg	2016.6.6	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.7	ND	ND	ND	ND	ND	ND	ND	ND
	2016.6.8	ND	ND	ND	ND	ND	ND	ND	ND

Table 4 Surface Water Environment Quality Monitoring Results （Continued）

Monitoring item \ Location	Monitoring time	W18 Cross section ahead of confluence of Mawei River into He River
pH	2017.3.21	7.84
	2017.6.27	7.57
Dissolved oxygen	2017.3.21	9.2
	2017.6.27	5.4
Permanganate index	2017.3.21	2.2
	2017.6.27	2.08
BOD5	2017.3.21	1.6
	2017.6.27	2.1
COD	2017.3.21	ND
	2017.6.27	12.4
NH3-N	2017.3.21	0.463
	2017.6.27	0.846
TP	2017.3.21	0.04
	2017.6.27	0.20
Petroleum	2017.3.21	0.02
	2017.6.27	0.01
Volatile phenol	2017.3.21	0.0017
	2017.6.27	ND
Cyanide	2017.3.21	ND
	2017.6.27	ND
Anionic surfactant	2017.3.21	0.05
	2017.6.27	0.05
Sulfide	2017.3.21	0.013
	2017.6.27	0.013
Copper （Cu）	2017.3.21	0.00060
	2017.6.27	0.23
Zinc (Zn)	2017.3.21	0.00242
	2017.6.27	ND
Plumbum（Pb）	2017.3.21	ND
	2017.6.27	0.0052
Cadmium	2017.3.21	ND
	2017.6.27	0.0001
Arsenic（As）	2017.3.21	0.0063
	2017.6.27	ND
Cr6+	2017.3.21	ND
	2017.6.27	ND
Hg	2017.3.21	ND
	2017.6.27	ND

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
pH	Range of monitored value	7.69~7.82	7.69~7.91	7.64~7.85	7.59~7.81	7.89~8.05	7.69~8.05	7.75~7.79	6~9	6~9
	Standard Index Sij	0.345~0.41	0.345~0.455	0.32~0.425	0.295~0.405	0.445~0.525	0.345~0.525	0.375~0.395		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Dissolved oxygen	Range of monitored value	5.5~5.7	5.9~6.6	5.2~5.5	5.1~5.6	6.7~7.0	5.1~5.5	5.8~6.1	3	2
	Standard Index Sij	0.51~0.55	0.35~0.47	0.55~0.60	0.53~0.62	0.27~0.33	0.55~0.62	0.44~0.49		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Permanganate index	Range of monitored value	1.6~1.7	1.4~1.6	2.1~2.2	3.2	1.9~2.0	5.1~5.2	2.4~2.6	10	15
	Standard Index Sij	0.16~0.17	0.14~0.16	0.21~0.22	0.32	0.19~0.20	0.51~0.52	0.24~0.26		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
BOD5	Range of monitored	3.3~3.6	1.6~1.7	1.1~1.3	1.7~1.9	ND	3.7~3.9	2.1~2.2	6	10

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	value									
	Standard Index Sij	0.55~0.60	0.27~0.29	0.18~0.22	0.28~0.32	0.04	0.62~0.65	0.35~0.37		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
COD	Range of monitored value	7~9	6~8	8~10	11~14	9~11	15~17	10~12	30	40
	Standard Index Sij	0.23~0.30	0.20~0.27	0.27~0.33	0.37~0.47	0.30~0.37	0.50~0.57	0.33~0.40		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
SS	Range of monitored value	7~8	ND~4	4~6	5~6	6~7	8~9	ND~ 10	60	150
	Standard Index Sij	0.12~0.13	0.03~0.06	0.06~0.10	0.08~0.10	0.10~0.12	0.13~0.15	0.03~0.17		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
NH3-N	Range of monitored value	0.099~0.110	0.080~0.091	0.102~0.113	**1.463~1.519**	0.177~0.191	**5.788~6.468**	**2.081~2.837**	**1.5**	**2.0**
	Standard	0.07~0.073	0.05~0.06	0.07~0.08	**0.98~1.01**	0.12~0.13	**3.86~4.31**	**1.39~1.89**		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	Index Sij									
	Noncompliance multiple	0	0	0	**0.01**	0	**2.86~3.31**	**0.39~0.89**		
	Noncompliance rate	0	0	0	**66.7%**	**0**	**100%**	**100%**		
TP	Range of monitored value	0.03	0.06	0.08~0.09	**0.43~0.45**	0.05~0.06	**0.53~0.55**	**0.37~0.38**	**0.3**	**0.4**
	Standard Index Sij	0.10	0.20	0.26~0.30	**1.43~1.50**	0.17~0.20	**1.77~1.83**	**1.23~1.27**		
	Noncompliance multiple	0	0	0	**0.43~0.50**	0	**0.77~0.83**	**0.23~0.27**		
	Noncompliance rate	0	0	0	**100%**	0	**100%**	**100%**		
Petroleum	Range of monitored value	0.01	0.01	0.01	0.02~0.03	0.01~0.02	0.03	0.02~0.03	0.5	1.0
	Standard Index Sij	0.02	0.02	0.02	0.04~0.06	0.02~0.04	0.06	0.04~0.06		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Volatile phenol	Range of monitored value	0.0029~0.0033	0.0014~0.0016	0.0011~0.0013	0.0038~0.0041	0.0029~0.0033	0.0039~0.0045	0.0038~0.0040	0.01	0.1
	Standard Index Sij	0.29~0.33	0.14~0.16	0.11~0.13	0.38~0.41	0.29~0.33	0.39~0.45	0.38~0.40		
	Noncomplia	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	nce multiple									
	Noncompliance rate	0	0	0	0	0	0	0		
Cyanide	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.2	0.2
	Standard Index Sij	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Anionic surfactant	Range of monitored value	0.10~0.11	0.11~0.12	0.14~0.15	0.13~0.15	0.13~0.14	0.12~0.13	0.10~0.12	0.3	0.3
	Standard Index Sij	0.33~0.37	0.37~0.40	0.47~0.50	0.43~0.50	0.43~0.47	0.40~0.43	0.33~0.40		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Sulfide	Range of monitored value	0.011~0.012	ND	ND	ND	0.011~0.013	0.005~0.007	ND	0.5	1.0
	Standard Index Sij	0.02	0.01	0.01	0.01	0.02~0.03	0.01	0.01		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncomplia	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	nce rate									
Copper（Cu）	Range of monitored value	0.00096~0.00122	0.00018~0.00024	ND	0.00041~0.00066	0.00079~0.00101	0.00583~0.00694	0.00076~0.00101	1.0	1.0
	Standard Index Sij	0.00096~0.00122	0.00018~0.00024	0.00004	0.00041~0.00066	0.00079~0.00101	0.00583~0.00694	0.00076~0.00101		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Zinc (Zn)	Range of monitored value	ND	0.00091~0.00123	ND	ND	ND	ND	0.00099~0.00130	2.0	2.0
	Standard Index Sij	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0005~0.0007		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Plumbum（Pb）	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.05	0.1
	Standard Index Sij	0.002	0.002	0.002	0.002	0.002	0.002	0.002		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Cadmium	Range of	ND	ND	ND	ND	ND	ND	ND	0.05	0.01

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	monitored value									
	Standard Index Sij	0.005	0.005	0.005	0.005	0.005	0.005	0.005		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Arsenic（As）	Range of monitored value	0.0048~0.0050	0.0034~0.0035	0.0023	0.0062~0.0065	0.0066~0.0070	0.0038~0.0039	0.0084~0.0085	0.1	0.1
	Standard Index Sij	0.05	0.03~0.04	0.02	0.06~0.07	0.07	0.04	0.08~0.09		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Cr6+	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.05	0.1
	Standard Index Sij	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Hg	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.01	0.001

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	Standard Index Sij	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
pH	Range of monitored value	7.47~7.62	7.62~7.98	7.31~7.50	7.74~7.99	7.93~8.08	7.91~8.12	7.93~8.04	6~9	6~9
	Standard Index Sij	0.235~0.31	0.31~0.49	0.15~0.25	0.37~0.49	0.46~0.504	0.46~0.56	0.46~0.52		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Dissolved oxygen	Range of monitored value	5.2~5.4	6.9~7.2	5.1~5.3	8.6~8.8	8.8~8.9	6.8~7.0	7.0~7.1	3	2
	Standard Index Sij	0.56~0.60	0.24~0.29	0.58~0.62	0.02~0.05	0.05~0.07	0.27~0.31	0.25~0.27		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Permanganate index	Range of monitored value	2.3~2.5	1.8	3.7~4.0	2.9~3.0	1.4~1.5	1.3~1.4	1.8~1.9	10	15
	Standard Index Sij	0.23~0.25	0.18	0.37~0.40	0.29~0.30	0.14~0.15	0.13~0.14	0.18~0.19		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
BOD5	Range of monitored value	3.0~3.3	1.6~1.7	3.4~3.8	1.7~2.0	0.8~0.9	ND	3.5~3.8	6	10
	Standard Index Sij	0.50~0.55	0.27~0.28	0.57~0.63	0.28~0.33	0.13~0.15	0.04	0.58~0.63		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
COD	Range of monitored value	11~13	10~15	15~18	12~13	11~12	10~11	9~10	30	40
	Standard Index Sij	0.37~0.43	0.33~0.50	0.50~0.60	0.40~0.43	0.37~0.40	0.33~0.37	0.30~0.33		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
SS	Range of monitored value	5~6	5~6	ND~5	ND~6	ND~4	5~6	5~7	60	150
	Standard Index Sij	0.08~0.10	0.08~0.10	0.03~0.08	0.03~0.10	0.03~0.07	0.08~0.10	0.08~0.12		
	Noncompliance multiple	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	Noncompliance rate	0	0	0	0	0	0	0		
NH3-N	Range of monitored value	**2.787~2.848**	0.477~0.541	**6.663~7.274**	0.477~0.505	0.080~0.088	0.155~0.177	0.258~0.338	1.5	2.0
	Standard Index Sij	**1.86~1.90**	0.32~0.36	**4.44~4.85**	0.32~0.34	0.05~0.06	0.10~0.12	0.17~0.23		
	Noncompliance multiple	**0.86~0.90**	0	**3.44~3.85**	0	0	0	0		
	Noncompliance rate	**100%**	0	**100%**	0	0	0	0		
TP	Range of monitored value	**0.31~0.32**	0.13~0.14	**0.72~0.74**	**0.47~0.51**	0.03	0.05	0.06~0.07	0.3	0.4
	Standard Index Sij	**1.03~1.07**	0.43~0.47	**2.40~2.47**	**1.57~1.70**	0.10	0.17	0.20~0.23		
	Noncompliance multiple	**0.03~0.07**	0	**0.40~0.47**	**0.57~0.70**	0	0	0		
	Noncompliance rate	**100%**	0	**100%**	**100%**	0	0	0		
Petroleum	Range of monitored value	0.01~0.02	0.01~0.02	0.03	0.03	0.01~0.02	0.01	0.01	0.5	1.0
	Standard Index Sij	0.02~0.04	0.02~0.04	0.06	0.06	0.02~0.04	0.02	0.02		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
Volatile phenol	Range of monitored value	0.0020~0.0023	0.0021~0.0025	0.002~0.0028	0.0014~0.0017	0.0021~0.0028	0.0024~0.0031	0.0019~0.0020	0.01	0.1
	Standard Index Sij	0.20~0.23	0.21~0.25	0.20~0.28	0.14~0.17	0.21~0.28	0.24~0.31	0.19~0.20		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Cyanide	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.2	0.2
	Standard Index Sij	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Anionic surfactant	Range of monitored value	0.10~0.11	0.10~0.11	0.11~0.13	0.09~0.12	0.09~0.10	0.09~0.13	0.14~0.15	0.3	0.3
	Standard Index Sij	0.33~0.37	0.33~0.37	0.37~0.43	0.30~0.40	0.30~0.33	0.30~0.43	0.47~0.50		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Sulfide	Range of monitored	0.012~0.013	0.013	0.009~0.011	0.013~0.014	ND	0.012~0.013	0.006~0.007	0.5	1.0

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	value									
	Standard Index Sij	0.02~0.03	0.03	0.02	0.03	0.01	0.02~0.03	0.01		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Copper（Cu）	Range of monitored value	0.00090~0.00112	0.00156~0.00206	0.00038~0.00049	0.00399~0.00464	0.00043~0.00052	ND	0.00575~0.00644	1.0	1.0
	Standard Index Sij	0.00090~0.00112	0.00156~0.00206	0.00038~0.00049	0.00399~0.00464	0.00043~0.00052	0.00004	0.00575~0.00644		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Zinc (Zn)	Range of monitored value	ND	0.00080~0.00109	0.00169~0.00222	0.00173~0.00186	ND	ND	ND	2.0	2.0
	Standard Index Sij	0.0002	0.0004~0.0005	0.0008~0.0011	0.0009	0.00017	0.00017	0.00017		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Plumbum（Pb）	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.05	0.1
	Standard	0.002	0.002	0.002	0.002	0.002	0.002	0.002		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	Index Sij									
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Cadmium	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.05	0.01
	Standard Index Sij	0.005	0.005	0.005	0.005	0.005	0.005	0.005		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Arsenic （As）	Range of monitored value	0.0053~0.0060	0.0060~0.0063	0.0055~0.0058	0.0015~0.0020	0.0014~0.0016	0.0072~0.0075	0.0018~0.0020	0.1	0.1
	Standard Index Sij	0.05~0.06	0.06	0.06~0.08	0.02	0.01~0.02	0.07~0.08	0.02		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		
Cr6+	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.05	0.1
	Standard Index Sij	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
	Noncomplia	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results

Location / Monitoring item	Evaluation index	W1 Cross section at the origin of Lining River	W2 Cross section at confluence of Lining River and Huangtian Branch Canal	W3 Cross section at the origin of Changlong River	W4 Tianbaotang Cross section of Changlong River	W5 Cross section at the origin of Huangtian Branch Canal	W6 Anshan Village cross section of Huangtian Branch Canal	W7 Shizigang cross section of Huangtian Branch Canal	Class IV water quality standard	Class V water quality standard
	nce multiple									
	Noncompliance rate	0	0	0	0	0	0	0		
Hg	Range of monitored value	ND	ND	ND	ND	ND	ND	ND	0.001	0.001
	Standard Index Sij	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
	Noncompliance multiple	0	0	0	0	0	0	0		
	Noncompliance rate	0	0	0	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results (Continued)

Location / Monitoring item	Evaluation index	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River	W18 Cross section before Mawei River flowing into He River	Class III water quality standard	Class IV water quality standard
pH	Range of monitored value	7.86~8.02	7.77~8.01	7.87~8.00	7.57~7.84	6~9	6~9
	Standard Index Sij	0.43~0.51	0.385~0.505	0.44~0.5	0.285~0.42		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Dissolved oxygen	Range of monitored value	7.6~7.7	7.9~8.0	7.6~7.8	5.4~9.2	5	3
	Standard Index Sij	0.27~0.3	0.19~0.24	0.26~0.3	0.053~0.876		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Permanganate index	Range of monitored value	1.6	1.6~1.7	1.7	2.08~2.2	6	10
	Standard Index Sij	0.27	0.27~0.28	0.28	0.345~0.367		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
BOD5	Range of monitored value	ND~0.8	1.3~1.6	1.3~1.4	1.6~2.1	4	6
	Standard Index Sij	0.06~0.2	0.325~0.4	0.325~0.35	0.4~0.525		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
COD	Range of monitored value	9~10	7~9	9~11	ND~12.4	20	30
	Standard Index Sij	0.45~0.5	0.35~0.45	0.45~0.55	0.125~0.62		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results (Continued)

Location / Monitoring item	Evaluation index	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River	W18 Cross section before Mawei River flowing into He River	Class III water quality standard	Class IV water quality standard
SS	Range of monitored value	7~9	6~7	4~6	/	30	60
	Standard Index Sij	0.23~0.3	0.2~0.23	0.13~0.2	/		
	Noncompliance multiple	0	0	0	/		
	Noncompliance rate	0	0	0	/		
NH3-N	Range of monitored value	0.260~0.277	0.258~0.305	0.296~0.313	0.463~0.846	1.0	1.5
	Standard Index Sij	0.260~0.277	0.258~0.305	0.296~0.313	0.463~0.846		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
TP	Range of monitored value	0.06	0.07~0.08	0.08~0.09	0.04~0.20	0.2	0.3
	Standard Index Sij	0.3	0.35~0.4	0.4~0.45	0.2~1		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Petroleum	Range of monitored value	0.01~0.02	0.02	0.02	0.01~0.02	0.05	0.5
	Standard Index Sij	0.2~0.4	0.4	0.4	0.2~0.4		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Volatile phenol	Range of monitored value	0.0032~0.0038	0.0030~0.00034	0.0020~0.0022	ND~0.0017	0.005	0.01
	Standard Index Sij	0.64~0.76	0.6~0.68	0.4~0.44	0.03~0.34		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results (Continued)

Location / Monitoring item	Evaluation index	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River	W18 Cross section before Mawei River flowing into He River	Class III water quality standard	Class IV water quality standard
Cyanide	Range of monitored value	ND	ND	ND	ND	0.2	0.2
	Standard Index Sij	0.01	0.01	0.01	0.01		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Anionic surfactant	Range of monitored value	0.14~0.16	0.13	0.12~0.13	0.05	0.2	0.3
	Standard Index Sij	0.7~0.8	0.65	0.6~0.75	0.25		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Sulfide	Range of monitored value	0.006~0.007	0.006~0.007	0.005~0.007	0.013	0.2	0.5
	Standard Index Sij	0.03~0.035	0.06~0.035	0.025~0.035	0.065		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Copper （Cu）	Range of monitored value	0.00041~0.00053	0.00052~0.00072	0.00029~0.00041	0.00060~0.23	1.0	1.0
	Standard Index Sij	0.00041~0.00053	0.00052~0.00072	0.00029~0.00041	0.00060~0.23		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Zinc (Zn)	Range of monitored value	ND	0.00093~0.00101	ND	ND~0.00242	1.0	2.0
	Standard Index Sij	0.00034	0.00093~0.00101	0.00034	0.00034~0.00242		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		

Table 5 Statistical Evaluation of Water Quality Monitoring Results (Continued)

Location / Monitoring item	Evaluation index	W15 Jigongzhou cross section of He River	W16 Babu Bridge cross section of He River	W17 Lingfeng Bridge cross section of He River	W18 Cross section before Mawei River flowing into He River	Class III water quality standard	Class IV water quality standard
Plumbum（Pb）	Range of monitored value	ND	ND	ND	ND~0.0052	0.05	0.05
	Standard Index Sij	0.002	0.002	0.002	0.002~0.104		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Cadmium	Range of monitored value	ND	ND	ND	ND~0.0001	0.005	0.05
	Standard Index Sij	0.005	0.005	0.005	0.005~0.02		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Arsenic（As）	Range of monitored value	0.0035~0.0036	0.0030~0.0032	0.0028~0.0029	ND~0.0063	0.05	0.1
	Standard Index Sij	0.07~0.072	0.06~0.062	0.056~0.058	0.003~0.126		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Cr6+	Range of monitored value	ND	ND	ND	ND	0.05	0.05
	Standard Index Sij	0.04	0.04	0.04	0.04		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		
Hg	Range of monitored value	ND	ND	ND	ND	0.0001	0.01
	Standard Index Sij	0.2	0.2	0.2	0.2		
	Noncompliance multiple	0	0	0	0		
	Noncompliance rate	0	0	0	0		

Table 6 Statistics of Noise Monitoring and Evaluation Results of the Project

Location	Date of monitoring	Monitored value L_{eq} [dB（A）]		Standard in force dB（A）	Standard Compliance Analysis
N1 JIGONGZHOU	2016.6.7	Daytime	53.3	60	Compliant
	2016.6.7~6.8	Nighttime	39.8	50	Compliant
	2016.6.8	Daytime	54.1	60	Compliant
	2016.6.8~6.9	Nighttime	40.4	50	Compliant
N2 Tianchongzhai	2016.6.7	Daytime	54.3	60	Compliant
	2016.6.7~6.8	Nighttime	39.9	50	Compliant
	2016.6.8	Daytime	53.9	60	Compliant
	2016.6.8~6.9	Nighttime	38.1	50	Compliant
N3 Sanjia Primary School	2016.6.7	Daytime	52.6	60	Compliant
	2016.6.7~6.8	Nighttime	40.9	50	Compliant
	2016.6.8	Daytime	54.3	60	Compliant
	2016.6.8~6.9	Nighttime	38.7	50	Compliant
N4 Hezhou Institute	2016.6.7	Daytime	53.6	60	Compliant
	2016.6.7~6.8	Nighttime	42.3	50	Compliant
	2016.6.8	Daytime	54.2	60	Compliant
	2016.6.8~6.9	Nighttime	40.1	50	Compliant
N5 Sanjia Village	2016.6.7	Daytime	54.2	60	Compliant
	2016.6.7~6.8	Nighttime	43.7	50	Compliant
	2016.6.8	Daytime	54.7	60	Compliant
	2016.6.8~6.9	Nighttime	41.4	50	Compliant
N6 Hezhou Experimental Middle School	2016.6.7	Daytime	53.5	60	Compliant
	2016.6.7~6.8	Nighttime	40.9	50	Compliant
	2016.6.8	Daytime	54.1	60	Compliant
	2016.6.8~6.9	Nighttime	41.1	50	Compliant
N7 Wenyuanhuadu	2016.6.7	Daytime	49.5	60	Compliant
	2016.6.7~6.8	Nighttime	43.2	50	Compliant
	2016.6.8	Daytime	51.2	60	Compliant
	2016.6.8~6.9	Nighttime	42.1	50	Compliant
N8 Xiyue Street	2016.6.7	Daytime	54.1	60	Compliant
	2016.6.7~6.8	Nighttime	43.0	50	Compliant
	2016.6.8	Daytime	52.2	60	Compliant
	2016.6.8~6.9	Nighttime	44.2	50	Compliant
N9 Hezhou Transportation Bureau	2016.6.7	Daytime	52.9	60	Compliant
	2016.6.7~6.8	Nighttime	41.2	50	Compliant
	2016.6.8	Daytime	52.4	60	Compliant
	2016.6.8~6.9	Nighttime	41.5	50	Compliant
N10 Xiwan Primary School	2016.6.7	Daytime	53.8	60	Compliant
	2016.6.7~6.8	Nighttime	41.4	50	Compliant
	2016.6.8	Daytime	54.2	60	Compliant
	2016.6.8~6.9	Nighttime	37.0	50	Compliant
N11 Lining Village	2016.6.7	Daytime	53.0	60	Compliant
	2016.6.7~6.8	Nighttime	36.6	50	Compliant
	2016.6.8	Daytime	53.7	60	Compliant
	2016.6.8~6.9	Nighttime	38.1	50	Compliant
N12 Changlong Village	2016.6.7	Daytime	53.5	60	Compliant
	2016.6.7~6.8	Nighttime	40.0	50	Compliant
	2016.6.8	Daytime	54.0	60	Compliant
	2016.6.8~6.9	Nighttime	38.7	50	Compliant
N13 Huangtian Town	2016.6.7	Daytime	54.2	60	Compliant
	2016.6.7~6.8	Nighttime	39.0	50	Compliant

Table 6 Statistics of Noise Monitoring and Evaluation Results of the Project

Location	Date of monitoring	Monitored value L_{eq} [dB（A）]		Standard in force dB（A）	Standard Compliance Analysis
	2016.6.8	Daytime	53.7	60	Compliant
	2016.6.8~6.9	Nighttime	37.1	50	Compliant
N14 Pinggui No. 3 Junior Middle School	2016.6.7	Daytime	52.6	60	Compliant
	2016.6.7~6.8	Nighttime	39.0	50	Compliant
	2016.6.8	Daytime	53.2	60	Compliant
	2016.6.8~6.9	Nighttime	40.4	50	Compliant
N15 Qianjin Road Primary School	2016.6.7	Daytime	54.7	60	Compliant
	2016.6.7~6.8	Nighttime	41.2	50	Compliant
	2016.6.8	Daytime	53.0	60	Compliant
	2016.6.8~6.9	Nighttime	41.2	50	Compliant
N16 Babu District Experimental Primary School	2016.6.7	Daytime	50.4	60	Compliant
	2016.6.7~6.8	Nighttime	40.7	50	Compliant
	2016.6.8	Daytime	52.3	60	Compliant
	2016.6.8~6.9	Nighttime	41.4	50	Compliant
N17 Hezhou Renmin Hospital	2016.6.7	Daytime	51.3	60	Compliant
	2016.6.7~6.8	Nighttime	42.3	50	Compliant
	2016.6.8	Daytime	53.6	60	Compliant
	2016.6.8~6.9	Nighttime	42.8	50	Compliant
N18 Anshan Village	2016.6.7	Daytime	52.7	60	Compliant
	2016.6.7~6.8	Nighttime	41.1	50	Compliant
	2016.6.8	Daytime	53.7	60	Compliant
	2016.6.8~6.9	Nighttime	41.1	50	Compliant
N19 Guangji Maternity Hospital	2016.6.7	Daytime	54.6	60	Compliant
	2016.6.7~6.8	Nighttime	40.5	50	Compliant
	2016.6.8	Daytime	53.7	60	Compliant
	2016.6.8~6.9	Nighttime	43.6	50	Compliant
N20 Technical School	2016.6.7	Daytime	53.4	60	Compliant
	2016.6.7~6.8	Nighttime	41.9	50	Compliant
	2016.6.8	Daytime	52.9	60	Compliant
	2016.6.8~6.9	Nighttime	43.6	50	Compliant
N21 Hezhou Chinese Traditional Medicine Hospital	2016.6.7	Daytime	54.1	60	Compliant
	2016.6.7~6.8	Nighttime	44.9	50	Compliant
	2016.6.8	Daytime	53.5	60	Compliant
	2016.6.8~6.9	Nighttime	38.8	50	Compliant
N22 Baimianshan	2016.6.7	Daytime	49.6	60	Compliant
	2016.6.7~6.8	Nighttime	41.4	50	Compliant
	2016.6.8	Daytime	44.9	60	Compliant
	2016.6.8~6.9	Nighttime	40.2	50	Compliant
N23 Dawodu	2016.6.7	Daytime	51.2	60	Compliant
	2016.6.7~6.8	Nighttime	42.1	50	Compliant
	2016.6.8	Daytime	50.1	60	Compliant
	2016.6.8~6.9	Nighttime	40.6	50	Compliant

Table 7　Soil Sample Monitoring and Analysis Results

Unit:（mg/kg，pH value - dimensionless

Monitoring site	Monitoring item	pH	Total Cr	Plumbum	Cadmium	Arsenic	Zinc	Copper	Hg
（GB15618-1995） Class II standard		>7.5	250	350	0.6	**25**	300	100	1.5
S21 500m upstream of Lingfeng Bridge (on the right bank)	Monitored value	8.2	51	54.8	0.23	**26.1**	160	45	0.322
	PI index	/	0.204	0.154	0.383	**1.044**	0.533	0.45	0.322
	Noncompliance multiple	/	0	0	0	**0.044**	0	0	0
S22 1000m upstream of Lingfeng Bridge (on the right bank)	Monitored value	8.2	39	57.7	**1.06**	**40.2**	**322**	73	**1.21**
	PI index	/	0.156	0.165	**1.767**	**1.608**	**1.073**	0.73	**1.21**
	Noncompliance multiple	/	0	0	**0.767**	**0.608**	**0.073**	0	**0.21**
S23-1 50m upstream of Fanglin Power Station（on the left bank）	Monitored value	8.2	46	66.6	0.37	**35.8**	**393**	60	**1.25**
	PI index	/	0.174	0.190	0.617	**1.432**	**1.31**	0.60	**1.25**
	Noncompliance multiple	/	0	0	0	**0.432**	**0.31**	0	**0.25**
S23-2 50m upstream of Fanglin Power Station（on the right bank）	Monitored value	8.2	51	70.3	**0.98**	**25.9**	279	78	**1.73**
	PI index	/	0.204	0.201	**1.633**	**1.036**	0.93	0.78	**1.73**
	Noncompliance multiple	/	0	0	**0.633**	**0.036**	0	0	**0.73**
S24-1 1000m upstream of Fanglin Power Station（on the left bank）	Monitored value	8.2	57	62.5	**1.29**	**52.4**	297	91	**1.65**
	PI index	/	0.228	0.179	**2.15**	**2.096**	0.99	0.91	**1.65**
	Noncompliance multiple	/	0	0	**1.15**	**1.096**	0	0	**0.65**

Table 7　Soil Sample Monitoring and Analysis Results

Unit:（mg/kg，pH value - dimensionless

Monitoring site	Monitoring item	pH	Total Cr	Plumbum	Cadmium	Arsenic	Zinc	Copper	Hg
S24-2 1000m upstream of Fanglin Power Station（on the right bank）	Monitored value	8.1	45	39.6	0.26	**58.0**	136	39	0.624
	PI index	/	0.18	0.113	0.433	**2.32**	0.453	0.39	0.624
	Noncompliance multiple	/	0	0	0	**1.32**	0	0	0
S25-1 2000m upstream of Fanglin Power Station（on the left bank）	Monitored value	8.0	36	47.8	0.53	**100**	155	41	0.964
	PI index	/	0.144	0.131	0.883	**4**	0.517	0.41	0.964
	Noncompliance multiple	/	0	0	0	**3**	0	0	0
S25-2 2000m upstream of Fanglin Power Station（on the right bank）	Monitored value	8.1	55	33.8	0.27	**105**	152	45	**4.36**
	PI index	/	0.22	0.097	0.45	**4.2**	0.506	0.45	**4.36**
	Noncompliance multiple	/	0	0	0	**3.2**	0	0	**3.36**

Table 8 Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
pH	Monitored value	6.9	7.1	7.1	7.3	6.9	>6.5
	PI index	/	/	/	/	/	
	Noncompliance multiple	/	/	/	/	/	
Copper	Monitored value	30	54	59	56	30	400
	PI index	0.075	0.135	0.147	0.14	0.075	
	Noncompliance multiple	0	0	0	0	0	
Zinc	Monitored value	118	257	266	387	163	500
	PI index	0.236	0.514	0.532	0.774	0.326	
	Noncompliance multiple	0	0	0	0	0	
Plumbum	Monitored value	80.3	118	116	102	90.9	500
	PI index	0.16	0.236	0.232	0.204	0.18	
	Noncompliance multiple	0	0	0	0	0	
Cadmium	Monitored value	0.45	**1.25**	0.81	**2.17**	0.44	1.0
	PI index	0.45	**1.25**	0.81	**2.17**	0.44	
	Noncompliance multiple	0	**0.25**	0	**1.17**	0	
Arsenic	Monitored value	**58.0**	**95.6**	**118**	**115**	**57.4**	40
	PI index	**1.45**	**2.39**	**2.95**	**2.875**	**1.435**	
	Noncompliance multiple	**0.45**	**1.39**	**1.95**	**1.875**	**0.435**	

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
Hg	Monitored value	0.249	0.445	0.335	0.272	0.196	1.5
	PI index	0.166	0.296	0.223	0.181	0.13	
	Noncompliance multiple	0	0	0	0	0	
Total Cr	Monitored value	64	64	71	123	67	300
	PI index	0.213	0.213	0.237	0.41	0.223	
	Noncompliance multiple	0	0	0	0	0	
Location **Monitoring item**	**Evaluation index**	**S6 downstream of dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**S7 dredging section of East No. 6 Branch Canal** (Sampling depth: 20m)	**S8 dredging section of Huangtian Branch Canal** (Sampling depth: 20m)	**S9 dredging section of Guposhan Drainage Canal** (Sampling depth: 20m)	**S10 dredging section of Taoyuan Drainage Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
pH	Monitored value	7.2	7.2	7.2	7.3	6.9	>6.5
	PI index	/	/	/	/	/	
	Noncompliance multiple	/	/	/	/	/	
Copper	Monitored value	30	62	54	71	50	400
	PI index	0.075	0.155	0.135	0.177	0.125	
	Noncompliance multiple	0	0	0	0	0	

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
Zinc	Monitored value	138	467	334	396	328	500
	PI index	0.276	0.934	0.668	0.792	0.656	
	Noncompliance multiple	0	0	0	0	0	
Plumbum	Monitored value	80.5	133	132	139	97.4	500
	PI index	0.161	0.266	0.264	0.278	0.189	
	Noncompliance multiple	0	0	0	0	0	
Cadmium	Monitored value	0.58	**1.50**	**2.38**	**1.91**	**1.27**	1.0
	PI index	0.58	**1.50**	**2.38**	**1.91**	**1.27**	
	Noncompliance multiple	0	**0.5**	**1.38**	**0.91**	**0.27**	
Arsenic	Monitored value	**74.5**	**42.5**	**64.6**	**64.0**	**42.6**	40
	PI index	**1.863**	**1.063**	**1.615**	**1.6**	**1.065**	
	Noncompliance multiple	**0.863**	**0.063**	**0.615**	**0.6**	**0.065**	
Hg	Monitored value	0.393	1.12	1.07	0.321	1.02	1.5
	PI index	0.262	0.747	0.713	0.214	0.68	
	Noncompliance multiple	0	0	0	0	0	
Total Cr	Monitored value	71	217	206	181	91	300
	PI index	0.231	0.726	0.678	0.603	0.303	
	Noncompliance multiple	0	0	0	0	0	

Table 8 Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
Location Monitoring item	**Evaluation index**	**S11 Upstream of Huangansi Drainage Canal dredging section** (Sampling depth: 20m)	**S12 Downstream of Huangansi Drainage Canal dredging section** (Sampling depth: 20m)	**S13 Upstream of Shizigang Drainage Canal dredging section** (Sampling depth: 20m)	**S14 Middle section of Shizigang Drainage Canal dredging section** (Sampling depth: 20m)	**S15 Downstream of Shizigang Drainage Canal dredging section** (Sampling depth: 20m)	**（GB15618-199Class III**
pH	Monitored value	7.1	6.9	7.3	7.2	7.1	>6.5
	PI index	/	/	/	/	/	
	Noncompliance multiple	/	/	/	/	/	
Copper	Monitored value	136	128	46	96	109	400
	PI index	0.34	0.32	0.115	0.24	0.272	
	Noncompliance multiple	0	0	0	0	0	
Zinc	Monitored value	**598**	**546**	221	**571**	**637**	500
	PI index	**1.19**	**1.09**	0.442	**1.14**	**1.27**	
	Noncompliance multiple	**0.19**	**0.09**	0	**0.14**	**0.27**	
Plumbum	Monitored value	140	159	99.3	223	191	500
	PI index	0.28	0.318	0.198	0.446	0.382	
	Noncompliance multiple	0	0	0	0	0	

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

<table>
<tr><th>Location / Monitoring item</th><th>Evaluation index</th><th>S1 100M downstream of confluence of Huangansi River into He River (Sampling depth: 20m)</th><th>S2 Lingfeng Bridge cross section of He River (Sampling depth: 20m)</th><th>S3 100m downstream of confluence of Shizigang River into He River (Sampling depth: 20m)</th><th>S4 Dredging section of East Trunk Canal (Sampling depth: 20m)</th><th colspan="2">S5 Dredging section of East No. 5 Branch Canal (Sampling depth: 20m)</th><th>（GB15618-199Class III</th></tr>
<tr><td rowspan="3">Cadmium</td><td>Monitored value</td><td>2.93</td><td>2.73</td><td>0.92</td><td>2.12</td><td colspan="2">2.60</td><td rowspan="3">1.0</td></tr>
<tr><td>PI index</td><td>2.93</td><td>2.73</td><td>0.92</td><td>2.12</td><td colspan="2">2.60</td></tr>
<tr><td>Noncompliance multiple</td><td>1.93</td><td>1.73</td><td>0</td><td>1.12</td><td colspan="2">1.6</td></tr>
<tr><td rowspan="3">Arsenic</td><td>Monitored value</td><td>56.4</td><td>62.2</td><td>51.0</td><td>85.4</td><td colspan="2">85.6</td><td rowspan="3">40</td></tr>
<tr><td>PI index</td><td>1.41</td><td>1.555</td><td>1.275</td><td>2.135</td><td colspan="2">2.14</td></tr>
<tr><td>Noncompliance multiple</td><td>0.41</td><td>0.555</td><td>0.275</td><td>1.135</td><td colspan="2">1.14</td></tr>
<tr><td rowspan="3">Hg</td><td>Monitored value</td><td>0.346</td><td>0.371</td><td>0.220</td><td>1.19</td><td colspan="2">2.22</td><td rowspan="3">1.5</td></tr>
<tr><td>PI index</td><td>0.23</td><td>0.247</td><td>0.147</td><td>0.79</td><td colspan="2">1.48</td></tr>
<tr><td>Noncompliance multiple</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0.48</td></tr>
<tr><td rowspan="3">Total Cr</td><td>Monitored value</td><td>129</td><td>142</td><td>69</td><td>135</td><td colspan="2">150</td><td rowspan="3">300</td></tr>
<tr><td>PI index</td><td>0.43</td><td>0.473</td><td>0.23</td><td>0.45</td><td colspan="2">0.5</td></tr>
<tr><td>Noncompliance multiple</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td rowspan="2">Location Monitoring item</td><td rowspan="2">Evaluation index</td><td rowspan="2">S16 500m downstream of Lingfeng Bridge on the right bank (Sampling depth: 20m)</td><td rowspan="2">S17 300m upstream of Lingfeng Bridge on the left bank（Sampling depth:10cm）</td><td rowspan="2">S17 300m upstream of Lingfeng Bridge on the right bank (Sampling depth: 20m)</td><td rowspan="2">S18 50m upstream of Fanglin Power Station on the left bank (Sampling depth: 20m)</td><td colspan="2">S18 50m upstream of Fanglin Power Station on the right bank</td><td rowspan="2">（GB15618-199Class III</td></tr>
<tr><td>Sampling depth: 20cm</td><td>Sampling depth:110cm</td></tr>
</table>

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	S1 100M downstream of confluence of Huangansi River into He River (Sampling depth: 20m)	S2 Lingfeng Bridge cross section of He River (Sampling depth: 20m)	S3 100m downstream of confluence of Shizigang River into He River (Sampling depth: 20m)	S4 Dredging section of East Trunk Canal (Sampling depth: 20m)	S5 Dredging section of East No. 5 Branch Canal (Sampling depth: 20m)		（GB15618-199Class III
pH	Monitored value	8.3	8.1	8.3	8.1	8.1	8.3	>6.5
	PI index	/	/	/	/	/	/	
	Noncompliance multiple	/	/	/	/	/	/	
Copper	Monitored value	49	52	83	78	85	73	400
	PI index	0.123	0.13	0.208	0.195	0.213	0.183	
	Noncompliance multiple	0	0	0	0	0	0	
Zinc	Monitored value	183	232	286	283	283	272	500
	PI index	0.366	0.464	0.572	0.566	0.566	0.544	
	Noncompliance multiple	0	0	0	0	0	0	
Plumbum	Monitored value	41.2	59.2	49.8	61.7	56.3	59.1	500
	PI index	0.082	0.118	0.100	0.123	0.113	0.118	
	Noncompliance multiple	0	0	0	0	0	0	
Cadmium	Monitored value	0.53	0.30	**1.14**	**1.08**	**1.42**	**2.24**	1.0
	PI index	0.53	0.30	**1.14**	**1.08**	**1.42**	**2.24**	
	Noncompliance multiple	0	0	**0.14**	**0.08**	**0.42**	**1.24**	
Arsenic	Monitored value	35.6	39.2	**50.0**	**65.2**	**58.8**	36.7	40
	PI index	0.89	0.98	**1.25**	**1.63**	**1.463**	0.918	
	Noncompliance multiple	0	0	**0.25**	**0.63**	**0.463**	**0**	

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / Monitoring item	Evaluation index	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)		**（GB15618-199Class III**
Hg	Monitored value	0.232	0.213	0.523	0.636	0.272	0.183	1.5
	PI index	0.155	0.142	0.349	0.424	0.181	0.122	
	Noncompliance multiple	0	0	0	0	0	0	
Total Cr	Monitored value	37	58	45	52	42	41	300
	PI index	0.123	0.193	0.15	0.173	0.14	0.137	
	Noncompliance multiple	0	0	0	0	0	0	
Location Monitoring item	**Evaluation index**	**S19 1000m upstream of Fanglin Power Station on the left bank** (Sampling depth: 20m)	**S19 1000m upstream of Fanglin Power Station on the right bank** Sampling depth: 20cm	**S19 1000m upstream of Fanglin Power Station on the right bank** Sampling depth: 100cm	**S20 2000m upstream of Fanglin Power Station on the left bank**（Sampling depth: 20）	**S20 2000m upstream of Fanglin Power Station on the right bank** Sampling depth: 20cm		**（GB15618-199Grade III**
pH	Monitored value	8.2	8.0	8.0	8.0	8.0		>6.5
	PI index	/	/	/	/	/		
	Noncompliance multiple	/	/	/	/	/		
Copper	Monitored value	56	82	82	124	63		400
	PI index	0.14	0.205	0.205	0.31	0.158		
	Noncompliance multiple	0	0	0	0	0		

Table 8　Sediment Monitoring and Analysis Results

Unit: mg/kg

Location / **Monitoring item**	**Evaluation index**	**S1 100M downstream of confluence of Huangansi River into He River** (Sampling depth: 20m)	**S2 Lingfeng Bridge cross section of He River** (Sampling depth: 20m)	**S3 100m downstream of confluence of Shizigang River into He River** (Sampling depth: 20m)	**S4 Dredging section of East Trunk Canal** (Sampling depth: 20m)	**S5 Dredging section of East No. 5 Branch Canal** (Sampling depth: 20m)	**（GB15618-199Class III**
Zinc	Monitored value	244	286	251	312	247	500
	PI index	0.488	0.572	0.502	0.624	0.494	
	Noncompliance multiple	0	0	0	0	0	
Plumbum	Monitored value	65.4	57.4	54.1	59.7	64.8	500
	PI index	0.131	0.115	0.108	0.119	0.130	
	Noncompliance multiple	0	0	0	0	0	
Cadmium	Monitored value	0.82	**1.32**	**1.79**	**1.91**	**1.98**	1.0
	PI index	0.82	**1.32**	**1.79**	**1.91**	**1.98**	
	Noncompliance multiple	**0**	**0.32**	**0.79**	**0.91**	**0.98**	
Arsenic	Monitored value	**45.2**	**48.2**	**75.2**	**76.2**	**91.8**	40
	PI index	**1.13**	**1.205**	**1.88**	**1.905**	**2.295**	
	Noncompliance multiple	**0.13**	**0.205**	**0.88**	**0.905**	**1.295**	
Hg	Monitored value	0.212	0.182	0.183	0.220	0.188	1.5
	PI index	0.141	0.121	0.122	0.147	0.125	
	Noncompliance multiple	0	0	0	0	0	
Total Cr	Monitored value	48	43	23	41	22	300
	PI index	0.16	0.143	0.077	0.137	0.073	
	Noncompliance multiple	0	0	0	0	0	

Table 9　River Sediment Toxity Leaching Results

Unit：　mg/L

Monitoring item / Monitoring site	Evaluation index	Plumbum	Cadmium	Arsenic	Hg	Cr6+
S1 100M downstream of the confluence of Huangansi River into He River (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S2 Lingfeng Bridge cross section of He River (Sampling depth: 20m)	Monitored value	0.51	0.014	ND	ND	0.02
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S3100M downstream of the confluence of Shizigang River into He River (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.02
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S4 Dredging section of Donggan Canal (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S5 dredging section of East No. 5 Branch Canal (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S6 downstream of dredging section of East No. 5 Branch Canal	Monitored value	0.86	0.037	ND	ND	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S7 dredging section of East No. 6 Branch Canal	Monitored value	0.26	0.031	ND	0.001	0.02
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S8 dredging section of	Monitored value	ND	ND	ND	ND	ND

Table 9　River Sediment Toxity Leaching Results

Unit：　mg/L

Monitoring item / Monitoring site	Evaluation index	Plumbum	Cadmium	Arsenic	Hg	Cr6+
Huangtian Branch Canal (Sampling depth: 20m)	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S9 dredging section of Guposhan Drainage Canal (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S10 dredging section of Taoyuan Drainage Canal (Sampling depth: 20m)	Monitored value	ND	ND	ND	0.01	0.10
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S11Upstream of Huangansi Drainage Canal dredging section (Sampling depth: 20m)	Monitored value	ND	ND	ND	0.01	0.10
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S12Downstream of Huangansi Drainage Canal dredging section (Sampling depth: 20m)	Monitored value	ND	ND	ND	0.001	0.01
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S13 dredging section of Shizigang Drainage Canal (Sampling depth: 20m) upstream	Monitored value	0.83	0.034	ND	ND	0.02
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S14Middle section of Shizigang Drainage Canal dredging section (Sampling depth: 20m)	Monitored value	ND	ND	ND	ND	0.02
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S15Downstream of Shizigang Drainage Canal dredging section	Monitored value	ND	ND	ND	ND	0.04
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5

Table 9 River Sediment Toxity Leaching Results

Unit： mg/L

Monitoring item / Monitoring site	Evaluation index	Plumbum	Cadmium	Arsenic	Hg	Cr6+
(Sampling depth: 20m)	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S16500m downstream of Lingfeng Bridge on the right bank（Sampling depth:10cm）	Monitored value	ND	ND	0.0014	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S17300m upstream of Lingfeng Bridge on the left bank (Sampling depth: 20m)	Monitored value	ND	ND	0.0003	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S17300m upstream of Lingfeng Bridge on the right bank (Sampling depth: 20m)	Monitored value	ND	ND	0.0015	0.00004	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S1850m upstream of Fanglin Power Station on the left bank (Sampling depth: 20m)	Monitored value	ND	ND	0.0009	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S1850m upstream of Fanglin Power Station on the right bank (Sampling depth: 20m)	Monitored value	ND	ND	0.0012	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S1850m upstream of Fanglin Power Station on the right bank（Sampling depth:110cm）	Monitored value	ND	ND	0.0019	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S191000m upstream of Fanglin Power Station on the left bank (Sampling depth: 20m)	Monitored value	ND	ND	0.0005	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S191000m upstream of	Monitored value	ND	ND	0.0013	ND	ND

Table 9 River Sediment Toxity Leaching Results

Unit： mg/L

Monitoring item / Monitoring site	Evaluation index	Plumbum	Cadmium	Arsenic	Hg	Cr6+
Fanglin Power Station on the right bank (Sampling depth: 20m)	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S191000m upstream of Fanglin Power Station on the right bank（Sampling depth: 100cm）	Monitored value	ND	ND	0.0022	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S202000m upstream of Fanglin Power Station on the left bank（Sampling depth: 20）	Monitored value	ND	ND	0.0017	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant
S202000m upstream of Fanglin Power Station on the left bank（Sampling depth: 20）	Monitored value	ND	ND	0.0024	ND	ND
	GB5085.3-2007 Leaching toxity standard value	5	1	5	0.1	5
	Status of standard compliance	Compliant	Compliant	Compliant	Compliant	Compliant

Note: When the test result is smaller than the method detection limit, the result is indicated as ND.

Annex 2:Surface Water Impact Prediction Process

I. Prediction of impacts on water environment with normal discharge

He River is the only destination of effluent discharge for Jiangnan Wastewater Treatment Plant. The hydrological parameters of flow rate, river width, river depth, and slope used in the prediction are cited from "Water Environment Capacity Research Report of Guangxi Zhuang Autonomous Region" prepared by the Environmental Science Research Institute of Guangxi Zhuang Autonomous Region affiliated to China Academy of Environmental Science. The prediction models as selected are the two-dimensional steady-state mixed attenuation model for shore discharge and the S-P model for fully mixed section recommended in HJ / T2.3-93 "Technical Guidelines of Environmental Impact Assessment - Surface Water Environment", as described as follows:

(1)Mixing Section

Two-dimensional steady-state mixed attenuation model for shore discharge:

$$c(x,y)=\exp(-K_1\frac{x}{86400u})\{c_h+\frac{c_pQ_p}{H\sqrt{\pi M_y xu}}[\exp(-\frac{uy^2}{4M_y x})+\exp(-\frac{u(2B-y)^2}{4M_y x})]\}$$

The length estimation equation for the mixing section (shore discharge) is:

$$l=\frac{(0.4B-0.6a)Bu}{(0.058H+0.0065B)(gHI)^{1/2}}\ 。$$

Where:
c --- concentration of pollutants on the predicted cross section, mg/L;
c0 --- concentration of pollutants at the initial computation point, mg/L;
K1 --- self-purification (pollutant degradation) coefficient, l/d;
U --- average cross-sectional flow rate, m/s;
x --- distance between the upper and lower cross sections, m;
y --- horizontal distance perpendicular to the river direction; m;
c_p --- pollutant discharge concentration, mg/L;
Q_p --- wastewater discharge volume, m^3/s;
c_h --- existing pollutant concentration in the river (upper reaches), mg/L;
Q_h --- river flow, m^3/s;
I --- river gradient, m/m;
H --- water depth, m;
B --- river width, m;
My --- horizontal mixing coefficient, m^2/s;
a --- distance from discharge outlet to river shore, m;
g --- gravity acceleration, m/s^2;

(2)Fully mixed river section

S-P Model is selected:

$$c = c_0 \exp(-K_1 \frac{x}{86400u})$$

$$c_0 = (c_p Q_p + c_h Q_h)/(Q_p + Q_h)$$

See Table 1 for values and sources of the aforesaid parameters.

Table 1: Values and Sources of Parameters Needed in Prediction

SN	Parameter	Value	Source
1	K1	K1 is valued at 0.2 for prediction of COD and 0.1 for prediction of NH3-N.	Surface Water Capacity Research Report for Guangxi Zhuang Autonomous Region
2	u	0.1m/s	Surface Water Capacity Research Report for Guangxi Zhuang Autonomous Region
3	c_p	c_p is valued at 50mg/L for prediction of COD and 5mg/L for prediction of NH3-N.	Class 1A discharge limit specified in the Pollutant Discharge Standard for Municipal WWTPs (GB18918-2002)
4	c_h	c_h is valued at 10mg/L for prediction of COD and 0.277mg/L for prediction of NH3-N at the upper reaches of the discharge outlet of Jiangnan WWTP.	Maximum value of existing environment quality monitoring data
5	Q_h	Qh is valued at 20.5 m^3/s at the discharge outlet of Jiangnan WWTP.	Surface Water Capacity Research Report for Guangxi Zhuang Autonomous Region, flow rate with an assurance rate of 90%
6	Q_p	Qp is valued at $0.1736m^3/s$ for Jiangnan WWTP.	Calculated at the design day treatment capacity and a daily operation time of 24h
7	I	0.00045m/m	Surface Water Capacity Research Report for Guangxi Zhuang Autonomous Region
8	H	2.5m	Surface Water Capacity Research Report for Guangxi Zhuang Autonomous Region
9	B	70m	Surface Water Capacity

Table 1: Values and Sources of Parameters Needed in Prediction

SN	Parameter	Value	Source
			Research Report for Guangxi Zhuang Autonomous Region
10	My	$0.063m^2/s$	Calculated with Taylor Method
11	a	0m	Discharge outlet is located on river shore; thus valued at 0
12	g	$9.8m/s^2$	Constant value of gravity acceleration

The calculation result for the mixing section at the lower reaches of the pollutant discharge outlet of Jiangnan WWTP is 3111m. See Table 2 and Table 3 for the prediction results.

Table 2： Prediction of COD Concentrations of Jiangnan WWTP in Normal Discharge Scenario

Y(m) / X(m)	0	10	20	30	40	50	60	70
1	34.6786	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998
10	17.8007	10.1457	9.9982	9.9982	9.9982	9.9982	9.9982	9.9982
20	15.5123	10.7549	9.9984	9.9964	9.9964	9.9964	9.9964	9.9964
30	14.4973	11.1941	10.0173	9.9947	9.9946	9.9946	9.9946	9.9946
40	13.8914	11.4385	10.0665	9.9933	9.9928	9.9928	9.9928	9.9928
50	13.4772	11.5674	10.1368	9.9938	9.9910	9.9910	9.9910	9.9910
60	13.1709	11.6314	10.2150	9.9975	9.9893	9.9892	9.9892	9.9892
70	12.9324	11.6581	10.2924	10.0054	9.9878	9.9875	9.9875	9.9875
80	12.7398	11.6628	10.3644	10.0174	9.9867	9.9857	9.9857	9.9857
90	12.5799	11.6543	10.4289	10.0330	9.9861	9.9839	9.9839	9.9839
100	12.4443	11.6378	10.4856	10.0513	9.9864	9.9822	9.9821	9.9821
120	12.2252	11.5926	10.5770	10.0931	9.9898	9.9791	9.9785	9.9785
140	12.0540	11.5408	10.6440	10.1371	9.9972	9.9767	9.9750	9.9749
160	11.9152	11.4882	10.6922	10.1799	10.0081	9.9753	9.9716	9.9714
180	11.7996	11.4372	10.7262	10.2197	10.0216	9.9752	9.9684	9.9679
200	11.7013	11.3886	10.7497	10.2555	10.0368	9.9764	9.9656	9.9644
220	11.6161	11.3429	10.7652	10.2871	10.0530	9.9789	9.9632	9.9611
240	11.5413	11.2999	10.7748	10.3148	10.0695	9.9825	9.9612	9.9580
260	11.4749	11.2595	10.7797	10.3387	10.0858	9.9870	9.9598	9.9552
280	11.4153	11.2217	10.7812	10.3592	10.1017	9.9923	9.9590	9.9528
300	11.3614	11.1861	10.7800	10.3767	10.1168	9.9982	9.9588	9.9507
500	11.0018	10.9186	10.7051	10.4450	10.2177	10.0626	9.9803	9.9555
700	10.7933	10.7427	10.6073	10.4275	10.2492	10.1072	10.0191	9.9896
900	10.6461	10.6117	10.5171	10.3859	10.2480	10.1305	10.0529	10.0260
1100	10.5312	10.5065	10.4372	10.3387	10.2322	10.1386	10.0753	10.0529

Table 2： Prediction of COD Concentrations of Jiangnan WWTP in Normal Discharge Scenario

X(m) \ Y(m)	0	10	20	30	40	50	60	70
1300	10.4362	10.4184	10.3664	10.2915	10.2092	10.1360	10.0858	10.0680
1500	10.3545	10.3420	10.3029	10.2457	10.1823	10.1255	10.0863	10.0723
1700	10.2824	10.2744	10.2452	10.2016	10.1529	10.1090	10.0786	10.0677
1900	10.2175	10.2131	10.1918	10.1589	10.1216	10.0879	10.0644	10.0561
2100	10.1580	10.1568	10.1418	10.1173	10.0890	10.0632	10.0453	10.0388
2300	10.1028	10.1043	10.0943	10.0765	10.0554	10.0359	10.0222	10.0173
2500	10.0509	10.0547	10.0489	10.0364	10.0210	10.0064	9.9961	9.9924
2700	10.0018	10.0075	10.0050	9.9968	9.9859	9.9752	9.9676	9.9649
2900	9.9548	9.9621	9.9624	9.9577	9.9503	9.9428	9.9373	9.9353
3100	9.9096	9.9182	9.9208	9.9188	9.9143	9.9094	9.9056	9.9042
3500	9.8234	9.8340	9.8398	9.8420	9.8417	9.8403	9.8390	9.8385
4000	9.7214	9.7335	9.7419	9.7472	9.7502	9.7516	9.7522	9.7523
4500	9.6239	9.6368	9.6467	9.6538	9.6587	9.6617	9.6634	9.6639
5000	9.5297	9.5429	9.5535	9.5616	9.5676	9.5716	9.5739	9.5746

Table 3 Prediction of NH3-N Concentrations of Jiangnan WWTP in Normal Discharge Scenario

Y(m) / X(m)	0	10	20	30	40	50	60	70
1	2.7449	0.2770	0.2770	0.2770	0.2770	0.2770	0.2770	0.2770
10	1.0573	0.2917	0.2770	0.2770	0.2770	0.2770	0.2770	0.2770
20	0.8287	0.3528	0.2771	0.2769	0.2769	0.2769	0.2769	0.2769
30	0.7273	0.3969	0.2792	0.2769	0.2769	0.2769	0.2769	0.2769
40	0.6669	0.4215	0.2843	0.2769	0.2769	0.2769	0.2769	0.2769
50	0.6257	0.4346	0.2914	0.2771	0.2769	0.2768	0.2768	0.2768
60	0.5952	0.4412	0.2994	0.2776	0.2768	0.2768	0.2768	0.2768
70	0.5715	0.4440	0.3073	0.2786	0.2768	0.2768	0.2768	0.2768
80	0.5524	0.4446	0.3147	0.2799	0.2769	0.2768	0.2768	0.2768
90	0.5366	0.4439	0.3213	0.2816	0.2770	0.2767	0.2767	0.2767
100	0.5232	0.4425	0.3271	0.2836	0.2771	0.2767	0.2767	0.2767
120	0.5016	0.4383	0.3366	0.2881	0.2778	0.2767	0.2766	0.2766
140	0.4848	0.4334	0.3436	0.2928	0.2788	0.2768	0.2766	0.2766
160	0.4713	0.4285	0.3487	0.2974	0.2802	0.2769	0.2765	0.2765
180	0.4600	0.4237	0.3525	0.3017	0.2819	0.2772	0.2765	0.2765
200	0.4505	0.4192	0.3551	0.3056	0.2837	0.2776	0.2765	0.2764
220	0.4423	0.4149	0.3570	0.3091	0.2856	0.2782	0.2766	0.2764
240	0.4351	0.4109	0.3583	0.3121	0.2876	0.2788	0.2767	0.2764
260	0.4288	0.4072	0.3591	0.3149	0.2895	0.2796	0.2769	0.2764
280	0.4232	0.4037	0.3596	0.3172	0.2914	0.2804	0.2771	0.2764
300	0.4181	0.4005	0.3597	0.3193	0.2932	0.2813	0.2773	0.2765
500	0.3852	0.3769	0.3554	0.3292	0.3064	0.2908	0.2825	0.2800
700	0.3674	0.3623	0.3487	0.3305	0.3126	0.2983	0.2894	0.2864
900	0.3557	0.3522	0.3427	0.3294	0.3155	0.3036	0.2958	0.2931
1100	0.3472	0.3447	0.3377	0.3277	0.3169	0.3075	0.3010	0.2988
1300	0.3407	0.3389	0.3336	0.3260	0.3177	0.3102	0.3051	0.3033
1500	0.3355	0.3342	0.3302	0.3244	0.3180	0.3122	0.3082	0.3068
1700	0.3312	0.3304	0.3274	0.3230	0.3180	0.3135	0.3104	0.3093
1900	0.3276	0.3272	0.3250	0.3216	0.3178	0.3144	0.3120	0.3111
2100	0.3246	0.3245	0.3229	0.3204	0.3175	0.3149	0.3130	0.3124
2300	0.3220	0.3221	0.3211	0.3193	0.3171	0.3151	0.3137	0.3132
2500	0.3196	0.3200	0.3194	0.3181	0.3166	0.3151	0.3140	0.3136
2700	0.3176	0.3182	0.3179	0.3171	0.3159	0.3148	0.3141	0.3138
2900	0.3157	0.3165	0.3165	0.3160	0.3153	0.3145	0.3139	0.3137
3100	0.3140	0.3149	0.3152	0.3150	0.3145	0.3140	0.3136	0.3135
3500	0.3110	0.3121	0.3128	0.3130	0.3129	0.3128	0.3127	0.3126
4000	0.3078	0.3090	0.3099	0.3105	0.3108	0.3109	0.3110	0.3110
4500	0.3049	0.3062	0.3073	0.3080	0.3085	0.3089	0.3090	0.3091
5000	0.3022	0.3036	0.3047	0.3056	0.3062	0.3067	0.3069	0.3070
11000	0.2767	0.2777	0.2785	0.2792	0.2798	0.2802	0.2804	0.2805

II. Prediction of impacts on water environment in the scenario of accidental discharge

In the prediction of the impacts on rivers by the direct discharge of untreated wastewater, He River is the destination of discharge of Jiangnan WWTP Subproject. Based on the scale of He River, the two-dimensional steady-state mixed attenuation model for shore discharge and the S-P model for fully mixed section recommended in HJ / T2.3-93 "Technical Guidelines of Environmental Impact Assessment - Surface Water Environment" are selected as the prediction models. In the accidental discharge scenario for Jiangnan WWTP, the prediction is conducted on the assumption that wastewater is discharged without prior treatment (i.e. at the design influent concentration of WWTP).

(1)Fully mixed river section

S-P model is adopted:

$$c = c_0 \exp(-K_1 \frac{x}{86400u})$$

$$c_0 = (c_p Q_p + c_h Q_h)/(Q_p + Q_h)$$

(2)Mixing section

Two-dimensional steady-state mixed attenuation model for shore discharge:

$$c(x,y) = \exp(-K_1 \frac{x}{86400u})\{c_h + \frac{c_p Q_p}{H\sqrt{\pi M_y x u}}[\exp(-\frac{uy^2}{4M_y x}) + \exp(-\frac{u(2B-y)^2}{4M_y x})]\}$$

$l = \dfrac{(0.4B - 0.6a)Bu}{(0.058H + 0.0065B)(gHI)^{1/2}}$; Calculation result of the length of the mixing section is 3111m.

Where:

c --- concentration of pollutants on the predicted cross section, mg/L;

c0 --- concentration of pollutants at the initial computation point, mg/L;

K1 --- self-purification (pollutant degradation) coefficient, l/d, valued at 0.2/d for COD and 0.1/d for NH3-N;

U --- average cross-sectional flow rate (m/s), both valued at 0.1 m/s;

x --- distance between the upper and lower cross sections (km);

c_p --- pollutant discharge concentration, mg/L; the discharge concentration in the accidental discharge scenario is valued at 280mg/L for COD and 32mg/L for NH3-N;

Q_p --- wastewater discharge volume, m^3/s; valued at $0.1736m^3/s$ at the discharge outlet of Jiangnan WWTP;

c_h --- existing pollutant concentration in the river (upper reaches), mg/L; valued at 11mg/L for COD and 0.313mg/L for NH3-N at the upper reaches of the discharge outlet of Jiangnan WWTP;

Q_h --- river flow, m^3/s; valued at $20.5m^3/s$ at the discharge outlet of Jiangnan WWTP;
I --- river gradient, m/m; valued at 0.00045/m/m;
H --- water depth, m; valued at 2.5m;
B --- river width, m; all valued at 70m;
My --- horizontal mixing coefficient, m^2/s; result of calculation in Taylor Method is $0.063m^2/s$;
a --- distance from discharge outlet to river shore, m; valued at 0;
g --- gravity acceleration, m/s^2; valued at $9.8m/s^2$;

Table 4 and Table 5 show the results of prediction for the accidental discharge scenario of Jiangnan WWTP based on the aforesaid models and parameters.

Table 4 Prediction of COD Concentrations of Jiangnan WWTP in Accidental Discharge Scenario

X(m) \ Y(m)	0	10	20	30	40	50	60	70
1	149.2012	10.9998	10.9998	10.9998	10.9998	10.9998	10.9998	10.9998
10	54.6915	11.8236	10.9975	10.9975	10.9975	10.9975	10.9975	10.9975
20	41.8841	15.2422	11.0060	10.9949	10.9949	10.9949	10.9949	10.9949
30	36.2074	17.7097	11.1194	10.9925	10.9924	10.9924	10.9924	10.9924
40	32.8217	19.0853	11.4026	10.9927	10.9898	10.9898	10.9898	10.9898
50	30.5098	19.8152	11.8035	11.0027	10.9873	10.9873	10.9873	10.9873
60	28.8021	20.181	12.2492	11.0311	10.9852	10.9847	10.9847	10.9847
70	27.4741	20.3378	12.6901	11.0825	10.9841	10.9822	10.9822	10.9822
80	26.4028	20.3715	13.1003	11.1572	10.9852	10.9797	10.9797	10.9797
90	25.5148	20.3314	13.4691	11.2520	10.9897	10.9773	10.9771	10.9771
100	24.7631	20.2467	13.7940	11.3622	10.9987	10.9752	10.9746	10.9746
120	23.5508	20.0083	14.3212	11.6110	11.0329	10.9727	10.9696	10.9695
140	22.6070	19.7334	14.7112	11.8726	11.0893	10.9742	10.9648	10.9644
160	21.8450	19.4539	14.9959	12.1274	11.1651	10.9814	10.9608	10.9595
180	21.2126	19.183	15.2014	12.3648	11.2557	10.9957	10.9579	10.9547
200	20.6766	18.926	15.3478	12.5803	11.3559	11.0174	10.9569	10.9504
220	20.2146	18.6845	15.4498	12.7725	11.4614	11.0462	10.9582	10.9468
240	19.8107	18.4587	15.5181	12.9423	11.5687	11.0812	10.9624	10.9444
260	19.4537	18.2477	15.5608	13.0911	11.6751	11.1217	10.9695	10.9436
280	19.1349	18.0506	15.5840	13.2208	11.7788	11.1664	10.9798	10.9448
300	18.8479	17.8661	15.5922	13.3334	11.8785	11.2143	10.9933	10.9482
500	16.9830	16.5169	15.3212	13.8647	12.5916	11.7234	11.2623	11.1235
700	15.9630	15.6800	14.9216	13.9143	12.9159	12.1211	11.6275	11.4623
900	15.2858	15.0931	14.5634	13.8289	13.0564	12.3985	11.9642	11.8134
1100	14.7892	14.6509	14.2624	13.7111	13.1144	12.5906	12.2357	12.1105
1300	14.4028	14.3030	14.0117	13.5925	13.1319	12.7218	12.4407	12.3409
1500	14.0906	14.0207	13.8015	13.4814	13.1264	12.8079	12.5884	12.5102
1700	13.8314	13.7862	13.6227	13.3788	13.1060	12.8599	12.6897	12.6290
1900	13.6115	13.5871	13.4676	13.2833	13.0748	12.8856	12.7544	12.7075

Table 4 Prediction of COD Concentrations of Jiangnan WWTP in Accidental Discharge Scenario

Y(m) / X(m)	0	10	20	30	40	50	60	70
2100	13.4216	13.4149	13.3307	13.1935	13.0354	12.8909	12.7903	12.7543
2300	13.2549	13.2633	13.2076	13.1078	12.9896	12.8802	12.8036	12.7761
2500	13.1064	13.1275	13.0950	13.0251	12.9385	12.8569	12.7992	12.7785
2700	12.9723	13.0041	12.9905	12.9446	12.8832	12.8236	12.7810	12.7655
2900	12.8498	12.8906	12.8923	12.8658	12.8245	12.7825	12.7518	12.7406
3100	12.7366	12.7848	12.7990	12.7882	12.7631	12.7351	12.7139	12.7061

Table 5 Prediction of NH3-N Concentrations of Jiangnan WWTP in Accidental Discharge Scenario

Y(m) / X(m)	0	10	20	30	40	50	60	70
1	16.1076	0.3130	0.3130	0.3130	0.3130	0.3130	0.3130	0.3130
10	5.3071	0.4074	0.3130	0.3130	0.3130	0.3130	0.3130	0.3130
20	3.8439	0.7984	0.3142	0.3129	0.3129	0.3129	0.3129	0.3129
30	3.1956	1.0809	0.3274	0.3129	0.3129	0.3129	0.3129	0.3129
40	2.8091	1.2385	0.3600	0.3132	0.3129	0.3129	0.3129	0.3129
50	2.5453	1.3223	0.4062	0.3146	0.3128	0.3128	0.3128	0.3128
60	2.3505	1.3645	0.4574	0.3181	0.3128	0.3128	0.3128	0.3128
70	2.1991	1.3828	0.5081	0.3242	0.3130	0.3127	0.3127	0.3127
80	2.0770	1.3871	0.5553	0.3330	0.3133	0.3127	0.3127	0.3127
90	1.9759	1.3828	0.5978	0.3441	0.3141	0.3127	0.3127	0.3127
100	1.8903	1.3735	0.6352	0.3570	0.3154	0.3127	0.3126	0.3126
120	1.7524	1.3470	0.6961	0.3860	0.3198	0.3129	0.3126	0.3126
140	1.6452	1.3163	0.7414	0.4165	0.3268	0.3136	0.3125	0.3125
160	1.5588	1.2850	0.7746	0.4462	0.3360	0.3149	0.3126	0.3124
180	1.4872	1.2547	0.7988	0.4739	0.3469	0.3171	0.3128	0.3124
200	1.4266	1.2260	0.8161	0.4991	0.3589	0.3201	0.3132	0.3124
220	1.3744	1.1991	0.8284	0.5217	0.3715	0.3239	0.3138	0.3125
240	1.3289	1.1739	0.8369	0.5417	0.3843	0.3284	0.3148	0.3127
260	1.2887	1.1504	0.8424	0.5593	0.3970	0.3336	0.3161	0.3132
280	1.2529	1.1285	0.8457	0.5748	0.4094	0.3392	0.3178	0.3138
300	1.2207	1.1081	0.8473	0.5882	0.4214	0.3452	0.3199	0.3147
500	1.0135	0.9599	0.8225	0.6550	0.5087	0.4089	0.3559	0.3399
700	0.9027	0.8701	0.7827	0.6666	0.5516	0.4600	0.4031	0.3841
900	0.8309	0.8086	0.7475	0.6626	0.5734	0.4974	0.4473	0.4299
1100	0.7796	0.7636	0.7187	0.6549	0.5858	0.5252	0.4841	0.4696
1300	0.7409	0.7294	0.6956	0.6469	0.5935	0.5459	0.5133	0.5017
1500	0.7107	0.7025	0.6770	0.6398	0.5985	0.5615	0.5360	0.5269
1700	0.6864	0.6811	0.6621	0.6336	0.6018	0.5732	0.5533	0.5463
1900	0.6666	0.6637	0.6498	0.6282	0.6039	0.5818	0.5664	0.5610
2100	0.6502	0.6494	0.6395	0.6235	0.6049	0.5880	0.5762	0.5720

Table 5 Prediction of NH3-N Concentrations of Jiangnan WWTP in Accidental Discharge Scenario

Y(m) / X(m)	0	10	20	30	40	50	60	70
2300	0.6364	0.6374	0.6308	0.6191	0.6052	0.5924	0.5834	0.5802
2500	0.6246	0.6271	0.6233	0.6151	0.6049	0.5953	0.5885	0.5861
2700	0.6145	0.6183	0.6167	0.6113	0.6040	0.5970	0.5920	0.5901
2900	0.6057	0.6105	0.6107	0.6076	0.6027	0.5977	0.5941	0.5928
3100	0.5979	0.6036	0.6053	0.6040	0.6011	0.5977	0.5952	0.5943

Annex 3:Public Participation Questionnaire and Feedbacks

1. Feedbacks of Hezhou Municipal Press, Publication, Radio, Film and Television Bureau on Preservation of Xiyue Street

Suggestions on Preservation of the Riverside Historical Heritage of Xiyue Street

Xiyue Street is a well-known historical and cultural street in Hezhou. This street block took shape in late Qing Dynasty and reached its heyday in the Minguo era, when, in particular during the period of Anti-Japanese War, hosted a large group of historical and cultural elites of China. With many ancient wharves, ancient ferries and ancient bridges and ancient trees along the river, the old communities of Hebianxiang Street, Sha Street and Xiyue Street hosted historical and cultural elite, such as He Xiangning, Liu Yazi, let alone the large number of historical architectures and cultural relics, e.g. the former residence of the famous Hong Kong film director Liu Shiyu, Liujiadianpu and Liu Yazi and the Xianfeng Bookstore where Zhang Tiesheng and Chen Cisheng covered in the World Affairs used to live. Xiyue Street is a miniature of the history of city development of Hezhou City and is a museum of the fresh history of Hezhou that records in the true sense the evolution of urban history and carries the context of historical development of Hezhou.

In July 2015, Hezhou initiated the declaration for national historical and cultural cities and Xiyue Street is one of the three historical and cultural blocks included in the declaration. The ancient embankment of the section of Shajie Wharf has been covered by the newly constructed flood control embankment. Hopefully, the surviving ancient wharves, bridges and embankment will be preserved to the best possibility in the project design and construction in the future. In such a context, the following recommendations are made:

1) The project design shall, to the maximum possibility, avoid the declared scope for preservation of the national historically famous city to preserve the ancient wharf, ancient embankment, ancient bridges and ancient trees along the river and protect the cultural heritage of Hezhou.

2) During the planning design of areas around Xiyue Street, the suggestions and advices proposed by Hezhou Office of Declaration of National Historical and Cultural City shall be incorporated and no construction activities shall be commenced until such planning design is reviewed and approved by the Municipal Government. Annex buildings of and new buildings to be constructed within the declared scope of national historical and cultural city shall have consistent style with the existing historical and cultural block.

3) Reference to the advanced experiences from Yongzhou City of Hunan Province and Wuzhou City of Guangxi ZAR is recommended. The flood dike to be constructed should be moved towards the waterfront area and the existing dike and ancient wharf should be preserved. Antique waterfront bridges and aisles may be constructed along the river banks to cover the sewage drainage pipelines along the river and improve cityscape.

4) The design style of Wuzhou and Guilin for flood dykes are recommended and the mining culture, money casting culture and red revolution culture unique in Hezhou should be presented in the form of reliefs on the existing flood dykes to enrich the urban cultural heritage of Hezhou. Riverside environment improvement should be integrated with the comprehensive urban development to not only create a new leisure space for Hezhou, but also revitalize this old and historical street.

Hezhou Municipal Press, Publication, Radio, Film and Television Bureau
February 25, 2017

2. Feedbacks by Hezhou Municipal Press, Publication, Radio, Film and Television Bureau (HPPRFTB) on Measures Proposed in the Report

Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

EIA Public Participation Questionnaire (for HCPPRFTB)

<table>
<tr><td>Name of organization</td><td colspan="3">Hezhou Municipal Culture, Press, Publication, Radio, Film and Television Bureau</td><td>Completed by</td><td>Xiong Kaikuo</td></tr>
<tr><td>Address of organization</td><td colspan="3">No. 233, Pinganxi Road, Hezhou</td><td>Contact information</td><td>5126058</td></tr>
<tr><td>Nature of organization</td><td>■ Government
☐ Public institution</td><td>Number of employees</td><td>28</td><td>Position</td><td>Section Chief</td></tr>
<tr><td colspan="6">Project overview:
This Project involves Babu District and Pinggui District of Hezhou City and mainly covers the drainage basins of the urban inland river and He River flowing through the urban center of Hezhou City. The Project comprises of three components, including: (1) Component 1: He River Flood Risk Improvement, which includes: (a) improvement and rehabilitation (or demolition) of a few small runoff hydropower stations on the main watercourse of He River to enhance flood discharge capacity; (b) appropriate widening of certain sections of the main watercourse of He River to increase the flood discharge capacity and build riverside green corridors; (c) enhancing and connecting East Trunk Canal and Mawei River to divert upstream flood from the northern part of the urban area to the downstream areas and build riverside green corridor to increase flood discharge capacity and reduce waterlogging risks in the urban center of Hezhou City; (2) Component 2: Urban Drainage and Wastewater Management, which includes: (1) rehabilitation of tributaries of urban inland rivers and construction of riverside green corridors to divert regional flood; (b) construction of stormwater pipeline and pump stations in selected areas; (c) construction of Jiangnan WWTP and main sewage pipelines; (3) Component 3: institutional capacity building and project management, which includes: (a) institutional capacity strengthening and (b) project management and supervision.</td></tr>
<tr><td colspan="6">Impact analysis:
The construction activities of He River (Guangming Bridge – Lingfeng Bridge Section) Integrated Rehabilitation Subproject, Huangan Temple Drainage Canal Pump Station Subproject and Huangan Temple Drainage Canal Integrated Rehabilitation Subproject under the Project may generate impacts on the historical and cultural street of Xiyue Street.</td></tr>
<tr><td colspan="6">Countermeasures to be taken:
1. The buildings (structures) in the Xiyue Street neighborhood should be designed in such a way that they have a uniform style with the existing buildings and should not be constructed until an approval has been granted by the Municipal Government.
2. The construction area included in the project design should avoid, where possible, the area of preservation of the historical and cultural street so as to preserve the ancient buildings, ancient wharf, ancient embankment, ancient bridges and ancient trees and keep the historical background of this historical and cultural street.
3. The river rehabilitation works should take account of the city style and natural background so as to create a unique cityscape.
4. The competent authorities should be consulted before construction to develop a practical and effective program for cultural relics protection.
5. A detailed construction program should be developed before construction and signs should be erected on construction sites to indicate the nature, significance, scope and measures of preservation of the respective cultural relics as well as the contact person and contact information of the cultural relics protection administration body.
6. Where construction becomes inevitable in the area of cultural relics preservation, manual excavation must be selected and no excavators, pile drivers and other mechanical equipment should be used in order to reduce vibration impacts on cultural relics in the construction process.
7. Construction camps, temporary top soil stockpiling sites must not be located in the area of protection of cultural relics.
8. Large vehicles and plants are prohibited to enter the area of preservation of cultural relics.
9. The construction contractor should provide education on protection of cultural relics to the construction workers and keep the cultural relics as far away from the construction activities as possible to avoid human damages to such cultural relics.
10. Upon the discovery of any cultural relics in the construction process, the construction activities should be suspended immediately and a report submitted to local cultural relics administration authority. The construction activities shall not resume until a notice on work resumption is received.</td></tr>
</table>

Does your organization agree with the measures to be taken? Do you have any other comments or suggestions? ***Answer: We agree with the preservation measure to be taken and propose the addition of one more measure, i.e. "10. Preservation of the historical buildings on Xiyue Historical and Cultural Street should be carried out in reference to the standards for cultural relics".***
What is your organization's attitude towards the construction of the Project from the general perspective of local economic development and environmental protection? ***Answer: Supportive.***

Guangxi Zhengze Environmental Protection Technology Co., Ltd. Date:

3. Feedbacks by Hezhou Municipal Culture Press, Publication, Radio, Film and Television Bureau (HCPPRFTB) on Measures Proposed in the Report

Guangxi Hezhou Urban Water Infrastructure & Environment Improvement Project

EIA Public Participation Questionnaire (for HCPPRFTB)

Name of organization	Hezhou Municipal Culture, Press, Publication, Radio, Film and Television Bureau			Completed by	Xiong Kaikuo
Address of organization	No. 233, Pinganxi Road, Hezhou			Contact information	5126058
Nature of organization	■ Government ☐ Public institution	Number of employees	28	Position	Section Chief

Project overview:

This Project involves Babu District and Pinggui District of Hezhou City and mainly covers the drainage basins of the urban inland river and He River flowing through the urban center of Hezhou City. The Project comprises of three components, including: (1) Component 1: He River Flood Risk Improvement, which includes: (a) improvement and rehabilitation (or demolition) of a few small runoff hydropower stations on the main watercourse of He River to enhance flood discharge capacity; (b) appropriate widening of certain sections of the main watercourse of He River to increase the flood discharge capacity and build riverside green corridors; (c) enhancing and connecting East Trunk Canal and Mawei River to divert upstream flood from the northern part of the urban area to the downstream areas and build riverside green corridor to increase flood discharge capacity and reduce waterlogging risks in the urban center of Hezhou City; (2) Component 2: Urban Drainage and Wastewater Management, which includes: (1) rehabilitation of tributaries of urban inland rivers and construction of riverside green corridors to divert regional flood; (b) construction of stormwater pipeline and pump stations in selected areas; (c) construction of Jiangnan WWTP and main sewage pipelines; (3) Component 3: institutional capacity building and project management, which includes: (a) institutional capacity strengthening and (b) project management and supervision.

Key problems:

The CCP Babu Special Branch located in Xiadao Primary School belongs to the right of way of the Project. The former teaching building on the site was already destroyed and the only building preserved is a streetside building. In the 1980s, the "CCP Babu Special Branch Memorial" was built up on the former site. Due to urban development, it is difficult to preserve the former site and the proposed plan at present is to relocate the remaining school gate from the former site to a new location for preservation.

Does your organization agree with the measures to be taken? Do you have any other comments or suggestions?

Answer: We agree with the preservation measure to be taken and propose the addition of one more measure, i.e. "10. Preservation of the historical buildings on Xiyue Historical and Cultural Street should be carried out in reference to the standards for cultural relics".

Description of cultural relics: CCP Babu Special Branch Site

Code: 451102805200000165 Year of construction: 1946, representative building of modern times

According to Article 20 of the Cultural Relics Law, it is recommended that this site should be avoided to the best possibility.

The CCP Babu Special Branch Site is a stronghold of CCP Babu Special Branch in the former Xiadao Primary School established in 1946 and served as the headquarter of the underground CCP leadership for Babu, Yongqing, Guiling, Nanxiang and Pinggui Mine District to spread revolutionary ideas to the massive teachers and students and local people and guide the youth towards the path of revolution. The Site of CCP Babu Special Branch is an important stronghold of activities in Hezhou in those years and

represents an important heritage of red revolution culture in Hezhou, thus embracing important value in development as a base of patriotism education and a destination of red culture tourism.
What is your organization's attitude towards the construction of the Project from the general perspective of local economic development and environmental protection?

Guangxi Zhengze Environmental Protection Technology Co., Ltd.   Date:

4. Feedbacks by individual experts on preservation of CCP Babu Special Branch Site

Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project

EIA Public Participation Questionnaire (for individuals)

<table>
<tr><td>Name of organization</td><td>Hu Qingsheng</td><td>Sex</td><td>M</td><td>Age</td><td>51</td></tr>
<tr><td>Occupation</td><td>Preservation of cultural relics</td><td>Education</td><td colspan="3">University</td></tr>
<tr><td>Address</td><td>Xiangyang Garden Residential Block</td><td>Telephone</td><td colspan="3">18077406926</td></tr>
<tr><td colspan="6">Project overview:
This Project involves Babu District and Pinggui District of Hezhou City and mainly covers the drainage basins of the urban inland river and He River flowing through the urban center of Hezhou City. The Project comprises of three components, including: (1) Component 1: He River Flood Risk Improvement, which includes: (a) improvement and rehabilitation (or demolition) of a few small runoff hydropower stations on the main watercourse of He River to enhance flood discharge capacity; (b) appropriate widening of certain sections of the main watercourse of He River to increase the flood discharge capacity and build riverside green corridors; (c) enhancing and connecting East Trunk Canal and Mawei River to divert upstream flood from the northern part of the urban area to the downstream areas and build riverside green corridor to increase flood discharge capacity and reduce waterlogging risks in the urban center of Hezhou City; (2) Component 2: Urban Drainage and Wastewater Management, which includes: (1) rehabilitation of tributaries of urban inland rivers and construction of riverside green corridors to divert regional flood; (b) construction of stormwater pipeline and pump stations in selected areas; (c) construction of Jiangnan WWTP and main sewage pipelines; (3) Component 3: institutional capacity building and project management, which includes: (a) institutional capacity strengthening and (b) project management and supervision.
Certain environmental impacts will be generated in the construction stage of the Project, e.g. wastewater, exhaust gas, solid wastes and noises. The operation stage involves no discharge of “wastewater, exhaust gas and solid wastes” and the adverse environmental impacts will be relatively insignificant. The negative impacts to be generated in the construction stage of the Project on environment can be effectively controlled through effective pollution control measures.
In order to assure successful implementation of the environmental protection activities in the Project, this EIA public participation survey is initiated for the Project under the relevant national laws and regulations on environmental protection. Please kindly complete the following questionnaire and present your valuable suggestions and comments. To us, your participation will be a powerful assurance to the success of our environmental protection activities.</td></tr>
<tr><td colspan="6">1. Do you know about “Guangxi Hezhou Urban Water Infrastructure and Environment Improvement Project”?
A. Yes; w about
2. Are you satisfied with the current status of water environment quality and flood drainage in Hezhou City?
A. Satisfied; ■ B. Average; C. Not satisfied
3. What are the impacts that you think the Project may generate on your daily life in the construction stage?
A. Environmental impact; B. employment (income); C. acquisition or occupation of homestead (farmland);
D. others; ■E. insignificant impact
4. Which of the following environmental impact is, in your opinion, the most significant one from the construction of the Project?
A. Air pollution; B. water pollution; C. Noise pollution; D. Solid wastes;■E. N/A
5. In which area do you think that greater efforts should be made under the Project in controlling environmental pollution (multiple choices are allowed)?
A. Air pollution; ou think that greater efforts should be made under the Project in controlling enviro
6. How will the Project affect your daily life and work upon completion?</td></tr>
</table>

■ow will the Project affect your daily life and work upon completion?the Pro

7. Do you think the Project will play a positive role in driving the harmonious development of economy and society?

■o you think the Project will play a positive role in

8. What is your attitude towards the construction of the Project based on the aforesaid knowledge?

■hat is your attitude towards the

9. What are your requests and suggestions on the environmental protection measures involved in the implementation process of the Project?

I suggest that the CCP Babu Special Branch Site in Xiadao Primary School and the Diandengzhai Remains should be preserved on their original sites.

Hezhou Research Institute of Environmental Science

Guangxi Zhengze Environmental Protection Technology Co., Ltd. Date: Sept. 12, 2017

5. Feedbacks by Hezhou Municipal Engineering Bureau (HMEB) on Measures Proposed in the Report

Guangxi Hezhou Urban Water Infrastructure & Environment Improvement Project

EIA Public Participation Questionnaire (for Municipal Engineering Bureau)

<table>
<tr><td>Name of organization</td><td colspan="3">Hezhou Municipal Engineering Bureau</td><td>Completed by</td><td>Zhao He</td></tr>
<tr><td>Address of organization</td><td colspan="3">No. 41, Jianshezhong Road, Babu District, Hezhou</td><td>Contact information</td><td>5277701</td></tr>
<tr><td>Nature of organization</td><td>■ Government
☐ Public institution</td><td>Number of employees</td><td></td><td>Position</td><td></td></tr>
<tr><td colspan="6">Project overview:
This Project involves Babu District and Pinggui District of Hezhou City and mainly covers the drainage basins of the urban inland river and He River flowing through the urban center of Hezhou City. The Project comprises of three components, including: (1) Component 1: He River Flood Risk Improvement, which includes: (a) improvement and rehabilitation (or demolition) of a few small runoff hydropower stations on the main watercourse of He River to enhance flood discharge capacity; (b) appropriate widening of certain sections of the main watercourse of He River to increase the flood discharge capacity and build riverside green corridors; (c) enhancing and connecting East Trunk Canal and Mawei River to divert upstream flood from the northern part of the urban area to the downstream areas and build riverside green corridor to increase flood discharge capacity and reduce waterlogging risks in the urban center of Hezhou City; (2) Component 2: Urban Drainage and Wastewater Management, which includes: (1) rehabilitation of tributaries of urban inland rivers and construction of riverside green corridors to divert regional flood; (b) construction of stormwater pipeline and pump stations in selected areas; (c) construction of Jiangnan WWTP and main sewage pipelines; (3) Component 3: institutional capacity building and project management, which includes: (a) institutional capacity strengthening and (b) project management and supervision.</td></tr>
<tr><td colspan="6">Impact analysis:
1. A certain volume of sludge will be generated from the dredging operations of He River, East Trunk Canal, Huangan Temple Drainage Canal, Shizigang Drainage Canal, Huangtian Branch Canal and Guposhan Drainage Canal;
2. Underground pipelines may be affected by the excavation activities to be conducted on the construction sites located 23m upstream of Sanjia Bridge, intersections of Huangan Temple Drainage Canal with Badaxi Road and Jianshezhong Road, intersections of Shizigang Drainage Canal with Guposhan Avenue, Wanquan Street, Zhushan Road, Badaxi Road, Yinhe Street, Jianshezhong Road, Pinganxi Road, Longshan Road, Anshanxi Road, Xingguang Road and Pinganxi Road as well as the Transportation Bureau at Jiangbeizhong Road.
3. The construction activities may generate impacts on 4 banyan trees at Xialiangzhai, 2 hackberry trees, 1 banyan tree and 1 camphor tree at Jiangbeizhong Road, 2 camphor trees and 1 banyan tree at Xinaner Street, 1 camphor tree at Jianshezhong Road, 1 camphor tree at Xinanyi Street and 1 camphor tree at Xiyue Street.</td></tr>
<tr><td colspan="6">Countermeasures to be taken:
1. Sludge generated from dredging of He River, Huangan Temple Drainage Canal and Shizigang Drainage Canal is dewatered to sludge cakes with a moisture content of less than 50% (in a total volume of approximately 12554m^3) and then transported to Hezhou Domestic Solid Waste Landfill for treatment. Sludge generated from dredging of East Trunk Canal, Huangtian Branch Canal and Guposhan Drainage Canal is dewatered to sludge cakes with a moisture content of less than 50% (in a total volume of approximately 2058m^3) and then transported to Hezhou Solid Waste Incineration Plant for disposal.
2. The following measures should be taken for excavation activities involved in underground pipeline construction: (1) communicating with and submitting construction plan to the competent authority, and finding out layout plan of underground pipelines; (2) planning the construction works in such a way that the underground pipelines are avoided where possible; (3) controlling or minimizing the construction time of pipeline construction; (4) immediately reporting the competent authority any cases of existing pipelines affected in the excavation process for emergency repair.
3. The following measures should be taken for construction activities involving famous and ancient trees: (1) minimizing the scope and construction period of construction activities; (2) making sure that the excavation operations will not affect the roots, branches and crowns of identified famous and ancient trees; (3) making sure no construction wastes, borrow fill and waste soil are stockpiled around the growing area of such trees; (4) making sure that such trees are not rolled or compacted by vehicles and construction plants.</td></tr>
</table>

Does your organization agree with the measures to be taken? Do you have any other comments or suggestions? ***We agree. Suggestion: 1) Underground pipeline survey data should be collected from housing and urban-rural development authority; a pipeline coordination team should be set up and departmental contact person defined. Construction plan should be developed based on pipeline location and depth. The owner unit of pipelines should be notified upon excavation so that on-site surveillance and emergency preparation can be facilitated (in particular with national defense and military optical cables). Formalities for temporary excavation should be fulfilled at the municipal engineering authority if any municipal roads are involved. 2) ancient trees should be protected in strict accordance with the respective measures.***
What is your organization's attitude towards the construction of the Project from the general perspective of local economic development and environmental protection? ***Supportive.***

Guangxi Zhengze Environmental Protection Technology Co., Ltd. Date:

6. Feedbacks by Hezhou Traffic Police No. 3 Brigade on Measures Proposed in the Report

Guangxi Hezhou Urban Water Infrastructure & Environment Improvement Project

EIA Public Participation Questionnaire (for Traffic Police No. 3 Brigade)

<table>
<tr><td>Name of organization</td><td colspan="3">Hezhou Traffic Police No. 3 Brigade</td><td>Completed by</td><td>Gao Gan</td></tr>
<tr><td>Address of organization</td><td colspan="3">68-32, Fanglin Road, Hezhou</td><td>Contact information</td><td>18677463066</td></tr>
<tr><td>Nature of organization</td><td>■ Government
☐ Public institution</td><td>Number of employees</td><td>26</td><td>Position</td><td>Vice Chief</td></tr>
<tr><td colspan="6">Project overview:
This Project involves Babu District and Pinggui District of Hezhou City and mainly covers the drainage basins of the urban inland river and He River flowing through the urban center of Hezhou City. The Project comprises of three components, including: (1) Component 1: He River Flood Risk Improvement, which includes: (a) improvement and rehabilitation (or demolition) of a few small runoff hydropower stations on the main watercourse of He River to enhance flood discharge capacity; (b) appropriate widening of certain sections of the main watercourse of He River to increase the flood discharge capacity and build riverside green corridors; (c) enhancing and connecting East Trunk Canal and Mawei River to divert upstream flood from the northern part of the urban area to the downstream areas and build riverside green corridor to increase flood discharge capacity and reduce waterlogging risks in the urban center of Hezhou City; (2) Component 2: Urban Drainage and Wastewater Management, which includes: (1) rehabilitation of tributaries of urban inland rivers and construction of riverside green corridors to divert regional flood; (b) construction of stormwater pipeline and pump stations in selected areas; (c) construction of Jiangnan WWTP and main sewage pipelines; (3) Component 3: institutional capacity building and project management, which includes: (a) institutional capacity strengthening and (b) project management and supervision.</td></tr>
<tr><td colspan="6">Key problems:
The Project is located in the urban center of Hezhou and road closure is needed for the construction of some components in the construction stage, thus generating impacts on traffic. What procedure should be followed to get permit for road closure? What are the specific requirements on traffic organization and bypass management?</td></tr>
<tr><td colspan="6">Countermeasures to be taken:
1. Submitting the construction plan of construction operations having impacts on public traffic to the traffic police authority for approval before the construction works commences;
2. implementing the construction activities section by section and finishing excavation and backfill in the shortest possible time;
3. providing access roads for construction areas close to public facilities such as hospitals, schools and bus stations and avoiding peak hours for material transportation to reduce pressure on urban traffic; providing special access roads for construction works in the vicinity of villages to reduce the occupation of rural roads and avoid damages by large plants and vehicles;
4. erecting bulletin boards on construction sites to disclose information on construction works and construction time to acquire public understanding of inconveniences from the construction activities and advising the public of the contact information and complaint hotlines, etc.
5. avoiding peak traffic hours upon scheduling pipeline construction or arranging traffic police for traffic diversion and dispatch so as to assure smooth flow of pedestrian and traffic and reduce traffic congestion and impacts on residents;
6. strengthening construction management and training to construction workers on environmental protection.</td></tr>
</table>

Do you have any other comments or suggestions? 1. ***Pre-construction advertisement should be well organized and implemented using the press so that announcements and rerouting notices are made public via micro blog, wechat, etc.*** 2. ***Bus rerouting should be well planned through communication with the Transportation Bureau;*** 3. ***Actions should be taken to control speed and overload of construction vehicles, which should be properly enclosed and wheels washed to reduce environmental impacts.***
What is your organization's attitude towards the construction of the Project from the general perspective of local economic development and environmental protection? ***We agree.***

Guangxi Zhengze Environmental Protection Technology Co., Ltd. Date: