Initial Environmental Examination

Project number: 48055-002
September 2016

People's Republic of China: Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project

Prepared by the Xinyu City Government for the Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)
CNY 1.00 = $ 0.154
$ 1.00 = CNY 6.49

ABBREVIATIONS

ADB	Asian Development Bank
AEP	Annual Exceedance Probability
AQG	Air Quality Guideline
BOD_5	5-day Biochemical Oxygen Demand
BOT	Build Operate Transfer
CNY	Chinese Yuan
COD	Chemical Oxygen Demand
CUT	Common Utility Tunnel
DEIA	Domestic Environmental Impact assessment
DO	Dissolved Oxygen
EA	Executing Agency
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EHS	Environmental, Health and Safety
EMP	Environmental Management Plan
EMS	Environment Monitoring Station
EPB	Environmental Protection Bureau
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GRM	Grievance Redress Mechanism
HSRND	High Speed Railway New District
IA	Implementing Agency
IEE	Initial Environmental Examination
JPG	Jiangxi Provincial Government
MOE	Ministry of Environment
$PM_{2.5}$	Particulate Matter with Diameter<2.5μ
PM_{10}	Particulate Matter with Diameter<10μ
PME	Powered Mechanical Equipment
PMO	Project Management Office
PRC	People's Republic of China
RP	Resettlement Plan
SEPP	Soil Erosion Protection Plan
SPS	Safeguard Policy Statement
SS	Suspended Solid
SSUS	Sub-Surface Utility System
TN	Total Nitrogen
TP	Total Phosphorus
TSP	Total Suspended Particulates
WHO	World Health Organization
WRB	Water Resources Bureau
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
XCG	Xinyu City Government

WEIGHTS AND MEASURES

^oC	Degree centigrade
dB	Decibel
ha	Hectare (10,000 m^2)
kg	Kilogram
km	Kilometer
km^2	Square kilometer
kW	Kilowatt
L	Liter
m	Meter
m^2	Square meter
m^3	Cubic meter
m^3/a	Cubic meter per annum
m^3/d	Cubic meter per day
mg/kg	Milligram per kilogram
mg/l	Milligram per liter
mg/m^3	Milligram per cubic meter
mu	Chinese land unit (1 ha=15 mu)
MW	Megawatt (1 million watts)
t	Metric ton (1,000 kg)
t/a	Ton per annum

NOTE

(i) In the report, "$" refers to US dollars.

Contents

I. EXECUTIVE SUMMARY

A. Introduction

1. The Xinyu City Government (XCG), People's Republic of China, has requested the Asian Development Bank (ADB) to provide investment and technical assistance support for the Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project (the Project). The Project will help the XCG develop the city as flood and climate resilient and environment friendly, as part of long-term plans under the Xinyu City Master Plan (2008-2030).

2. This Initial Environmental Examination (IEE) has been prepared in accordance with domestic regulatory requirements and the Asian Development Bank's Safeguard Policy Statement (SPS, 2009). It is based on: (i) information in the domestic environmental impact assessment (DEIA) and feasibility study report (FSR) prepared by national institutes for the project; and (ii) fieldwork and sector studies conducted between December 2015 and May 2016 by a consultant team for the project preparatory technical assistance (PPTA), on water resources, wetlands, social issues, and climate change. The IEE includes an Environmental Management Plan (EMP) (Attachment 1), which will be the guiding document for environmental-related issues in the construction and operational phases of the Project.

B. The Project

3. The Project is focused on improved water resources management (WRM) and green urban planning in the upper watershed of the Kongmu River. In particular, to support water conservation (by capturing stormwater for urban landscape irrigation), flood control, and solid waste management for the design of a new district which will support over 57,000 people in the next 10 years, the High Speed Rail New District (HSRND). The HSRND is situated 10 km north of the existing Xinyu City center. Most of the project focuses on the planned site of the HSRND. Additional minor works, mainly for solid waste control, are included for villages north and north-west of Xinyu City. The project applies the principals of the PRC's "Sponge City" Design Guidelines to support WRM. The innovative stormwater management system developed under the project will provide significant flood attenuation and water quality improvement, removing about 40% of the pollutant load from urban stormwater generated from the HSRND. Lakes will provide flood storage, and fringing wetlands will improve water quality through sedimentation and biological processes. The lakes will also provide aesthetic value and ecological habitat. The canals provide flood retention and include wetland planting which have water quality benefits. The stormwater storage in the utility tunnel will help flood management in the middle of the catchment. The project includes training of government staff in the management of stormwater and wetland systems.

4. The expected impact of the Project will be improved water environment and quality of life in Xinyu City. The expected outcome of the Project will be improved management of surface water resources in Xinyu City. The Project will have three outputs, as follows. Project components and anticipated benefits are summarized in Table ES-1. Physical works under the Project are limited to outputs 1 and 2.

5. **Output 1: Development of integrated rural and urban flood management system** will include (i) increase of flood retention capacity in the upper watershed, including (a) development of innovative stormwater management, and (b) development of flood retention capacities in lakes; and (ii) flood protection along the Kongmu River.

6. **Output 2: Construction of water pollution sources management systems and water related basic amenities** will include the (i) expansion of wastewater service delivery system; (ii) improvement of a solid waste management system; (iii) construction of the

amenity space in the lakes.

7. **Output 3: Enhancement of the flood and environmental risk coping capacity and know-how dissemination** will include (i) capacity development for flood and environmental risk management in Kongmu River watershed, including (a) strengthen flood management, river basin and spatial planning, (b) promotion of community based flood risk and environmental management, and (c) knowledge sharing and know-how dissemination; (ii) improvement of flood forecasting and warning system; and (iii) improvement of water quality monitoring system for river and wetlands.

Table ES-1. Summary of Project Elements

No.	Project Element	Project Description	Primary Benefits
Output 1 – Development of flood management system			
1.1	Increased flood retention capacity in the HSRND	• Excavate and dredge 1.78 million m^3 spoil from 8 artificial lakes (6 existing and 2 to be constructed by the project) for increased flood storage. • Construct 16.37 km of canals for stormwater conveyance. • Construct 5.87 km of stormwater pipelines • Implement "Sponge City" design in roads and parks, develop guidelines for residential areas. • Construct 3.7 km of Sub-Surface Service Delivery System (SSUS).[2]	Storage capacity increased by 0.608 m^3. Control 75% of the annual runoff from the Project Area; and develop a drainage system adequate to manage a 5% AEP[1] storm event to reduce flooding in the HSRND. SSUS will result in reduced disturbance to traffic from road excavations for maintenance and prolonged service life of road pavements. The system coverage will be for up to 130,000 people.
1.2	Flood protection along Kongmu River	Construct a flood protection levee (1.2 km length) along Kongmu River.	Protect 0.12 km^2 of village and 0.19 km^2 of farmland from 2% AEP[1] flood event.
Output 2 – Development of water pollution source management system and water related basic amenities			
2.1	Waste water and stormwater delivery system	Construct 5.87 km of wastewater sewers and two wastewater pumping stations.	Collect waste water from a 6.2 km^2 area of the HSRND to prevent pollution to surface waters in the HSRND and Kongmu River. 57,000 residents in the HSRND will be connected to new sanitary sewers.
2.2	Solid waste management system	Construct two waste transfer stations, collection stations, other infrastructure and provision of solid waste related vehicles.	Waste collecting rate of Ouli Town and Guanchao Town will increase to 80 %, and HSRND will reach 100 %. 32,500 t of waste flowing into Kongmu River Watershed will be reduced annually. In total, 89,000 people (including 42,000 females) will benefit.
2.3	Maintenance of amenity space along the lakes	Construct 50.55 ha of constructed wetlands, lakes, and vegetated canals, for water treatment, stormwater storage, and landscaping. Construct back-up water supply system for constructed wetlands and landscape irrigation.	Pollutant loads in stormwater run-off from for Suspended Solids (SS), Chemical Oxygen Demand (COD) and other parameters will be reduced by at least 40% compared to standard (no Sponge City) urban designs.
2.4	Landscape Works	Develop 19.32 ha of park, road side and canal side green spaces.	Well-designed urban green spaces will enhance landscape value, provide ecological habitat, and also provide socio-economic benefits.

No.	Project Element	Project Description	Primary Benefits
Output 3 – Enhancement of flood and environmental risk coping capacity and knowledge dissemination			
3.1	Capacity development for flooding and environmental risk management		Improve government capacity to manage flood risk and increase awareness of sustainable water management for residents. Provide advanced flood warning for villages along Kongmu River Improve water quality monitoring and management in the HSRND
3.2	Improvement of flood forecasting and warning system		
3.3	Improvement of water quality monitoring system		

[1]Large floods occur less frequently than small floods, and are classified by the Annual Exceedance Probability (AEP) of a given river peak flow. An AEP of 5% for a given flood level means there is a 5% chance of having a flood exceed that level in any year. [2]Systems that carry multiple utilities.

8. Overall, the Project design elements will contribute to development of the HSRND as a model "Sponge City", in line with the PRC's "Construction Guideline for Sponge City Standards" (2014), and will serve as a model for future water-sensitive urban development in Jiangxi Province. The guidelines aim for a 75% rainfall control rate; a minimum of 60% reduction of stormwater runoff; and, a 40% reduction in stormwater pollutant load.

C. Baseline Environment

9. **Overview.** The Kongmu River discharges into the Yuan River, a tributary of the Ganjiang River, which flows into the Yangtze River through Poyang Lake. The Kongmu river basin is 531 km^2. The topography of the upper Kongmu River consists of low mountains, which transition to low hills and floodplains around Xinyu City. There are no large dams along the Kongmu River, but the river system has been modified by long-term land use and numerous medium and small sized dams and reservoirs. The largest of these is the Shijiutan Reservoir, constructed in 1972 and located upstream of Xinyu City Centre. The Project Area is predominantly rural land north and north-west of Xinuy City, including the site for the planned HSRND. Crops grown include rice, soy beans, sweet potatoes, peanuts and watermelon. The hydrology of the upper Kongmu River is modified and regulated by reservoirs and weirs. Drainage flows from northeast to southwest to the Kongmu River, with areas adjacent to the river subject to frequent flooding. Numerous small lakes have been created through the Project area for aquaculture and irrigation supply. Water quality in the Kongmu River is relatively good (Grade II-III), whereas water quality in lakes across the Project area is generally poor and eutrophic.

10. **Physical Environment.** There are no major industrial developments or other emissions sources within or close to the sampling locations in the Project area, and air quality/noise environment of the Project Area is relatively good. Noise and air monitoring indicate the Project area meets Class II standards for environmental quality and ambient air quality standards respectively. Soil and lake sediments in the Project Area meet Class II Environmental Quality Standard for Soils, aside from slight exceedances of cadmium at one site, which is likely a consequence of the use of pig manure as a fertilizer.

11. **Ecology.** Ecological values in the project sites are relatively low. Habitats are modified and dominated by agricultural land and villages. All lakes and ponds in the Project Area are artificial, have poor water quality and limited wetland vegetation, and are managed for aquaculture production and irrigation water. No native plant or animal species of conservation interest were recorded from the Project Area. The Kongmujiang National Wetland Park is located immediately south of the planned site of the HSRND. The park mainly comprises rural landscapes of villages and agricultural land, with planted and landscaped wetlands and

narrow, fragmented patches of secondary vegetation along the river. The Yuk Sau Mountain National Forest Park is located south of the planned HSRND, on the opposite bank of the Kongmu River, and would not be affected by the Project.

12. **Socio-economic status.** The Project is located within the Yushui District of Xinyu, where the majority of the population is still rural. Six villages were surveyed in the Project Area, and all households surveyed were rural, and employment was dominated by agriculture.

13. **Climate Change.** Observed results suggest that in Xinyu, overall temperatures are rising. While there is no trend variation of annual precipitation, in summer and winter precipitation is increasing, the number of rainy days is decreasing, while heavy rainfall events are increasing. Drought is in a downward trend, but the increase of rainfall variability and increase in the frequency and intensity of extreme rainfall events will increase flood risk.

D. Impacts and Mitigation Measures

14. **Avoided Impacts.** An integrated approach for project design and safeguards resulted in significant avoided impacts for the Project: (i) dredging of the Kongmu mainstream, and construction of 6 large levees, was originally proposed by the XCG. Hydrological modeling by the PPTA determined that these works were not necessary to meet the target flood control standards. Dredging and all except one levee were subsequently removed from the project design, resulting in greatly reduced physical, ecological and social impacts; (ii) introduction of foreign fauna and flora species into the wetlands was proposed by XCG, but subsequently removed due to PPTA explanation of the ecological risks posed. Only native plant species will be used for wetland design; (iii) canal layout was refined to reduce the number of affected households by 450; and (iv) two proposed lakes and associated canals were removed from the Project design, further reducing the number of affected households and sites.

15. **Construction Phase.** Key risks and mitigation measures were as follows. (i) Dredging and excavation of existing and new lakes and canals (potential sedimentation to downstream waters, including the Kongmu River and Baiyun Reservoir). This impact will be controlled through the scheduling dredging works for the dry season; the closing of lake outflow gates during dredging works; and use of coffer dams and sedimentation tanks to control run-off from excavation works close to Kongmu River. (ii) Clearance of small areas of secondary scrub and trees along the Kongmu River, for the construction of the outlets of two canals. The total area affected is 40 m of riverbank. This impact is minor due to the modified nature of the impacted habitat, the very small area of river bank affected, and the large area of contiguous riparian habitats (11.3 km) on the river banks either side. (iii) Habitat loss within the Kongmujiang National Wetland Park due to embankment and canal construction. All affected habitats (about 5.7 ha) are agricultural land, village areas, and secondary scrub, and have low ecological value. Habitat clearance by the project will be compensated by the construction of about 19 ha (Table ES-1) riparian habitats along the Kongmu River.

16. **Operation Phase.** Potential indirect impacts to the hydrology and ecology of the Kongmu River downstream of the HSRND, as a consequence of the Project, are considered minor. This is due to the project design, which includes control of stormwater quantity and quality discharge from the HSRND, and the limited scale of flood levees to be built. Induced impacts could occur in the event of malfunctioning of stormwater management systems. The risk of this having a substantial impact on the Kongmu River is low due to the relatively small amount of stormwater generated from the HSRND (which comprises just 3% of the total Kongmu River Watershed). Monitoring will also be implemented to check the quality of stormwater being discharged to the river.

17. **Climate change.** A climate risk vulnerability assessment (CRVA) was conducted for the

Project based on projected climate change, assuming a project design life of 30-40 years. The Project is fundamentally designed toward improving resilience to climate change, especially flood management systems and measures, sewage infrastructure, sub-surface utilities, solid waste management, constructed wetlands, and landscaping with native plant species.

E. Public Consultation and Grievance Redress Mechanism

18. Two rounds of information dissemination and two rounds of public consultation were conducted for the Project. Eight government agencies and 18 resident groups were consulted. The main concerns of consulted parties were nuisance during the construction phase in terms of air quality, noise, and construction/domestic waste. The DEIA Institute presented the planned mitigation measures to be adopted. All government agencies present expressed their support for the Project and readiness to coordinate with the PMO. Other participants expressed support and there was no opposition.

19. A Grievance Redress Mechanism (GRM) has been developed in compliance with the SPS requirement to address environmental, health, safety, and social concerns associated with Project construction, operation, and leasing arrangements. The GRM also facilitates a timely and effective response to any complaints from affected persons.

F. Environmental Management Plan

20. An Environmental Management Plan was developed that describes the requirements for impact mitigation, roles and responsibilities, monitoring, and reporting for environmental safeguards. The EMP includes the GRM and an environmental monitoring program, to monitor and report on the environmental performance of construction and operations. The program forms part of a comprehensive set of environmental management documents. The EMP includes institutional responsibilities, training needs, reporting schedules and implementation costs. It will include the program for future public consultation.

G. Risks and Assurances

21. To support effective implementation of the Project EMP: (i) a full-time Environment Officer will be appointed in the Project Management Office; (ii) a Loan Implementation Environmental Consultant, a Constructed Wetland Specialist, and an Environmental Engineer will be recruited to support local agencies; (iii) pre-construction readiness procedures and defined roles and responsibilities of all relevant agencies have been included in the EMP; and (iv) staff will receive training in EMP implementation. Project-specific environmental assurances (Section X) have been agreed and are included in the Project agreement between the XCG and ADB.

H. Conclusion

22. It is concluded that full and effective implementation of the Project EMP, together with the training and Project assurances, will minimize the environmental risks of the Project and achieve compliance with the policy and regulatory standards applied in this IEE.

II. INTRODUCTION

23. Located in Jiangxi Province, 135 km southwest of Nanchang, Xinyu is a new industrial city and the National Pilot City of New Energy, Science and Technology. Xinyu has a population of 1.16 million and is located on the junction of the Kongmu and Yuan Rivers.

24. The Kongmu River is a tributary of the Yuan River, which is a turn a tributary of the Ganjiang River that flows into the Yangtze River through Poyang Lake. The Kongmu River has a catchment area of approximately 600 km^2 and a length of 50 km downstream of Shiniutan Reservoir. The topography of the upper Kongmu River consists of low mountains, but transitions to rolling hills and floodplain toward Xinyu City, which has an elevation of approximately 50 m.

25. The Kongmu River is the main source for Xinyu's water supply. Currently, water quality in the Kongmu River is Class II-III, which is suitable for drinking water and swimming (PRC Environmental Water Quality Standard GB 3838-2002). Various locations along the Kongmu River experience floods every year, due to the low flood control capacity of the Kongmu River and the low flood retention capacity of the upper watershed.

26. Xinyu City Government (XCG) is developing the new district of Gaotie, located on the outskirts of the existing city, to cater for the rapidly expanding population and to take advantage of new business opportunities created by the recent High Speed Rail (HSR) connection from Changsha to Shanhai, passing through three Provinces (Hunan, Jiangxi, Zhejiang). The construction of a HSR Station north of Xinyu has served as a stimulus for new urban development in the area. The HSR New District (HSRND) is being developed adjacent to the HSR Station, approximately 10 km to the north west of Xinyu city center (Figure II-1). The HSRND will have commercial and residential uses, accommodating new migrants to the Xinyu urban area and serving new employment opportunities being created through the HSRND development. There will be no industrial development in the HSRND.

27. The Xinyu City Government (XCG) has prepared the Xinyu City Urban Master Plan (2008-2030), which aims to achieve improved flood and environmental management, but the XCG recognizes that more needs to be done to achieve acceptable flood and environmental management, considering the rate of ongoing development. XCG requested lending support from ADB for the Xinyu New District Comprehensive Climate Change and Stormwater Management Project. The aim of this Project was to provide integrated, climate resilient flood and environmental management for the HSRND. Under the Cities Development Initiative for Asia (CDIA; ADB's program to support formulation of urban development projects) ADB provided $0.3 million for a prefeasibility study, which was completed by GHD consulting (Beijing) Co. Ltd. in January 2013. The XCG subsequently added other components to the Project, which were accepted by the central government of the People's Republic of China (PRC) and ADB. The Project was then renamed "Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Management Project".

28. Based on ADB's Safeguard Policy Statement (SPS, 2009), the environmental risk rating of the project is "Category B", requiring the preparation of an Initial Environmental Examination (IEE) and Environmental Management Plan (EMP).

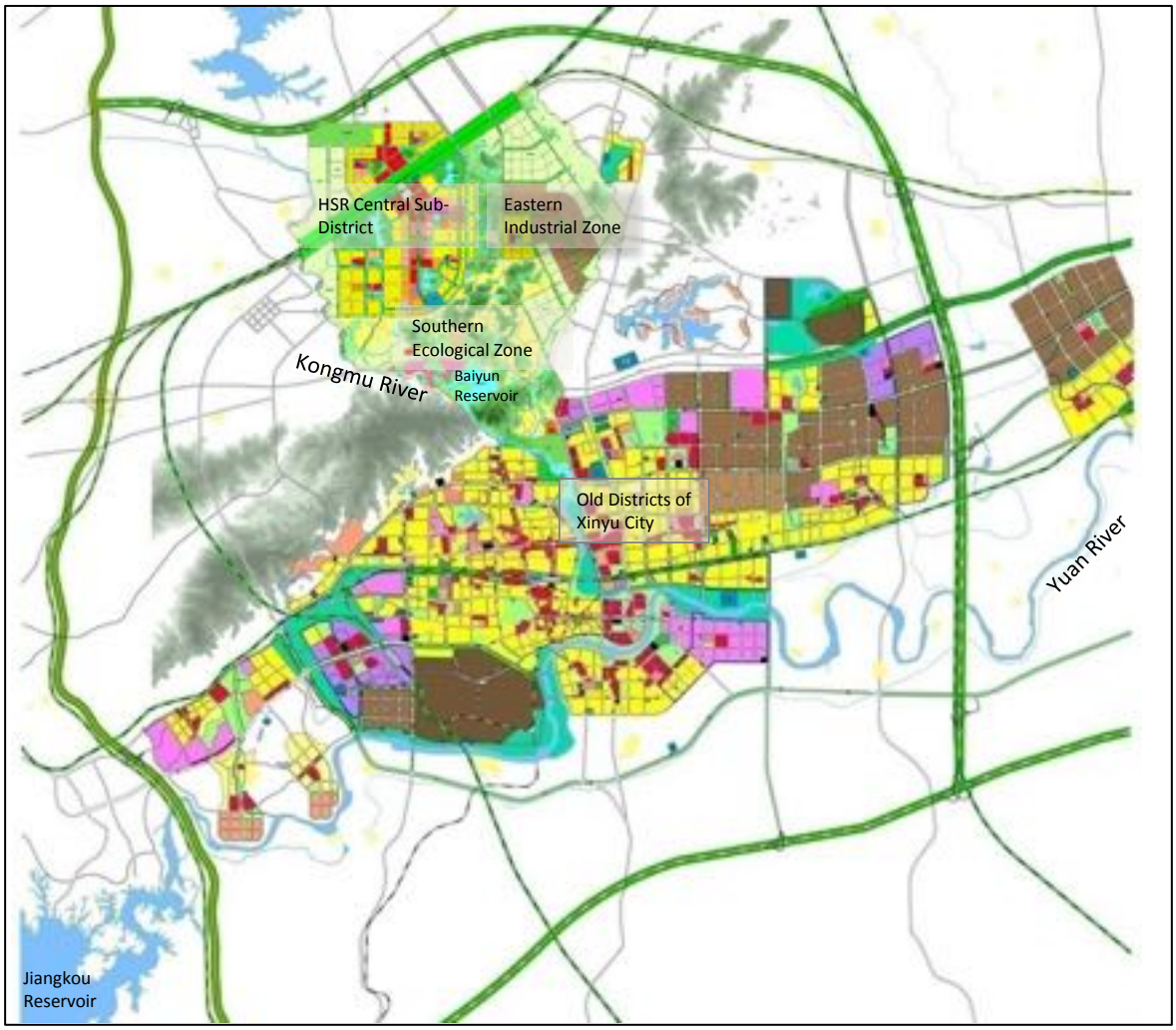

Figure II-1. Xinyu City and HSRND

29. The IEE is based on: (i) information in the Feasibility Study Report (FSR) prepared by Shanghai Urban Construction Design and Research Institute (SUCDRI) and DEIA prepared by the Jiangxi Academy of Environmental Science; (ii) fieldwork conducted between December 2015 and May 2016 by a consultant team for the project preparatory technical assistance (PPTA). PPTA fieldwork included inspection of most proposed sites for construction of Project components; and (iii) other sector studies by the PPTA team, including water resources, wetlands, social issues and climate change. The data presented in tables and figures in this IEE are from the FSR and domestic EIAs unless stated otherwise.

30. The EMP (Attachment 1) is based on the finding and recommendations of the IEE and domestic studies. The EMP will be the key guiding document for environmental-related issues in the construction and operation phases of the Project.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Policy Framework

31. Jiangxi Province requires both mitigation and adaptation strategies to address climate change, incorporating technological innovation and structural adjustment, whilst also setting goals controlling greenhouse gas emissions.

32. Policies and actions for mitigation of climate change impacts include: (i) promote the optimization of industrial structure through economic structural adjustment; (ii) improve energy efficiency; (iii) development of renewable energy; (iv) reduce greenhouse gas emissions by the development of a circular economy; (5) reduce greenhouse gas emissions caused by agriculture production (6) strengthen carbon sequestration promoting tree planting, (7) enhance the scientific response to climate change by increasing research efforts.

33. Adoption of climate change policies and mitigation actions has been implemented in Jiangxi Province in agriculture, forestry, water resources, Poyang Lake Wetlands and other vulnerable areas. Positive results have been achieved, including: (i) efforts to establish and improve the adaptation of policies and regulations to climate change; (ii) the protection of forests and other natural ecosystems; (iii) strengthening of policies and regulations in water conservation and water planning, especially in regards to: flood control and disaster mitigation; the rational allocation of water resources; and water resources protection (iv) improved monitoring and early warning systems for extreme weather and climate events. (IV) research on human health issues caused by climate change.

B. Legislative Framework for Environment Impact Assessment in the PRC

34. The DEIA upon which this Project IEE is based was prepared under the PRC EIA Law of 2003 and Management Guideline on EIA Categories of Construction Projects (2015). The Interim Guideline on Public Participation in EIA (2006) also provides for opportunities to involve the public in the EIA process. This was strengthened by the Requirements on Preparation of Environmental Impact Report Summary (2012[51], MEP), which requires that the summary of DEIA report are disclosed on local EPB websites. Key national laws and regulations that guide the DEIA for the Project are in Tables III-1 and III-2.

Table III-1. Applicable Environmental Laws

Title	Year
Environmental Protection Law	2015
Environmental Impact Assessment Law	2003
Water Law	2002
Water Pollution Prevention and Control Law	2008
Air Pollution Prevention and Control Law	2016
Noise Pollution Control Law	1997
Solid Waste Pollution Prevention and Control Law	2005
Water and Soil Conservation Law	2011
Forest Law	1998
Wild Fauna Protection Law	2004
Land Administration Law	2004
Agricultural Law	2003
Fishery Law	2004
Flood Control Law	1998
Protection of Cultural Relics Law	2015

Table III-2. Applicable Administrative Regulations

Regulation	Year
National	

Regulation on River Course Management	1988
Regulation on Environmental Protection Management for Construction Projects	1998
Regulation on Basic Farmland Protection	1999
Implementation Regulation on Water Pollution Prevention and Control Law	2000
Implementation Regulation on Air Pollution Prevention and Control Law	1991
Regulation on Wild Flora Protection	1996
State Council on Scientific Development Implementation on Environmental Protection Enhancement	2005
Emergency Notice of the State Council on Resolutely Stopping the Basic Farmland Occupation for Tree Planting	2004
Opinions on the Further Work of Basic Farmland Protection	2005
Notice on strengthening environmental impact assessment management to guard against environmental risks	2005
Interim Guideline on Public Participation in EIA	2006
Technology Policy on Ground Traffic Noise Pollution Control	2010
List of National Priority Protective Wild Fauna	2014
List of National Priority Protective Wild Flora	1999
Classification of Construction Project Environmental Protection Management (MEP)	2009
Local	
Regulation on Construction Project Environmental Protection in Jiangxi Province	2001
Regulation on Environmental Pollution Prevention and Control in Jiangxi Province	2008
Measures on Water Source Pollution Prevention and Control for Domestic Drinking Water in Jiangxi Province	2006
List of National Priority Protective Wild Fauna	1995
List of National Priority Protective Wild Flora	2005
Approval of Surface Water Function Zong Division in Jiangxi Province	2007
Surface Water Function Zong Division in Jiangxi Province	2007
Regulation on Ancient and Famous Trees Protection in Jiangxi Province	2004
Guidance Catalogue on Industrial Structure Adjustment	2011
List on Construction Project Environmental Impact Assessment Classification Management	2015

35. Implementation of the environmental laws and regulations is supported by a series of associated technical specifications (Table III-3).

Table III-3. Applicable Technical Specifications Relating to Environmental Impact Assessment

Technical Specification	Year/Code
Technical Guideline on EIA: Outline	HJ2.1-2011
Technical Guideline on EIA Regarding Atmospheric Environment	HJ 2.2-2008
Technical Guideline on EIA Regarding Surface Water	HJ/T 2.3-1993
Technical Guideline on EIA Regarding Acoustic Environment	HJ 2.4-2009
Technical Guideline on EIA Regarding Ecological Impact	HJ 19-2011
Technical Guideline on EIA Regarding Water Conservancy and Hydroelectric Engineering	HJ/T88-2003
Technical Guideline on Underground Water Environment	HJ610-2016
Technical Guideline on Environmental Risk Assessment for Construction Project	HJ/T 169-2004
ADB Environmental Protection Policy	2012

36. PRC national standards that set the levels of environmental performance required for relevant activities are classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. These are listed in Table III-4.

Table III-4. Applicable Environmental Standards

Standard	Code
Ambient Air Quality Standard	GB 3095-1996/2012
Integrated Emission Standard of Air Pollutants	GB 16297-1996
Emission Standards for Odor Pollutants	GB 14554-93
Urban Ambient Acoustic Quality Standard	GB 3096-2008
Emission Standards of Environment Noise for Boundary of Site Noise	GB 12523-2011

Surface Water Quality Standard	GB 3838-2002
Underground Water Quality Standard	GB/T 14848-93
Integrated Wastewater Discharge Standard	GB 8978-1996
Soil Quality Standard	GB15618-1995

C. International Agreements

37. The PRC is a signatory to international agreements on environment protection. Those relevant to the Project, along with the date of signing by the PRC, include:

- *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 23 February 2005. To reduce greenhouse gas emissions by enhancing the national programs of developed countries aimed at this goal and by establishing percentage reduction targets for the developed countries;
- *Montreal Protocol on Substances That Deplete the Ozone Layer*, 1 January 1989. To protect the ozone layer by controlling emissions of substances that depletes it; and,
- *United Nations Framework Convention on Climate Change*, 21 March 1994. To stabilize greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system.

D. Applicable PRC and ADB Policies and Assessment Categories

38. Under PRC regulations, the Project activities are classified as “Significant Impact”, requiring a full Environmental Impact Statement (EIS). Based on the PRC Management Guideline on EIA Categories of Construction Projects (MEP, 2008), two EIS studies are required, with the EIS approved by the Xinyu Environment Protection Bureau.

39. ADB’s SPS provides the basis for this Project IEE. All projects funded by ADB must comply with the SPS. The purpose of the SPS is to establish an environmental review process to ensure that projects funded under ADB loans are environmentally sound, comply with domestic laws, and are not likely to cause significant environment, health, or safety hazards. The project is classified as Category B for environment by ADB, requiring the preparation of an IEE and EMP.

E. Assessment Standards

1. Evaluation against Ambient Standards

40. The environmental standard system that supports the implementation of environmental protection laws and regulations in the PRC can be classified by function-ambient environmental quality standards, and by pollutant emission and/or discharge standards. ADB’s SPS requires projects to apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group’s Environmental, Health and Safety Guidelines (EHS). For this assessment, where EHS standards exist for parameters and are relevant, they are used in parallel with PRC standards.

41. The Xinyu City Environmental Protection Bureau (EPB) has nominated the environmental quality classes as the applicable standard of Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project (Table III-5).

Table III-5. Environmental Quality Classes in the Project Area

Variable	Scope	Function Classes
Air	All project areas	Class II of GB3095-2012
Noise	Town planning area	Class II of GB3096-2008

Variable	Scope	Function Classes
	Village area	Class I of GB3096-2008
	Roadside area	4a of GB3096-2008
	Both sides of railway	4b of GB3096-2008
Surface Water	Grade I Zone of Water Source	Class II of GB3838-2002
	All Other Project Area	Class III of GB3838-2002
Soil (Sediment)	All project areas	Class II of GB15618-1995

42. Air quality. The ambient air quality standard for the project areas has been nominated by the EPB as Class II of Ambient Air Quality Standard (GB 3095-2012).

43. The WHO has set up Air Quality Guideline (AQG) standards for various air quality parameters for the protection of public health. Recognizing that progressive actions are needed to achieve these standards and the financial and technological limitations of some countries or localities (especially in developing countries), the WHO also established interim targets as intermediate milestones towards achieving the AQG. Table III-6 compares the PRC's GB 3095-2012 Class II standards with the World Bank Group's EHS standards.

Table III-6. Comparison of PRC and WBG Ambient Air Quality Standards. n/a=not applicable

Variable	Averaging period	PRC Class II (μg/m^3) GB 3095-2012	World Bank Group EHS (μg/m^3)	
			Interim target	AQG
SO_2	1-year	60	n/a	n/a
	24-hour	150	50-125	20
	1-hour	500	n/a	n/a
NO_2	1-year	40	n/a	40
	24-hour	80	n/a	n/a
	1-hour	200	n/a	200
CO	24-hour	4,000	n/a	n/a
	1-hour	10,000	n/a	n/a
TSP	1-year	200	n/a	n/a
	24-hour	300	n/a	n/a
PM_{10}	1-year	70	30-70	20
	24-hour	150	75-150	50
$PM_{2.5}$	1-year	35	15-35	10
	24-hour	75	37.5-75	25

44. Noise environment for the project's settings will be evaluated against Class I and II standards of the Ambient Acoustic Quality Standard (GB3096-2008) (Table III-7). The PRC standards are more stringent than those of WB EHS.

Table III-7. Ambient Acoustic Quality Standards (unit: dB (A))

Applicable Class	Standard Value	
	Day-Time	Night-Time
Class I (residential, hospital, education, research, administrative area)	55	45
Class II (residential, commercial and industrial mixed area)	60	50
Class 4a (along roads)	70	55
Class 4b (along railways)	70	60
World Bank EHS	70	70

45. Surface water quality: the ambient environmental standard applied in this IEE is Surface Water Ambient Quality Standard (GB3838－2002) Classes II and III (Table III-8). There are no EHS guidelines or targets for water quality in this context.

Table III-8. Surface Water Ambient Quality Standards (Unit: mg/L)

Standard	DO	BOD	COD	NH_3-N	Coliform/l
(GB3838-2002) – Class II	6	3	15	0.5	2000
(GB3838-2002) – Class III	≥5	≤4	≤20	≤1.0	10000

46. Groundwater quality will be assessed against Class III standards in Quality Standards for Groundwater (GB/T14848-1993) (Table III-9). There are no equivalent EHS targets.

Table III-9. Quality Standards for Groundwater

Item	pH	Permanganate Index	Total	Nitrate Nitrogen	Fluoride	Total E.coli
Class III	6.5-8.5	≤3.0 mg/L	≤450 mg/L	≤20 mg/L	≤1.0 mg/L	≤3.0x10^3/L

47. Soil quality will be assessed against Class II of Environmental Quality Standard for Soils (GB 15618-1995) (Table III-10). There are no equivalent EHS targets.

Table III-10. Environmental Quality Standard for Soils (Class II)

Parameter	Maximum Allowable Concentration (mg/kg dry weight)		
pH	<6.5	6.5-7.5	>7.5
Cadmium (Cd)	0.30	0.30	0.60
Mercury (Hg)	0.30	0.50	1.0
Arsenic (As) paddy / dry land	30 / 40	25 / 30	20 / 25
Copper (Cu) farmland / orchard	50 / 150	100 / 200	100 / 200
Lead (Pb)	250	300	350
Chromium (Cr) paddy / Dry land	250 / 150	300 / 200	350 / 250
Zinc (Zn)	200	250	300
Nickel (Ni)	40	50	60

2. Emission Standards for Construction and Operation Activities

48. Air quality. For the project construction, fugitive emission of PM (such as dust from construction sites) is regulated under PRC's Air Pollutant Integrated Emission Standard (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and ≤1.0mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particle diameter. Odor from the temporary storage and treatment of sediment spoil from dredging should follow the Malodorous Pollutant Emission Standard (GB 14554-93). The maximum allowable concentration at the boundary of the sites for odor is 20 (dimensionless). During the operation stage, air pollutants discharged should comply with Grade II standard in Air Pollutant Comprehensive Emission Standard (GB16297-1996) (Table III-11).

Table III-11. Air Pollutants Limit

Pollutant	Maximum Allowable Concentration	Limit Concentration for Fugitive Emission Monitoring	Standard
PM	120 mg/m^3	Maximum concentration at the boundary 1.0 mg/m^3	GB16297-1996
Odor	20 (dimensionless)		GB14554-93

49. Construction noise will be assessed against the PRC Emission Standards of Ambient Noise for Boundary of Site Noise (GB 12523-2011) (Table III-12).

Table III-12. Emission Standards of Ambient Noise for Boundary of Site Noise (GB 12523-2011)
Unit: Leq [dB (A)]

Period	Noise Limit	
	Day	Night
Construction	70	55

50. Discharge of wastewater into the area of Kongmu River included in Grade I Zone (Category I water body of GB 3838-2002), Grade II Zone (Category II water body) and Buffer Zone (Category III water body) of Baiyun Reservoir is forbidden in both construction and operation stage. In other project area, wastewater generated during construction and operation will be discharged into Category III water body. Class I of GB 8978-1996 applies for

construction sites under this Project (Table III-13).

Table III-13. Class I of Integrated Wastewater Discharge

Parameter	Class I
	For discharge into Category III water body
pH	6–9
SS mg/L	70
BOD_5 mg/L	20
COD mg/L	100
TPH mg/L	5
NH_3-N mg/L	15

IV. DESCRIPTION OF THE PROJECT

A. Overview

51. Xinyu City is a prefecture-level city located in the mid-west of Jiangxi Province, 135 km southwest of Nanchang Municipality, the provincial capital. The total land area of Xinyu is 3,178 km^2, and the total population is 15 million. Xinyu has direct jurisdiction over Yushui urban district, Fairy Lake scenic district, Gaoxin technical and economic development zone, Fenyi County, 17 towns, 15 townships, two sub-districts, 446 villages and 51 communities. Xinyu is a new industrial city and is one of the fastest industrializing in Jiangxi. In 2009, Xinyu was designated as the first National Model City of New Energy Technology in the PRC by the Ministry of Science and Technology. Steel, energy, and new materials are the three pillar industries of Xinyu.

52. Kongmu River is a 49.5 km river originating from Fenyi County in Xinyu, which flows from north to south of Xinyu into the Yuan River. The Yuan River is a tributary of Ganjiang River which flows into Yangtze River through Poyang Lake. The entire 597 km^2 watershed of the Kongmu River is in Xinyu. The river is one of the two water supply sources for Xinyu, and a national wetland park established along the river to the north of Xinyu City Centre is a major recreational asset.

53. The flood control capacity of Kongmu River is not sufficient, and flood damage is frequent. Temperatures and precipitation in Xinyu are increasing due to climate change and since 2000 flood events are occurring more frequently. Severe flooding occurred in and around Kongmu River in 2006, 2010, and 2012, affecting both downtown areas of Xinyu and villages upstream. The floods in 2010 were particularly severe, causing central urban precincts to be inundated by 1 m or more for up to three days. The flood in 2012 affected over 10,400 people (including 270 who were evacuated), and damages were estimated to exceed CNY 25 million. Flood damage is anticipated to increase due to development of new districts in the upper Kongmu River watershed and climate change.

54. Water quality in Kongmu River is relatively good, and is currently class II-III. Infrastructure development, rapid urbanization, and economic development in the upper Kongmu River watershed is resulting in increased pollution load, from domestic wastewater, solid waste, and untreated stormwater runoff.

55. The XCG has prepared various long-term plans for flood and environmental management, including improvements to the Kongmu River such as construction of embankments and conservation of wetlands. Although these initiatives have helped, Xinyu still has fundamental problems with Kongmu River and its watershed, including (i) insufficient flood control capacity of Kongmu River and frequently occurring/increasing floods; and (ii) anticipated deterioration of water quality and environment in and around Kongmu River due to development in the upper watershed.

56. There is an opportunity to complement and strengthen these plans, with additional, targeted measures for flood control and pollution management, and, to adopt “sponge city” design concepts in line with the PRC’s National ‘Construction Guideline for Sponge City’ Standards (2014). Sponge City refers to management of stormwater run-off through landscape treatments to reduce flood risks, improve water quality and add social and ecological value. It is similar to the concepts of Water Sensitive Urban Design, Low Impact Development and Sustainable Urban Drainage Systems, in Australia, North America and Europe. The overall concept behind these approaches is summarized in Figure IV-1 below.

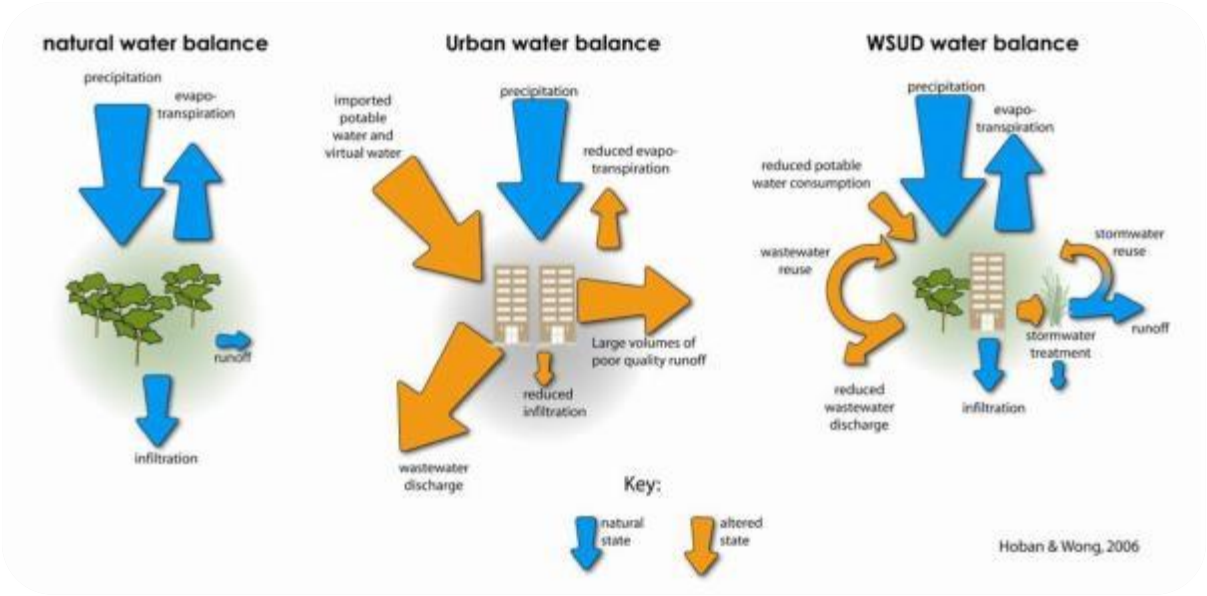

Figure IV-1. Overall Concept of Sponge City and Water Sensitive Urban Design

57. The impact of the Project will be improved water environment and quality of life in Xinyu. This will be achieved by integrating various environmental and flood management strategies with the HSRND development. The stormwater management system includes a number of components: sponge city construction, the canals, the treatment wetlands, the artificial lakes, the canals and the stormwater storage chamber in the utility tunnel. Sponge city construction provides significant flood attenuation and water quality improvement, removing about 40% of the pollutant load. The lakes will provide flood storage, incorporate fringing wetlands, and improve water quality through sedimentation and bio filtration processes. They will also provide aesthetic values and habitat for water birds, fish, amphibians and others. The canals include wetland planting which provide flood retention and water quality benefits. The stormwater storage in the utility tunnel helps flood management in the middle of the catchment. The project includes training of government staff in the management of stormwater and wetland systems. The outcome of the Project will be improved management of surface water resources in Xinyu City, to be achieved through the following three outputs:

58. **Output 1: Development of integrated rural and urban flood management system** will include (i) increase of flood retention capacity in the upper watershed, including (a) development of innovative stormwater management, and (b) development of flood retention capacities in lakes; and (ii) flood protection along the Kongmu River.

59. **Output 2: Construction of water pollution sources management systems and water related basic amenities** will include the (i) expansion of wastewater service delivery system; (ii) improvement of a solid waste management system; (iii) construction of the amenity space in the lakes.

60. **Output 3: Enhancement of the flood and environmental risk coping capacity and know-how dissemination** will include (i) capacity development for flood and environmental risk management in Kongmu River watershed, including (a) strengthen flood management, river basin and spatial planning, (b) promotion of community based flood risk and environmental management, and (c) knowledge sharing and know-how dissemination; (ii) improvement of flood forecasting and warning system; and (iii) improvement of water quality monitoring system for river and wetlands.

61. Construction works that are assessed in this document are summarized in Table IV-1

and described in Section B (Project Design). The project location and sites is shown in Figure IV-2. A schematic layout of proposed canals and lakes is in Figure IV-3.

Table IV-1. Summary of Project Construction Works

Component			Unit	Length/ Area	Affected Land (mu)
Output 1: Development of Integrated Rural and Urban Flood Management System					
Output 1-1: Increase of flood retention capacity in the upper watershed					
Increase of flood retention capacities of lakes	Lakes	Lake excavation	m^3	1,207,380	801.17
		Lake dredging	m^3	569,327	
		Lake embankment	m	2168.8	
		Lake outlets			
	Canals	Canal construction	Km	16.37	299.74
		17 hydraulic drops and 29 overflow dams	-	-	
		1 bridge (in canal) of 35.5 m long and 69 m wide			
Innovative on-site stormwater management	Stormwater managemen	Stormwater pipeline network	Km	5.87	
	Sponge City	Sponge City in Residential Areas	-	-	249.81
		Sponge City along Xiangyun Road	m	4710	
		Sponge City Elements in Parks	-	-	
	Common Utility Tunnel	Sub-surface Service Delivery System	Km	3.7	
Output 1-2: Flood protection along Kongmu River					
Embankment and associated infrastructure		Flood levees of Kongmu River	m	1186	82.98
		Drainage culvert	m	909	
		1 Pumping station (10 m^3/s capacity), 1 drainage pump gate, and 1 drainage sluice gate	-	-	
Output 2: Construction of water pollution sources management systems and water-related basic amenities					
Output 2-1: Construction of Wastewater Pipes and Pump Stations					
Wastewater Management System		Sanitary sewers	km	5.87	0.46
		Pumping Station (2 stations, with capacity 15000 t/d and 10000 t/d)	Station	2	
Output 2-2: Construction of a Solid Waste Management System					
Solid waste containers	Litter Bin		Bin	1249	
	Hook Arm Boxes		Box	49	
Collection and transportation of solid waste	Solid waste transfer stations		Station	2	4.6
	Collection Stations		Station	42	
	Waste collection ports		Port	9	
Solid waste related vehicles	Electric tricycles for waste collection		Tricycle	65	
	Waste salvage ship		Ship	9	
	Hook waste trucks		Truck	9	
	Street sanitizer		Sanitizer	4	
	Cleaning trucks		Truck	3	
	Suction sewer truck		Truck	1	
	Waste transfer trucks of 14t		Truck	4	
Output 2-3: Maintenance of the amenity space along the lakes					
Artificial Wetland	Wetlands adjacent to lakes in the HSRND		m^2	145,700	216.31
	Riparian wetlands along Kongmu River		m^2	47,500	
Ecological restoration	Wetland planting in canals				
Water supplement for wetland	Water supplementing pipes		m	15,025	
	1 pump station for water supplement intake (0.5 t/d)				
	Landscape sprinkler irrigation system		m^2 (Service area)	1,302,000	
Landscape Works	Park greenspace		Ha	11.1	119.49
	Road greenspace		Ha	16.8	188.02

Component		Unit	Length/ Area	Affected Land (mu)
	Canal greenspace	Ha	22.5	420.83
	Wetland landscaping	Ha	0.15	

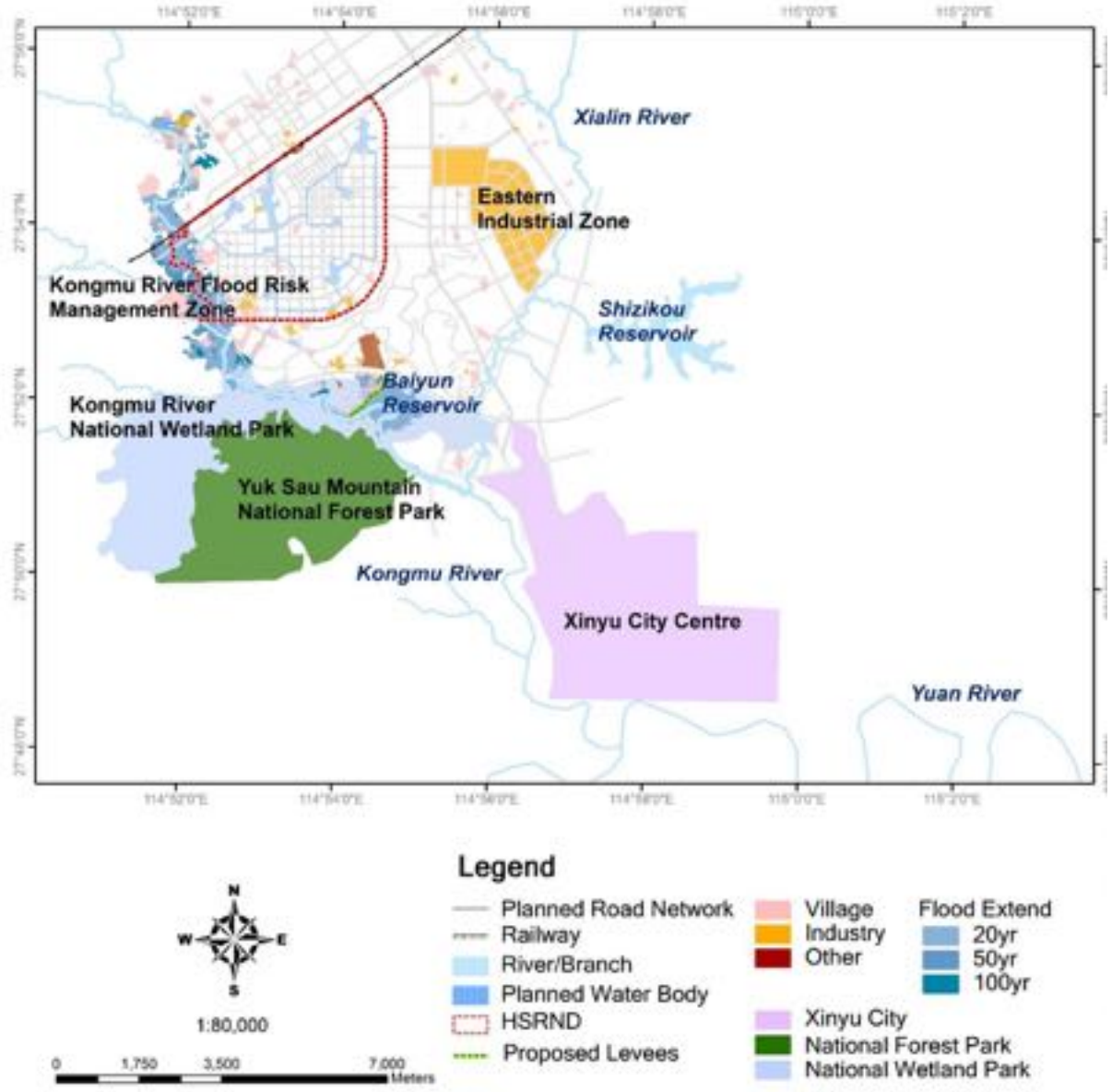

Figure IV-2. Overall Development Area Showing Key Features of the Surrounding Environment.

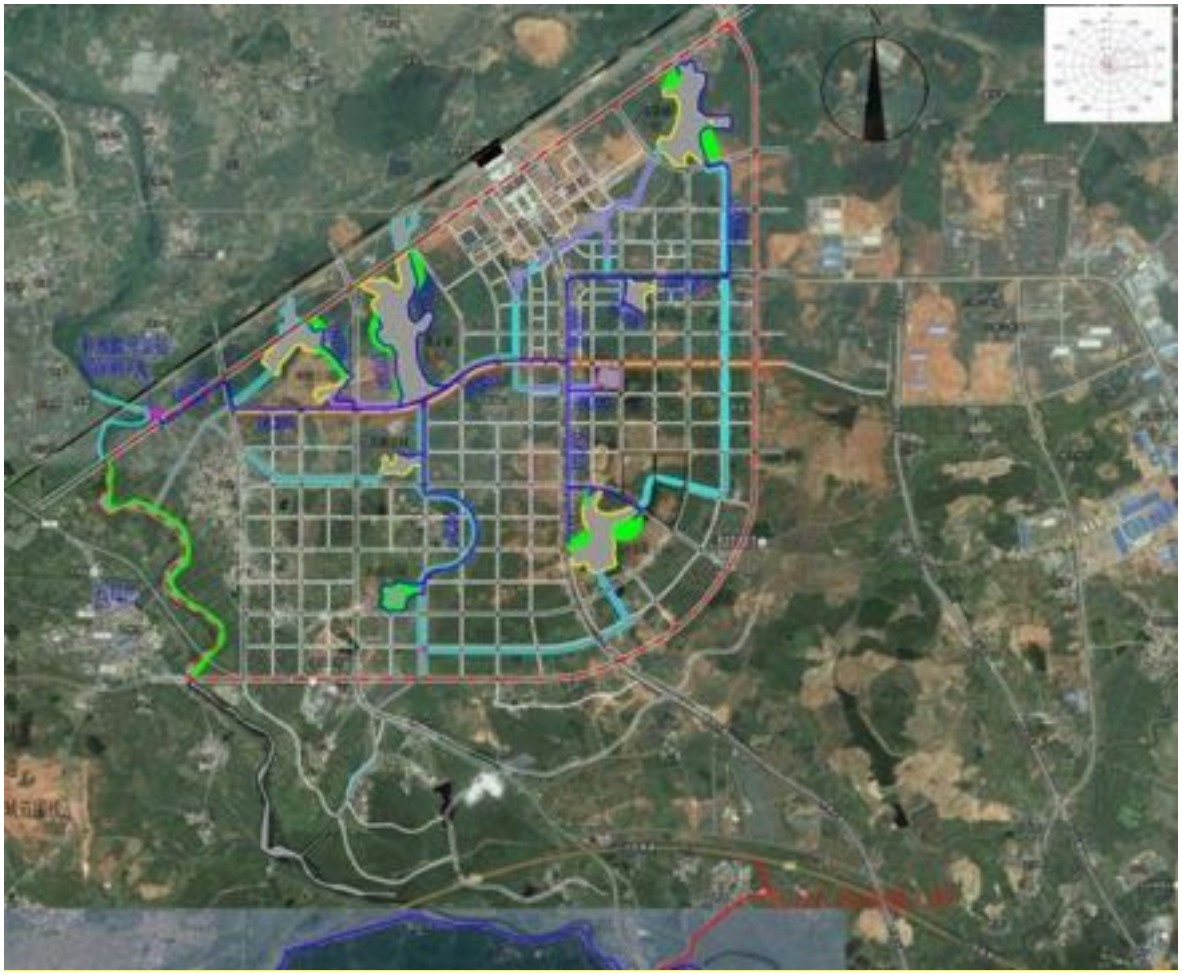

Figure IV-3. Location of Project Elements.

Note: **The development area is the planned High Speed Rail New District. Grey polygons = the project lakes. Green polygons = the constructed wetlands to be built around the lakes.**

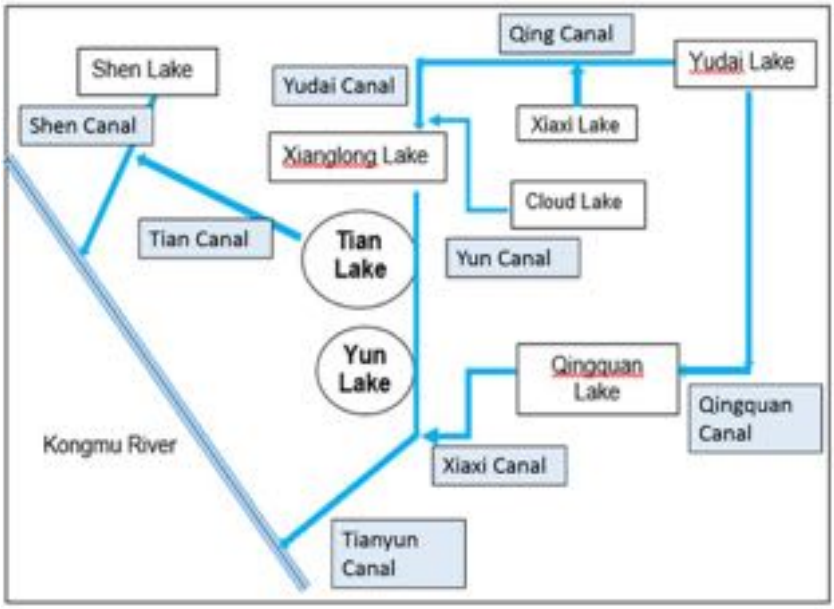

Figure IV-4. Schematic Layout of Lake and Canal System.

Note: Tian Lake and Yun Lake would be newly constructed by the project.

B. Project Benefits

62. The impact of the Project will be improvement of the quality of life in Xinyu and adoption of integrated and climate-resilient flood and environmental management strategies by other river watersheds, based on the example demonstrated in the Kongmu River watershed. The HSR district is forecast to have a population of 57,000 people by 2020 and 130,000 people by 2030. The project will provide benefits to the existing and future populations as described below:

- Improved Flood Control: Efficient stormwater management within the HSR district will ensure that the new area is free from flooding and water logging, benefiting 57,000 people by 2020 and 130,000 people by 2030. The construction of a flood levee, flood proofing and early flash flood warnings will reduce flood hazards and benefit 8,000 people in villages located along the Kongmu River. The Project would control of 75% of the annual runoff from the planning area; and the drainage system will be adequate to manage a 5% AEP storm event without nuisance flooding in the HSRND. Additionally, flood control embankments would protect 0.12 km^2 of village and 0.19 km^2 of farmland from 2% AEP flood. The project would not impact flooding in the downtown (old) Xinyu Area.

- Water Quality Improvement: Pollutant loads in stormwater run-off from the site for Suspended Solids (SS), Chemical Oxygen Demand (COD) and other parameters will be reduced by more than 40 % compared to 'business as usual' development of the HSRND.

- Enhanced Wastewater Management: Infrastructure will collect wastewater from a 6.2 km^2 area of the HSRND so as to prevent pollution to the surface waters in the HSRND and Kongmu River in future development. 57,000 people in the newly developed HSRND will be connected to new sanitary sewers.

- Solid waste management: Solid waste management services will be provided for the HSR district benefitting 57,000 and 130,000 people by 2020 and 2030. Services will also be provided for Gaunchao and Ouli towns, benefiting 44,000 people.

- Sub-surface Utility System: The direct benefits of completed SSDS include: reduced disturbance to traffic from road excavations for maintenance and prolonged service life of road pavements. The population benefited can be up to 130,000.

- Landscape Enhancement: Development of green space alongside lakes, canals, roads and other public open space will embrace and celebrate water and create a continuous public lake edge with a range of formal and natural style parklands. Each activity node will be designed to form a necklace of highlights along the waterfront to attract residents and visitors to the lake and riverside. Well-designed urban green spaces will enhance landscape value, provide ecological habitat, and also provide socio-economic benefits.

- Capacity Development and Training. The Project will improve flood and environmental risk management in Kongmu River watershed; provide enhanced flood forecasting and warning system; and improve water quality monitoring for river and wetlands.

- Sponge City Development. Through the various design elements described above, the Project will contribute to development of the HSRND as a model 'sponge city', in line with the PRC's National 'Construction Guideline for Sponge City' Standards (2014), and serving as a model for future water-sensitive urban developments in Xinyu and the wider Jiangxi Province. The design will result in a 75% rainfall control rate; a minimum of 60% reduction of stormwater runoff; and 40% reduction in the pollutant load in stormwater

C. Project Design

Output 1. Integrated Rural and Urban Flood Management System

Output 1.1: Increase Flood Retention Capacity

63. **Artificial lakes.** The Project will reduce the risks that increased urbanization resulting from the HSRND will not exacerbate flooding in the Kongmu River. Management of urban stormwater discharge from the HSRND will be achieved by using six existing artificial lakes, and constructing another two small lakes, to store excess stormwater. The existing lakes are currently used for aquaculture and irrigation water storage, functions that would be discontinued as the HSRND is developed. Other small lakes in the HSRND would be reformed and incorporated into the residential and commercial developments (works not undertaken by this project). To maximize storage capacity and functionality, the 8 project lakes will be dredged and linked through a series of existing and new canals. This flood protection system is designed to accommodate a 1 in 50 year flood event (Table IV-2). The layout of lakes and connecting canals adopted by the Project generally follows the original layout proposed in the HSRND Partition Plan, and is shown in Figure IV-5.

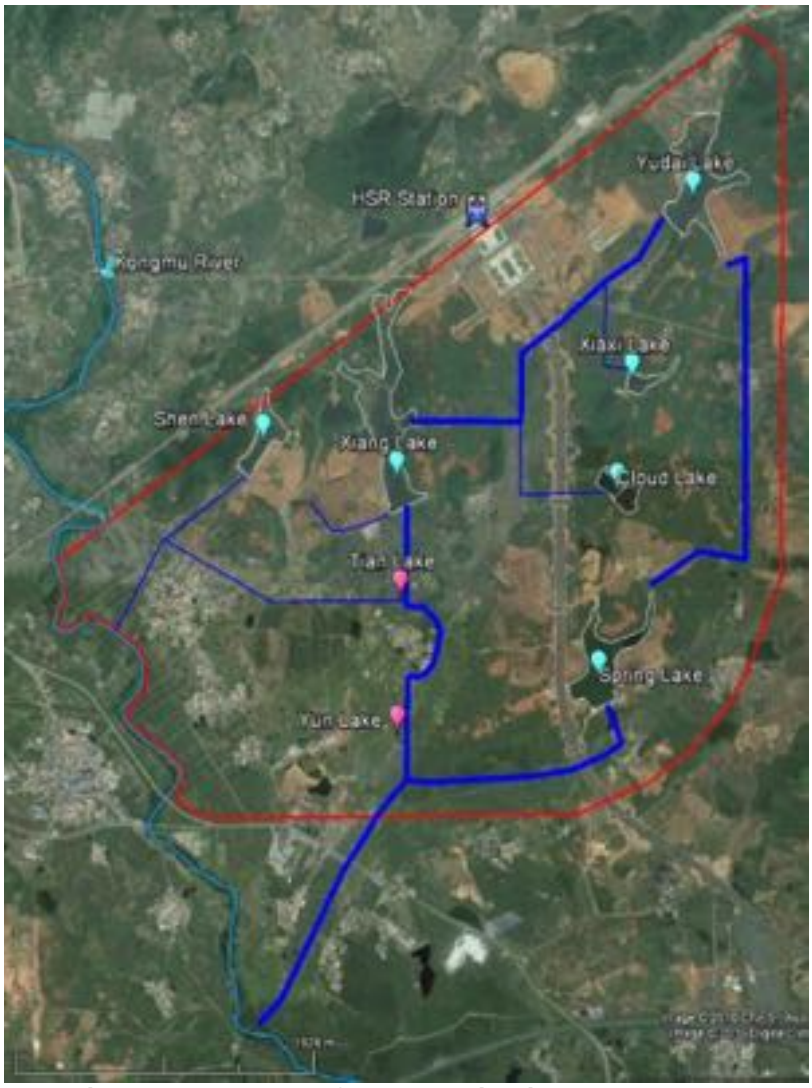

Figure IV-5. Layout of HSR-ND Flood Storage System

Note: The extent of the planned HSRND is shown in red. Canals are shown in blue. The width of the blue line indicates the depth of the canal. New constructed wetlands are shown with pink markers.

Table IV-2. Summary of Flood Retention Design Standards

Item	Quantity
Flood Control Standard	1 in 50 year
Level of the Embankment	Level 2
Water-logging control standard	1 in 20 year, 24-hour rainfall discharged in 24 hours
Engineering Level of Canal	Level IV
Main building level	Level 4
Temporary building level	Level 5
Seismic design intensity	Degree 6

64. The larger lakes of the site have been created by blocking natural drainage lines. This type of structure intercepts water washing down the drainage line and within an agricultural landscape it is prone to sediment build-up. In this Project it is planned to dredge sediment from six of the lakes (Table IV-3). This will both remove nutrients from the lake and increase flood storage capacity. Preliminary lake sediment survey has been conducted to develop an estimate of the amount of sediment. The quantity estimate was based on a dredging depth of 0.6 m. Dredging and sediment management is estimated to take at least five months, based on 22 days a month and a treatment rate of 5,600 m^3/day. The six existing lakes will be maintained at a lower level than at present, providing an increased flood storage volume of 269,725 m^3, and the two lakes to be constructed will have a storage volume of 338,450 m^3. The total increase in flood storage will therefore be 608,175 m^3.

Table IV-3. Proposed Lake Dredging, Excavation and Water Level Management

Constructed Lake	Proposed Dredging (m^3)	Proposed Excavation (m^3)	Normal water level (m)	High Water Level (m)	Design Crest Elevation (m)
Cloud	21,612		69.9	70.5	71.80
Shen	51,535	123,178	67.0	68.0	69.35
Qingquan (Spring)	168,606	263,141	66.0	68.0	69.36
Tian (new)		163,980			-
Xiang (Xianglong)	179,714	188,741	63.0	65.0	66.58
Xiaxi	16,017	77,091	70.5	71.5	72.69
Yudai	131,843	195,904	73.0	74.0	75.32
Yun (new)		169,473			-
Total	**569,327**	**1,180,508**			

65. Cutter Suction Dredging (CSD) will be adopted for the Project, with the excavated sludge discharged to a holding area by pipe. The dredged sludge will be placed in the temporary storage area and subject to natural air dried method for sludge treatment. After solidification, the sludge will be used for canal fill material. Dredging will be restricted to the dry season (November-April) to increase construction efficiency and reduce downstream water quality impacts due to higher water levels and increased site run-off.

66. In addition to dredging, five of the existing lakes will be expanded through excavation to provide additional space for constructed wetlands for stormwater treatment. A further two new Lakes will also be excavated as part of the stormwater management system (Table IV-3).

67. **Canals.** To supplement the Lake improvement program, a series of canals will also be constructed under the Project. The canals have four design goals:

- To receive stormwater runoff directly from the Project site (72% of volume);
- Transfer of water from the lakes to the Kongmu River (28% of volume);
- Contribute to water quality improvement, particularly in relation to the stormwater that discharges directly into the canals; and,

- Provide a high amenity landscape that link across the site.

68. The most efficient arrangement for the canal system is to connect the highest lakes (Yudai Lake and Shen Lake) to the Kongmu River. The proposed design involves 16.4 km of canals with two outlets into the Kongmu River; one in the north-west of the site and the second 2.5 km downstream (Figure IV-4). The two canal systems have a connecting canal that runs from Tian Lake across to the canal from Shen Lake. Ten canal sections are proposed (Table IV-4). Note that although these artificial, concrete lined channels are canals, they are named as “rivers” in the domestic design documents. To accurately reflect the nature of these structures, they are referred to as canals in this document.

Table IV-4. Description of the Canals

Name	Flow Direction	Length (m)	Details
Cloud Canal	NW	811	Cloud Lake to the Yudai Canal
Qing Canal	N	531	Xiaxi Lake to the Yudai Canal
Tain Canal	NW	1,649	Tian Lake to the Shen Canal
Qingquan Canal	SW / SE	1,122	Links Qingquan (Spring) Lake to the Xia Canal
Shen Canal	SW	1,282	Shen Lake to Kongmu Canal and is joined by the canal from Tian Lake
Xia Canal (upper)	S	3,753	Yudai Lake to Qingquan (Spring) Lake
Xia Canal (lower)	W	160	Qingquan (Spring) Lake to the Xiang-Kongmu Canal
Xianglong Canal	E-W	515	Xianglong Lake – lake to the west, interchange
Yudai Canal	SW	2,569	Yudai Lake to Xiang Lake and is joined by canals from Xaixi Lake and Cloud Lake
Tian Yun Canal	S	3,977	Xianglong Lake to the Kongmu Canal. Passes Tian Lake and Yun Lake and is joined by Xia Canal (lower)

69. Four canals designs are proposed based on the peak volume of water that will flow through each canal. All designs have the same trapezoidal section, with a base of 4 m width and bank width of 20 m, but the depths vary (3 m, 4 m, 5 m and 6 m). A typical canal cross section is shown in Figure IV-7. All of the canals will have a concrete base to prevent scouring (as flood flows will have an erosion rate exceeding soil cohesion). To improve ecological and landscape value, stone masonry and other structures will be embedded in the floor and banks of the canals to allow planting of wetland vegetation.

Figure IV-6. Layout of New Canals

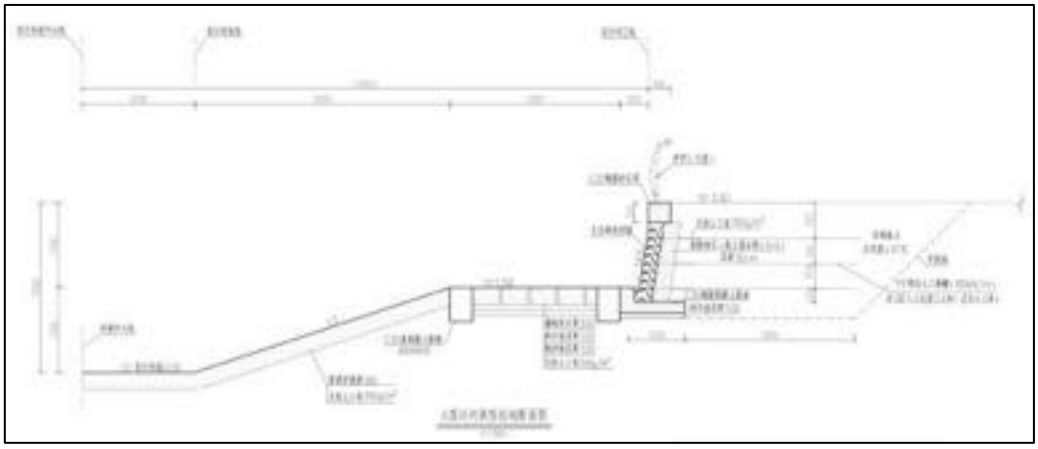

Figure IV-7. Typical Section of Canal (Type A)

70. The canal system will drop around 16.5 m between Yudai Lake and Kongmu River, and over 13 m between Shen Lake and Kongmu River. Water flow in the canals will be managed by 29 weirs and 17 “drops” in the canals with their associated “overflow dams” that will absorb some of the energy from the drop in height.

71. **Stormwater Management.** A stormwater drainage network has been planned for the HSRND (Figure IV-8). The pipes will discharge into the treatment wetlands around the lakes, although no detailed design of these connections is available at this stage. Two components of the HSRND stormwater drainage network will be constructed by the project. (i) stormwater

conveyance and storage, as part of the Subsurface Utility Service System, routed along one of the main planned roads of the HSRND: Xiangyun Road (Huyi Road – Xiaxi Road); and (ii) pipelines along Xiangyun Road section east to Huxi Road (see the pink dotted lines in Figure IV-8). A bill of quantities for construction is provided in Table IV-5. The Xinyu City Administration Bureau (XCAB) will be responsible for maintenance of the stormwater pipe system and the wetlands. The Xinyu City Water Affairs Bureau (XCWAB) will be responsible for the maintenance of the embankments that form the lakes. XCWAB will also manage the flood forecasting and warning system (including issuing warnings to villages located along the Kongmu River and Xinyu City). The following measures address any potential malfunctioning of the stormwater management system: (i) the system does not require active management during storm events: it does not have any mechanical or electrical components that need to be operated or which can fail; (ii) water quality requires effective ongoing maintenance of the wetland system. The project will include training for the department responsible for managing the wetlands; (iii) lake embankments will be inspected regularly and after every flood, as per routine official O&M procedures. No emergency provisions are required, as the stormwater system will collect the runoff and convey it to the river. In large events that exceed the design storm then the piped stormwater system capacity will be exceeded and the extra stormwater will be safely carried by the roads without flooding homes or businesses.

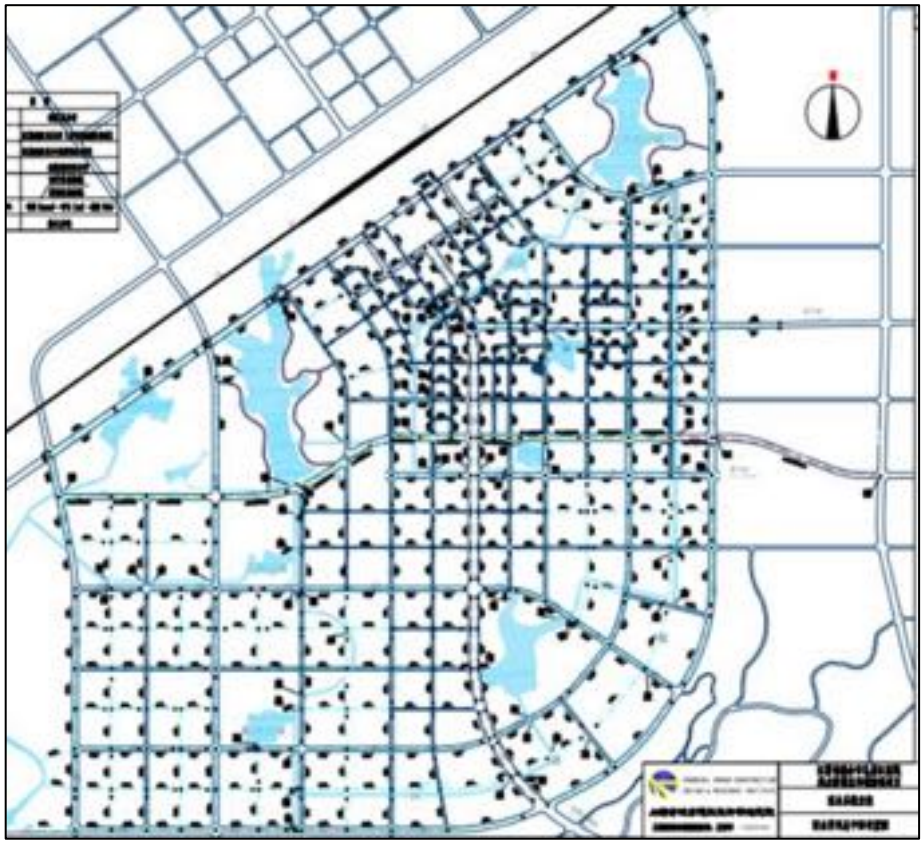

Figure IV-8. Stormwater Pipeline Layout.

Table IV-5. BoQ of Stormwater Pipelines

S/N	Item	Size	Unit	Quantity	Remarks
	Xiangyun Road (Huyi Ave- Zhuyuan Rd)				
1	Reinforced Concrete Pipe	Φ300	M	2772	Average depth – 1.3m; link to rainwater gully
2	Reinforced Concrete Pipe	Φ800	M	1040	Average depth – 2.2m, branch sewers
3	Manhole	Φ1500	No.	52	reinforced concrete
4	Gully Gratings	-	No.	154	Brick, refer to GB standard drawing 06MS201-page8/11
5	Flow Gauge	-	No.	7	

S/N	Item	Size	Unit	Quantity	Remarks
	East Extension of Xiangyun Road (Zhuyuan Rd – Chuangye Ave)				
1	Reinforced Concrete Pipe	Φ1200	M	212	Average depth – 2.7m
2	Reinforced Concrete Pipe	Φ1000	M	914	Average depth – 2.5m
3	Reinforced Concrete Pipe	Φ300	M	1044	Average depth – 1.3m; link to rainwater gully
4	Reinforced Concrete Pipe	Φ800	M	400	Average depth – 2.2m, branch sewers
5	Manhole	Φ1500	No.	20	reinforced concrete
6	Manhole	1300x1100	No.	23	reinforced concrete
7	Manhole	1500x1100	No.	6	reinforced concrete
8	Gully Gratings		No.	58	Brick, refer to GB standard drawing 06MS201-page8/11
9	Flow Gauge		No.	1	

72. **Sponge city infrastructure.** Sponge city infrastructure refers to landscape treatments that help to manage urban stormwater through water quality improvement and flood retention. Typical sponge city components are shown in Figures IV-9a to IV-9e. Under the current Project, sponge city components will be incorporated with the conventional stormwater drainage network and the system of constructed wetlands, lakes and canals that will manage stormwater run-off in the HSRND. Sponge City Infrastructure will be constructed in three areas of the HSRND: within residential developments, along Xiangyun Road, and within parks/open space network.

Figure IV-9a. Permeable pavement

Figure IV-9b. Bio-swales

Figure IV-9c. Bioretention Unit

Figure IV-9d. Rain Garden

Figure IV-9e. Pond

73. **Sponge City in Residential Areas.** Sponge city elements will be included in residential areas of the HSRND. The general intention will be to adopt the following strategies which would be connected to the conventional stormwater drainage system:

- Directing roof rainwater to onsite storage and/or water harvesting gardens. During high rainfall events these would then overflow in to the stormwater drainage system.
- The use of “permeable pavements” which enables the rainwater to infiltrate into the soil or flow down into drainage pipes and be directed to water harvesting gardens integrated into the roadway landscaping.
- The use of underground rainwater storage tanks to buffer the flow of stormwater.
- The use of bio-retention gardens in low-lying areas, where plants, microbes and the soil absorb the water and incorporate pollutants.

74. The Project does not include the detailed engineering design of these elements, but will

provide overall guidelines to include various combinations of these strategies to meet the standards in Table IV-6.

Table IV-6. Stormwater Control Rates for Residential Areas

Land Use and Control Objective	Control rate
Residential	
Stormwater runoff control rate	≥ 80%
Rainwater pipe disconnection	≥ 50%
Pedestrian pavement water rate	≥ 50%
Residential land greening rate	≥ 30%
Commercial land greening rate	≥ 10%
Rainwater Storage Tank	≥ 100m^3 / ha

75. **Sponge City along Xiangyun Road.** Sponge city elements would be introduced to manage >70 % of stormwater runoff from the road, and increase green space along the road to >20 %. Typical sections of sponge city roads are provided in Figure IV-10, and a bill of quantities for construction provided in Table IV-7. Two major sponge city elements will be constructed: (i) bioswales will be constructed along both sides of the road, collecting stormwater run-off from the paved road surfaces. The bioswales will be connected to a Subsurface Utility Service System, where the cleaned stormwater can be temporarily stored to minimize peak discharge; and (ii) permeable paving will be used for >70 % of cycle/pedestrian paths.

76. **Sponge city within parks/open space network.** Sponge city elements including permeable pavement, bio-swales, bioretention units, rainwater gardens and small ponds will be integrated with the design of parks/open space network. These ponds are different from the lakes described under Output 1.1, being smaller in scale, and having a much more limited water quality improvement and flood control function. Stormwater run-off within the parks would be channeled through a sequence of bio-swales and rainwater gardens before discharging into the conventional stormwater drainage network. The FSR notes that sponge-city elements will be carefully designed to complement overall landscaping of the Parks, but no further design details are provided. Control standards adopted for sponge city elements in public open space are summarized in Table IV-8.

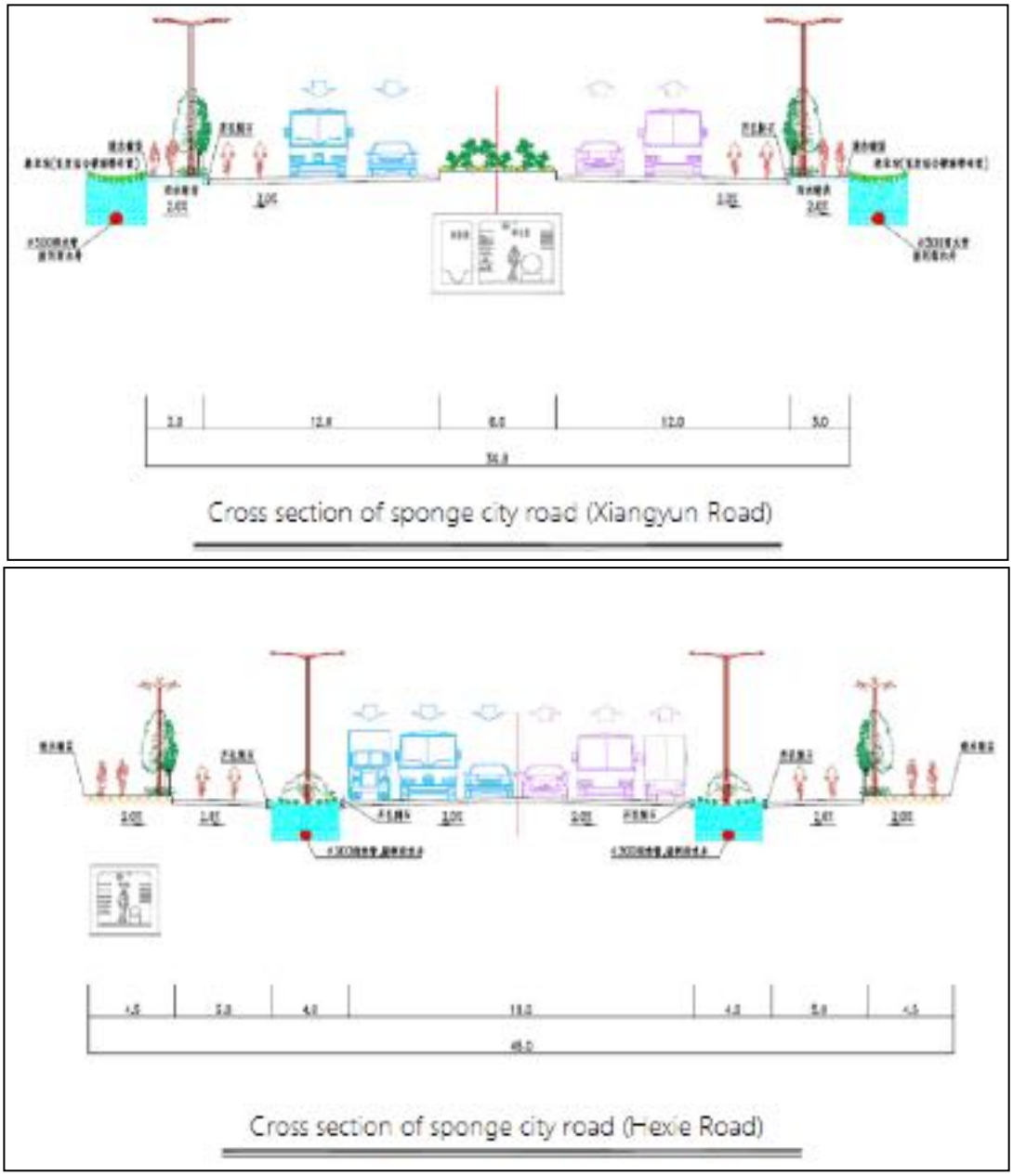

Figure IV-10. Cross-Sections of Sponge City Roads

Table IV-7. Bill of Quantities for Sponge City Roads

No.	Item	Unit	Quantity	Remarks
Xiangyun East Road (west of Hucheng road)				
1	Bioswale	m^2	296.8	Combine with landscaping
2	Earth filling	m^3	240,000	-
3	Earth excavation	m^3	300,000	-
4	Newly constructed roads for vehicles	m^2	95,000	main road
5	Newly constructed isolation belts	m^2	21,000	-
6	Newly constructed sidewalks	m^2	24,000	homogeneous bricks
7	Newly arranged flat stones	m	15,000	Concrete
Xiangyun East Road (east of Hucheng road)				
1	Bioswale	m^2	80	Combine with landscaping
2	Earth filling	m^3	320,000	-
3	Earth excavation	m^3	400,000	-
4	Newly constructed roads for vehicles	m^2	100,000	main road
5	Newly constructed isolation belts	m^2	22,000	-

6	Newly constructed sidewalks	m^2	25,000	homogeneous bricks
	Newly arranged flat stones	m	16,000	Concrete

Table VI-8. Stormwater Control Standards for Parks/Public Open Space

Target	Control Standards
Control rate of landscaped area rainwater runoff	⩾90 %
Permeable pavement rate of slow lanes	⩾70 %
Greening rate of grassed swales, rainwater garden and ponds	⩾10 %

77. **Sub-Surface Utility System (SSUS).** These carry multiple utilities and offer advantages over traditional single purpose buried trenches: ease of access, smaller footprint, reduced traffic disturbance during maintenance, and flexibility for upgrades/carrying of additional future infrastructure. Under the Project, SSUS totaling 3.7 km length will be constructed under Xiangyun road (Figure IV-11). These will carry six utilities: water supply, stormwater, gas pipeline, sewage, electricity, and communications pipelines. The stormwater and sewerage pipes will connect to stormwater and sewerage pipes both upstream and downstream of the SSUS. Likewise the cables will connect to the power and communications network. The stormwater cabin will provide some temporary stormwater storage to reduce flooding, but has no treatment function to improve stormwater quality. The SSUS constructed by the project are three-cabin tunnels (Table IV-9).

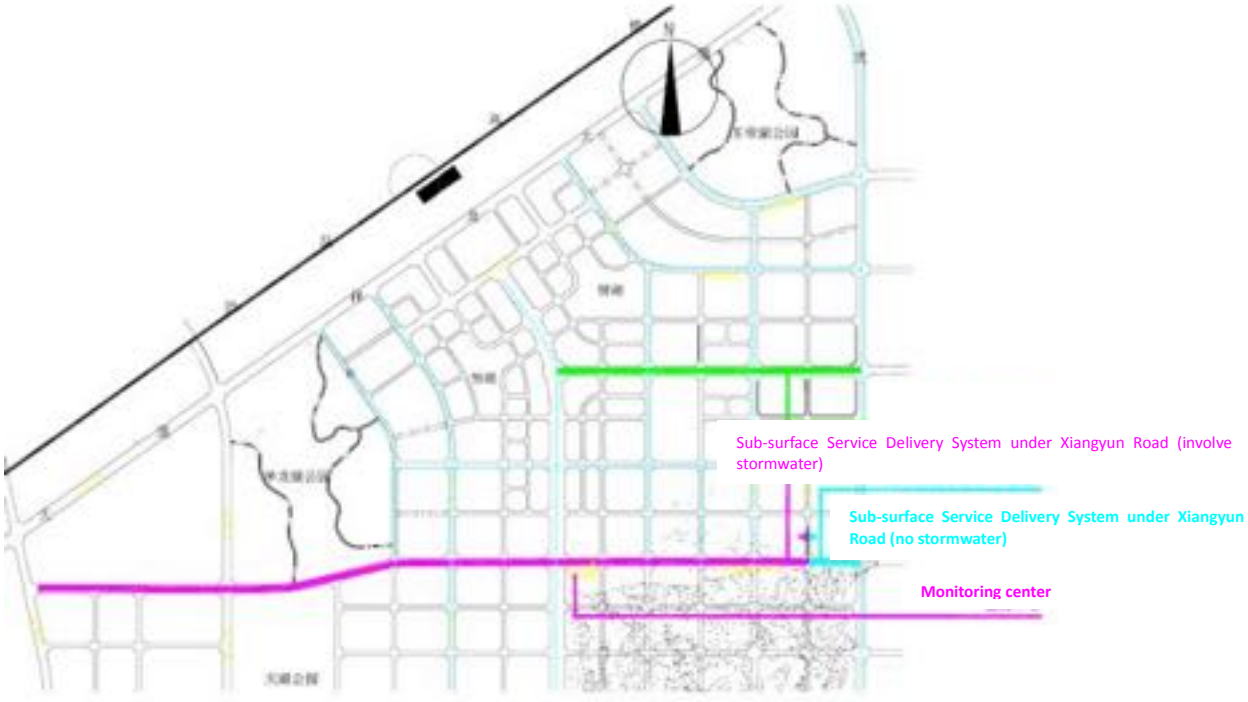

Figure IV-11. Routing of Proposed SSUS

Table IV-9. Summary of SSUS Included Under the Project

Road the SSUS will be under	Water supply pipeline	Electricity cable	Communication cable	Gas pipeline	Sewage pipeline	Stormwater pipeline
Xiangyun Road (Huyi Avenue ~ Zhuyuan Road)	DN1000	110kV*2, 10kV*8	12-24 holes	DN300	DN800	DN800~1000
Xiangyun Road (Zhuyuan Road ~Hucheng Avenue)	DN1000	110kV*2, 10kV*8	12-24 holes	DN250	DN800	DN800~1200

78. Under the current Project, design of the SSUS comprises main works and ancillary

works. The main works include design of the main body and joints of the SSUS. Ancillary works covers all other aspects including water supply and drainage design, fire protection design, ventilation design, architectural design, power supply and distribution design, lighting design, monitoring design and signage. The design and installation of actual utilities is not considered under the Project. To facilitate safe operation and maintenance of the SSUS, the following design features will be incorporated:

- Protective netting will be set in both fan inlets and exhaust blower outlets.
- When maintenance staffs need to enter the SSUS to conduct repair or inspection, the control center will switch on blowers and corresponding air valves to ventilate one hour in advance.
- Anti-intrusion monitoring facility would be installed and are considered sufficient to prevent unauthorized access.

79. Typical section of SSUS is provided in Figure IV-12.

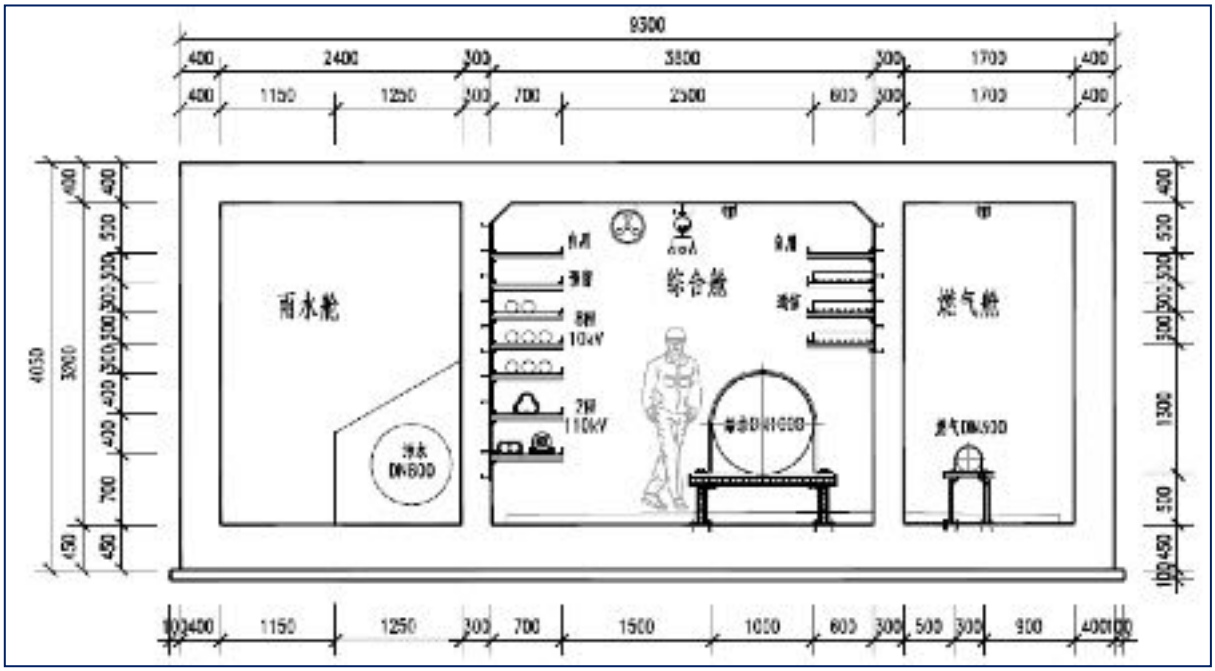

Figure IV-12. Typical SSUS Section along Xiangyun Road (Huyi Avenue ~ Zhuyuan Road)

80. The SSUS under Xiangyun Road will be laid under the central green belt, under soil of 3.0 m depth. There are five stormwater outlets along the tunnel. Five stormwater lift pump stations and one sewage lift pump station are included in the design (Figs. IV-13 and IV-14).

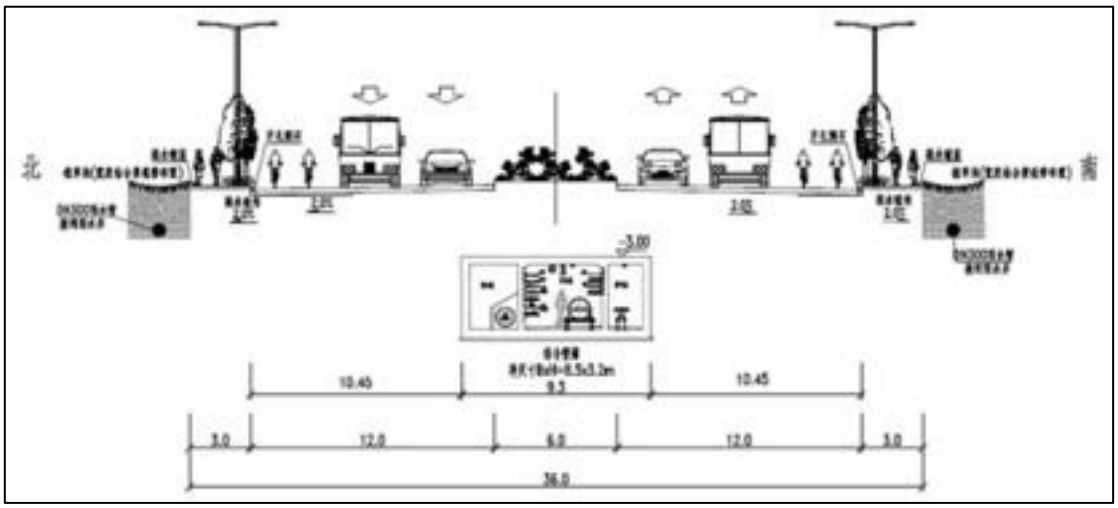

Figure IV-13. Location of SSUS under Xiangyun Road (Huyi Avenue ~ Zhuyuan Road)

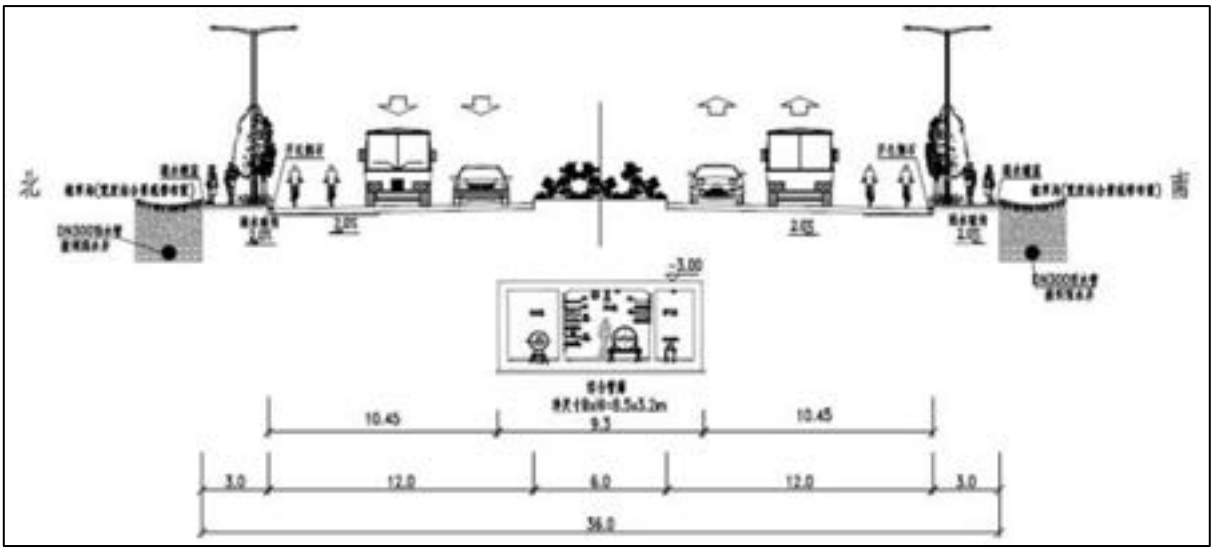

Figure IV-14. Location of SSUS under Xiangyun Road (Zhuyuan Road ~ Hucheng Avenue)

81. The standard section size of tunnel is shows below **(Table V-10)**.

Table V-10. List of Cross Section Size of Standard Section of Tunnel

No.	Road name	Net size of integrated cabin width×height (m)	Net size of gas cabin width×height (m)	Net size of sewage cabin width×height (m)	Net size of stormwater cabin width×height (m)
1	Xiangyun Road (Huyi Avenue ~ Zhuyuan Road)	3.8×3.2	1.7×3.2	2.4×3.2 (one cabin for sewage and stormwater)	
2	Xiangyun Road (Zhuyuan Road ~ Hucheng Avenue)	3.8×3.2	1.7×3.2	2.4×3.2	—

Output 1.2: Flood Protection along Kongmu River

82. To better manage existing flooding along the Kongmu River, a 1.19 km long embankment is proposed to protect three villages close to the river (Shebei, Dawu and Hupi) (Figure IV-15). The embankment will protect 0.12 km^2 of village and 0.19 km^2 of farmland from up to 1-50 year flood event. Ancillary works associated with the embankment include a 909 m drainage ditch, a pumping station with a capacity of 10 m^3/s, a 4 m wide drainage pump gate, and a 4 m wide drainage sluice gate. Constructing an embankment to prevent flooding from the river will block runoff flowing into the river from the protected area, which could cause localized flooding upstream of the embankment. There is a drain along the embankment that directs this water to the lowest point where there is a pump and sluice gate. When the river is high the pump discharges any stormwater collected upstream of the embankment and the sluice gate will be closed. When the river levels are low the sluice gate will open to allow water to discharge under gravity.

83. The embankment is being constructed to protect the villages from flooding by the Kongmu River. The embankment will not have any effect on flood levels: it will remove a very small volume of flood storage (the volume of lost flood storage is less than 1/2000 of the volume of the 50 year flood, and this loss of this small volume will not have any impact on flood levels).

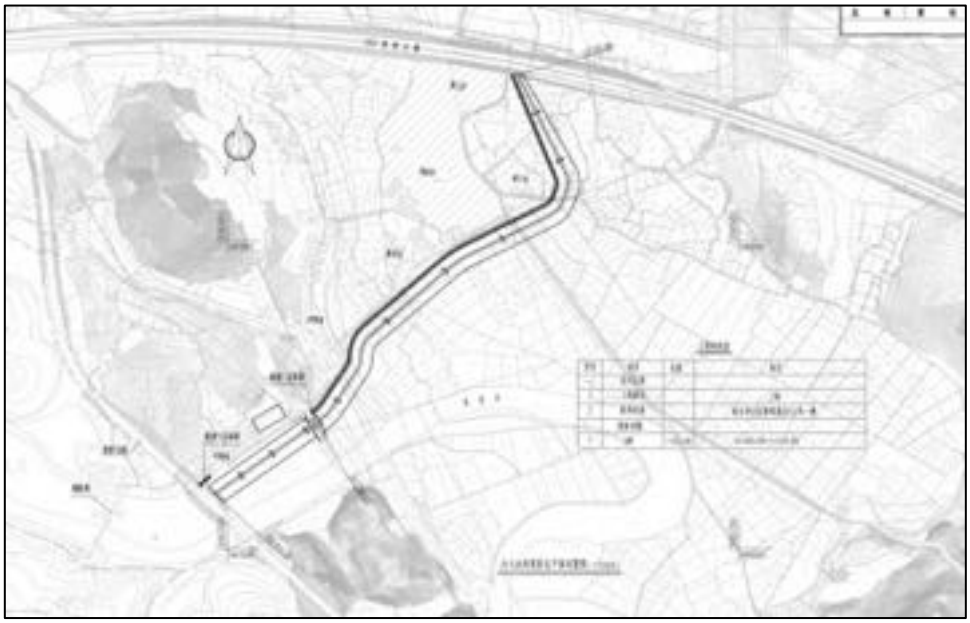

Figure IV-15. Layout of Proposed Embankment

Output 2: Water Pollution Management

Output 2.1: Wastewater Pipes and Pump Stations

84. **Wastewater Sewers and Pumping Stations.** Sanitary Sewers (total 15.87 km) will be laid from east Xiangyun Road and Chuangye Road, and connected to Xiacun WWTP. The sewers to be laid as part of the Project are shown in Figure IV-16. The bill of quantities of the sanitary sewers is summarized in Table IV-11.

Figure IV-16. Sanitary Sewer Layout (show in Pink) and Location of Wastewater Pumping Stations

Table VI-11. BoQ of Sanitary Sewers

S/N	Item	Size	Unit	Quantities	Remarks
Xiangyun Road (Huyi Ave – Hucheng Ave)					
1	Spiral Wound HDPE Pipe	DN400	m	782	branch sewers; average depth – 2.5m; ring stiffness ≧8kN/m^2
2	Manhole	Φ1000	No.	46	reinforced concrete
East Extension of Xiangyun Road (Hucheng Ave – Chuangye Ave)					
1	Spiral Wound HDPE Pipe	DN1000	m	1000	average depth – 2.8m; ring stiffness ≧10kN/m^2
2	Spiral Wound HDPE Pipe	DN400	m	240	branch sewers; average depth – 2.5m; ring stiffness ≧8kN/m^2
3	Manhole	1300x1100	No.	17	reinforced concrete
4	Manhole	Φ1000	No.	12	reinforced concrete
Chuangye Avenue					
1	Spiral Wound HDPE Pipe	DN1000	m	2412	average depth – 2.8m; ring stiffness ≧10kN/m^2
2	Spiral Wound HDPE Pipe	DN400	m	616	branch sewers; average depth – 2.5m; ring stiffness ≧8kN/m^2
3	Ductile Iron Pipe	DN700	m	876	Pressure pipes; average depth – 2.4m
4	Manhole	1300x1100	No.	40	reinforced concrete

85. Two integrated prefabricated wastewater pumping stations will be installed with design capacities of 10,000 m^3/d and 15,000 m^3/d (Figure IV-15).

Output 2.2: Solid Waste Management System

86. The Solid Waste Management System to be included under this Project covers three areas: the HSRND, Ouli Town and Guancao Town (Figure IV-17). The System would address domestic waste management only, and would involve deployment of litter bins where waste can be disposed of by local residents. The waste would be taken to one of 42 local waste collection stations, where they would be transferred to small vehicles. Sixteen of the collection stations will be located in the HSRND, with the remainder distributed through surrounding districts. No further descriptions of the footprint, design or exact locations of the waste collection stations are available at this stage of the project. The vehicles would take the waste to one of two waste transfer stations for compression, before finally being sent to Xinyu Household Waste Incineration and Power Generation Plant. Details of the required waste collection infrastructure are provided in Tables IV-12 and Figure IV-18 and IV-19 below. In addition to this solid waste management infrastructure, there will be an education program under output 3 of the project which emphasizes the 3 R's.

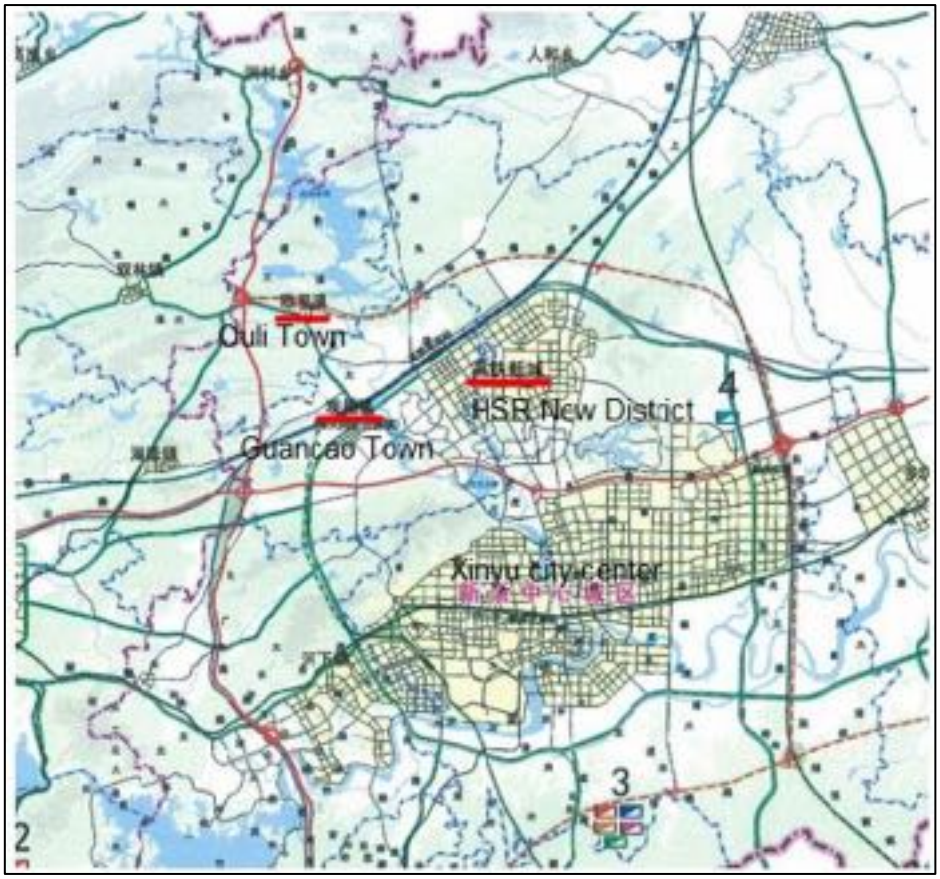

Figure IV-17. Location of HSRND, Ouli Town and Guancao Town

Table IV-12. Number and Location of Public Litter Bins

No.	Location	Number of litter bins
1	Zhanxi Road	6
2	Zong'er Road	6
3	Zongsan Road	6
4	Zhandong Road	6
5	Huju Road	66
6	Xianglong Road	26
7	Xiangfeng Road	22
8	Xiangyun West Road	48
9	Xiangyun East Road	48
10	Banks of lakes and rivers	1,015
	Total	**1,249**

Figure IV-18. Household and Public Litter Bins

Figure IV-19. Hook Arm Box and Waste Collection Station

87. The specification and locations of the four waste transfer stations are shown in Table IV-13 and Figure IV-20.

Table IV-13. Construction of Waste Transfer Stations

Waste Transfer Station	Population	Scale of waste transfer stations(t/d)	Timeframe*
1# - Zhanghe Road	50,000	65	To be constructed in short-term
2# Zhanggu Road	39,000	51	To be constructed in short-term

* Constructed in the short term means in the next five or six years. These facilities will be adequate to serve a population of 57,000. However, future additional transfer stations will required as the population grows to 130,000.

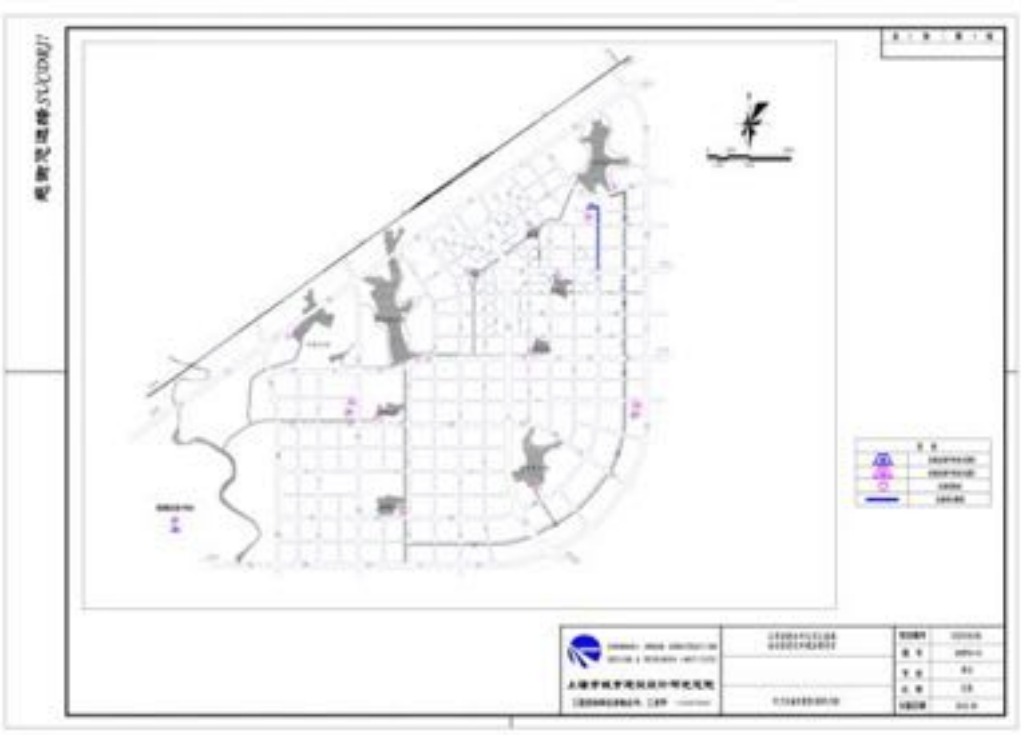

Figure IV-20. Location of Waste Transfer Stations

88. Mobile waste compression technology would be used in the waste transfer stations, and waste trucks fitted with removable carriages (Figure IV-21). Near the two constructed waste transfer stations, the municipal sewage pipe network would be constructed at the same time. Sewage from the waste transfer stations and leachate from waste compression would be connected to municipal sewage pipe network after simple sedimentation treatment, then sent to the city wastewater treatment plant for treatment. The deodorization system of waste transfer stations would adopt BENTAX high-energy and reactive-oxygen ion deodorization method.

Figure IV-21. Mobile Waste Compressor and Waste Transport Truck with Removable Carriage

Output 2.3: Constructed Lakes and Wetlands

89. Maintenance of amenity space along the lakes will cover various Project elements including constructed wetland creation, ecological restoration along the canals, landscape irrigation supply and general landscape works.

90. **Constructed Wetlands.** As part of the Project, constructed wetlands are being incorporated into HSRND surface water systems to provide stormwater treatment, and also provide ecological and landscape enhancement. There will be two main types of constructed wetland; those around five lakes of the HSRND, and wetlands at the riparian area of the Kongmu River.

91. The process flow for stormwater is summarized in Figure IV-22. Untreated stormwater drainage will be diverted to the wetlands via a coarse grille for litter screening. Water will then be routed through surface flow and subsurface flow constructed wetlands before entering the main open water area of the lakes. Open water areas will contain submerged plants to provide additional water quality improvement. Treated water from the lakes will eventually be discharged to Kongmu River via the HSRND canal system. The wetland at the junction in Kongmu River will be created by widening the river by about 10m to extend its floodplain. Reed beds will be established in this area, providing a surface flow wetland to further purify water discharging into Kongmu River from HSRND.

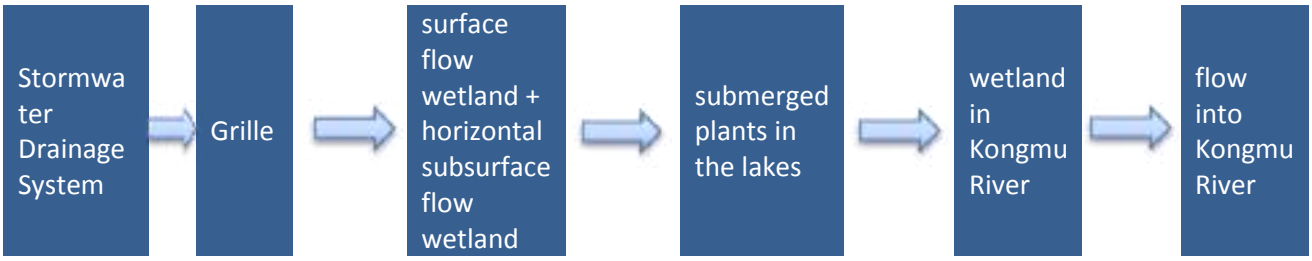

Figure IV-22. Process flow for Stormwater

92. **Lake Constructed Wetlands.** In total, there will be 12 constructed wetlands with a total area of 35.34 ha constructed around five lakes of the HSRND (totaling 14.56 ha) and at the riparian area of the Kongmu River (totaling 19.16 ha). Details of the 'lake' wetlands are provided in Table IV-14. The location of all proposed wetlands is shown in Figure IV-23.

Table IV-14. Details on the Surface and Sub-surface Wetlands

Wetland	Treatment	Annual Volume	Peak storm	Surface	Sub-surface	Total

	Wetland (ha)	Stormwater (m3)	-water flow (m3/s)	Flow (ha)	flow (ha)	Area (ha)
Shen Lake NE	16.6	183,607	3.78	0.45	0.45	0.90
Shen Lake SE	0.0		0.00	1.16		1.16
Qingquan Lake NE	58.2	643,465	13.25	0.50	1.99	2.49
Qingquan Lake NW	4.8	53,078	1.09	0.13	0.13	0.26
Qingquan Lake SW	11.3	124,734	2.57	0.53	0.53	1.07
Xiang Lake CW	32.2	356,510	7.34	0.92	0.92	1.83
Xiang Lake NE	33.8	374,059	7.70	0.75	0.75	1.50
Xiang Lake SW	9.9	109,474	2.25	0.27	0.27	0.54
Yudai Lake NW	19.5	215,963	4.45	0.53	0.53	1.06
Yudai Lake SE	50.4	557,655	11.48	1.16	1.16	2.33
Yun Lake	5.1	56,064	1.15	1.44		1.44
Totals	**241.9**	**2 674,610**		**7.83**	**6.73**	**14.56**

Figure IV-23. Location of Proposed Constructed Wetlands

93. These wetlands will primarily be used for stormwater quality improvement to treat effluent quality to Class III surface water quality standard (Table IV-17). Effluent water quality will meet Class III of *Environmental Quality Standards for Surface Water (GB3838-2002)* (Table IV-15).

Table IV-15. Water Quality of the Wetland in HSR New District (mg/l)

Pollutants	Water Quality Standard (Class III)	Influent water quality	Water quality discharged from the lakes	Water quality discharged from the canals
COD	20	10.022	6.01	<6.01
TN	1	2.646	1.59	0.85
TP	0.2	0.328	0.2	<0.2

94. Planting plans for the constructed wetlands have been developed based on proposed water depths within the wetlands as well as existing/future climatic conditions in Xinyu. The plants selected include emergent species capable of growing in both surface and sub-surface wetlands, as well as species adapted to relatively shallow and deep waters. The vegetation configuration of the wetland in HSRND shown in Table IV-16.

Table IV-16. Vegetation Species and Planting Density in the Constructed Surface Flow Wetlands

Species	Planting Density*	Planting Area	Main planting area
Phragmites sp.	16-25 plugs/m^2	8%	surface flow
Typha orientalis Presl	9-16 plugs/m^2	5%	surface flow
Zizania latifolia	8-12 plugs/m^2	3%	surface flow
Oenanthe javanica	16-25 plugs/m^2	3%	surface flow
Iris tectorum Maxim	16-25 plugs/m^2	3%	surface flow
Schoenoplectus tabernaemontani	16-25 plugs/m^2	2%	surface flow
Monochoria korsakowii	16-25 plugs/m^2	5%	surface flow
Scirpus sp. Linn	25-36 plugs/m^2	12%	subsurface flow
Acorus calamus	9-16 plugs/m^2	7%	surface flow, subsurface flow

*Typically there are 2-3 plants per plug

95. In addition to emergent plants in the constructed wetlands, submerged plants will be provided in the lakes. Planting numbers have been calculated based on the TN reduction of submerged plants and the pollutant load/distribution in the lakes (Table IV-17).

Table IV-17. Submerged Plants to be provided in the HSRND Lakes

Lake	***Vallisneria natans***	***Potamogeton distinctus***	***Elodea nuttallii***	***Hydrilla verticillata***
Shen Lake	31,906	3,757	11,549	20,026
Xianglong Lake	137,078	16,143	49,617	86,038
Yudai Lake	120,168	14,152	43,496	75,425
Qingquan Lake	153,317	18,055	55,495	96,231
Yun Lake	34,020	4,006	12,314	21,353

96. The constructed wetlands along the Kongmu River will be planted with *Phragmites australis* (a widespread species) at a density of 20 clumps/m^2.

97. **Wetland planting in the canals.** Wetland planting will be provided within the canals linking Lakes in three HSRND with Kongmu River. The planting will reduce the pollution load discharge into the Kongmu River, and maintain water quality of the river at Class III surface water quality standard, while also increasing the landscape and ecological value of the canals. Planting within the canals has been designed based water depth, flow rates, water quality parameters and climatic considerations. Proposed species and planting densities are provided in Table IV-18.

Table IV-18. Canal Wetland Planting

Growth Form	Species	Area (m^2)	Density (Plant/m^2)
Emergent	*Phragmites australis*	16,000	15~25
	Acorus calamus	6,400	
	Canna indica	8,000	
	Typha orientalis	13,000	
Submerged	*Vallisneria natans* (Lour.) Hara	24,850	80~100
	Potamogeton distinctus A.Benn.	2,926	
	Elodea nuttallii	8,995	
	Hydrilla verticillata	15,597	
Floating	*Trapa bispinosa* Roxb.	600	6~10
	Nymphoides peltatum (Gmel.) Kuntze	2,000	

98. **Landscape Irrigation Supply.** The constructed wetlands created under this Project (together with other landscaped areas in the HSRND) will require additional water supply during extended dry periods to prevent plant death and maintain water quality improvement functionality. The maximum daily supplementary water requirements are shown Table IV-19.

Table IV-19. Maximum Daily Water Supplement Calculation

Water Demand	**m^3/d**
Maximum daily supplementary demand for artificial wetland	2590
Maximum daily supplementary demand for landscape irrigation	3834
Total Water Demand	**6424**

99. To meet this demand, a pumping station is proposed in the northwest of the HSRND, drawing water from Kongmu River to maintain water flow through the constructed wetlands and provide irrigation for other green areas. The irrigation supply will not adversely impact flow in the Kongmu River for the following reasons: (i) water would not be abstracted continuously; (ii) the total volume of water abstracted would be small in relation to overall flow volume in Kongmu River; and (iii) water abstracted to maintain wetland habitats would return back to the Kongmu River through the lake and canal system. The location of the pumping station and related pipeline system is shown in Figure IV-24.

Figure IV-24. Water Supply System for Artificial Wetland Maintenance and Landscape Irrigation

100. **Landscape Works.** Landscape planning covered by the Project will include green space of the parks, greenway of Xiangyun Road greenways of the rivers, and wetland landscape (Figure IV-25).

Figure IV-25. Landscape System Planning and Analysis Chart

101. Green space in the Parks will comprise sloping lawns around 5-10 m in width around the edges of lakes (10 m for the large lakes such as Yudai Lake, Xianglong Lake, Shenhu Lake; 5 m for the small lakes). The total area of the park green space is about 11.1 ha.

102. Greenways along Xiangyun Road will be 15 m in width, covering approximately 16.8 ha in total.

103. Along the canals, the width of the water surface and the green space together will be around 40 m, with the width of the greenway at least 10 m. The area of the greenways will be about 22.5 ha.

104. Wetland landscaping will cover wetlands in the HSRND and rehabilitation of short sections of the Kongmu river banks that will be cleared for canal construction. Landscaping will include deck promenades. The total area of landscaping in wetland areas is 0.15 ha.

Output 3: Enhancement of flood and environmental risk coping capacity and knowledge dissemination

105. Output 3 will develop non-structural measures to enhance flood and environmental management. Whilst structural flood and environmental management measures, such as those described in Output 1, are important they can often be significantly enhanced through the implementation of non-structural measures. Non-structural measures normally do not have technical or engineering designs, but endeavor to change the community awareness and behaviour. This requires the involvement of governments, relevant agencies, the general public and most importantly the people affected by the recurrent problems of flooding and environmental degradation. Non-structural measures require public participation based on an ongoing development of public awareness, as well as on the evaluation of past experience.

Output 3.1: Capacity Development for Flood and Environmental Risk Management in Kongmu River watershed

106. Output 3.1 has two main deliverables. The first is concerned with improving the capacity of government agencies and the broader community to manage floods and the environment. It largely involves training and community awareness programs. The second part is concerned with developing strategies and tools for disseminating lessons learned from this project (in all areas) to other cities and river valleys on a National and International scale.

Output 3.2: Improvement of Flood Forecasting and Warning System

107. Output 3.2 is concerned with developing an improved flood forecasting and warning system for the villages located along the Kongmu River. A flood forecasting and warning system for Xinyu City has recently been established, but this system does not address the villages along the Kongmu River. The focus for this project is enhancing the existing system to enable it to provide effective forecasts and warnings for the Kongmu.

108. The existing system has been developed for a much larger catchment with a much longer warning time. One of the challenges in providing effective flood warning to the Kongmu River villages is that the warning time is much shorter. The Kongmu River watershed has a catchment area of 500 km^2. Historically, floods have been generated by storms with durations of 12-36 hours, but they can be caused by storms of much shorter duration. The centroid of the catchment upstream of the HSRND is located only 7 km away, with a travel time of the order of 2 hours, creating a flash flood situation. In order to maximize the warning time, the system will most likely need to be based on recorded rainfall, rather than observed flood levels. Even so, the warning time for some events may be as short as 2 hours. The short warning time limits what can be achieved by the emergency response plan.

Output 3.3: Improvement of the Water Quality Monitoring System for River and Wetlands

109. Water quality monitoring stations will be installed at key locations in order to monitor water quality discharging from the HSRND and to monitor water quality in Baiyun Reservoir, in at least three sites: (i) at the outlet on the main canal discharging from the HSRND; (ii) at the outlet emanating from Shen Lake; and, (iii) on the Kongmu River at the water supply intake in Baiyun Reservoir.

V. DESCRIPTION OF THE ENVIRONMENT

A. Environmental Setting

110. **Hydrology and water resources.** The Kongmu River is a tributary of the Yuan River, a major eastern tributary of the Gan River, which joins the Yangtze River. The Gan River flows south to north through Jiangxi Province and past the provincial capital of Nanchang. Xinyu and the Kongmu River basin are 150 km west of Nanchang. The Kongmu River basin covers an area of 531 km^2. The topography of the upper Kongmu consists of low mountains, which transition to hills and floodplains around Xinyu City, which has an elevation of 50 m.

111. The Kongmu River system has been modified by historical landuse changes and smaller river regulation projects. The Shijiutan Reservoir is a mid-sized reservoir constructed in 1972 and located in the upper Kongmu. The total catchment is 19.95 km^2 with storage capacity of 13,680,000 m^3. The major design purpose for the reservoir is irrigation: it has no drinking water supply or flood control function. The reservoir was reinforced in 2006 and main characteristic of the reservoir includes: (i) design standard of one in 100 years and design water level in the 100 year event of 118.84 m; (ii) open side-spillway (located on left side of dam), crest elevation of 117.8 m, maximum discharge flow rate of 140 m^3/s, and top width of spillway of 30 m; and, (iii) dam height of 22.7 m, dam length of 156 m, and crest elevation of the embankment at 122.71 m.

112. The Baiyun Reservoir is a small reservoir on the Kongmu River just upstream of Xinyu city, constructed in 2007, with a storage capacity of 8.8 x 106 m^3 to supplement municipal water supply. To protect water quality in the Baiyun Reservoir, areas of the Kongmu River immediately upstream of the reservoir are classified as primary, secondary and buffer zones to control potential discharges to the river (Figure V-1). A third reservoir, Jiangkou, is located on the Yuan River (a tributary of the Kongmu), west of Xinyu City, and drains into the Kongmu downstream of the city (Figure II-1). The Baiyun Reservoir is the principal drinking water source for Xinyu City. It will also be the principal drinking water source for the proposed HSRND. The projected water demand of HSRND is 21,743 m^3/d by 2020 and 51,044 m^3/d by 2030. Xinyu City only utilizes around 10% of the reservoir capacity for its drinking water needs, and the reservoir has sufficient capacity to service the existing and new area at the same time. The supply will be from the No.4 WTP in Baiyun Reservoir.

113. Project Area. The topography of the Project Area is gently undulating, with the highest areas in the northeast sloping to the southwest. Site drainage flows in this general direction to the Kongmu River, with areas adjacent to the river subject to frequent flooding (Figure V-2).

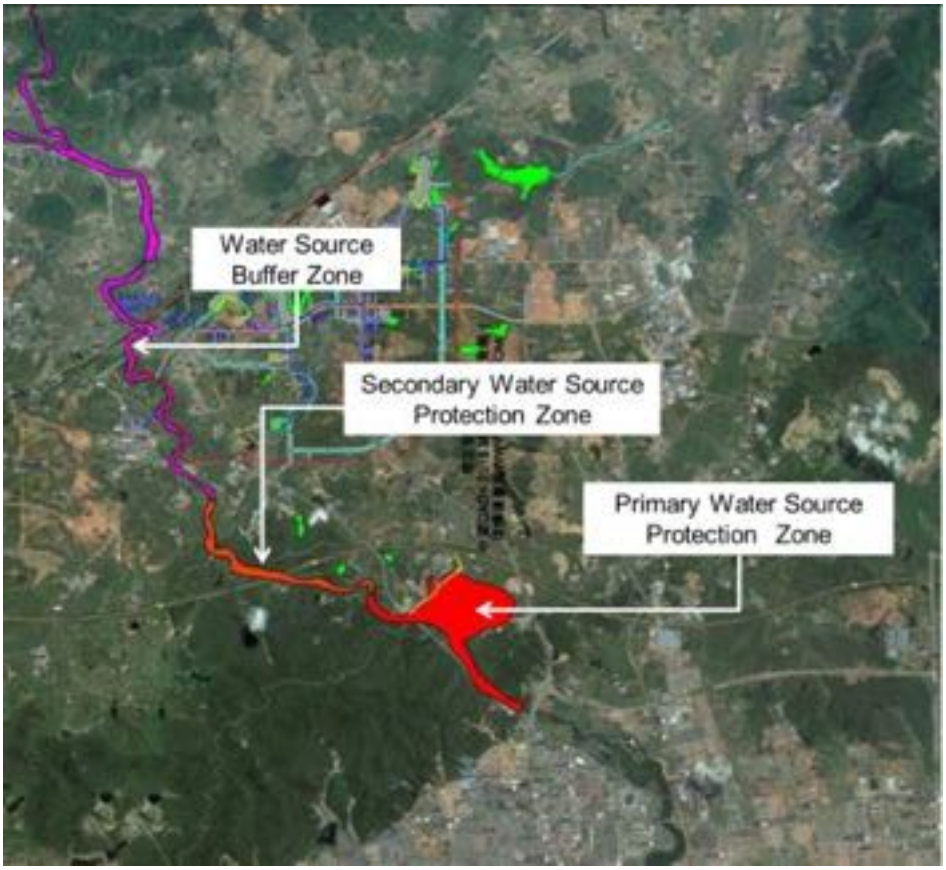

Figure V-1. Water Protection Zones along the Kongmu River

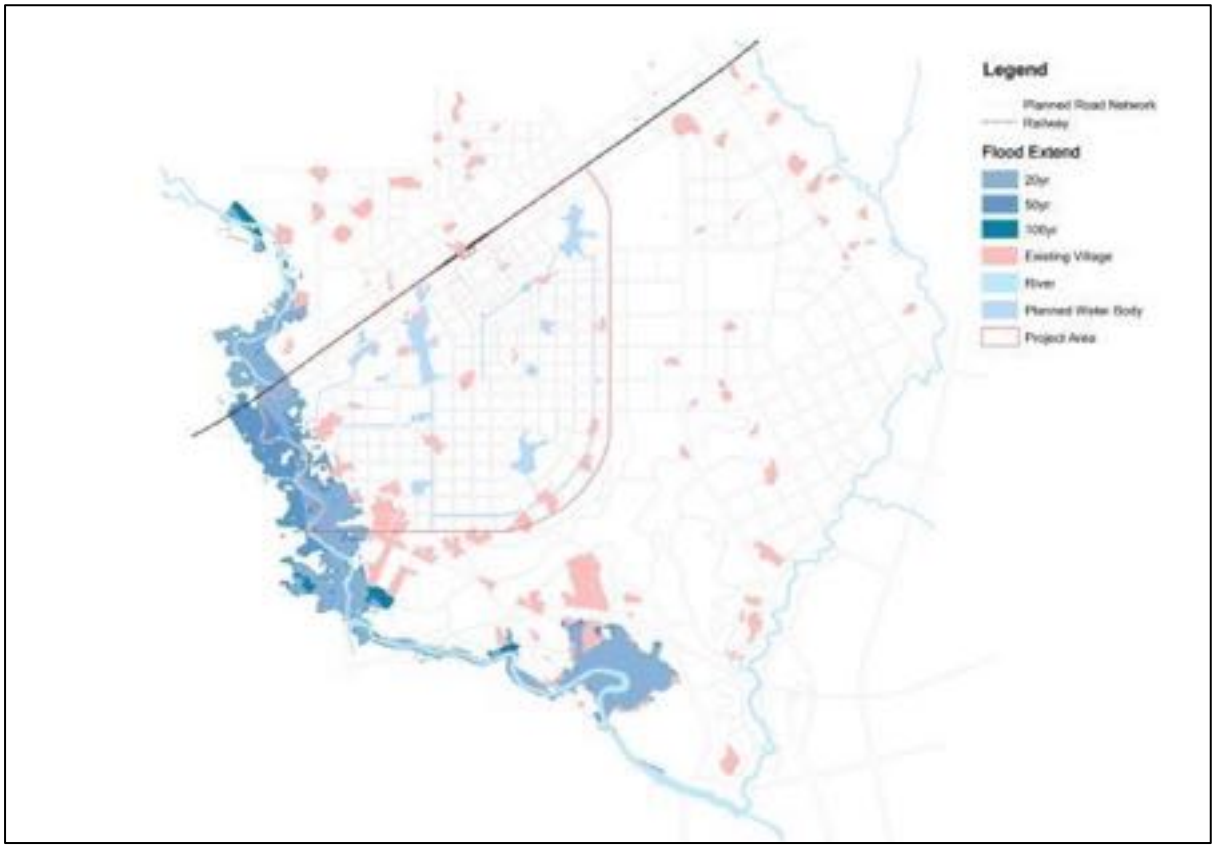

Figure V-2. Flooding Assessment along Kongmu River adjacent to the HSRND

114. Hydrology of the upper Kongmu is highly modified. There are two major drainage lines that run from the north-east corner of the site, south west to the Kongmu River. The flat land adjacent to these drainage lines, and the floodplain adjacent to the Kongmu River, are primarily used for rice production. To provide water supply and storage for the rice production several dams have been constructed in the north and east of the site (Figure V-3).

115. The HSRND has six large artificial lakes: Yudai Lake (north east), Xiang Lake (central north), Shen Lake (north west) and Spring (Qingquan) Lake (south east), Xiaxi Lake and Cloud Lake (Figure V-3). These lakes have a total area of 60.5 ha. In addition, there are nine other lakes of 1-2 ha and many artificial water bodies <1 ha across the Project Area. Existing lakes in the Project Area are intensively managed, have poor water quality and steep banks that support limited emergent wetland vegetation.

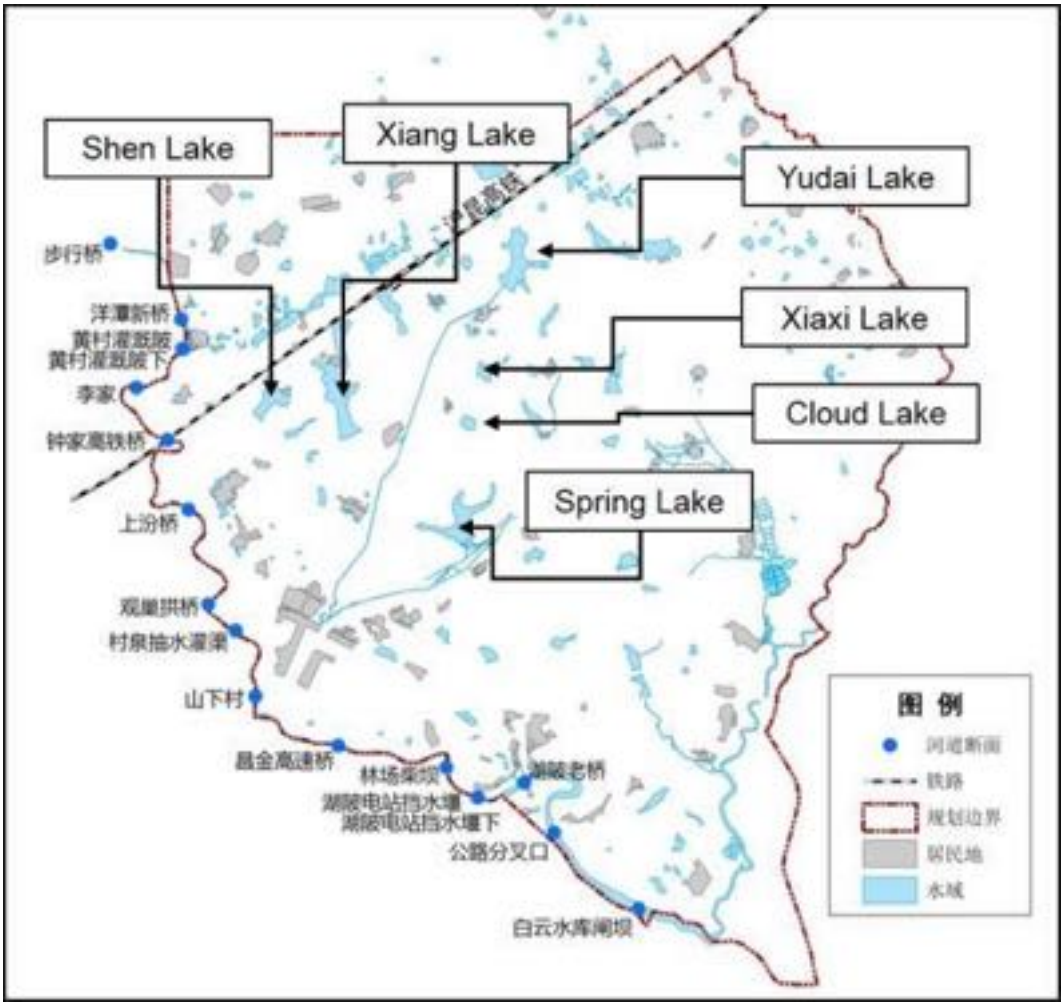

Figure V-3. Hydrological Features of the Project Area

B. Physical Environment of the Project Site

116. Environmental baseline monitoring was conducted by Pony Testing International Group from 4 to 10 June 2016. The location of various sampling points is shown in Figure V-4.

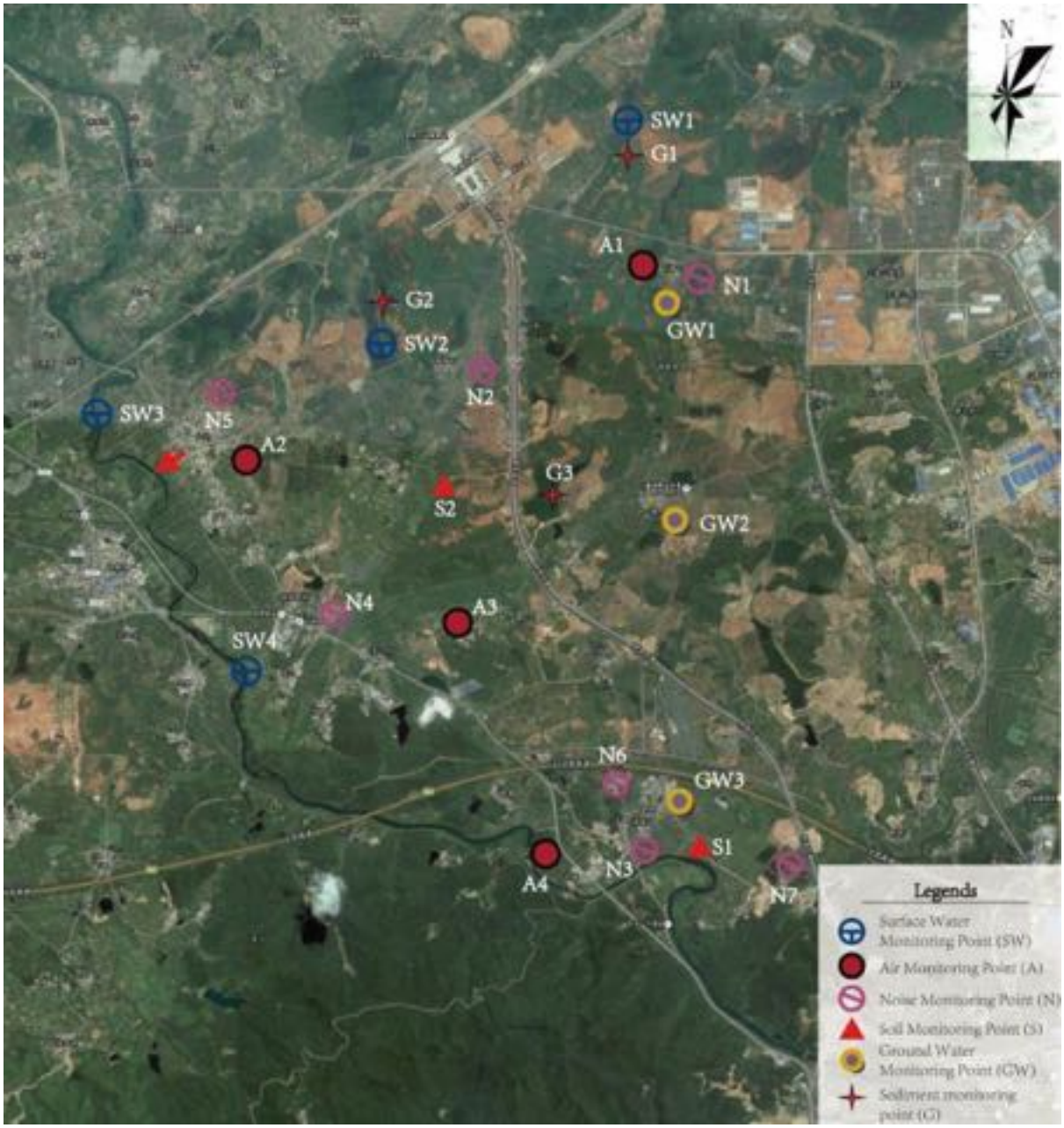

Figure V-4. Location of Environmental Sampling Points

117. **Surface water quality.** Water quality data was collected at two locations along the Kongmu River: the water intake of No.4 Water Treatment Plant (WTP); and where the Yuan River discharges into Jiangkou Reservoir. Additional data was collected from five locations distributed through the Project Area: Xianglong and Yudai Lakes in the HSRND; 500 m upstream from the outflow of these lakes into Kongmu River; Cunquan Village; and 200 m downstream from the discharge of Xiacun WWTP in Yuan River. Sampling and analysis were conducted according to *Technical Specifications Requirements for Monitoring of Surface Water and Waste Water (HJ/T91-2002)* and *Surface Water Quality Standard (GB3838-2002)*. The results of water quality sampling are shown in Table V-1.

118. Key findings of the water quality sampling include:

- For the lakes, TP in Xainglong Lake and COD_{cr}, NH_3-N, TP, and TN in Yudai Lake all exceed PRC standards. This is likely a result of existing aquaculture in the lakes, and potentially domestic wastewater discharge.

- The major pollutant at the sampling location 500 m upstream of the lake discharge into Kongmu River and Cunquan Village is COD_{cr}. This is likely from agricultural non-point source pollution.
- Water quality samples from the Yuan River indicate that the main pollutant is COD_{cr}, likely to result from domestic wastewater discharges.
- The water quality from the sampling location where the Yuan River flows into Jiangkou Reservoir can meet the Class III of GB3838-2002 requirements. Samples from the water intake of No. 4 WTP meet the Class II of GB3838-2002 requirement.

Table V-1. Baseline Surface Water Quality Sampling and Water Quality Standards

No.	Area	Monitoring Location/Section	Date	Parameters (mg/L)												
				pH	CODcr	NH_3-N	TN	TP	SS	DO	Fe	Mn	SO_4^{2-}	NO_3^-	Cl^-
SW1	HSRND	Xianglong Lake	2016.6.4	7.47	19	0.061	0.216	0.14	＜4	6.8	-	-	-	-	-
			2016.6.5	7.51	18	0.056	0.206	0.13	＜4	6.7	-	-	-	-	-
			2016.6.6	7.55	18	0.078	0.212	0.15	＜4	6.6	-	-	-	-	-
SW2		Yudai Lake	2016.6.4	7.06	45	1.05	2.55	0.46	5	4.8	-	-	-	-	-
			2016.6.5	7.05	46	1.02	2.29	0.47	5	5.1	-	-	-	-	-
			2016.6.6	7.12	42	1.08	2.58	0.47	6	5.3	-	-	-	-	-
SW3	Kongmu River (buffer zone/ secondary protected zone)	500m upstream from discharge of lakes into Kongmu River	2016.6.4	7.88	39	0.022	-	-	5	-	＜0.03	＜0.01	24.9	1.76	3.87
			2016.6.5	7.83	38	0.020	-	-	5	-	＜0.03	＜0.01	25.2	1.58	3.56
			2016.6.6	7.85	37	0.025	-	-	5	-	＜0.03	＜0.01	28.0	1.49	3.79
SW4		Cunquan Village	2016.6.4	7.83	45	0.042	-	-	5	-	＜0.03	＜0.01	25.4	1.48	4.10
			2016.6.5	7.85	46	0.025	-	-	6	-	＜0.03	＜0.01	22.4	1.45	3.99
			2016.6.6	7.92	45	0.017	-	-	6	-	＜0.03	＜0.01	22.2	1.47	3.54
Routine Monitoring Location		Routine monitoring station of the water intake of No. 4 WTP	2014.1.6	7.64	10.1	0.133	-	-	-	-	0.112	0.013	27.35	0.4	8.19
			2014.3.4	7.9	10.5	0.219	-	-	-	-	0.18	0.01L	17.61	0.29	29.58
			2014.5.7	8	9.12	0.092	-	-	-	-	0.105	0.01L	19.65	0.26	29.21
			2014.7.2	7.76	9.32	0.33	-	-	-	-	0.126	0.01L	26.3	0.48	15.3
			2014.9.2	7.66	8.62	0.294	-	-	-	-	0.06	0.032	29	0.74	36.5
			2014.11.6	7.74	9.02	0.314	-	-	-	-	0.03L	0.01L	21.6	0.61	39.2
			2015.1.7	7.98	11.7	0.267	-	-	-	-	0.035	0.01L	28.6	0.54	37.3
			2015.3.4	8	10.2	0.295	-	-	-	-	0.052	0.01L	17.6	0.26	29.6
			2015.5.6	8.1	10.7	0.256	-	-	-	-	0.03L	0.01L	35.4	0.22	30.1
			2015.7.2	8.1	11.6	0.24	-	-	-	-	0.271	0.028	19.5	0.29	32.5
			2015.9.7	7.82	10.3	0.318	-	-	-	-	0.08	0.01L	27.6	0.18	35.2
			2015.11.3	7.48	11.6	0.307	-	-	-	-	0.03L	0.01L	25.4	0.36	32.5
	Yuan River	Routine monitoring station Yuan River flow into Jiangkou Reservoir	2014.1.6	7.74	13.6	0.639	0.125	0.1-25	-	-	-	-	-	-	-
			2014.3.4	7.28	14.4	0.745	0.122	0.122	-	-	-	-	-	-	-
			2014.5.7	7.74	14.6	0.806	0.114	0.114	-	-	-	-	-	-	-
			2014.7.2	7.68	14.4	0.758	0.095	0.095	-	-	-	-	-	-	-
			2014.9.2	7.48	14.1	0.611	0.1	0.1	-	-	-	-	-	-	-
			2014.11.6	7.32	13.9	0.569	0.086	0.086	-	-	-	-	-	-	-
			2015.1.7	7.64	15	0.78	0.099	0.107	-	-	-	-	-	-	-
			2015.3.4	7.84	15.9	0.762	0.109	0.099	-	-	-	-	-	-	-
			2015.5.6	7.78	16.2	0.737	0.098	0.109	-	-	-	-	-	-	-
			2015.7.2	7.62	13.6	0.815	0.112	0.098	-	-	-	-	-	-	-
			2015.9.7	7.58	14.3	0.825	0.126	0.112	-	-	-	-	-	-	-
			2015.11.3	7.34	13.6	0.768	0.113	0.126	-	-	-	-	-	-	-
SW5	Yuan River	200 m downstream	2016.6.4	7.79	41	0.239	-	-	11	-	0.07	＜0.01	31.2	1.82	9.21

		from outlet of Xiacun WWTP	2016.6.5	7.70	41	0.253	-	-	15	-	0.07	＜0.01	26.6	1.68	8.99
			2016.6.6	7.64	39	0.243	-	-	12	-	0.07	＜0.01	25.0	1.63	8.41
Class II of GB3838-2002				6~9	≤15	≤0.5	≤0.5	≤0.1 (≤0.025 in lake, reservoir)	-	≥6	-	-	-	-	-
Class III of GB3838-2002				6~9	≤20	≤1.0	≤1.0	≤0.2 (≤0.05 in lake, reservoir)	-	≥5	-	-	-	-	-
Supplementary item for central drinking-water source area of GB3838-2002				-	-	-	-	-	-	-	0.3	0.1	250	10	250

L=refers to a consistent sampling result over several samples e.g. 5L = the value of 5 was obtained in repeated samples. n.b. Data collection varied across sampling locations depending on potential contamination issues.

Table V-2. Baseline Groundwater Quality Sampling and Groundwater Quality Standards

Item	Unit	Monitoring Location			Category III Standard
		Huxia Village (GW1)	Darentang Village (GW2)	Hupi Village (GW3)	
pH		7.01	7.11	7.06	6.5～8.5
SS	(mg/L)	19	22	82	1000
I_{Mn}	(mg/L)	0.36	0.48	0.44	3.0
Total coliform bacteria	(No./L)	Not Detected	Not Detected	Not Detected	3.0
Total Bacteria		22	17	35	100
NH3-N	(mg/L)	<0.02	<0.02	<0.02	0.2
NO3-N	(mg/L)	0.33	3.23	3.05	20
NO2-N	(mg/L)	<0.001	<0.001	<0.001	0.02
Fe	(mg/L)	<0.0045	<0.0045	<0.0045	0.3
Mn	(mg/L)	<0.0005	<0.0005	<0.0005	1.0
Zn	(mg/L)	<0.001	<0.001	<0.001	1.0
Cr6+	(mg/L)	<0.004	<0.004	<0.004	0.05
Pb	(mg/L)	<0.0025	<0.0025	<0.0025	0.05
As	(mg/L)	<0.0010	<0.0010	<0.0010	0.05
Hg		<0.0005	<0.0005	<0.0005	0.01

119. **Groundwater quality.** Groundwater was sampled from three water intake wells at local villages. Quality of the samples was all found to comply with GB/T 14848-93 Category III standards (Table V-2).

120. **Noise.** Ambient noise sampling was conducted at seven representative sensitive receivers across the Project Area. Following standards for PRC EIA, noise measurements were taken once in the day and once at night on two consecutive days (Table V-3).

Table V-3. Baseline Noise Sampling and Applicable Noise Standards

No.	Monitoring Location	Monitored L_{eq}（dB(A)）				Applicable Standard	
		2016.06.04		2016.06.05			
		Day	Night	Day	Night	Day	Night
N1	Huxia Village	49.7	46.9	50.8	47.1	60	50
N2	Gaolongxia Village	48.1	47.4	49.8	48.2	60	50
N3	Hupi Village	49.0	46.6	48.9	47.8	60	50
N4	Grain Management Office in Guanchao Town	48.5	47.4	50.4	47.2	60	50
N5	Shangfen Village	51.9	49.1	52.7	50.6	60	50
N6	Xiashan group of Hupi Village	59.4	53.9	58.8	52.9	60	50
N7	Hejiashan Village	50.3	48.8	52.4	50.8	60	50

121. Sampling results show that the noise at the sampling sites during both daytime and nighttime met the environmental quality standards for noise (GB3096-2008) Class II except for the location of Shangfen Village and Xiashan group of Hupi Village, where minor exceedances were recorded at night. The main noise pollution sources at these areas were vehicle noise and construction noise.

122. **Air quality.** Continuous air quality monitoring was conducted over seven days (4-10 June 2016) at four sensitive receivers in the Project Area. There are no significant industrial developments or other emissions sources within/close to the sampling locations, and daily average concentration of SO_2, NO_2, PM_{10}, and TSP all meet Class II requirements of "Ambient Air Quality Standards" (GB3095-2012), (Table V-4).

Table V-4. Baseline Air Quality Sampling and Air Quality Standards

No.	Monitoring Location	Parameter			
		SO_2	NO_2	PM_{10}	TSP
		24-hour average (mg/m^3)			
A1	Huxia Village	0.015-0.017	0.019-0.021	0.053-0.063	0.102-0.113
A2	Shangfen Village	0.014-0.113	0.018-0.021	0.054-0.063	0.102-0.119
A3	Nanxia Village	0.014-0.017	0.019-0.021	0.055-0.063	0.1-0.118
A4	Shebei Group of Hupi Village	0.014-0.017	0.019-0.021	0.055-0.064	0.105-0.116
Class II of GB 3095-2012		0.15	0.8	0.15	0.3

123. **Soil.** Samples were taken at two sites. Site 1 is the orchard to the south of Hupi Village. It is in the land area adjacent to the primary water source protection zone of No. 4 WTP, and the land use status is vineyard. Site 2 is in the farmland to the east of Yadang Village. It is in the land area adjacent to secondary water source protection area of No. 4 WTP, and the land use status is paddy fields. The results are shown in Table V-5.

Table V-5. Baseline Soil Quality Survey and Soil Quality Standards

Parameter	Class II of GB15618-1995	S1	S2
pH	6.5~7.5	7.3	7.4
Pb (mg/kg)	300	26.7	11.4
Hg (mg/kg)	0.5	0.102	0.135
As (mg/kg)	Paddy field 25; Dry field 30	2.46	4.84
Cr6+ (mg/kg)	Paddy field 300; Dry field 200	49.0	75.9

Cu (mg/kg)	Farmland100; Orchard 200	27.6	17.9
Ni (mg/kg)	50	26.9	20.5
Cd (mg/kg)	0.3	0.388	0.240
Zn (mg/kg)	250	84.0	46.1

124. Results show that the soil pollution for most parameters met Class II Environmental Quality Standard for Soils (GB 15168-1995). However there was slight exceedance of cadmium (Cd) at Site 1. This is probably from the pig manure used as a fertilizer for grape vines. Heavy metals are often found in animal feed additives in the PRC, and their presence in manure fertilizers is a widespread problem.

125. **Sediment.** The PRC does not have a standard for waterbody sediments. However, since sediments are commonly disposed of on land (most likely for future agricultural or landscaping use), it is common practice to use Environmental Quality Standard for Soils (GB 15168-1995) to assess sediment quality. Sediment samples were taken from three representative lakes to be dredged and embanked – Xianglong Lake, Yudai Lake and Qingquan Lake (Table V-6).

Table V-6. Baseline Lake Sediment Survey and Relevant Standards

Monitored items	Class II of GB15618-1995	Xainglong Lake (G1)	Yudai Lake (G2)	Qingquan Lake (G3)
pH	6.5~7.5	7.4	7.5	7.3
TN (mg/kg)	-	1.36	1.40	1.53
TP (mg/kg)	-	0.83	0.90	1.01
Cr6+ (mg/kg)	Farmland 300	<5	<5	<5
Ni (mg/kg)	50	43.8	33.3	42.0
Cd (mg/kg)	0.3	0.097	0.075	0.165
Cu (mg/kg)	Farmland 100	29.1	29.8	37.4
Pb (mg/kg)	300	22.2	15.5	25.3
Zn (mg/kg)	250	90.1	147	137
Hg (mg/kg)	0.5	0.0591	0.118	0.168
As (mg/kg)	Paddy field 25	0.360	1.62	2.49
BHC (mg/kg)	-	<0.005	<0.005	<0.005
DDT (mg/kg)	-	<0.005	<0.005	<0.005

126. Results show that the sediments meet Class II Standards of GB15618-1995. Levels of both TN and TP are low, and residual toxic pesticides were not detected.

C. Ecological Resources

127. **Regional Habitats and Vegetation.** Xinyu City has rich and diverse plant resources. Across the whole city, there are 193 families and 1427 species of wild plants, including 28 families and 102 species of ferns, 9 families and 30 species of gymnosperms, 156 families and 1295 species of angiosperms. There are 38 families and 122 species of higher aquatic plants. There are 29 National Protected plant species recorded in the City Area, although most of these are planted and do not represent wild populations of conservation significance. Species include *Ginkgo biloba*, *Metasequoia glyptostroboides*, *Amentotaxus formosana*, *Davidia involucrata*, *Taxus mairei*, *Cycas revoluta*, *Bretschneidera sinensis*, *Pseudolarix amabilis*, *Liriodendron chinense*, *Pseudotaxus chienii*, *Ormosia henryi*, *Fokienia hodginsii*, *Magnolia officinalis subsp. officinalis*, *Magnolia officinalis subsp. biloba*, *Cinnamomum camphora*, *Machilus* sp., *Phoebe bournei*, *Phoebe chekiangensis*, *Camptotheca acuminata*, *Tsoongiodendron odorum*, *Abies ziyuanensis*, *Magnolia decidua*, *Podocarpus macrophyllus*, and *Phoebe sheareri*. Nineteen species of them are rare and endangered plants, for instance, *Magnolia sargentiana*, *Cinnamomum micranthum*, *Coptis chinensis*, *Dysosma pleiantha*, *Glycine soja*, *Ormosia hosiei*, *Emmenopterys henryi*, and *Changnienia amoena*. Over 100 provincial level protected species have been recorded from the City, including *Amitostigma*

gracile, *Bletilla striata*, *Habenaria dentata*, *Liparis bootanensis*, *Pholidota chinensis*, *Llex latifolia*, *Kalopanax dysosma*, *Elaeocarpus sylvestris*, *Prunus persica*, *Elaeocarpus japonus*, *Cephalotaxus sinensis*, *Nageia nagi*, *Cryptomeria japonica*, *Acer buergerianum* and *Acer palmatum*.

128. **Project Area Habitats and Vegetation.** Surveys undertaken for the DEIA recorded nine habitat types from the HSRND area, as summarized in Table V-7 and Figure V-5. Habitats were typical of rural landscapes.

Table V-7. Habitat Types Recorded from the Project Area

Habitat	Description
Canal	Channelised/artificial channels for irrigation/drainage. Small patches of wetland vegetation including *Phragmites australis*, *Typha angustifolia*, *Triarrhena sacchariflora*, *Carex* sp., *Polygonum hydropiper*, and *Echinochloa crusgalli*
Riparian forest	Planted riparian trees (mostly *Salix matsudana*) tolerant of damp soils and occasional inundation
Wet Agricultural Land	Rice/aquatic plants vegetables in shallow water area
Dry Agricultural Land	Terrestrial herbaceous crops including *Zea mays*, *Ipomoea batatas, Glycine max, Arachis hypogaea* and *Citrullus lanatus*
Terrestrial scrubland	Young secondary vegetation dominated by *Salix matsudana*. Other species include *Broussonetia papyrifera Cynodon dactylon*, *Conyza canadensis*, *Setaria viridis*, *Artemisia lavandulaefolia* and *Arthraxon hispidus*.
Artificial Lakes	Artificial lakes used for agricultural irrigation and fish farming (the lakes are not used for provision of drinking water supply). Limited vegetation due to steep banks and management regime.
Orchard	Located in residential neighborhood of vineyards, watermelon yard, etc.
Rural Developed Area	Includes village housing, roads etc. as well as areas of abandoned land dominated by weed species such as *Setaria viridis*, *Cynodon dactylon*, *Erigeron annuus* and *Imperata cylindrica*.
Channelised River Bank	masonry or concrete revetment alongside rivers

Farmland

Terrestrial Scrubland

Lake

Wet Agricultural Land

Orchard

Canal

Riparian Forest

Rural Developed Area

Channelised River Bank

Figure V-5. Typical Habitats within the Project Area

129. Due to the relatively disturbed nature of the Project Area, plant species diversity recorded during surveys of the HSRND Area was relatively low. Records were made of 52 families, 97 genera and 138 species of vascular plants, comprising five species of ferns, five species of gymnosperm, and 128 species of angiosperm. No species of conservation significance – i.e., IUCN listed, national or provincial protected species – were recorded from the HSRND area. No trees of high amenity value were recorded from the HSRND area. Aquatic economic plants include *Nelumbo* sp., *Trapa natans*, *Euryale ferox*, *Eleocharis dulcis*, *Zizania latifolia*, *Eichhornia crassipes*, and *Spirodela polyrhiza*.

130. **Regional Terrestrial Wildlife**. Terrestrial wildlife from Xinyu City reported in the DEIA includes 20 species of amphibian; 30 species of reptile; 170 species of bird; and 50 species of mammals. Among them, four species are first class national protected animals, which are *Muntiacus crinifrons*, *Neofelis nebulosa*, *Tragopan caboti* and *Syrmaticus ellioti*. Fourteen species are second class national protected animals, which are *Viverra zibetha*, *Viverricula indica*, *Cervus unicolor*, *Hydropotes inermis*, *Macaca mulatta*, *Macaca thibetana*, *Manis pentadactyla*, *Prionodon pardicolor*, *Capricornis sumatraensis*, *Andrias davidianus*, *Hoplobatrachus tigerinus*, *Tyto capensis*, *Aix galericulata* and *Lophura nycthemera*. Eighteen species are Jiangxi Provincial level protected animals: *Prionailurus bengalensis*, *Canis lupus*, *Mustela sibirica*, *Paguma larvata*, *Deinagkistrodon acutus*, *Zaocys dhumnades*, *Elaphe taeniura*, *Bungarus fasciatus*, *Bungarus multicinctus*, *Naja atra*, *Pelophylax nigromaculatus*, *Pica*, *Leucodioptron canorus*, *Terpsiphone paradisi*, *Bambusicola thoracica*, *Francolinus pintadeanus*, *Lanius* sp. and *Alcedo atthis*. The vast majority of these species, particularly

threatened birds and mammals, require intact natural habitats and it is unlikely that populations persist in the modified and lowland rural landscapes of the proposed HSRND. Forested hill ranges are present in and around Xinyu City, including within the Yuk Sau Mountain National Forest Park (Section V.D) and catchments of reservoirs. Remnant populations of some species may persist in such areas. The project does not involve activities in forested hill areas of Xinyu City.

131. **Project Area Terrestrial Wildlife.** The DEIA reports historical terrestrial wildlife survey data from the HSRND. Records from the Project Area were mostly common and widespread species typical of rural habitats including *Rana nigromaculata*, *Fejervarya limnocharis*, *Elaphe carinata*, *Sinonatrix annularis*, *Anas poecilorhyncha*, *Turdus merula*, *Coccothraustes migratoria*, *Passer montanus*, *Gallinula chloropus*, *Pipistrellus abramus*, *Mustela sibirica*, *Rattus norvegicus* and *Mus musculus*. No species considered of conservation interest (i.e., IUCN listed, national or provincial protected species) were recorded from the HSRND area.

132. **Regional Aquatic Wildlife.** The DEIA also references historical records of aquatic fauna from the Kongmu River. These comprise 6 orders and 14 families of fishes, mostly Cypriniformes orders and carps families fishes, including *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Mylopharyngodon piceus*, *Cyprinus carpio*, *Carassius*, *Carassius auratus*, *Cyprinus flammans*, *Parabramis pekinensis*, *Megalobrama amblycephala*, *Megalobrama terminalis*, *Siniperca chuatsi*, *Xenocypris davidi*, *Plagiognathops microlepis*, *Xenocypris argentea*, *Distoechodon tumirostris*, *Squaliobarbus curriculus*, *Hemiculter leucisculus*, *Pseudohemiculter dispar*, *Pseudolaubuca sinensis*, *Pseudorasbora parva*, *Opsariichthys bidens*. There are also Perciformes, Siluriformes, Synbranchiformes, Anguilliformes and other fish species. Besides, there are national and Jiangxi provincial key protected aquatic wild animals, including *Andrias davidianus*, *Hynobius chinensis*, *Cynops orientalis*, *Lutra*, *Geoemyda spengleri*, *Channa asiatica*, *Channa maculata*, *Quasipaa spinosa*, *Pelophylax nigromaculatus*, *Eriocheir sinensis*, *Pelodiscus sinensis* and *Bufo gargarizans*. Other aquatic animals include crustaceans (*Trionyx* sp., *Testudo* sp., *Macrobrachium* sp., *Potamon* sp., and *Caridina* sp.) molluscs (*Hyriopsis cumingii*, *Cristaria plicata*, *Sinanodonta woodiana*, *Cipangopaludina* sp., *Cremnoconchus* sp., *Lymnaea stagnalis*, *Corbicula aurea*, and *Unio douglasiae*) and free-swimming plankton (*Chlorella* sp., *Bacillariophyceae*, *Dinoflagellata*, *Cyanobacteria*, *Rotifera*, *Cladocera*, *Copepoda*, and *Protozoa*).

133. Mean density and biomass of benthic animals in the Kongmu River adjacent to the HSRND were 2,748.56 individual/m^2 and 155.18 g/cm^2 respectively. Average oligochaeta density was 94.19 %. Gastropods occupied the highest proportion in biomass, which were 72.5 %, were placed in a dominant position together with *Tubifex* sp.

134. Various introduced and invasive fish species (e.g., *Anguilla* sp., *Piaractus brachypomus*, *Tilapia* sp., *Oreochromis niloticus*, *Carassius cuvieri*, *Carassius carassius*, *Clarias lazera*, *Micropterus salmoides*, *Silurus meridionalis* and *Letalurus Punetaus*) have also been recorded from Kongmu River.

D. Protected Areas and Physical Cultural Resources

1. Kongmujiang National Wetland Park

135. The Kongmujiang National Wetland Park covers 1,295 ha and is located immediately south of the HSRND, along the Kongmu River (Figure V-6). The park incorporates the Baiyun Reservoir. Planning objectives for the Park are described in the "Kongmujiang National Wetland Park Master Plan (2007-2015)", and focus on maintaining water quality, improving infrastructure, develop wetland landscapes, and providing science education and leisure opportunities. There is little emphasis on ecological conservation, and much of the Park

consists of agricultural land and village areas of limited ecological interest.

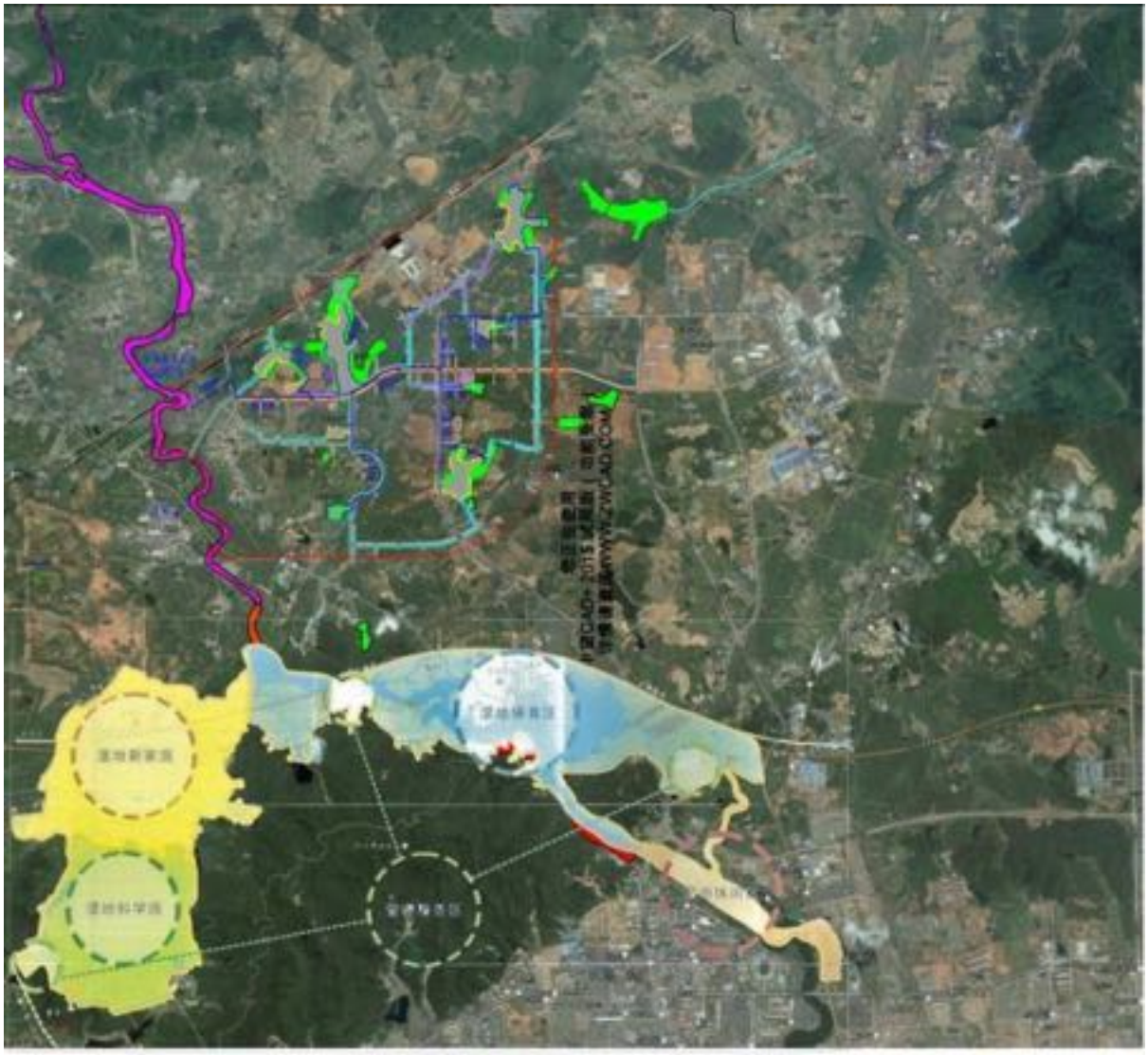

Figure V-6. Location of Kongmujiang National Wetland Park in Relation to the Project

136. An inventory of wildlife recorded from the Wetland Park site and adjacent areas is provided in the Masterplan. A total of 28 orders, 67 families and 188 species of vertebrates were recorded from the area; comprising 57 species of fishes, 11 species of amphibian, 21 species of reptile, 84 species of birds, and 15 species of mammals. Thirteen of these species are Class II national protected wild animals, and 42 species are Jiangxi Provincial Protected Animals. Twenty-three and eight species of wintering birds are listed in Sino-Japanese Protection Agreement and Sino-Australian Protection Agreement respectively.

2. Yuk Sau Mountain (Yangtiangang) National Forest Park

137. Yuk Sau Mountain National Forest Park (formerly known as Yangtiangang National Forest Park), comprises 627 ha of forest land area and 667 ha of cultivated area. It is located about 1 km from the planned HSRND, south of the G60 Hukun Expressway (Figure V-7). The park supports mature subtropical east and central Asian evergreen broadleaf forest, evergreen coniferous forest, and mountain shrub. The park is not part of the construction areas of the project and is not discussed further in this report.

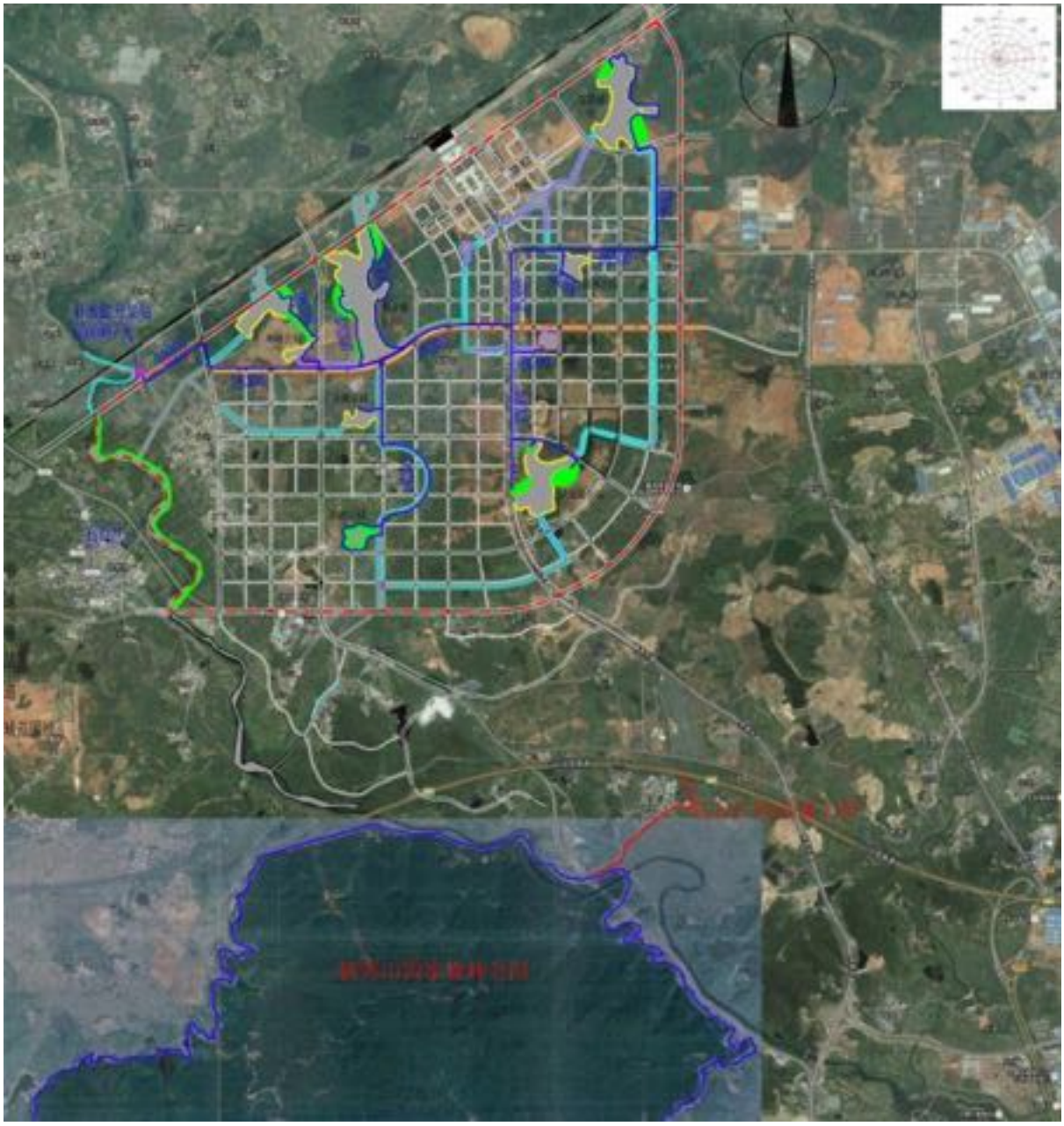

Figure V-7. Location of Yuk Sau Mountain National Forest Park in Relation to the Project

E. Socio-economic Conditions

138. Xinyu is a prefecture level city located in the middle part of Jiangxi province. It is bounded between two provincial capitals, Nanchang for Jiangxi province and Changsha for Hunan province. Xinyu has a total area of 3,178 km^2. It is located 135 km southwest of the provincial capital (Nanchang) or about two and half hours away by car via highway. Xinyu has direct jurisdiction over 1 urban district (Yushui district), 1 county (Fenyi County), 17 towns, 15 townships, 2 sub-districts, 446 villages and 51 communities. The city is well known for its Scenic District (Fairy Lake Scenic district). The city has existed for over 1,700 years. It became a county in 267 during the Three Kingdoms Period: became a major city in Southern PRC with a population of over 50,000 during the Jin Dynasty; became part of Yuanzhou (currently called Yichun) during the Tang Dynasty; and in 742, the city's name Xinyu; and eventually in 1957, the government of PRC officially affirmed the city's name as Xinyu.

139. Table V-8 shows a summary of the total land and demographic profile of Xinyu City

together with Yushui district, where the Project Area is located. Three towns and six villages included in the baseline social survey are all located in the Yushui district.

Table V-8. Land and Population (2014) of Jiangxi, Xinyu City (and Yushui District)

Location	Area (km^2)	House-holds	Total Population	Rural Population	Urban Population	Males	Females	Density (capita/km^2)
Xinyu City	3178	397,023	1,223,015	798,604	424,411	645,633	577,382	365
Yushui District	1775	290,925	886,559	542,903	343,656	466,140	420,419	499.47
Jiangxi Province	166,933	12,977,600	45,421,600	2,261,060	22,811,000	23,347,000	22,075,000	271

Source: 2015 Xinyu Statistical Yearbook. Note: Demographic data refer to registered population.

140. General socio-economic and demographic data of the six villages surveyed in the Project Area are presented in Table V-9.

Table V-9. General Information (Socio-economic and Demographic Profile of the Surveyed Villages) 20 March-20 April 2016

General Information Indicators of the Villages	Project areas (Surveyed Villages) 20 March-20 April 2016					
	Shangfen	Maoshan	Shetou	Yangtan	Hupi	Gaozhan
No. of Households	980	360	400	835	552	396
% of Agricultural Household	100	100	100	100	100	100
No. of Population	3,500	1,300	1,500	3,184	1,600	1,592
% of Agricultural Population	100	100	100	100	100	100
Total Labor Force	2,200	1,300	800	1,782	1,040	815
No. of Male Labor Force	1,050	700	420	912	570	450
No. of Female Labor Force	1,150	600	380	870	470	365
Total Farmland Area (mu)	3,200	3,600	1,472	3,004	1,968	1,728
Per Capita Farmland Land (mu)	0.91	2.77	0.98	0.94	1.23	1.09

Source: 2014 Yushui District Statistical Yearbook. PRC.

141. **Economic Profile.** In 2014, the total GDP of Xinyu reached CNY90 billion, or an increase of 8.8% over the previous year. The GDP composition ratio for the primary, secondary, and tertiary sectors were 5.84%, 57.81%, and 36.35%, respectively. Its per capita GDP averaged CNY77,730 in the same year. In 2014, Yushui District produced a total GDP of CNY19.7 billion, or CNY44,974 per capita, which was lower than the Xinyu average. The proportion of agriculture sector in the overall economy, which is an important indicator of the economic development, was 12.54% in Yushui district. This is higher than the Xinyu average. The proportion of the secondary sector was 58.15 % and the proportion of the tertiary sector was 29.31% in Yushui District.

142. In the same year, the average annual disposal income of urban residents of Xinyu City was CNY27,626 per capita and CNY28,273 per capita for Yushui district. These are higher than the Jiangxi provincial average (CNY24,309). Similarly, the average annual net income of the farmers was CNY12,831 per capita and CNY12,970 per capita in Xinyu and Yushui district, respectively. Again, these are higher than that of Jiangxi provincial average (CNY10,117). Average yearly wage for urban employees was CNY46,936 and CNY42,436 in Xinyu and Yushui district, respectively. Of which the yearly wage in sectors of finance, water management, education, health, public administration, entertainment and power industry was higher (above CNY50,000-CNY90,000).

143. Table V-10 shows the economic profile or performance in various economic indicators for Jiangxi province, Xinyu and Yushui district.

Table V-10. Economic Performance in Jiangxi, Xinyu/ Yushui District (in Yuan, %)

City/ District/	GDP (thousand)	Per Capita	Primary Industry	Secondary Industry	Tertiary Industry	Average Yearly	Per Capita Annual	Per Capita Annual Net

Province		GDP	(%)	(%)	(%)	Wage	Disposal Income of Urban Resident	Income of Rural Resident
Xinyu	90,026,830	77,730	5.8%	57.81%	36.35%	46,936	27,626	12,831
Yushui	19,671,760	44,974	12.54%	58.15%	29.31%	42,436	28,273	12,970
Jiangxi Province	1,570,860,000	34,660	10.7%	48.8%	35.9%	46,218	24,309	10,117

Source: 2015 Xinyu Statistical Yearbook 2015.

144. Table V-11 shows the general economic profile of the six villages surveyed in the Project Area.

Table V-11. General Economic Profile of the Surveyed Villages (20 March-20 April 2016)

General Information Indicators of the Villages	Project areas (Surveyed Villages) 20 March-20 April 2016					
	Shangfen	Maoshan	Shetou	Yangtan	Hupi	Gaozhan
Per Capita Annual Farmer net Income (Yuan)	12,000	10,000	3,000	9,896	13,000	8,500
Poor Population	116 (3.3%)	54 (4.2%)	72 (4.8%)	56 (1.8%)	23 (1.42%)	64 (4.0%)
Total number of poor population in 6 affected villages = 385 (Average: 3.15%)						
Income Structure	Non-farm earning 60%	Non-farm earning 50%	Non-farm earning 65%	Non-farm earning 65%	Non-farm earning 50%	Non-farm earning 55%
	Rice 20%	Grape 20%	Rice 20%	Rice 15%	Grape 25%	Vegetable 30%
	Fruit 10%	Rice 15%	Orange 10%	Vegetable 10%	Vegetable 15%	Rice 12%

F. Existing and Predicted Climate Change

1. Existing Climate

145. The Kongmu River Basin is located in a south-east monsoon climate zone. The average annual temperature is 18.0℃ (range 19.2℃ to 17.0℃) from 1981 to 2010. Historical figures show the temperature reaches the monthly average low level at 3.0℃ in January and the highest level at 32.5℃ in July. The average annual precipitation is 1,603.1 mm ranging from 1,052.1 mm to 2,169.6 mm. The distribution of monthly precipitation is uneven, with the annual precipitation in the wettest year is twice that of the driest year. The precipitation from March to June is about 54.5% of the annual total (Figure V-8).

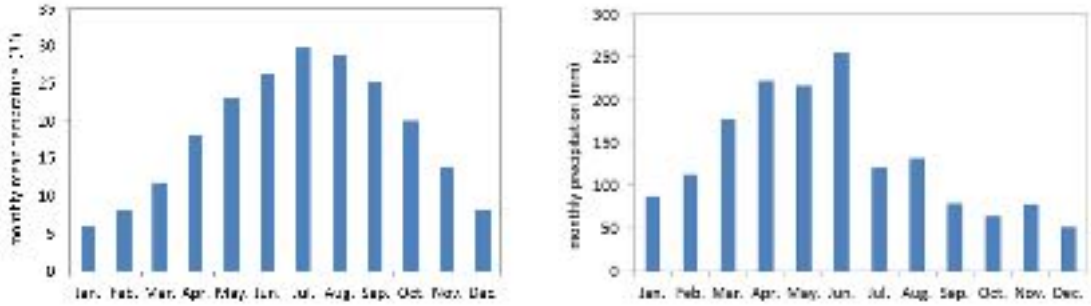

Figure V-8. Mean Annual Rainfall and Temperature for Xinyu (1981–2010)

2. Observed Climate Change

146. Observed climate changes for the Project Area were analyzed based on the climate observation of Xinyu Meteorological Station from 1961-2015. The annual mean temperature has increased, especially since the 1990s, characterized with substantial warming of the

annual minimum temperature (Figure V-9). The annual mean temperature has increased 0.23 ℃/10 a, with the largest rate of warming for the annual minimum temperature (0.38 ℃/10 a) and less warming for the annual maximum temperature (0.07 ℃/10 a), respectively. The annual precipitation features no obvious changing trend, but with a highest magnitude of annual variation in recent years, and characterized with decrease in rain days, increase in daily precipitation (Figure V-9).

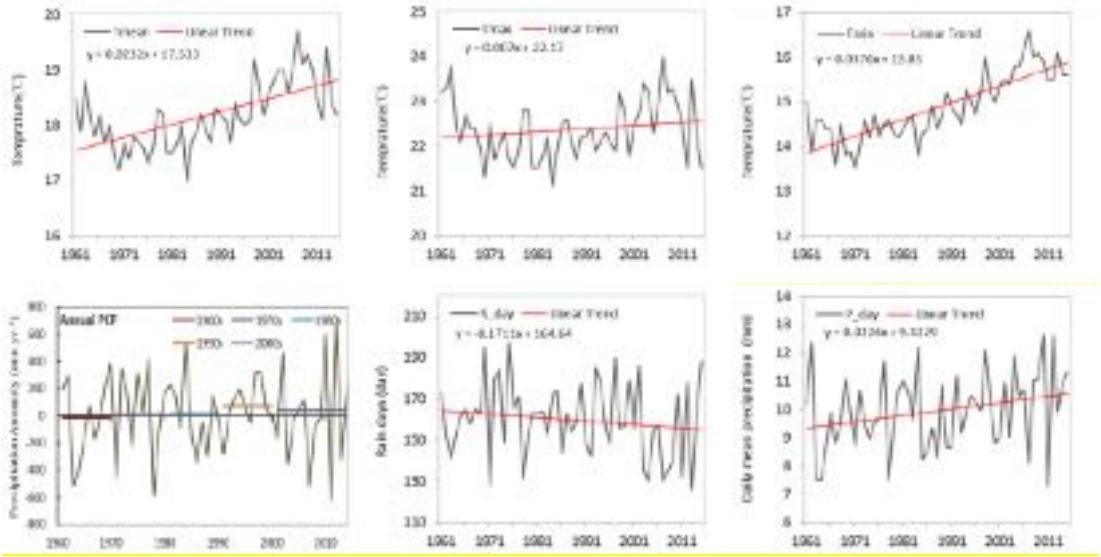

Figure V-9. Observed trend of temperature and precipitation in Xinyu, 1961-2015.

Note: Tmean = annual mean temperature; Tmax = annual maximum temperature; Tmin = annual minimum temperature; Annual PCP = annual precipitation; R_day = the number of annual rainfall days; P_day = daily precipitation intensity in rainfall days.

147. General trends in extreme events including droughts, storms, heat waves and cold events were analysed based on daily precipitation and temperature from 1961–2015. Trends show less intense droughts and more severe storms in recent years (Figure V-10). There is a general decrease both for heat waves and for cold events, which indicate a more moderate climate than before (Figure V-11).

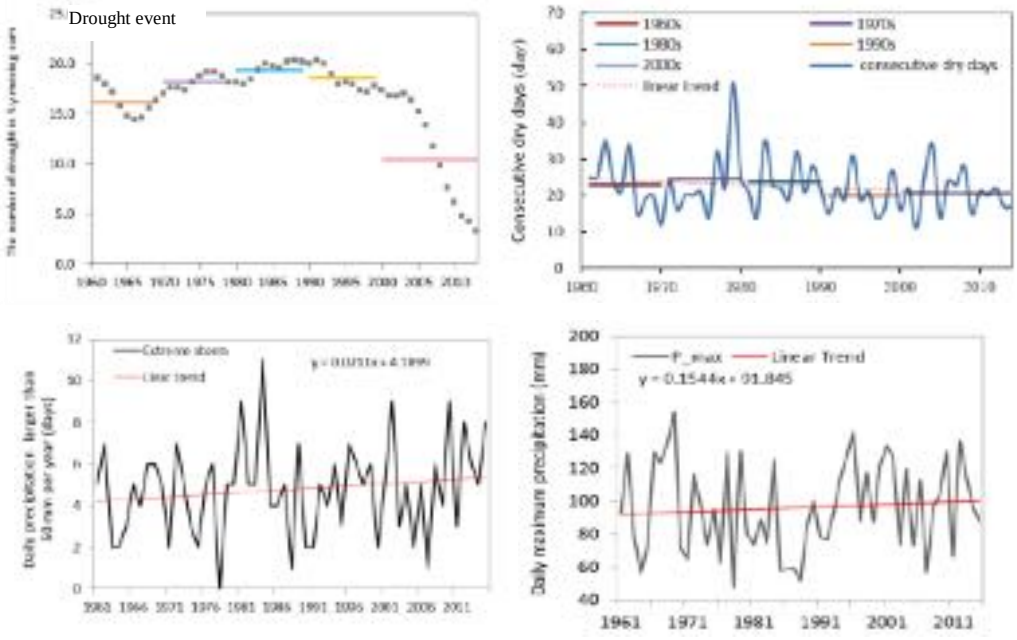

Figure V-10. Observed trend and decadal variation of number of drought events, the longest

consecutive dry days (upper), number of extreme storms, and daily maximum precipitation (lower) in Xinyu, 1961-2015.

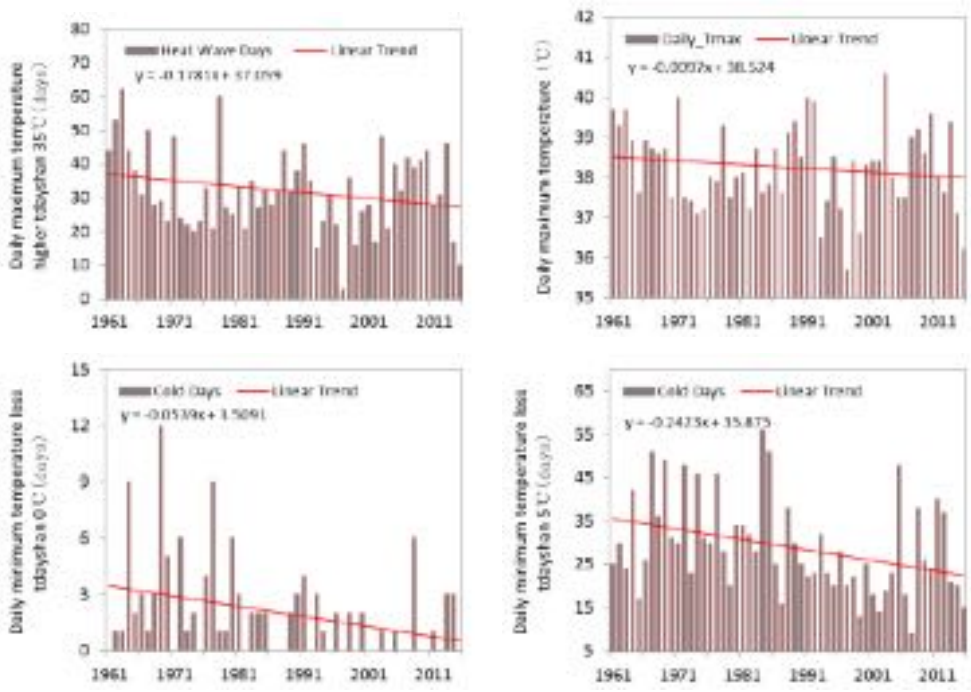

Figure V-11. Observed trend of heat wave days, daily maximum temperature (upper) and cold days with daily minimum temperature less than 0℃ and 5℃ (lower) in Xinyu, 1961-2015.

148. Observed results suggest that in Xinyu, annual mean temperatures are in a rising trend, whilst annual precipitation presents no clear trend. The number of annual rainfall days is decreasing, while the number of extreme storm events is increasing. Increase in the frequency and intensity of extreme rainfall events will increase flood risk. Drought is in a downward trend.

3. Projected Climate Change

149. The climate projection used in this report was based on 3 GCMs (Global Climate Models) under the RCPs (Representative Concentration Pathways) emission scenario within the CMIP5 (Coupled Model Intercomparison Project Phase 5). The projected monthly average minimum temperature, monthly average maximum temperature, and monthly total precipitation in four grids surrounding Xinyu County were used for the future climate change analysis. The changes of annual mean temperature, annual maximum and minimum temperature, and annual precipitation were calculated basing on downscaled IPCC5 (CMIP5) data for 2010-2099. Considering the project construction period is 2016-2020, changes of temperature and precipitation are calculated for 2020-2049 (2030s). The period 1986-2005 is used as baseline in for the climate change projection.

150. The temperature projected continual increase, and was characterized by a higher warning trend than the current observed rate of warming (1961–2015) of Xinyu (0.23℃/10a) projected by all 3 RCPs for all GCMs except for only one case. Annual mean temperatures are predicted to increase by a range of 1.1–1.9℃ during the time period of 2020–2049 against the baseline. Annual precipitation is projected to increase slightly. Rainfall intensity is also predicted to slightly increase, not exceeding 12% against the baseline in the most likely scenario, although highly uncertain with large inter-annual variations (Figure V-12).

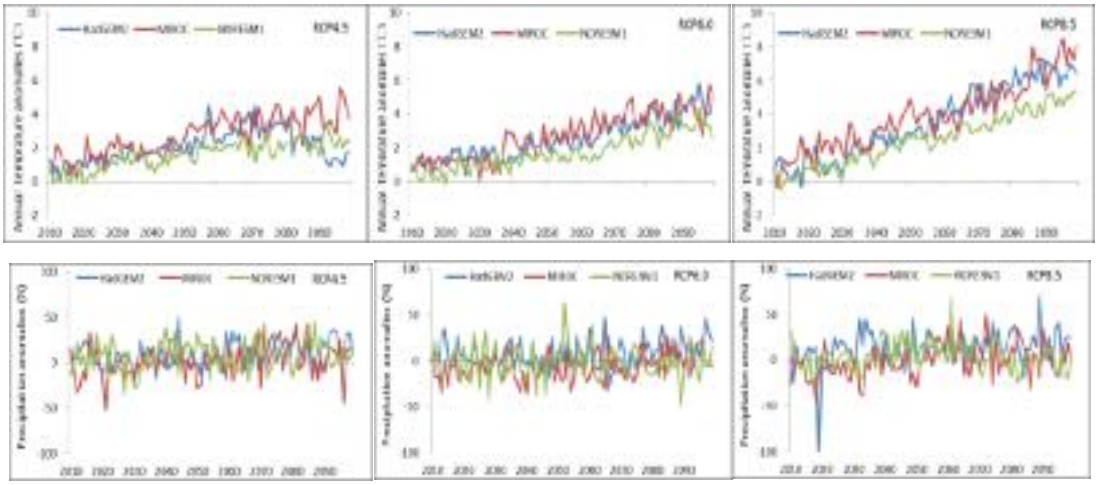

Figure V-12. Projected annual mean temperature changes (upper) and projected annual precipitation changes (lower)in Xinyu under RCP4.5, RCP6.0 and RCP8.5 for HadGEM2, MIROC and NORESM1 during 2010-2099 (baseline: 1986-2005, unit: %)

G. Associated Facilities

151. Wastewater and solid waste management infrastructure servicing the project area that will interface with the project are described in the following sections.

1. Wastewater Infrastructure

152. There are four wastewater treatment plants (WWTPs) in Xinyu City: Chengdong WWTP, Gaoxin WWTP, Chengxi WWTP (under construction) and Xiacun WWTP (Figure IV-13). City South Area, City North Area and Xianlai Area will be served by Chengxi WWTP once it is completed. City East Area is served by Chengdong WWTP (design capacity: 120,000 m^3/d). Gaoxin Industrial Zone is served by Gaoxin WWTP (40,000 m^3/d). Xiacun Industrial Park in HSRND is served by Xiacun WWTP (design capacity: 10,000 m^3/d).

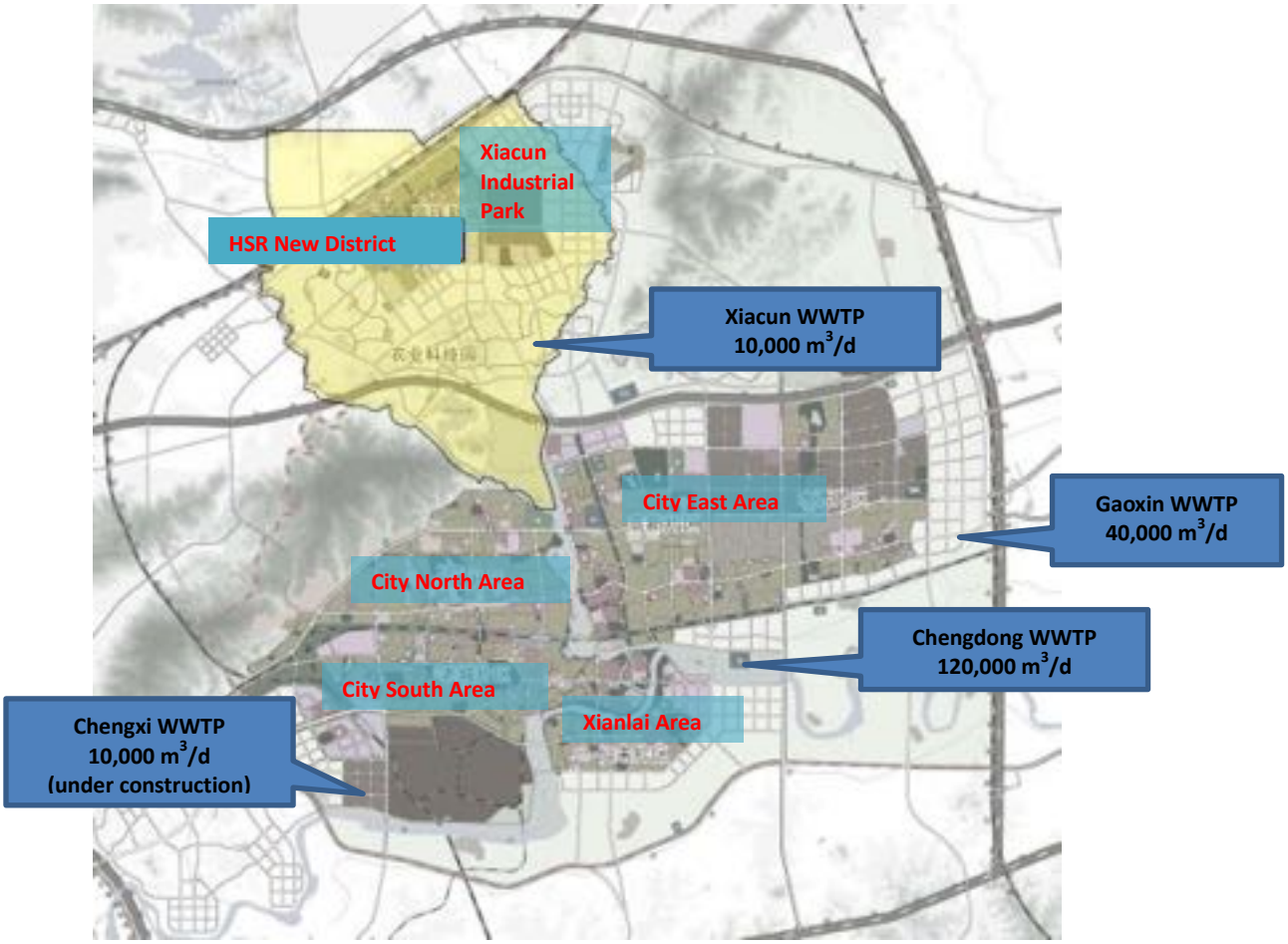

Figure V-13. Existing Wastewater Treatment Facilities of Xinyu City

153. Xiacun WWTP is executing 1B discharge standards and is operated by Nanchang Public Utility Group under a BOT contract. The existing treatment process and influent/effluent water quality of the Xiacun WWTP is shown in Figure V-14 and Table V-12 below. Effluent from the Xiacun WWTP is pumped to the nearby Yuan River through a DN 500 outfall. After on-site dewatering to water content of 80 %, sludge from the WWTP is transported by truck to Xinyu City Landfill, located some 20 km from the WWTP.

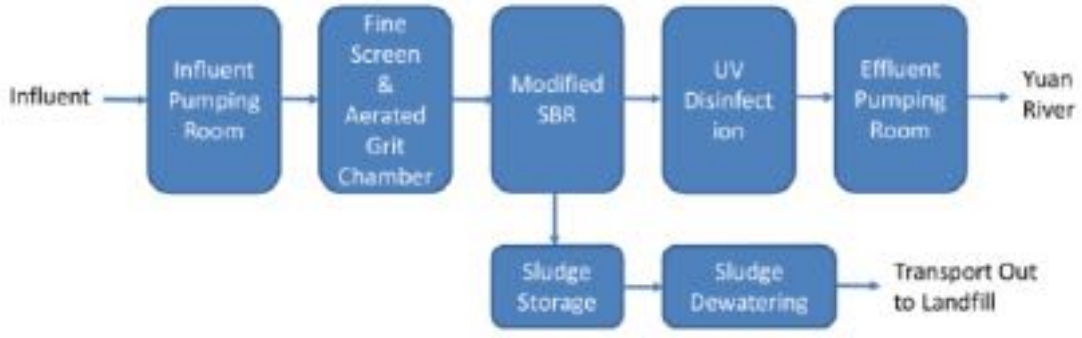

Figure V-14. Xiacun WWTP Treatment Process

Table V-12. Design Influent and Effluent Quality of Xiacun WWTP

Item	COD_{cr}	BOD_5	SS	NH_3-N	TN	TP
Design Influent	380	200	250	28	40	4
Design Effluent	≤60	≤20	≤20	≤8	≤20	≤1.0

154. The current treatment volume of Xiacun WWTP is 6,000 m^3/d, which is significantly below the design capacity of 10,000 m^3/d. Furthermore, land has been reserved within the WWTP plot for future expansion to a maximum capacity of 40,000 m^3/d. The additional WWTP capacity will accommodate increases in wastewater volume as the HSRND is developed.

155. According to the HSRND Plan (2010-2030), the population of HSRND will rise to 57,000 by 2020 and 130,000 by 2030, eventually producing 29,831 m^3/d of wastewater (Table V-13).

Table V-13. Wastewater Volume Forecast of HSR New District

	Water Demand (highest day, m^3/d)	Leakage	Daily Variation Coefficient	Wastewater Generation Rate	Wastewater Volume (average day, m^3/d)	Design Capacity of the Proposed WWTP
2020	21,743	12%	1.4	0.9	12,480	15,000
2030	51,044	10%	1.4	0.9	29,831	30,000

156. The HSRND will adopt separate drainage systems for wastewater and stormwater. Wastewater will be collected and conveyed to the proposed WWTP for treatment before discharge. Under the current Project, wastewater drainage systems will be constructed for the 'Short-term Development Area' of HSRND (Figure IV-15). The wastewater collection system will be laid at the same time as the HSRND roads are constructed.

Figure IV-15. Location of the Short-term and Long-term Development Areas of the HSRND.

2. Solid Waste Management

157. Currently, solid waste from Xinyu is disposed of at either the Lujiaoling Waste Landfill Plant or the Xinyu City Household Waste Incineration Plant.

158. The Lujiaoling Waste Landfill Plant began operation in 2007. It is located along Jixin Road in Zhushan Town and Liangshan Towns, 8 km southeast of the city centre (Figure IV-16). It covers an area of 565 mu, has a storage capacity of 3.6 million m^3, and a service duration of 18 years. Since November 2015 (when the incineration and power generation plant began operating) it has not received household waste, but takes in slag for landfill.

159. The Xinyu City Household Waste Incineration and Power Generation Plant is located close to the Lujiaoling Landfill, 7.8 km from the city centre (Figure IV-16). The plant was constructed in 2014 and the grid-connected power generation commenced in November 2015. All household waste from the service area is now disposed at the incinerator rather than landfill. The plant has an area of 6.56×10^4 m^2, and can treat 600 t/d of domestic waste, with an annual treatment volume of 25.4×10^4 t/a. Power generated by waste heat 6800×10^4 kW.h/a, the grid-connected power volume 4900×10^4 kW.h/a, over 8,000 working hours in a year. The plant comprises two mechanical grate furnaces with treatment capacity of 2×300 ton/day, one 9 MW condensing steam turbine generator unit, and a 38 ×19 ×12 m waste pit with a capacity of 10550 m^3, which can store about 4000 t of waste. The charge of waste treatment is CNY69.5 per ton. The plant meets relevant national standards for environment including Class II requirement of *Standard for Pollution Control on the Landfill Site for Domestic Waste (GB 16889-2008)*, flue gas *Standard for Pollution Control on the Municipal Solid Waste Incineration (GB 18485 -2014)*, fly ash *Standards for Hazardous Wastes - Identification for Extraction Toxicity (GB 5085.3-2007)*, and the leaching toxicity requirement of *Standard for Pollution Control on the Landfill Site for Domestic Waste (GB 16889-2008)*.

Figure IV-16. Location of Lujiaoling Waste Landfill Plant and Xinyu City Household Waste Incineration and Power Generation Plant.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Design Phase and Avoided Impacts

160. The integrated design and safeguard project planning approach, implemented through the PPTA, resulted in significant avoided impacts. The following aspects were proposed by the XCG early in the design phase and, upon additional hydrological modeling and other studies by the PPTA team, were subsequently excluded from the project design due to the potential for hydrological and/or ecological impacts.

(i) Hydrological Modeling Studies – Dredging. Modeling work has determined that dredging of the main Kongmu River is not necessary to meet target flood control standards. Dredging would have the potential to cause substantial water quality and ecological impacts. The proposed works were excluded from the project design.
(ii) Hydrological Modeling Studies – Embankment Design. The original Project design included construction of five flood control embankments along the Kongmu River. These would have had potential direct impacts to agricultural land and riparian habitats due to embankment construction, and potential indirect impacts to downstream ecology and hydrology of Kongmu River. Hydrological modeling (together with other considerations such as cost benefit analysis) demonstrated that only one embankment was considered viable by the end of the early design phase, substantially reducing direct and indirect impacts resulting from this Project component.
(iii) Canal System. The original canal layout for the Project would have impacted several village areas resulting in over 1,528 households having to be relocated. Certain sections of the canal network were realigned in the final plan, reducing the number of affected households to 1078.
(iv) Lake Construction. The original Project plan included the construction of an additional two new lakes in the west of the HSRND, along with new canals connecting those lakes to Kongmu River. Construction of these items would have caused direct impacts due to the construction footprint, increased spoil generation and land acquisition issues. Indirect impacts could have resulted from site run-off during construction and air quality/noise disturbance. These new lakes and connecting canals have been removed from the Project.
(v) Introduction of aquatic fauna and plants in the Project wetlands. Early Project designs included the release of fish, shellfish and plankton into newly created wetland habitats, as well as introduction of exotic plant species. Due to potential ecological impacts to local wetland ecology, the EA agreed that: (i) only native plant species are used in wetland design; and (ii) release of fauna has been excluded from the Project design.

B. Pre-Construction Phase

161. Prior to construction, the following measures will be implemented.

(i) Implementation of Output 3 (enhancement of the flood and environmental risk coping capacity and know-how dissemination) will improve overall water management in the Kongmu River watershed.
(ii) Institutional strengthening. (a) A full-time PMO Environment Officer will be assigned to the Project (the same officer assigned throughout the Project preparation phase of this IEE) to coordinate EMP implementation. (b) Under the loan consulting services, the PMO will hire a Loan Implementation Environment Specialist (LIEC) to provide external support. (c) The terms of reference for these personnel are in the EMP (Attachment 1).
(iii) Updating the EMP. In the event of any changes in Project design, the EMP will be updated as needed, including mitigation measures and monitoring. This will be the responsibility of the PMO, PIUs, and Design Institutes.

(iv) Training in environmental management. The LIEC and personnel from provincial EPD and municipal EPBs will give training in implementation and supervision of environmental mitigation measures to contractors and Construction Supervision Companies (CSCs).
(v) Grievance Redress Mechanism (GRM). The PMO and PIUs will implement the Project GRM at least three months before the start of construction, to ensure that communities are well informed and have the opportunity to discuss any concerns (further to the public consultations already conducted for this IEE; Section IX).
(vi) Bidding document and contract documents. The EMP will be included in the bidding documents and contracts for procurement of civil works. All contractors and subcontractors will be required to comply with the EMP.
(vii) Contractor obligations. In their bids, contractors will respond to the environmental clauses for contractual terms and EMP requirements. Prior to construction, each contractor will develop a Site EMP, based on the Project EMP (Attachment 1), and assign a person responsible for Environment, Health, and Safety (EHS). The site EMP shall include the following: (a) site drainage and soil erosion protection; (b) dredge spoil holding and treatment sites, material haulage routes, and waste disposal arrangements; (c) spill control and management; (d) health and safety; (e) surface water and groundwater protection; (f) temporary traffic management; and (g) construction site access control. The site EMP will be submitted to the environmental officers of each county PMO for approval, with support of the local EPBs.

C. Construction Phase

1. Sensitive Receptors and Project Area of Influence

162. Sensitive receptors to the construction and operation phases of the Project were identified through field survey and reviewing the likely extent of environmental impacts (Table VI-1). The planned Project works occur within or near four villages in the HSRND, as well as water quality and ecological sensitive areas of the Kongmu River. Despite the wide range of activities to be conducted in the Project, construction works for most involve similar concerns for water quality impacts, earthworks, dust and noise control, ecological impacts, and occupational and community health and safety. These, along with site-specific mitigation measures, are described in the following sub-sections.

Table VI-1. Sensitive Receptors and Project Area of Influence

Indicator	Village	Group	Distance and Location	Potential impact
Construction Phase				
Air, noise and water quality	Hupi	Shebei	15 m from the north of the levees; 15 m from the west of the management station	Construct of flood levees of Kongmu River
		Dawu	15 m from the north of the levees; 15 m from the east of the management station	
		Hupi	15 m from the north of the levees	
	Maoshan	Dangbei	After resettlement, 5 m from both side of the river	Construction of Tianyun Canal
		Maoshan	After resettlement, 5 m from both side of the river	
		Nanxia	120 m from the south of the river	Construction of Xiaxi Canal
		Tangxia	After resettlement, 5 m from both side of the river	Construction of Qingquan Canal
	Shangfen	Gaolouxia	100 m from both side of the river	Construction of Yudai Canal
		Yadangcun	15 m from the west of the river	Construction of Tianyun Canal
		Shangfen	15 m from the south of the river	Construction of Shen Canal

Indicator	Village	Group	Distance and Location	Potential impact
	Gaozhan	Gaowuli	20 m from the east of the river	Construction of Xiaxi Canal
		Huxia	After resettlement, 5 m from both side of the river	
		Zhoujia	After resettlement, 5 m from the south of the river	Construction of Yudai Canal
Surface Water			1) Water Features in the HSRND 2) Kongmu River Downstream of the HSRND	Lake and canal construction; other earthworks associated with the Project Development
Ecology			1) Areas of permanent and temporary land acquisition and adjacent areas 2) Areas covered under Surface Water Zone of Influence	Various works resulting in direct impacts (e.g., habitat loss) and indirect (e.g., noise disturbance) impacts
Operation Phase				
Surface Water			Kongmu River Downstream of the HSRND	Stormwater discharge from the HSRND
Ecology			1) Areas of permanent and temporary land acquisition and adjacent areas 2) Areas covered under Surface Water Zone of Influence	Works resulting in direct and permanent habitat loss; stormwater discharge from the HSRND

2. Soil and Earthworks

163. Excavation works, backfill, and surplus soil volumes were estimated for the Project components involving earthworks. A domestic Soil Erosion Protection Plans (SEPP) was prepared by a certified national institute for each component, and approved by the Jiangxi Water Resources Department. All soil required for the Project will be sourced from within the construction sites and balanced (Table VI-2).

Table VI-2. Summary of Soil Excavation, Reuse and Disposal

No	Project Item	Classif-ication	Exca-vation	Back-fill	Allocate and transport within Project				Temporary stockpiling utilization
					Soil Import		Soil Export		
					Quantity	Source*	Quantity	Disposal*	
1	Embankment	Earthwork	1.85	19.4	17.55	2			
		Topsoil	0.9	0.38			0.52	2	0.9
		Subtotal	2.75	19.78					
2	Lakes/Wetlands + Canals	Earthwork	193.36	163.78			29.58	1, 3	
		Topsoil	5.59	9.68	4.09	1, 3			5.59
		Subtotal	198.95	173.46					
3	Sponge City (Roads + Public Open Space)	Earthwork	12.33	24.36	12.03	2			
		Topsoil	6.94	3.33			3.61	2, 4	6.94
		Subtotal	19.27	27.69					
4	Stormwater and wastewater infrastructure	Earthwork	1.08	1.08					
		Topsoil	0.09	0.13	0.04	3			0.09
		Subtotal	1.17	1.21					
5	Solid Waste Treatment Infrastructure	Earthwork	0.15	0.15					
		Topsoil	0.03	0.03					0.03
		Subtotal	0.18	0.18					
Total		Earthwork	**208.77**	**208.77**	**29.58**		**29.58**		
		Topsoil	**13.55**	**13.55**	**4.13**		**4.13**		**13.55**
		Subtotal	**222.32**	**222.32**	**33.71**		**33.71**		**13.55**

*Refers to numbers in left-hand column

164. **Sediment Management.** The FSR includes a detailed sediment survey to be conducted during the detailed design phase of the Project. It will document the lake bathymetry, sediment deposition and the characteristics of the pollutants in the sediment. This information will be used to design a sediment removal and management program that will comply with the requirements of environmental approval, including the control of sediment resuspension and the potential released of contaminants into the water and air.

165. **Soil erosion.** Potential erosion could occur during construction of the canals, lake dredging/excavation and embankment, and any instances when surface vegetation and soil are removed. Erosion may occur after construction if site restoration has been inadequate. Before construction, contractors will be required to prepare a Site Drainage and Soil Erosion Management Plan to prevent soil erosion. The plan will include the following measures.

(i) Identify exact locations for temporary stockpile sites of soil and sediment before any construction. These sites will: (i) be located at least 50 m from the shorelines of the artificial lakes; (ii) for sediment, will be lined, to prevent seepage and water logging; and (iii) will not be located on farmland.

(ii) During embankment construction: (a) maintain slope stability at cut faces by implementing erosion protection measures such as terraces and silt barriers; (b) construct berms or drainage channels around the perimeter of the construction site to capture soil runoff and direct rainwater away; and (c) plan and implement construction in staged sections, with one section completed and stabilized before beginning the next.

(iii) Stabilize all cut slopes, embankments, and other erosion-prone working areas.

(iv) Stabilize all earthwork disturbance areas within 30 days after earthworks are completed.

(v) Minimize open excavation areas during trenching activities.

(vi) Use appropriate compaction techniques for pipe trench construction.

(vii) Provide temporary detention ponds or containment to control silt runoff.

(viii) Construct intercepting channels and drains to prevent runoff entering construction sites, and divert runoff from sites to existing drainage or open ground for watering the vegetation.

(ix) Strip and stockpile topsoil, and cover or seed temporary soil stockpiles.

(x) Limit construction and material handling during periods of rains and high winds.

(xi) Properly slope or re-vegetate disturbed surfaces e.g. pipeline trenches and cut banks.

(xii) Protect slopes on both sides of embankment.

(xiii) All dredged sediment, channel soil and spoil disposal sites, embankments, and revetments, will be rehabilitated once they are completed (or full in the case of the disposal sites).

(xiv) Landscaping will only use native plant species.

(xv) Construction camps and storage areas will be located to minimize land area required.

166. Compliance with these measures will be checked through internal inspection and monitoring by the CSCs, PMO Environment Officer, and County EPBs. Compliance inspection and monitoring will be conducted semi-annually during construction by licensed institutes. Results will be submitted to the PMO, PIUs, local EPBs and WRBs for progress reports and acceptance of construction.

3. Water Quality

167. Construction activities may cause short-term and localized impacts to water quality of the Kongmu River due to run-off from construction sites, sedimentation due to lake/canal dredging, and improper release of wastewater from construction activities. These are addressed as follows.

168. **Construction Site Run-off.** To minimize potential water quality impacts from site run-off, the following measures will be implemented:

(i) Sedimentation tanks will be installed for construction sites generating runoff with high concentrations of suspended solids.
(ii) Use of coffer dams and sedimentation tanks would also be adopted to minimize sedimentation impacts from excavation of foundation pits for engineered structures.
(iii) The flood control embankment along Kongmu River would be constructed 6.3 km away from the water intake location of WTP No.4., which is within the primary protection zone of the WTP. Sediment run-off in this area will be controlled by covering exposed areas of the earth embankment with tarpaulin or other suitable materials.

169. **Lake/Canal Dredging.** To minimize potential water quality impacts from lake/canal dredging, the following measures will be implemented.

(i) Lake dredging will be scheduled in the dry season and outside of the agriculture irrigation season.
(ii) Lake outflow gates will be closed during dredging works to prevent release of sediments into drainage systems that will eventually drain to Kongmu River.
(iii) Wastewater from the dewatering of dredged sediment will be treated by sedimentation in consolidation tanks. Wastewater from these tanks will be returned back to the lake when SS concentration is less than 20 mg/L (meeting Class I requirement of GB8978-1996). Compliance with PRC standards will be conducted by licensed institutes.
(iv) The newly excavated Tianyun Canal will discharge into the Kongmu River within the Secondary Water Source Protection Area. To ensure water quality is protected, the sedimentation tank will be used for all excavation and construction works within 1000 m of the Kongmu River.
(v) Both Tian Canal and Hehachi Lake are close to the Water Source Buffer Zone of Kongmu River. Drainage from coffer dams and foundation pits used in these areas will only be discharged into Kongmu River by temporary diversion canal after sedimentation. The diversion canal will be refilled following completion of construction works.

170. **Construction Wastewater.** Wastewater will be produced from the maintenance and cleaning of Powered Mechanical Equipment (PME) and vehicles, water from mixing and curing concrete, inappropriate storage and handling of fuel, accidental spills, and disposal of domestic wastewater from construction camps. To control these potential issues, the following measures will be implemented.

(i) Sedimentation tanks will be installed on-site to treat process water (e.g. concrete batching for construction) and equipment cleaning water. If necessary, neutralizer and flocculants such as CaO and PAM will be used to facilitate sedimentation.

(ii) Oil separators will be installed to treat wastewater from cleaning of PME and vehicles. The cleaned wastewater will be reused for equipment cleaning.
(iii) For the alkali wastewater from concrete mixing and equipment cleaning, after neutralization and precipitation treatment, reuse will be considered for watering of construction areas. Solid waste from the sediment tank will be disposed of at the local landfill.
(iv) Buried integrated biochemical treatment tanks will be used to treat domestic wastewater generated at construction sites. Portable toilets and small package WWTPs will be provided for the workers and canteens. If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers. Discharging domestic wastewater from construction sites to the Kongmu River will be forbidden to protect drinking water safety.

171. These measures are considered sufficient to manage the risk of sediment or other inputs into the Kongmu River during construction. Water quality will also be monitored by local EMSs during construction as per the EMP.

4. Air Quality

172. Air pollution from construction activities is likely to be generated from: (i) dust from earth works, traffic, and concrete mixing; and (ii) fumes from PME/Vehicles. The main pollutants would be Total Suspended Particulates (TSP) and Nitrogen Oxides (NO_x). Odour from sludge drying sites during lake dredging works is also of potential concern.

173. Dust from earth works. The DEIA predicted that concentrations of fugitive dust (TSP) would be high within 50 m of works areas without the implementation of dust prevention measures. However, TSP concentrations would drop quickly with distance from the source: impacts more than 200 m from the pollution source would be negligible. If soil moisture content is high, the impact of TSP would not extend further than 100 m from works areas.

174. The following mitigation measures to minimize air pollution impact on construction sites will be adopted.

(i) Spray water on construction site and roads especially where sites are located within 200 m of residential areas.
(ii) Where construction sites are located within 50 m of residential areas, semi-closed construction measures will be adopted to minimize dust impacts.
(iii) Concrete mixing systems will not be established within 50 m of residential areas/villages. Dust removal equipment and screen shed will be deployed around concrete mixers to minimize TSP generation.
(iv) Construction sites should avoid farmland occupation where possible.
(v) Construction activities likely to generate dust will be suspended during strong windy days.
(vi) Stockpiled materials that could generate dust will be well managed: either watered or covering with tarpaulin. The storage of these materials on site will be minimized by regularly removing them off site for proper disposal.
(vii) Trucks transporting earth materials will not be overloaded to avoid spilling dusty materials onto public roads. Earth that is transported by truck will be covered by tarpaulin/other suitable material during transportation.
(viii) Wheel washing equipment/manual wheel washing will be adopted at the exit of works areas to prevent trucks from carrying muddy or dusty substance onto public roads.
(ix) Immediately cleanup all muddy or dusty materials on public roads outside the exits of the works areas.
(x) Sensibly plan the transport routes and time to avoid busy traffic and heavily populated areas when transporting earthy materials.

175. Fumes from PME/Vehicles. The following measures will be implemented to minimize air quality impacts from PME/Vehicles: (i) PME/vehicles will be routinely and properly maintained; (ii) if required, retrofit construction plant with particulate reduction device to reduce dark smoke emission; and (iii) divert PME exhaust away from public areas

176. Odor. The DEIA predicted that during dredging works, odor at 30 m distance from the source would be mild, so location of sludge drying areas will be more than 30 m from nearby villages.

5. Noise

177. The main source of noise will be from PME used during construction and transportation activities. Applicable construction noise standards are 60 dB(A) during daytime and 50 dB(A) at night-time (according to GB 12523-2011). The following predictive model recommended in *Technical Guideline on EIA Regarding Acoustic Environment* (HJ2.4-2009) was used to forecast noise levels:

$$L_i = L_0 - 20\lg\left(\frac{R_i}{R_0}\right) - \Delta\mathrm{L}$$

L_i and L_0 are equipment noise level at R_i and R_0 respectively, dB(A); ΔL is additional diffusion attenuation caused by barriers, vegetation, air and earth, dB(A);

178. Noise from various PME at different distances is shown in Table VI-3.

Table VI-3. Noise from PME at different distance (Unit: dB (A))

Machinery	Distance to machinery (m)	Sound Level (dB(A))	Predicted sound level with different distance to the source (dB(A))							
			10m	20m	30 m	50 m	100 m	150 m	200 m	300 m
Excavator	3	84	71.6	65.5	59.5	56.0	51.6	45.5	42.0	39.5
Bulldozer	3	85	72.6	66.5	60.5	57.0	52.6	46.5	43.0	40.5
Tamper	1	85	63.0	57.0	51.0	47.5	43.0	37.0	33.5	31.0
Mixer	1	90	68.0	62.0	56.0	52.5	48.0	42.0	38.5	36.0
Dredger	1	90	76.0	70	64	60.5	56.0	50	46.5	44

179. Based on the types of PME expected to be used and their sound power levels, the DEIA predicted impact distances would be within 7 m during daytime and up to 39 m at night time. Table VI-4 shows that the construction noise levels at sensitive receptors in Project Area would range from 58.8 dB(A) to 84.1 dB(A).

Table VI-4. Unmitigated Construction Noise Levels at Sensitive Receptors

Sensitive Receptor	Construction Noise Source	Distance (m)	Construction Noise	Baseline value		Predicted (unmitigated) value		Noise standard	
				Day	Night	Day	Night	Day	Night
Hupi Village	Flood control embankment	15	77.3	59.4	50.6	77.4	77.3	60	50
Maoshan Village	Tianyun Canal	100	58.1	59.4	50.6	61.8	58.8	60	50
Dangbei Village	Tianyun Canal	5	84.1	59.4	50.6	84.1	84.1	60	50
Gaolouxia Village	Utility Tunnel under Xiangyun Road	5	84.1	49.8	48.2	84.1	84.1	60	50

Sensitive Receptor	Construction Noise Source	Distance (m)	Construction Noise	Baseline value		Predicted (unmitigated) value		Noise standard	
				Day	Night	Day	Night	Day	Night
Gaozhan Village	Yudai Canal	5	84.1	50.8	46.9	84.1	84.1	60	50
Shangfen Village	Tian Canal	5	84.1	52.7	50.6	84.1	84.1	60	50

180. Construction noise will need to be mitigated by the following measures to comply with PRC Construction Site Noise Limits and protect sensitive receptors.

(i) Ensure noise levels from equipment and machinery conform to PRC standard of GB 12523-2011; adopt good O&M of machinery to minimize noise.
(ii) Equipment with high noise and high vibration will not be used near village or township areas. Only low noise machinery or equipment with sound insulation will be employed.
(iii) Use temporary hoardings or noise barriers to shield off noise sources when there are residences within 50 m of the noise source
(iv) Avoid construction between 2200 and 0600 hours within 300 m of sensitive receptors. However, recognizing that construction occasionally would require some works to be conducted at night to take advantage of less road traffic or to avoid worsening day time traffic conditions, night time construction work will prevent using high sound PME and nearby residents will be notified of such night time activities well beforehand.
(v) Regularly monitor noise at sensitive areas (see Attachment 1). If noise is exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.

181. With the implementation of recommended mitigation measures, noise levels can be reduced as shown in Table VI-5 below:

Table VI-5. Mitigated Construction Noise Levels at Sensitive Receptors

Sensitive Receptor	Construction Noise Source	Dist(m)	Predicted (unmitigated) value		Sound insulation measure and sound reduction		Predicted (mitigated) value	Noise standard	
			Day	Night				Day	Night
Hupi Village	Flood control embankment	15	77.4	77.3	sound insulation screen	20	57.3	60	50
Maoshan Village	Tianyun Canal	100	61.8	58.8		/	/	60	50
Dangbei Village	Tianyun Canal	5	84.1	84.1		20	64.1	60	50
Gaolouxia Village	Utility Tunnel under Xiangyun Road	5	84.1	84.1		20	64.1	60	50
Gaozhan Village	Yudai Canal	5	84.1	84.1		20	64.1	60	50
Shangfen Village	Tian Canal	5	84.1	84.1		20	64.1	60	50

6. Vibration

182. Potential vibration impacts could result from piling, lake/canal excavation, soil compaction, pipeline trenching and embankment construction. Mechanical vibration may cause structural damage to nearby buildings. This impact will be minor as no construction techniques or equipment used (e.g., blasting) will result in substantial generation of ground vibration. Sudden and discontinuous vibration can also cause stress among workers and communities. To address these issues: (i) piling and compaction operations will be prohibited

at night; (ii) communities will be consulted prior to large earthworks to ensure they are informed, and to avoid sensitive timing e.g. exams at nearby schools or festivals. All works will comply with the *Standard of Environmental Vibration in Urban Area (GB10070–88)*.

7. Solid waste

183. Solid waste generated during construction will include construction and demolition waste dominated by excavated spoil during earth works for lake excavation, utility tunnel and embankment construction, dredged sediment from lakes, and refuse generated by construction workers on construction sites. If not properly disposed, such wastes will create community health and sanitation problems, and may also be washed into drainage systems and cause impacts to Kongmu River. To minimize issues with solid waste, the following measures would be implemented:

(i) General refuse generated by the workers will be stored in closed containers and regularly transported off-site for disposal at Xinyu City Household Waste Incineration and Power Generation Plant.
(ii) Excavated materials will be cleared and removed regularly, and reused on-site where possible, as described in Table V-2.
(iii) General construction/demolition waste will and re-used on site for landscaping/fill, or transported off-site for disposal Lujiaoling Waste Landfill Plant.
(iv) Dredged lake sediment totaling 60,000 m^3 after drying will be dried at the dredged sediment disposal site. Sediment monitoring results (Table V-8) show that sediment from the representative lakes can meet PRC's Environmental Quality Standard for Soils (GB 15618-1995) Class II standards for both heavy metals and pesticides, meaning that the dredged sediment is classified as general solid waste. This means is can be re-used on site for landscaping/fill. The Xinyu Urban and Rural Construction Investment Group Co. Ltd. will be responsible for reuse of dredged sediment according to the institutional arrangement for project implementation, and will determine where dredged sediments will be reused according to the construction schedule developed in the detailed design stage.

8. Ecology and Biodiversity

184. **Habitat clearance.** Construction works will result in the permanent loss of habitats within the footprint of different Project elements, and temporary habitat loss for the establishment of works areas, storage sites and access roads. Habitat loss and disturbance is assessed as follows.

(i) Clearance of agricultural lands and perimeters of artificial lakes (about 158 ha). The clearance of these habitats, within the context of the rural landscape mosaic, will have minor ecological impact.
(ii) Clearance of a narrow fringe of secondary vegetation along the Kongmu River bank (about 0.2 ha). The outlets of two project canals, Tianyun and Shen, will be located on the bank of the Kongmu River. This will require construction works along a limited stretch (30-40 m at each outlet) of the river bank. The impact is considered minor due to (i) the small area of habitat affected (in total about 80 m length x 25 m wide), and (ii) the total length of remaining riparian habitat in the Project Area (about 11.3 km along the Kongmu River banks, from the HSR track in the north to the G60 Hukun Expressway in the south). The total length of impacted area constitutes about 0.7% of this total length.
(iii) Clearance of agricultural lands and secondary vegetation within the Kongmujiang National Wetland Park (about 5.7 ha). Two Project components, the flood control embankment, and a short (approximately 50 m) downstream stretch of the Tainyun Canal, will be constructed within the park. Despite the location of these works within a wetland park, the impacts arising from habitat loss are minor: (i) the park supports few natural habitats; (ii) all Project works (5.5 ha for the flood control embankment and 0.2 ha for the

Tianyun Canal) will be located in secondary scrub vegetation, irrigation channel, dry agricultural land, and village area, of low ecological value.

185. Construction works in all sites, including the wetland park, will be carefully controlled. Siting of works areas/storage sites and routing of access roads in areas of low ecological value (e.g., existing disturbed sites) will be clearly demarcated. Temporary works areas will be fully reinstated following the completion of works.

186. **Habitat fragmentation.** Potential habitat fragmentation impacts could occur during construction of linear project elements such as canals and flood control embankments. These impacts are considered minor in scale due to the low value of affected habitats, and low probability that species of conservation concern would be affected.

187. **Species injury/mortality.** Proposed works could cause direct injury/mortality of fauna, during vegetation clearance/earth works, construction traffic, and/or unauthorized actions of construction staff (e.g. fishing/hunting).

188. These impacts are considered minor in scale as due to the low probability that species of conservation concern would be affected.

189. **Noise and visual disturbance.** Disturbance to fauna could result from construction, including noise and vibration from construction machinery, vehicles, and increased levels of human activity and presence. Such impacts would vary depending on the location, timing, nature of construction works and presence of ecological sensitive receivers. Such risks are considered minor due to the small scale of proposed works, low ecological value of affected habitats (primarily agricultural land and village areas), and low probability of species of conservation concern being affected. Potential disturbance may result from (i) disturbance to modified wetland habitats including lakes and agricultural irrigation channels. While these habitats are of limited ecological value, they provide feeding and breeding habitats for some common and widespread species of birds, fish, and frogs; and (ii) disturbance to Kongmu River during construction of the downstream sections of the Tianyun and Shen Canals, riparian wetlands and the flood control embankment. These minor risks will be mitigated within the Kongmujiang National Wetland Park and at the Kongmu River by staging the construction in short segments, to minimize disturbance.

190. **Air pollution.** Construction phase activities could result in localized air quality impacts from dust generation and exhaust emissions from construction plant and vehicles. Air quality degradation can result in ecological impacts through direct particle deposition on plants, and sub-lethal effects of pollutants on plants and animals. These impacts would be very minor due to small area and low ecological value of the habitats and species affected. Any potential impacts can be controlled through standard good site practice..

191. **Water Quality.** The water quality of lakes and irrigation channels within the HSRND could be impacted by proposed construction phase activities. In particular, sediments mobilized by excavation and dredging works during deepening of the lakes and canal/wetland construction can impact aquatic communities in these waterbodies, as well as communities in the Kongmu River (which is the receiving water body for most of the HSRND drainage). Sediments can also be carried by run-off from work sites adjacent to lakes and drainage channels. Other potential sources of water quality pollution could result from spillage or leaking of fuel, oils, cleaning chemical and other material stored or used within works areas. Measures to reduce water quality impacts from dredging works and general construction activities are described in Section VI.1. With the implementation of these measures, water quality impacts will be minor and localized in nature. No significant water quality impacts to aquatic communities in the Kongmu River are expected.

192. **Overall measures to minimize ecological risks.** The following good site practice measures will be implemented in all works sites associated with the Project to minimize disturbance impacts.

(i) All construction plant will be well maintained to reduce noise and air pollution.
(ii) Strict controls for construction traffic: maximum speed limit for all vehicles of 40km/h; ensuring all vehicles are well maintained; and, prohibiting horn use while stationary or when driving in Kongmujiang National Wetland Park (except in emergency situations).
(iii) Dust suppression measures (e.g., wheel washing) will be implemented.
(iv) Site run-off control measures (e.g., covering stockpiled soils with tarpaulin, routing site run-off through sediment traps) will be implemented.
(v) Adequate toilets and litter bins will be provided on construction sites.
(vi) Prior to any works within the Kongmujiang National Wetland Park, construction staff will receive basic education on the park and codes of conduct, including: key habitats and species; and, no littering, hunting, fishing, no unauthorized damage to vegetation, and minimizing noise and disturbance.

2. Social Issues

193. The Project will involve permanent and temporary land acquisition, removal of houses, and impacts to over 3,000 people. Land uses in areas to be affected by the Project comprise village areas, irrigation ponds and agricultural land, and areas where construction has taken place. The main crops in the Project area are rice, *Zea mays*, *Ipomoea batatas*, *Glycine max*, *Arachis hypogaea* and *Citrullus lanatus*. Within the Kongmujiang National Wetland Park, around 216 mu of agricultural land will be affected by the project. A resettlement plan has been prepared in accordance with PRC and ADB requirements to ensure that all affected residents have been documented and receive adequate compensation and/or support. Detailed analyses of impacts to livelihoods, resettlement, and economic analysis are included in these plans, and are available in Chinese and English language at the PMO office and ADB website.

3. Community and worker health and safety

194. The objective of environmental health and safety is to provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. It also covers the establishment of preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. It is therefore a combination of occupational health and safety of staff/workers at the subproject facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities.

195. The civil works contractors will implement adequate precautions to protect the health and safety of the workers and community. Signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles and excavations, and raising awareness on safety issues. At the end of each day, all sites and equipment will be made secure (through fencing and/or lock-down of equipment) to prevent public access.

196. The contractors will also implement precautions to protect the health and safety of construction workers. The occupational health and safety risks will be managed by applying measures in the following order of preference: avoiding, controlling, minimizing hazards, and providing adequate protective equipment. Each contractor's Site Environmental Management and Supervision Plan will include measures for health and safety for personnel. The plan will be submitted to the PMO for review and appraisal and will include the following provisions for health and safety:

(i) Personal protection. Provide Personal Protection Equipment (PPE) appropriate to the job, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations, for workers.
(ii) Emergency Preparedness and Response. An emergency response plan to take actions on accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events will be prepared, and submitted to the IA for review and appraisal. A fully equipped first-aid base in each construction site will be provided.
(iii) Records Management. A Records Management System will be established to document occupational accidents, diseases, and incidents, that: (a) includes a tracking system to ensure that incidents are followed-up; (b) can easily retrieve records; and (c) can be used during compliance monitoring and audits. The system will be backed up on at least one external hard drive to protect records against loss or damage.
(iv) Safety communication. Ensure that safety, rescue and industrial health matters are given a high degree of publicity to all persons regularly or occasionally on the Site. Posters drawing attention to site safety, rescue and industrial health regulations will be made or obtained from the appropriate sources and will be displayed prominently in relevant areas of the site.
(v) Training, awareness and competence. Train all construction workers in basic sanitation and health care issues, general health and safety matters, and on the specific hazards of their work.

4. Physical Cultural Resources

197. No cultural heritage or archaeological sites are known from the Project Area. However, construction activities have the potential to disturb unknown underground cultural relics. The EMP mitigation measures include immediate suspension of construction activities if any archaeological or other cultural relics are encountered, in accordance with the PRC Cultural Relics Protection Law 2002. The Xinyu Cultural Heritage Bureau, PMO, and implementing agency will be promptly notified. Construction will resume only after investigation and with the permission of the appropriate authority. The clause for protection of unknown underground cultural relics will be included in construction contracts.

D. Operational Phase

1. Water Resources

198. **Water quality and urban stormwater run-off.** Urban stormwater quality can be poor, with high loadings of nutrients and sediments carried in the 'first flush' of stormwater. Stormwater run-off from the newly constructed HSRND is of concern as it could increase pollution loading to receiving water-bodies, including lakes, canals and finally the Kongmu River. To address this issue, Sponge City Design Elements (e.g., bioswales, raingardens) will be designed under the Project that would clean and collect the first flush of stormwater from the HSRND. Sponge City planning would meet "Code for Design of Outdoor Wastewater Engineering" standards to collect the first 8mm of runoff. 75 % of runoff (during 30 mm/day rainfall event) will be controlled, resulting in 40 % stormwater pollutants will be captured (approximately 7.6 t of SS, 5.0 t of COD, 0.4 t of TN, and 0.1 t of TP annually) before they reach the wetlands.

199. Following initial treatment with Sponge City Design Elements, run-off from the HSRND will be further treated by the constructed wetlands around the lakes, canals and Kongmu River. According to the DEIA, wetland treatment will further improve stormwater quality so that water quality arriving at the water quality protection zones of Kongmu River will satisfy Class III Water Requirement in "Environmental Quality Standards for Surface Water"

(GB3838-2002). With these treatment measures in place, no water quality impacts from stormwater degradation are expected. The project will also implement a water quality monitoring program (including construction of monitoring stations) at the discharge outlets to be constructed by the project, from the HSRND to the Kongmu River. This, combined with an assurance for monitoring and mitigation against Grade II water quality standards (Section XI), will reduce the risk of water quality impacts from the HSRND to the Baiyun Reservoir. No project risks to other reservoirs in the upper Kongmu basin are anticipated due to the upstream location of the reservoirs. There will be no project impacts to the Jiangkou Reservoir, as it is located along the Yuan River (a tributary of the Kongmu) upstream of Xinyu City and the HSRND.

200. **Water quality and solid waste transfer stations.** Small volumes of wastewater will be generated through the operation of solid waste transfer stations. The wastewater can be divided into high concentration (leachate, wastewater after cleaning garbage trucks/other equipment, wastewater of ground washing) and low concentration (sewage from employees). High concentration wastewater will be collected by suction sewage vehicles and delivered to Xinyui City Household Waste Incineration and Power Generation Plant. The incineration plant would use appropriate technologies (e.g., MBR) to treat waste water until it meets appropriate standards, then it will be reused as process water for the power plant. Low concentration wastewater will be treated by septic tanks at the solid waste transfer stations, then discharged into municipal sewage pipe network for eventual treatment as WWTP in Xinyu City.

201. **Water quality and sewerage infrastructure.** The effectiveness of sewerage pipes constructed under this Project is contingent on in the expansion of the Xiacun Wastewater Treatment Plant (WWTP). The current treatment volume of Xiacun WWTP is 6000 m^3/d. It has reserved the land for future expansion to 40,000 m^3/d. According to the wastewater volume forecast of HSRND by PPTA team, the designed capacity of proposed WWTP to accept the wastewater from HSRND will be 15,000 m^3/d in 2020 and 30,000 m^3/d in 2030. The treatment capacity of Xiacun WWTP is therefore sufficient after expansion to accept the wastewater from HSRND. The Xinyu City Government will either amend the current Xiacun WWTP BOT contract or conclude a new BOT contract with Nanchang Public Utility Group, which would include the treatment volume to be increased and timeline (increase from 10,000 t/day to 25,000 t/day by 2020). A loan assurance has been developed for the timely expansion of the WWTP.

202. **Hydrological impacts**. The risk that hydrology of the Kongmu River might be affected downstream of the HSRND as a consequence of the Project was assessed through hydrological modeling. The risk is considered minor for the following reasons: (i) stormwater from the HSRND will be managed to ensure no increase in the volume of run-off or peak discharge entering the Kongmu River; (ii) stormwater from the HSRND will be managed to ensure water quality impacts to Kongmu River are controlled; (iii) construction of the levee adjacent to Kongmu River can reduce the volume of water stored on the floodplain (causing increased flows downstream), but in this case the lost flood storage capacity is minimal. The hydrological modeling conducted as part of the PPTA found the effect of embankment construction on downstream flooding too small to be quantified.

2. Air Quality

203. The main operation phase air quality issue will be odor from the solid waste transfer stations. The odour is mostly from solid waste delivery and compacting at the transfer station, with TSP, H_2S, and NH_3 the main emission pollutants. Transfer vehicles will produce some TSP, H_2S, and NH_3 during operation as well. According to “Technical Code for Transfer Station of Municipal Solid Waste” (CJJ47-2006), the waste transfer stations planned under this Project are small in scale (daily capacity 50-150 t/d), which under the standard, require a

setback of at least 10 m from neighboring buildings. The transfer stations planned under the HSRND will be located under separately zoned planning areas with no surrounding buildings nearby. The transfer station in Guanchao Town would be constructed more than 10 m away from the surrounding buildings.

204. High-energy ion air purification BENTAX technology will be used for deodorization during waste processing. At the collecting dump and when collecting vehicles dump the waste, the facility will automatically start spaying deodorant, decomposing approximately 80% of major pollutants H_2S and NH_3. The deodorant will continue to operate until odor concentration reaches emission standards (H_2S concentration <0.06 mg/m^3, NH_3 concentration <1.5 mg/m^3). Dust generated during waste processing will be managed with dust-controlling spray system. Dust control spray systems will reduce dust to < 0.2 mg/m^3.

205. No residential areas, schools, hospitals and other sensitive areas will be planned within 50 m of the solid waste transfer stations. Odors will have minimum impact on the surrounding environment.

3. Noise

206. Mechanical noise will be generated from the operation of the sewage pumping stations, waste transfer stations, and utility tunnel fans. The DEIA estimates the noise levels at the source to be between 75-85 dB(A). No significant noise impacts are expected during the operation phase of the Project, for the following reasons.

(i) The noise will be generated in closed or partially-enclosed structures within the stations.
(ii) For all three types of noise-generating facilities, levels will be controlled to within 70 dB(A) during day time and 55 dB(A) during night time at a distance of 1 m from the boundary of the facility, to comply with the Class 4a of the Emission standard for industrial enterprise noise as boundary (GB12348-2008).
(iii) Sewage pumping stations. The two pumping stations will be located in the greenbelt of the proposed Xiangyun Road and Chuangye Road. Noise-generating equipment such as wastewater lift pumps will enclosed in a building, which typically attenuates levels by 35-40 dB(A).
(iv) Waste transfer stations. Noise will be generated by compactors and the operation of waste trucks entering and exiting the stations. The stations will only operate during the daytime, and will be located at least 50 m from residential areas, schools, hospitals and other sensitive receptors.
(v) The utility tunnel fans will be located along the alignment of the SUSS, in the central green belt of Xiangyun Road. Impacts to potential sensitive receivers are expected to be minimal.

4. Solid Waste

207. The Project is expected to have a positive impact on solid waste management during the operation phase. Waste transfer stations and other infrastructure will allow for effective management of domestic waste generated from the HSRND and adjacent districts.

208. The current treatment volume of Xinyu City Household Waste Incineration and Power Generation Plant is 480 m^3/d, which is significantly below the design capacity of 600 m^3/d. There is also an expansion plan for an additional 300 m^3/d capacity in the future. According the solid waste quantity estimate, the solid waste produced in the Project Area will be 89 m^3/d in total. So the Xinyu City Household Waste Incineration and Power Generation Plant will have adequate capacity for the final disposal of solid waste collected in the Project Area.

5. Ecology and Biodiversity

209. **Habitat loss and disturbance.** The relatively low impact of habitat clearance by the Project (Section VI.C.8) is further underscored by the additional habitats to be constructed, and improved habitat management, as follows.

(i) Existing lakes in the Project Area are intensively managed, have poor water quality and steep banks that support limited emergent wetland vegetation. Under the Project, these lakes will be enlarged and re-profiled, and areas of wetland planting, using native wetland plant species, will be incorporated into the lake margins. This is expected to improve water quality. The lakes are primarily designed for water quality improvement, but would also enhance the ecological value of the area.
(ii) Existing irrigation channels will be replaced with canals which would also incorporate wetland planting. This includes some 500 m of the section of the Tianyun Canal that falls within the Kongmujiang National Wetland Park.
(iii) Under the Project design, 19 ha of agricultural land along the Kongmu River will be restored to riparian wetland habitat. This would lead to an overall increase in the area of ecologically valuable wetland habitats along riparian zone of the Kongmu River compared to the baseline condition.

210. Other operation phase ecological impacts (e.g. noise and visual disturbance) are expected to be minor or negligible in scale, within the context of the modified and populated lowland areas of Xinyu City.

6. Social

211. For lands within the boundaries of the HSRND, these will be acquired by the XCG and re-zoned for commercial and residential use as per the HSRND Master Plan. Persons and communities affected by the ADB-supported components of the HSRND are included within the project resettlement plan. For all other affected persons and land uses, the XCG will implement livelihood restoration plans (including cash compensation, skill training, employment promotion and social insurance) and official XCG resettlement plans. Agricultural land to the south of the planned HSRND is irrigated with water from the existing Spring Lake, through a small irrigation channel that discharges into the Kongmu River. After completion of the Project, this irrigation water supply could be affected, as the existing lakes will no longer be intended for irrigation water use, and water from the lakes will be discharged through new canals rather than irrigation channels. To offset this risk: (i) a loan assurance is included in the Project to ensure an adequate water supply is maintained to the irrigation area during and after Project completion (Section XI); (ii) one of the new Project canals, Tianyun, will convey water from Spring Lake and Yun Lake to the Kongmu River, and extend through the irrigation area. The potential to extend a new irrigation channel from the canal will be assessed during the detailed design phase; and, (iii) irrigation outlets are present in all of the existing lakes, and will be retained, including within Spring Lake, so that the lakes may be used for irrigation if required. Within the Kongmujiang National Wetland Park, none of the existing crossings for people and livestock will be affected by the project i.e. there will be no impacts on daily movements and access.

7. Physical Cultural Resources

212. No cultural heritage or archaeological sites are known from the Project area.

E. Indirect, Induced, and Cumulative Impacts

213. Indirect impacts are adverse and/or beneficial environmental impacts which cannot be immediately traced to a project activity but can be causally linked. Induced impacts are

adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project which may occur later or at a different location. Cumulative impacts are the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project.

214. **Indirect impacts.** The hydrology and ecology of the Kongmu River might be affected downstream of the HSRND as a consequence of the Project. The scale of these impacts is considered negligible for the following reasons (i) Stormwater from the HSRND will be managed to ensure no increase in the volume of run-off or peak discharge entering the Kongmu River; (ii) Stormwater from the HSRND will be managed to ensure water quality impacts to Kongmu River are controlled; (iii) Construction of the embankment adjacent to Kongmu River can reduce the volume of water stored on the floodplain (causing increased flows downstream), but in this case the lost flood storage capacity is minimal. Hydrological modeling conducted as part of the PPTA found the effect of embankment construction on downstream flooding too small to be quantified.

215. **Induced Impacts.** Potential induced impacts could arise if the stormwater management designs in the Project are not as effective as expected. As a consequence, water discharged into the Kongmu River could be of less than Grade III Standard, impacting water quality, drinking water supplies and ecological resources. This impact is likely to be of limited concern due to the relatively small volume of water discharged from the HSRND compared to the overall flow volume of the Kongmu River. The HSRND constitutes only 3% of the entire Kongmu River Catchment, meaning that water discharged into the river from the HSRND will have a small impact on overall River water quality even if Grade III Standards are not achieved. Furthermore, a requirement for water quality monitoring upstream and downstream of discharge points into the Kongmu River has been included in the EMP. In the event that the water quality standard at the outflow does not meet standards, a review of wetland treatment system management will be conducted to identify potential source of poor discharge standards, and implement remedial measures. This action is also included as a loan assurance between the XCG and ADB. The HSRND will not involve any industrial development or associated impacts.

216. **Cumulative Impacts.** The proposed project is linked with the development of the planned HSRND. Successful delivery of the HSRND and the current project adopting ‘Sponge City’ will increase water resource management capacity in Xinyu, and serve as a model for future water-sensitive urban developments in Xinyu and the wider Jiangxi Province.

F. Climate Change

1. Climate Risk Vulnerability Assessment

217. A Climate Risk Vulnerability Assessment (CRVA) was conducted for the Project based on the projected climate change assuming a Project design life of 30-40 years. Many of the Project components and outputs will have significant positive effects and contributions to the climate change resilience of the Project Area. Key adaptation measures included in the Project design are described below.

218. **Enhancing Flood Retention Capacity of Rivers and Lakes.** The adaptation issues considered include: (i) material and site selection will be based on estimated climate change impacts and risks; (ii) in the design of canals, dams and gates linking lakes and Kongmu River, recurrence intervals for floods may be potentially altered due to the increasing intensity of storm events; (iii) for rivers, dams, and flood gates (if involved), reducing the risks of deposition, slippage, overtopping should be taken into consideration; (iv) the design of the river channel needs to provide sufficient velocity for self-cleansing during low flow conditions.

219. An assessment was made of water levels for ten canals for 5% AEP under climate change. The increase in water levels along the canals ranged from 0.0m to 0.15m (Table -8), and the design of the canals updated to accommodate predicted increased flow.

Table VI-8. Computed Water Level Changes for Canals

Canal	Base elevation (m)	Water level (m)		
		Historical climate	Increase in design flows of 15%	Changes
Xiaxi (Upper reach)	66.18-70.00	68.38-71.52	68.50-71.53	0.01-0.12
Quinquang	62.67-65.39	64.55-66.97	64.59-67.02	0.01-0.05
Xiaxi (Lower reach)	57.55-62.49	60.75-63.07	60.88-63.12	0.05-0.13
Tianyun	50.00-62.00	56.05-64.10	56.05-64.21	0.00-0.15
Yudai	62.85-70.00	64.05-72.20	64.40-72.33	0.07-0.13
Shen	53.00-63.00	56.69-64.60	56.65-64.61	0.00-0.05
Tian	56.01-60.79	57.85-62.73	57.89-62.74	0.01-0.04
Cloud	63.16-66.00	65.35-68.04	65.47-68.04	0.00-0.12
Qing	65.93-69.00	68.35-71.11	68.43-71.13	0.02-0.08
Xianglong	64.00-68.00	64.18-69.17	64.20-69.18	0.01-0.03

220. **Sponge City planning and with innovative stormwater management**. The bioswales along Xiangyun Road will be 8 m in width; with a stormwater conveyance capacity of 12m^3 per meter of the swale. The storage capacity has been increased by 15% over the original design rainfall to account for climate change.

221. **Enhancing flood prevention capacity of Kongmu River.** The adaptation issues considered include: (i) The material selection of earth dikes and concrete walls will be based on estimated climate change impacts and risks; (ii) in the design of earth dikes, concrete walls and flood detention areas, the potential alteration of recurrence intervals for floods and flow rates due to the increasing intensity of storm events will be considered.

222. An assessment was made of flood levels for the 2% AEP flood under climate change. The average increase in flood levels along the Kongmu River was 0.28 m (Table VI-9). Under the impact of climate change the 2% AEP flood levels are similar to the 1% AEP flood levels for the historical climate.

Table VI-9. Computed Flood Levels in Kongmu River under Climate Change Scenario (from SD1-Enhance Flood Management)

Location	Invert Level (m)	Flood Levels – Existing Climate (m)				Flood Levels – Climate Change (m)
		1% AEP	2% AEP	5% AEP	10% AEP	2% AEP
Buxing Bridge	54.66	61.64	61.47	61.18	60.21	61.61
Yangtanxin Bridge	52.12	60.60	60.56	60.52	59.33	60.42
Huangcun Irrigation Bank	52.00	58.99	58.73	58.38	57.91	58.95
Downstream Huangcun Irrigation	52.00	58.97	58.71	58.36	57.89	58.93
Li Jia	53.43	58.76	58.50	58.15	57.70	58.72
Zhongjia Gaotie Bridge	52.03	58.34	58.07	57.76	57.19	58.30
Shangfen Bridge	51.02	57.84	57.56	56.70	56.20	57.80
Guanchao Arch Bridge	50.35	56.87	56.53	56.00	55.57	56.82
Cunquan Irrigation Ditch	50.70	56.61	56.20	55.56	55.03	56.55
Shanxia Village	49.28	56.46	56.03	55.34	54.72	56.40
Changjin Gaosu Bridge	48.29	55.94	55.49	54.76	54.06	55.87

Location	Invert Level (m)	Flood Levels – Existing Climate (m)				Flood Levels – Climate Change (m)
		1% AEP	2% AEP	5% AEP	10% AEP	2% AEP
Linchang Wood Dam	47.51	54.59	54.21	53.59	52.98	54.52
Hupo Power Station	47.00	54.44	54.06	53.48	52.90	54.37
Downstream Power Station	47.00	54.34	53.85	53.18	52.43	54.27
Hupo Old Bridge	45.13	54.16	53.66	52.94	52.13	54.09
Road Instersection	44.03	52.33	51.81	50.97	50.18	52.26
Baiyun Reservoir Dam	43.00	45.91	45.62	45.16	44.77	45.87

223. The calculated water level for 2% AEP for flood levees is 54.06 m under historical climate and the corresponding top of channel embankment calculated is 56.45 m. The calculated water level for 2% AEP for flood levees is 54.38 m considering climate change and the corresponded top of channel embankment calculated is 56.77 m.

224. **Adaptation measures for water pollution management and water-related basic amenities.** The adaptation issues considered include: (i) selection of materials, instruments, wastewater and stormwater pipes and the site will be based on estimated climate change impacts and risks; (ii) the instruments will be placed in a safe place to avoid the impact of floods; (iii) selecting appropriate construction materials and protection measures to avoid equipment aging and damage due to high temperatures and extreme weather conditions; (iv) appropriate foundation protection and compaction will be adopted to avoid network system damage due to flooding and ground subsidence; (v) the design of wastewater collection system is required to provide self-cleansing velocity during low flow condition; (vi) during construction, risky assets will be able to be protected, replaced or moved in emergency, such as electricity supply and acquisition.

225. Adaptation measures for wastewater network include: (i) The materials selection for sewage network and pump station consider potential leakage caused by ground subsidence; (ii) The pump stations have been designed with self-cleansing capacity as an adaptation to increased precipitation variability, and to account for drought conditions.

226. Adaptation measures for stormwater network are considered in the Project design as following. (i) Taking increasing annual precipitation and rainfall intensity into consideration, the storage capacity for rainwater cabin has been increased by 15%; (ii) ground subsidence and structural deformation have been considered in the sub-surface utility design.

227. **Solid waste collection and transportation.** Adaptation measures included in the Project design include: (i) The location of solid waste collection, transfer and staff rest sites have been designed to cope with the requirements of local flood control standards and the flood hazard map provided by the PPTA; (ii) the solid waste transfer equipment have been designed with high-performance seals, so that if flooding occurs the contaminants will not leak; (iii) The material of garbage container materials and other equipment have been design to resistance to local extreme climate.

228. **Landscaping and wetland design.** Adaptation measures adopted for the Project design for selection of plant are that: (i) all selected plant species are native species; (ii) all species occur across a wide range latitudes, including north of Jiangxi Province.

229. The projected increase in annual precipitation and rainfall intensity will increase the stormwater flow into constructed wetlands. The potential increase in stormwater could increase the quantity or decrease the quality of stormwater treated by wetland. Constructed

wetlands have been designed to accommodate a 15% increase in precipitation, increasing the area of constructed wetlands by 1.93 ha over the original design. Other adaptive changes to constructed wetland design are summarized in
230.
231.

232. **Table**10 and VI-11.

Table VI-10. Changes in wetland design to adopt climate change

Aspect	Historical climate	Climate change impacts
Precipitation (mm)	1603	1843
Annual runoff (1,000 m3)	11910	13,710
Stormwater treatment (t/d)	32655	37553
Stormwater treated by wetland (t/d)	10,895	12,528
Wetland area (ha)	12.85	14.78
Investment (million CNY)	92,0634	96,5193

Table VI-11. Water Quality Control Considering Adapation Measures

Pollutant	Increased by climate change (t/a)	Water quality		
		Without adaptation (mg/L)	With adaptation (mg/L)	Target (mg/L)
COD	1.37	20.1	20	20
TN	0.68	1.05	1	1
TP	0.27	0.22	0.2	0.2

2. Greenhouse Gas Emissions

233. Major project greenhouse gas (GHG) emissions were calculated for electricity use in: (i) the garbage salvage boats and pumping stations, during operations; and, (ii) municipal solid waste (MSW) management, in which GHGs are emitted through the processes of household solid waste management, including collection and transport, waste treatments, infrastructure for waste treatment facilities, and production of energy and ancillary materials consumed. Total GHG emissions for i and ii were estimated at ~478 t CO_2 equivalent (t CO_{2e}) per year (Table VI-12a) and ~33,703 t CO_{2e}/year (Table VI-12b) respectively. Total combined GHG emissions were estimated to be about 34,180 t CO_{2e}/yr. These values are well below the SPS threshold level of 100,000 t CO_{2e} per year.

Table VI-12a. Estimation of Annual GHG Emission by the Project, Excluding Municpal Waste Management

Items	Units	tons CO_2 equivalent
Hook arm waste vehicles (< 5t) -(12,000 km/yr)	9	44.064
Waste transport vehicle (23t)- (15,000 km/yr)	4	24.48
Road sweeper (16t)- (15,000 km/yr)	4	24.48
Garbage cleaning vehicle (16t)- (15,000 km/yr)	3	18.36
Suction sewage truck (< 5t)- (15,000 km/yr)	1	12.648
Waste Collecting Boats (kw-hr/year)	36,990	25.08
Pumping station for Wastewater (kw-hr/year)	273,750	185.60
Household Solid Waste Management (kw-hr/year)	52,017	35.27
Wetland (kw-hr/year)	158,400	107.40
Solid Waste Incineration (tons)	32,485	6887

Total		**477.38**

Note: estimated using online GHG calculator (www.carbonneutral.au). Estimates of unit numbers are from the detailed engineering design report for the project.

Table VI-12b. Estimation of Annual GHG Emission by the Municpal Waste Management

Assumed fraction dry biomass	0.5	
Tons CH4 (methane) generated per ton of dry MSW	0.083	tCH4/ton dry MSW
Tons of wet MSW generated per year	32,485	tons wet MSW/year
Tons of dry MSW per year (50% dry)	16242.5	tons dry MSW/year
Annual methane generation	1348.1275	tCH_4/year
GWP of Methane	25	tCO_2/tCH_4
Annual CO_2eq generation	**33,703**	**tCO_2/year**

VII. ANALYSIS OF ALTERNATIVES

234. During Project preparation, alternative designs were assessed in consideration of technical, economic, and energy efficiency and environmental and social impacts. Seven alternatives were assessed: (i) 'no Project' alternative; (ii) lake dredging and sludge treatment methods; (iii) HSRND Canal alignments; (iv) sub-surface utility systems (v) flood embankment alignments (vi) wastewater management systems; and (vii) artificial wetland schemes.

1. No-Project Alternative

235. If the Project is not implemented, adverse environmental, social and economic impacts can be expected in the HSRND, adjacent areas and Kongmu River, including (i) deteriorating water quality in the Kongmu River; (ii) continued/increased risk of damage to people, residential properties, agricultural land, infrastructure and other physical assets from flooding; (iii) increased illegal dumping of solid waste causing environmental nuisances; (iv) degradation of natural resources and biodiversity; and (v) increased nuisance/traffic delays in the HSRND resulting from utilities maintenance.

2. Design Options for Output 1: Development of Integrated Rural and Urban Flood Management System Flood Management Systems and Measures

2.1 Increase Flood Retention Capacity in the Upper Watershed

236. For lake dredging required under the Project, three alternatives (excavate, transport and blow technology; harrow, throw and blow technology; and direct blow and fill technology using cutter suction dredger) where reviewed. A summary of these alternatives is provided in Table VII-1. The direct blow and fill technology of cutter suction dredger is considered the preferred method due to high efficiency, low cost, adaptability to different soil properties and suitability for working in relatively shallow waters.

Table VII-1. Alternatives Comparison of Dredging Method

Dredging Method Alternatives	Application condition	Advantages	Disadvantages
Excavate, transport, blow technology	Inland rivers and lakes, coastal wharfs. Dredging/ filling of sandy and cohesive soils	Flexible layout, economical dredging cost, adapting to excavating sandy soil and cohesive soil	Low vacuum power, poor effect of excavating flowing sludge
Harrow, throw (transport), blow technology	Inland river and lake area of gentle storm	Small impact on navigation during construction, limited disturbance to soil properties, suction dredger's inadequate array can be solved by adding pumps.	Has requirements on property of soil needs dredging, not suit simultaneous sweeping and construction, loading facility is needed on trailing suction dredgers.
Direct blow and fill technology of cutter suction dredger	Inland river and lake areas. Various soil types	High efficiency, relatively economical dredging cost, high construction precision, strong adaptability to soil property, environmental reamer can be installed to meet the requirement of	Small-type cutter suction dredger's has low vacuum power and array pitch is short, if the array pitch is long, booster pump is needed, which is not economical

		environmental dredging	

237. Dredged material from the lakes will require treatment and disposal. Two alternative methods were reviewed for sludge disposal: transport to agricultural fields/gardens, and on-site landfill. The two options are compared in Table VII-2. On-site landfill is selected as the preferred option due to lower processing time, environmental impacts and transportation costs.

Table VII-2. Comparison table of sludge treatment plan

Item	Option 1: Transport to agriculture fields and gardens	Option 2: On-site landfill
Sludge drying requirement	High	High
Construction land use	A large drying landfill yard is needed, long drying time.	Do not need temporary landfill yard, just meet the requirement of construction site
Environmental impact	Odor pollution causes during landfill and drying; the product is beneficial to crops and can beautify the environment	Dehydrate and solidify sludge via adding curing agent, which can avoid odor; dried sludge is used to engineering backfill to avoid pollution spread during transfer
Construction progress	Long compost reaction time; drying is largely affected by weather	Drying equipment is joint with environmental cutter suction device; treatment not affected by weather
Transportation Costs	Higher	Lower

238. According to the HSRND Partition Plan (2010-2030), after the lakes in HSRND are connected, excess urban stormwater would be discharged into Kongmu River, upstream of the Baiyun Reservoir which is the water source of Xinyu No.4 Water Treatment Plant (Figure VII-1).

Figure VII-1. Original Canal Layout Option

239. To minimize potential water quality impacts to the Baiyun Reservoir, alternative

drainage options were reviewed. The key constraint in developing these alternatives is the topography of the HSRND. This runs from higher elevations in the northeast to lower in the southwest, making the Kongmu River the natural receiving waterbody for the HSRND. Directing all stormwater run-off to other locations (e.g., Xia River, located to the SE of HSRND) would require pumping and/or extensive regrading works of the whole HSRND which are not feasible. As a consequence, any alternative options still require the majority of HSRND drainage to run from northeast to southwest and discharge to Kongmu River. Other factors considered include water quality, land requisition and construction costs. Two alternative options were reviewed, as described below.

240. The second option would involve construction of a new canal from the upstream of Xiaxi River, crossing Mabuling Village, and then turning to the south to connect the Xia River. The general layout of Option 2 is shown in Figure VII-2 below. This option would result in 22.4% of stormwater discharge from the HSRND being diverted from the Kongmu River/Baiyun Reservoir to the Xia River, resulting in a moderate reduction in pollution loading to the Baiyun Reservoir (COD 66.22 t/a, TN 3.21 t/a, TP 0.64 t/a). To achieve these benefits, Option 2 would require construction of a new canal 4560 m long and ancillary infrastructure, along with several new bridges. It would increase land acquisition requirements by 18,000 m^2 compared to the original option, and would require about 6000 m^2 of demolition.

Figure VII-2. Layout of Option 2

241. The third Option reviewed would also divert a portion of stormwater drainage from the HSRND to the Xia River, but the Canal carrying this water would be further south than Option 2 (downstream of Qingquan Lake, Figure IV-3 refers). The available drainage amount accounts for 45.8% of the total drainage amount in the whole area. This would result in a moderate reduction in pollution loading to the Baiyun Reservoir (COD 45.77 t/a, TN 2.29 t/a, TP 0.46 t/a). To achieve these benefits, Option 3 would require construction of a new canal 3780m long and ancillary infrastructure, along with several new bridges. It would increase land acquisition requirements by 15,000 m^2.

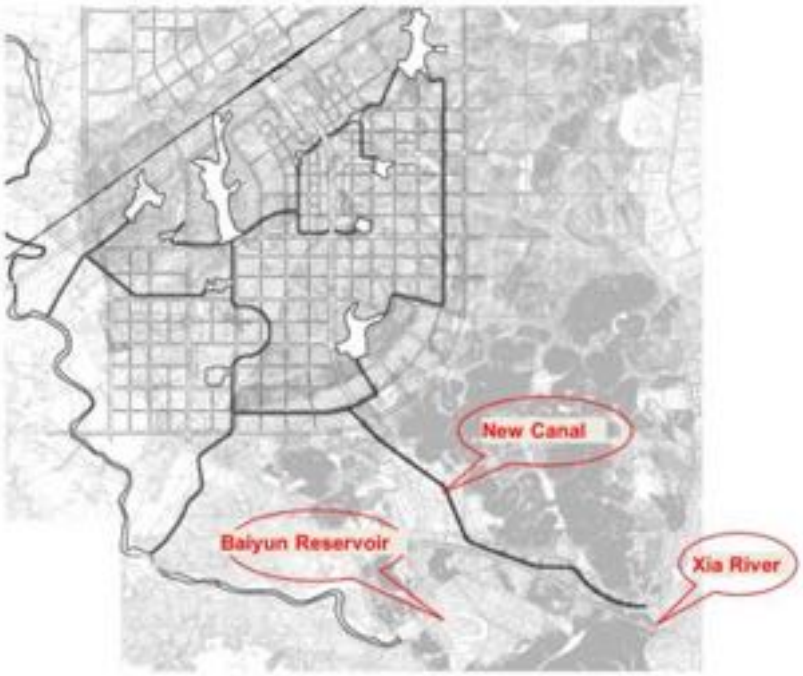

Figure VII-3. Layout of Option 3

242. The three Options are compared in Table IV-3 below. Options 2 and 3 can reduce pollution loading Baiyun Reservoir in flood period, but not by a substantial amount. However, these alternative Options would be much more expensive than the original option due to required land acquisition (and in the case of Option 2 demolition requirements) and construction costs. Taking these factors into consideration, the small improvement in water quality resulting from Options 2 and 3 does not justify the higher investment required. Option 1 was therefore selected as the preferred alternative.

Table IV-3. Comparison Table of plan layout plans

Item	Option 1	Option 2	Option 3
Percentage reduction of discharge to Baiyun Reservoir during flood period	0	22.9%	45.8%
COD inflow to Baiyun Reservoir (t/a)	82.76	64.22	45.77
TN inflow to Baiyun Reservoir (t/a)	4.14	3.21	2.29
TP inflow to Baiyun Reservoir (t/a)	0.83	0.64	0.46
Length of newly-construct canal (m)	-	4650	3780
Land acquisition and building demolition requirements	Land requisition and building removal within planning scope	Building removal of about 6,000m^2, land requisition of about 18,000m^2	Land requisition of about 15,000m^2
Other	-	Remove and restore 1 pump room; damage existing roads; construct 12 bridges; reinstate irrigation channels	Damage existing roads; construct seven new small bridges; reinstate irrigation channels

243. **Innovative on-site stormwater management.** Various alternative design elements of the SUSS were reviewed, including the overall section plan, diameter of water supply

pipelines, and stormwater drainage configuration. These options are as follows.

(i) Section plan alternatives. SUSS can be circular or rectangular in section. Circular sections are structurally strong, and can be constructed quickly using pipe-jacking method. Rectangular sections are generally required to be cast-in-place, but have a much better internal space utilization.
(ii) As SSUS would be constructed at the same time as major roads in the HSRND, open cut construction is feasible, and therefore the more space efficient rectangular sections would be adopted.
(iii) Water supply pipeline alternatives. With the development of the HSRND, population and water demand will increase considerably. Experience from similar new town developments in Jiangxi Province has shown that the design diameter of water supply pipelines is often insufficient. To provide some contingency for the Project if additional water supply pipelines capacity is required, two options have been reviewed: (i) reserve space within the SUSS for additional water supply pipelines of the same diameter as the pipelines in the plan; or (ii) include larger diameter pipelines in the SUSS.
(iv) Option 1 will allow for simple and convenient future upgrading as required. The disadvantage is that space reserved in the SUSS for additional pipes will be wasted if additional capacity is not required. For this reason, Option 2 is preferred to better utilize space within the SUSS.

244. **Stormwater drainage configuration alternatives.** Two stormwater drainage conveyance options within the SUSS were assessed. Option 1 included a small stormwater drainage compartment within the SUSS located on top of larger compartment but no additional areas for stormwater storage. Option 2 has a slightly larger stormwater drainage compartment that can be used for temporary storage of excess stormwater. (Figure VII-4).

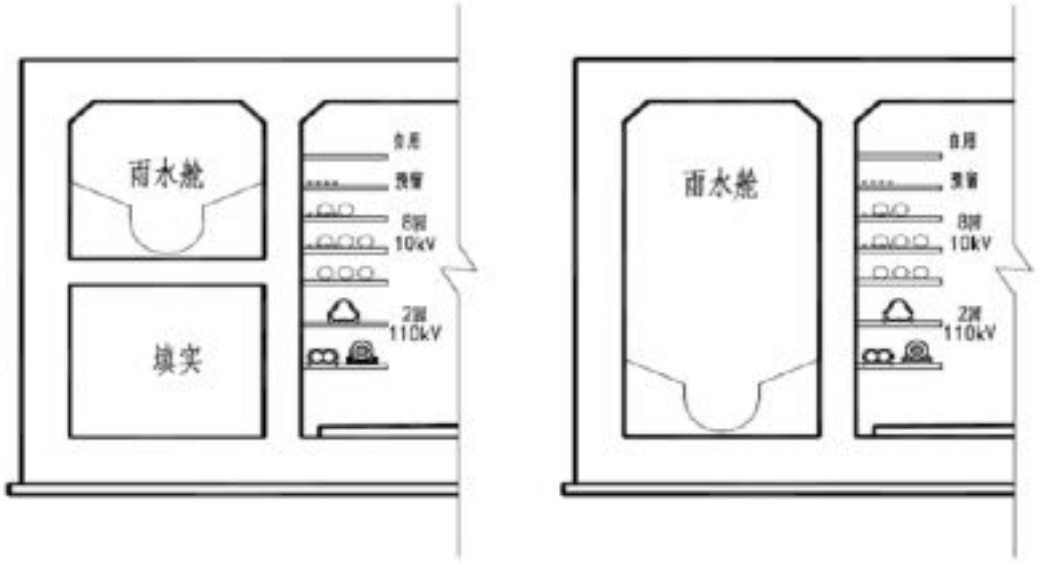

Figure VII-4. Option 1 (l) and Option 2 (r) Stormwater Drainage Configuration Alternatives

245. The two options are compared in Table VII-4. Option 1 is the preferred alternative in the view of saving investment and making stormwater flow into water body by itself. However, if the below space of stormwater cabin in Option 2 can be used for the initial rainfall storage and pollution control to satisfy the functional demand of tunnel, the Option 2 is recommended. Currently, constructing an individual stormwater compartment (Option 2) is recommended.

Table VII-4. Comparison of Stormwater Drainage Configuration Alternatives

Item	Option 1	Option 2
Section size	Smaller overall size due to effective	Larger overall size due to individual

	use of the space above other cabin	cabin
Security	Stormwater cabin is set above other cabin, so waterproof will be noticed during construction	High security since individual cabin is set to avoid impacts on other cabins

2.2 Flood Protection along Kongmu River

246. **Embankment and associated infrastructure.** Two embankment alignment options along the Kongmu River were reviewed under this Project. The alternative alignments are shown in Figure VII-5, and a summary comparison is provided in Table VII-5.

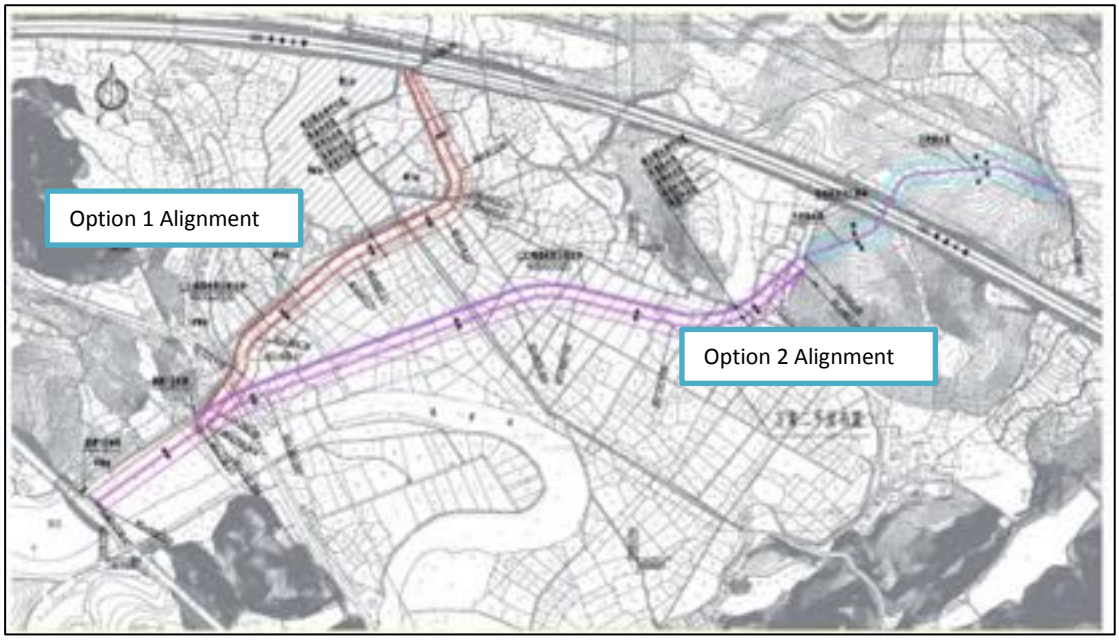

Figure VII-5. Alternative Embankment Alignments along the Kongmu River

Table VII-5. Comparison of Alternative Embankment Alignments along the Kongmu River

Item	Option 1	Option 2
Description	Construct 1.19 km embankment; new drainage ditch (0.909 km) behind embankment; new sluice gate; new pump gate	Construct 1.47 km embankment; new drainage ditch (1.244 km) behind embankment; new drainage canal of about 580.5 m; 2 sluice gates; and, reform a people-passing box culvert
Protection Scope	Protect village of about 0.12 km^2, farmland of about 0.19 km^2	Protect village of about 0.16 km^2, farmland of about 0.47 km^2
Drainage Type	Centralized water catchment, compulsive drainage with pump	Excavate drainage canal, self- drainage
Construction Difficulty	Construct embankment on land, small difficulty	Construct embankment on land, but need to reconstruct existing G60 Highway people-passing box culvert into drainage box culvert and excavate drainage canal, larger difficulty
Impacts on Baiyun Reservoir	Occupy 0.31 km^2 of Baiyun Reservoir	Occupy 0.63 km^2 of Baiyun Reservoir
External Coordination	Relatively easy	Requires coordination with highway management department
CAPEX (xCNY10,000)	7066	7490
OPEX (xCNY10,000)	36.78	17.64

247. Option 2 has advantages of protecting a larger area of farmland and village, and reduced operating costs as no pump would be require. On the other hand, Option 2 would require a significantly longer embankment, and would also have greater interface issues with the existing highway and Baiyun Reservoir, increasing cost and inter-government department collaboration requirements. For these reasons, Option 1 was selected.

3. Design Options for Output 2: Construction of water pollution sources management systems and water-related basic amenities

3.1 Expansion of Wastewater Service Delivery System

248. Early plans by the XCG to include expansion of the Xiacun WWTP in the Project were subsequently changed. The following information was prepared prior to this change and is retained for completeness of due diligence. Two alternative wastewater management options were originally reviewed. Option 1 would involve expanding the existing Xiacun WWTP from 10,000 m^3/d to 25,000 m^3/d by 2020, and 40,000 m^3/d by 2030; and upgrading Xiacun WWTP from Class 1B to Class 1A. This option would require the installation of two wastewater pumping stations. Effluent would be discharged to the Yuan River. Option 2 would involve constructing a new WWTP for the HSRND (15,000 m^3/d by 2020 and 30,000 m^3/d by 2030) at the south west corner of District. Effluent would be treated to meet Class IV of surface water quality standard, and reused to maintain lake/canal levels and for landscape irrigation. The two options are shown in Figures VII-6 and VII-7 below, and compared in Table VI-6.

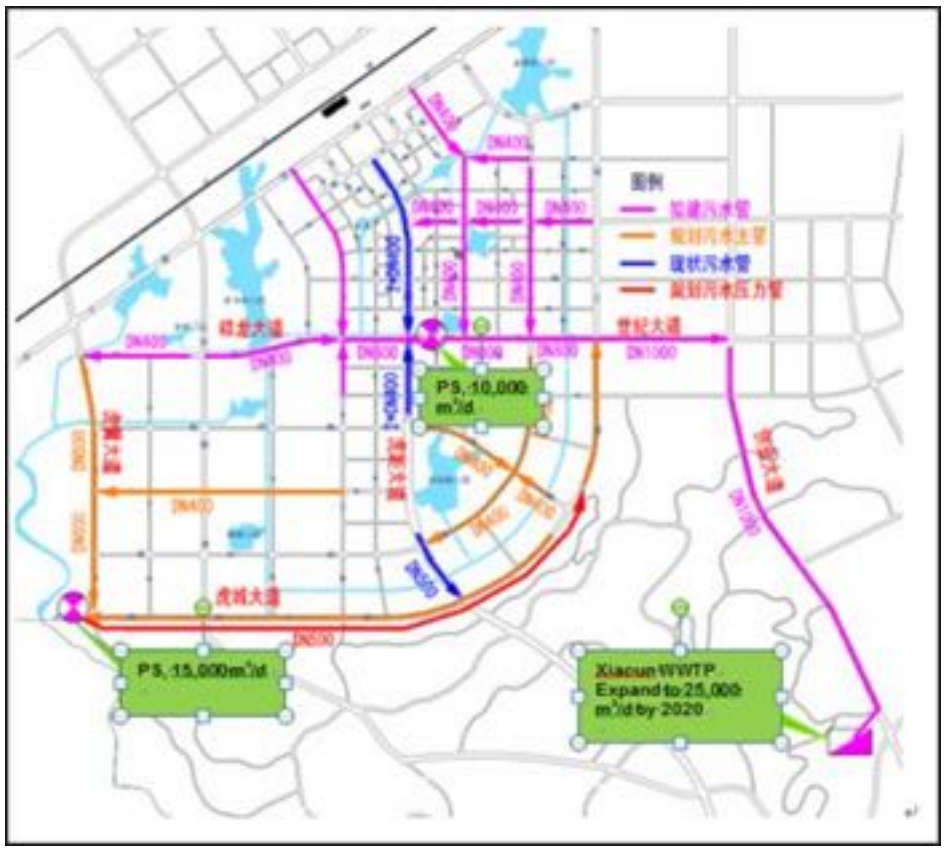

Figure VII-6. Wastewater Treatment Scheme – Option 1

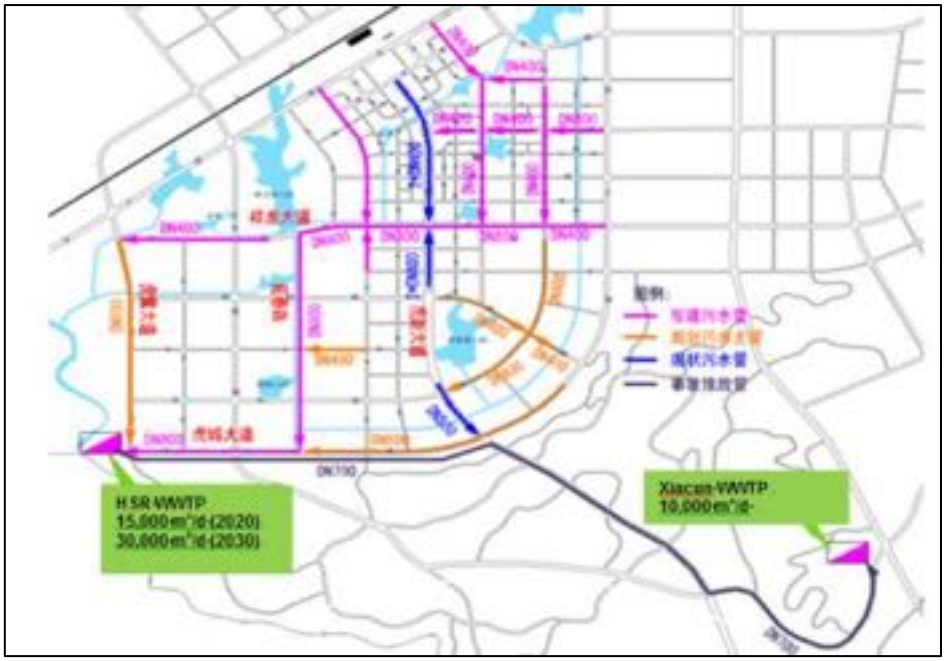

Figure VII-7. Wastewater Treatment Scheme – Option 2

Table VII-6. Comparison of Alternative Wastewater Management Options

Wastewater Management Options	Advantages	Disadvantages
Option 1 1) WWTP expansion of 15,000 m^3/d, Class 1A discharge standard 2) Sanitary sewers of 13.8 km 3) Two pumping stations (15,000 m^3/d & 10,000 m3/d)	• Consistent with existing plans • Land for WWTP expansion has been reserved. • No impact to water quality of Kongmu River	• Long connection pipe to Xiacun WWTP • No water reuse. • High pumping cost.
Option 2 1) New WWTP construction of 15000 m^3/d, effluent meets Class IV of surface water standard 2) Sanitary sewers of 13.2 km 3) Emergency outfall 7.1 km 4) Reclaimed water pipe 26 km	• No pumping station needed. Wastewater flows by gravity. Save energy for pumping. • Waste water reuse to replenish the lakes.	• High requirement for treatment efficiency of WWTP and artificial wetland. • Risk for drinking water safety.

249. The comparison in Table VII-6 shows that Option 2 has some advantages as it requires no pumping, and would allow for long-term sustainable reuse of treated wastewater. However, very high treatment standards would be required given that treated wastewater would eventually be discharged to the Baiyun Reservoir. Given the cost involved and the risk to public health in the event of technical issues with the WWTP, Option 1 is considered a safer and more preferable alternative.

3.2 Construction of a Solid Waste Management System

250. According to existing environmental and sanitary plans, and the current situation of solid waste management in Xinyu City, it is proposed that all waste collected under this Project would be transferred to Xinyu City Household Waste Incineration and Power Generation Plant for treatment. Two alternative schemes were considered (Table VII-7) to collect and transfer waste to the Incineration Plant. Under Option 1, waste transfer stations would be established for Ouli Town/Guancao Town and the HSRND. The waste would be compressed in the transfer stations and sent to the Incineration Plant for treatment. Under Option 2, waste generated from the HSRND would be taken to Ouli Town/Guancao Town Waste Transfer Station, then taken to the Incineration Plant (i.e., no separate waste transfer

station at the HSRND).

Table VII-7. Comparison of construction cost of waste collection and transfer system. Price in CNY x10,000

Item	Option 1				Option 2			
	Quantity	Unit	Unit Price	Total price	Quantity	Unit	Unit Price	Total price
Hook arm waste truck	5		180000	90	4		180000	72
Hook arm waste box	38		18000	68.4	37		18000	66.6
Waste transfer station	1		3000000	300	2		3000000	600
Waste transfer truck	2		500000	100	2		500000	100
Total				**558.4**				**838.6**

Note: This table only includes the different investment of Option 1 and Option 2, the same investment is excluded, such as waste bin, waste collection station, etc.

Table VII-8. Comparison of annual operation cost of waste collection and transfer system. Price in CNY x10,000

Item		Option 1				Option 2			
		Quantity	Unit	Unit Price	Total price	Quantity	Unit	Unit Price	Total price
Staff salary	drivers and operators of hook arm truck	5		30000	15	4		30000	12
	drivers of transfer truck	2		30000	6	2		30000	6
	management staff of transfer station	2		30000	6	4		30000	12
Waste transport cost	collection station - transfer station	162060	km	0.71	11.5	105120	km	0.71	7.5
	transfer station - treatment plant	54020	km	1.48	8	61758	km	1.48	9.1
Maintenance cost	Assumed 1% per annum of original investment				5.6				8.4
Total					52.1				55

Note: This table only includes the different investment of proposal 1 and proposal 2, the same investment is excluded, such as salary of cleans, etc.

251. From Tables VII-7 and VII-8, it can be seen that the construction cost of Option 1 is CNY2.802 million lower than Option 2, transport costs are lower, and maintenance costs could save CNY29,000/yr. Option 1 was selected as the preferred scheme.

3.3 Maintenance of the Amenity Space along the Lakes

252. The quality of stormwater can be improved by various ecological treatment processes. Three alternatives, constructed wetlands, stabilization pond, and floating wetlands were reviewed to determine the most appropriate approach for this Project based on various criteria, as described in Table VII-9.

Table VII-9. Comparison of Water Quality Treatment Alternatives

Treatment Process	Advantages	Disadvantages
Constructed Wetland	1) Low construction cost, low energy consumption, easy maintenance and management 2) Good pollutant removal effect 3) Provides ecological, landscape and social benefits	1) Requires moderate footprint 2) Potential mosquito nuisance 3) Can become clogged because of poor management.
Stabilization	1) Can utilize existing terrain, with simple	1) Requires large footprint

Treatment Process	Advantages	Disadvantages
Pond	structure and low construction cost 2) Easy, low cost maintenance and management 3) Limited sludge production 4) Good impact resistance for water quality and water quantity	2) Climate has a great influence on the treatment effect 3) If the design or operation management is not properly, it will be made secondary pollution 4) Potential mosquito and odour nuisance 5) Sludge is not easy to discharge, treatment or utilization.
Artificial Floating Island	1) Flexible design can be deployed in various configurations 2) Can be used in deeper waters where aquatic plants can't be planted 3) Provides ecological and landscape benefits	1) Suitable for slightly-polluted surface water body 2) Potential mosquito nuisance 3) Construction and O&M cost is higher

253. Based on the expected quality and quantity of stormwater runoff, this Project will use constructed wetlands for stormwater treatment. This option is preferred due to water quality treatment capacity, low construction costs and flexible design options. Different designs of artificial wetland systems were reviewed (Table VII-10).

Table VII-10. Alternatives Comparison of Artificial Wetland Wastewater Treatment

Parameters	Surface flow	Subsurface flow	Subsurface upward vertical flow	Subsurface downward vertical flow
Flow Characteristics	surface overflow	horizontal subsurface flow	upward vertical flow	downward vertical flow
Load	Low	Relatively high	High	High
Occupation area	Large	Medium	Relatively small	Relatively small
Structural complexity	Simple	Medium	Complex	Complex
Construction cost	Low	Relatively high	High	High
Operational costs	Low	Medium	Low	Low
Seasonal changes in performance	Medium-high	Medium	Medium	Medium
Sanitary conditions	Relatively poor	Good	Medium	Medium
Landscape value	Good	Good	Relatively good	Relatively good
Removal of micro-organism	Medium	Strong	Strong	Strong
Nitrification	Relatively strong	Relatively strong	Medium	Strong
Denitrification	Weak	Strong	Relatively strong	Medium
Removal of phosphorus	Weak	Relatively strong	Relatively strong	Relatively strong

254. The Project area has a moderate climate with four distinct seasons, sufficient sunshine, abundant rainfall, a long frost-free period and short winter. Under these conditions, and based on the likely pollution loading of water to be treated, all of the wetland alternatives considered could meet the requirements for water quality improvement. Therefore, the most cost effective option with maximum water quality improvement has been selected. This would involve combining two options: "water surface flow artificial wetland + subsurface flow artificial wetland". By combining these two processes, nitrogen and phosphorus removal will be maximized.

VIII. PUBLIC CONSULTATION, PARTICIPATION AND INFORMATION DISCLOSURE

255. Meaningful participation and consultation for Project planning, feasibility study, environmental impact and mitigation, design and implementation are important safeguard requirements. The PRC Environmental Protection Law and the Regulations of the Administration of Construction Project Environmental Protection (Order No. 253 of the State Council) require that a DEIA solicits the opinions of organizations concerned and residents within and near the project sites. In August 2012, the PRC National Development and Reform Commission (NDRC) issued a requirement for "Social Risk Assessment of Large Investment Projects", which emphasizes the importance of public consultation in an effective manner, and requires that the results of public consultation are clearly summarized in the DEIA report. ADB's SPS (2009) also requires meaningful public participation, consultation and information disclosure. The consultation process for this Project followed both the PRC law and the SPS.

256. Public consultations for the environmental assessment were undertaken between March and June 2016 and included: (i) information disclosure; (ii) informal communication with key stakeholders which include residents, local authorities and sector specific institutions and authorities; (iii) questionnaire surveys; and (iv) stakeholder meetings attended by residents and other concerned stakeholders.

A. Information Disclosure

257. The first information disclosure was undertaken by the DEIA institute on 15 March 2016, supported by a web page on the Xinyu Government website describing the planned Project. The disclosure explained the basic specifications of the Project construction, work procedure and content of the DEIA, main purpose and opportunities for public consultation.

Figure VIII-1. First Round of Project Information Disclosure in Xinyu Government Website

258. In translation, the notice reads:

> **The first publicity of EIA of Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project**
>
> In accordance with the "*Interim Measures for Public Participation in Environmental Impact Assessment, State Environmental Protection Bureau 2006 [the 28th*]", information disclosure on the Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Management Project, as follows:
>
> 1. Project description
> 2. Contact information of both the construction unit and domestic EIA institute
> 3. Work procedure and main contents of EIA
> 4. Items of public consultation
>
> (details are included under each of these headings)

259. The second information dissemination phase was undertaken by the EIA Institute on May 12, 2016, when the environmental impacts were assessed and mitigation measures formulated. Information disclosures explained the summary of the draft DEIA report, and the comments collection for the public. This was also supported by internet disclosure at Xinyu Government website. The web page is translated below.

Figure VIII-2. Second Round of Project Information Disclosure in Xinyu Government Website

260. In translation, the notice reads:

The second publicity of EIA Summary of Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project

In accordance with the "*Interim Measures for Public Participation in Environmental Impact Assessment, State Environmental Protection Bureau 2006 [the 28th*]", information disclosure on the Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project, as follows:

1. Project Overview
2. Positive environmental impact of the project
3. Summary of the possible harmful environment impact caused by the project.
4. Prevention and mitigation for the harmful impact
5. Conclusion of the EIA report
6. The main ways for public comments collection
7. Main items for public comments
8. Ways for the public to refer to the summary of EIA
9. Publicity period

(details are included under each of these headings)

B. Public Consultation

261. First Round Public Consultation. The first round of public consultation was undertaken in the form of a questionnaire survey, which was conducted on 15-17 June 2016 during the period of second round of information disclosure. Fifty-five questionnaires were distributed and 53 (96.4%) were returned. They focused on the understanding of the Project, and the view on the potential impacts on the environment during construction and operation stage. The breakdown of 44 personal participants and the results of questionnaire survey are listed in Tables VIII-1 and VIII-2 respectively. The number of respondents is small in the context of Yushui District as a whole, but the total number of residents directly and permanently affected by Project construction would form a very small proportion (3,693 people; or less than 0.4%) of the total population of Yushui District.

Table VIII-1. Round 1 of Public Consultation Undertaken by PMO, EIA Institute and PPTA Team. Breakdown of Participants

Participants		Number	Ratio%
Gender	Male	40	91%
	Female	4	9%
Age	< 40	13	30%
	40-60	22	50%
	>60	9	20%
Education	College degree or above	3	7%
	Middle school	31	70%
	Primary school	10	23%
Profession	Officer	0	0%
	farmer	44	100%
	Workman	0	0%
	self-employed and student	0	0%

Table VIII-2. Round 1 of Public Consultation Undertaken by PMO, EIA Institute and PPTA Team. Results of Questionnaire Survey

Question	Comments	Number	Ratio (%)
1. Do you agree with the Project construction?	Yes	44	100
	No	0	0
	Don't care	0	0
2. Are you satisfied with the environmental condition in the Project area?	Satisfied	6	13
	Dissatisfied	18	42
	Very dissatisfied	14	32
	Don't care	6	13
3. What do you think the effect of the	Significantly improved	5	11

Question	Comments	Number	Ratio (%)
proposed Project to the local flooding?	Slightly improved	25	57
	Not obviously effected	9	21
	Others	5	11
4. What is the main environmental problem to your life in the anticipate environment impacts?	Water pollution	31	70
	air pollution	11	26
	Noise pollution	37	85
	Ecological destruction	15	34
	Public health	16	36
	Others	6	13
5. How do you think the environment impact when the remediation measures are conducted?	No impact	13	30
	Acceptable	26	60
	Unacceptable	0	0
	Don't care	4	10
6. Do you think the proposed Project will benefit the local environment?	Benefit	44	100
	No benefit	0	0
	Don't know	0	0
7. What do you think the impact to local residents of the Project construction will be?	No impact	14	32
	Acceptable	27	62
	Unacceptable	0	0
	Don't care	3	6

262. All participants agreed with the Project construction, and thought the Project would benefit the local environment. 74 % of the participants were not satisfied with the existing local environment conditions. On the question of the flooding control effect of the Project, 68% of the participants thought the Project will improve the flood control along the Kongmu River.

263. The main concerns related to environmental impacts caused by the Implementation of the Project were water pollution (70 %), air pollution (26 %), noise (85 %), ecological degradation (34 %), community health (36 %) and other impact (13 %). On the question of the environmental impact when mitigation measures have been conducted, 30 %, 60 % and 10 % indicated no impact, acceptable and don't care respectively. No participant indicated they found proposed mitigation measures unacceptable. On the question of the impact to the life of local residents by the Project construction: 32 %, 62 %, and 3 % of the participants indicated no impact, acceptable and don't care respectively. No participant considered impacts to the lives of local residents to be unacceptable. Mitigation and management of these potential issues are addressed by the Project design and IEE, and will be enforced during Project construction through implementation of the Project EMP.

264. Second round public consultation. The second public consultation and participation were conducted on 17 June 2016 in the meeting room of Xinyu Investment Holding Group, after the preliminary draft DEIA was completed. It was conducted in form of a public forum by invitation (Figure VIII-3). A total of 26 participants attended (Table VIII-3) representing local communities and enterprises in the Project Area, and related government agencies.

Figure VIII-3. Public Forum on June 17, 2016

Table VIII-3. Communities, Enterprise, and Government Agencies Participated in the Public Forum June 17, 2016

No.	Communities/Enterprise/Government agencies	
1	Management Committee of HSRND	
2	Yushui District EPB	
3	Xiannvhu District EPB	
4	Guanchao Town Government	
5	Ouli Town Government	
6	No.4 WTP of Xinyu City	
7	Administrative Office of Yuk Sau Mountain National Forest Park	
8	Administrative Office of Kongmujiang National Wetland Park	
9	Shangfen village committee in Guanchao Town	
10	Manshan village committee in Guanchao Town	
11	Hupi village committee in Guanchao Town	
12		Huxia Village Group
13		Shanbei Village Group
14		Gaolouxia Village Group
15	Shangfen Village	Shangfen Village Group
16		Yapodang Village Group
17		Gaowuli Village Group
18	Maoshan Village	Maoshan Village Group
19		Nanxia Village Group
20		Darentang Village Group
21	Hupi Village	Meitan Village Group
22		Shebei Village Group
23		Xiashan Village Group
24		Hupi Village Group
25		Hejiashan Village Group
26		Louxia Village Group

Source: DEIA institute meeting records

265. The forum explained the basic specifications of the Project, DEIA process, status of the

surrounding environment, potential pollutants and control measures during the construction and operation stage. The main concerns were air quality, noise, and construction and domestic wastes generated during the construction stage. The DEIA Institute presented the planned mitigation measures to be adopted. All government agencies present expressed their support for the Project and readiness to coordinate with the PMO. Other participants expressed support and there was no opposition. The main issues raised by the participants and the reply from DEIA institute are shown as below (Table VIII-4).

Table VIII-4. Main Issues and Response

No	Main issues	Response
1	Raised by Yuk Sau Mountain National Forest Park: If the all of the rainwater flow into Kongmu River, it is worried about that polluted rainwater may cause the water pollution of Kongmu River.	The current situation in HSRND area is mainly farmland, and village area. There is also some pig farm in this area. The main pollution in this area is domestic waste, non-point source from farmland and point source from cultivation. These pollutant flow into Kongmu River by the current irrigation channels. After this Project construction, rainwater will be collected and treated by the constructed wetlands and then discharged in to Kongmu river. So this Project will benefit the water pollution reduction for Kongmu River.
2	Raised by Yuk Sau Mountain National Forest Park: Flood levees construction for Baiyun Reservoir may increase water level upstream, causing flooding of upstream areas including some farmland.	The increased water level caused by flood levees construction of Baiyun Reservoir belongs to the area of Kongmu River Watershed Planning. Flood embankments constructed for this project will not increase upstream flooding issues.
3	Raised by local resident: The farm irrigation facilities may be destroyed by the Project construction so impact the agriculture production.	The Project construction will be arranged in non-agriculture irrigation period. If there is damage to the irrigation facilities, repair will be conducted timely to ensure no impact to the agriculture production.

Source: DEIA institute meeting records

IX. GRIEVANCE REDRESS MECHANISM

266. A Grievance Redress mechanism (GRM) has been developed in compliance with ADB's SPS (2009) requirement to address environmental, health, safety, and social concerns associated with Project construction, operation, land acquisition, and leasing arrangements. The GRM is designed to achieve the following objectives: (i) provide channels of communication for local communities to raise concerns about environment- and social-related grievances which might result from the Project; (ii) prevent and mitigate adverse environmental and social impacts to communities caused by Project construction and operation, including those associated with resettlement; (iii) improve mutual trust and respect and promote productive relationships between the Project agencies and local communities; and (iv) build community acceptance of the Project. The GRM is accessible to all members of the community, including women, youth, and poverty-stricken residents. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media.

267. Public grievances to be addressed by the GRM may include damage to public roads, residences, and/or interruption of public services, dust emissions, construction noise, soil erosion, inappropriate disposal of waste materials, and safety measures for the general public and construction workers. Public grievances related to involuntary resettlement may relate to the lack, or un-timely payment of, compensation monies, other allowances, and/or lease monies as per entitlements described in the resettlement plan and associated documents.

268. The GRM meets the regulatory standards of the PRC that protect the rights of citizens from construction-related environmental and/or social impacts. Decree No. 431 Regulation on Letters and Visits, issued by the State Council of PRC in 2005, codifies a complaint acceptance mechanism at all levels of government and protects the complainants from retaliation. Based on the regulation, the former State Environmental Protection Administration (SEPA) published updated Measures on Environmental Letters and Visits (Decree No. 34) in 2006.

269. Currently in Jiangxi Province (and generally in the PRC), when residents or organizations are negatively affected by a development, they may complain, by themselves or through their community committee, to the contractors, developers, the local EPB, provincial EPD, or by direct appeal to the local courts. The weaknesses of this system are: (i) the lack of dedicated personnel to address grievances; and (ii) the lack of a specific timeframe for the redress of grievances. The Project GRM addresses these weaknesses.

270. The Xinyu PMO will appoint a PMO Environment Officer to coordinate the GRM. The Officer will instruct contractors and Construction Supervision Companies (CSCs) on the GRM procedures. The Officer will coordinate with Xinyu City EPB and other related government divisions, and will be supported by the Loan Implementation Environmental Consultant (LIEC) hired under the Project implementation support. The PMO has drafted GRM tracking and documentation system, and the contact persons in the system have also been confirmed by the PMO, Xinyu City EPB and IA.

271. The details of the GRM, including a time-bound flow chart of procedures, are included in the Project EMP (Attachment 1 of this IEE).

X. ENVIRONMENTAL MANAGEMENT PLAN

272. A Project Environmental Management Plan (EMP) has been prepared (Attachment 1), based on the DEIAs, discussions with the PMO, implementing agencies, Xinyu EPBs, other government agencies, and local communities. The EMP defines mitigation measures for the anticipated environmental impacts, institutional responsibilities, and mechanisms to monitor and ensure compliance with PRC's environmental laws, standards and regulations and ADB's SPS.

XI. PROJECT ASSURANCES

273. ADB-funded projects are required to comply with a standard set of loan assurances for environmental safeguards. In addition, the following Project-specific assurances are included in the Project agreement between ADB and the XCG.

(i) XCG shall ensure that all Project activities requiring the use of plants, including the Project embankments, constructed wetlands, landscaping, and post-construction rehabilitation, will only use native plant species from Xinyu City and which are locally sourced, to strengthen the rehabilitation of natural habitats and avoid the introduction of non-native invasive weeds.

(ii) XCG shall ensure that no fauna will be released as part of the Project.

(iii) XCG shall engage an environmental engineer with experience in the design of "Sponge City" requirements and constructed wetlands, to assist in the detailed design of the proposed HSRND. This will strengthen achievement of the water quality and flood management objectives under the Project, and, the Sponge City targets for the proposed HSRND.

(iv) The Project is designed to discharge water of at least national quality Grade III from the proposed HSRND into the Kongmu River. This water will be discharged via two canals, Tianyun and Shen, to be constructed by the Project. Xinyu City obtains its drinking water supply from water intakes downstream of the proposed HSRND, making its drinking water supply vulnerable to the upstream development. XCG shall ensure that: (i) a water quality monitoring program will be implemented at the outlets of the Tianyun and Shen Canals into the Kongmu River; and (ii) in the event that monitoring at either outlet indicates a decline in water quality below Grade III, XCG shall review the operation and maintenance of the Project water treatment structures (lakes, canals, constructed wetlands) and correct any issues identified responsible for poor performance of the system.

(v) XCG shall ensure that sufficient water is provided to the Project lakes, canals, and constructed wetlands, to ensure the efficient operation and maintenance of these facilities.

(vi) XCG shall ensure that for all communities which are dependent on water supply from the existing lakes in the proposed HSRND, these communities shall be assured an uninterrupted water supply after completion of the HSRND. In particular, XCG shall ensure the uninterrupted provision of irrigation water to cultivated land south of the proposed HSRND, which currently receives its irrigation water from Qingquan Lake.

(vii) XCG shall ensure that stormwater in the south-west portion of the proposed HSRND, which is not covered by the Project water drainage and treatment system, will be pumped to Yun Lake, for subsequent discharge. This will achieve complete capture of all stormwater under the Project design for the proposed HSRND.

XII. CONCLUSIONS

274. The Project will improve water resources management in the Kongmu River Catchment, helping to secure safe drinking water supplies, maintain water quality to protect ecological resources, and manage flood risks. Cumulatively, the Project will complement a range of domestically-funded programs, which together will help achieve the targets of the Xinyu City master plans for development and environmental management.

275. Key construction impacts arise from: (i) the planned dredging and excavation of artificial lakes and canals, which may cause sedimentation to downstream water and ecological sensitive receivers associated with the Kongmu River and Baiyun Reservoir, (ii) minor ecological impacts due to habitat loss of areas adjacent to the Kongmu River and low-value habitat within the Kongmujiang National Wetland Park (iii) impacts to soil, water, air, and communities, from construction noise, fugitive dust, earthworks, solid waste disposal, interference with traffic and municipal services during various construction works, permanent and temporary acquisition of land, involuntary resettlement, and occupational and community health and safety. Operational impacts considered were: (i) minor ecological impacts due to habitat loss adjacent to the Kongmu River and within the Kongmujiang National Wetland Park.

276. Measures to avoid, minimize, and mitigate these and other potential Project impacts have been developed within the Project EMP (Attachment 1). Meaningful public consultation was conducted in the five Project counties in accordance with PRC and ADB requirements. Public concerns have been integrated into the domestic feasibility study reports and Project EMP. Public consultation will continue throughout Project implementation. A Project GRM has been developed and will be implemented at the county and site levels.

277. A Climate Risk Vulnerability Assessment (CRVA) was conducted for the Project based on the projected climate changes assuming a Project design life of 30-40 years. Many of the Project components and outputs will have significant positive effects and contributions to the climate change resilience of the Project area. Key adaptation measures which have been included in the Project design include construction of flood management systems and measures, sewage infrastructure, sub-surface utilities, solid waste management and constructed wetlands and landscaping with native plant species.

278. Based on the information presented in this IEE, and assuming full and effective implementation of the Project EMP, training, and loan assurances, potential adverse environmental impacts are expected to be minimized and/or mitigated to within the standards applied in this IEE.

ATTACHMENT 1. ENVIRONMENTAL MANAGEMENT PLAN

ENVIRONMENT MANAGEMENT PLAN FOR THE JIANGXI KONGMU RIVER WATERSHED FLOOD CONTROL AND ENVIONMENTAL IMPROVEMENT PROJECT

People's Republic of China

Prepared by the Xinyu City Government for the Asian Development Bank

A. Objectives

1. This Environmental Management Plan (EMP) is for the Jiangxi Kongmu River Watershed Flood Control and Environmental Improvement Project in Xinyu City of Jiangxi Province, the People's Republic of China (PRC). The EMP complies with the Asian Development Bank's (ADB) Safeguard Policy Statement (SPS, 2009) and is based on the domestic Environmental Impact Assessment (DEIAs) prepared by Jiangxi Academy of Environmental Science and Project Initial Environmental Examination (IEE). The EMP describes: roles and responsibilities of all project agencies to implement this EMP; mitigation measures; inspection, monitoring, and reporting arrangements; training and institutional strengthening; Grievance Redress Mechanism (GRM); and future public consultation.

2. In the design stage the PMO will pass this EMP to the Design Institutes for incorporating mitigation measures into the detailed designs. The EMP will be updated at the end of the detailed design, as needed. To ensure that bidders will respond to the EMP's provisions, the PMO and Implementation Agency (IA) will prepare and provide the following specification clauses for incorporation into the bidding documents: (i) a list of environmental management requirements to be budgeted by the bidders in their proposals, based on this EMP; (ii) environmental clauses for contractual terms and conditions; and (iii) this EMP.

B. Organizations and Their Responsibilities for EMP Implementation

3. The EMP implementation arrangements and responsibilities of governmental organizations are summarized in **Table EMP-1**.

Table EMP-1. Project Operation and Maintenance Arrangements in Xinyu City

No.	Component / Sub-component	Implementing Agency	Operation and Maintenance Unit
1	**Develop of flood management system**		
1.1	Increase flood retention capacity of HSRND	XURCIG	XCWAB, XCAB
1.2	Flood protection along Kongmu River	XURCIG	XCWAB
2	**Develop water pollution source management system and water related basic amenities**		
2.1	Construct wastewater pipes and pump station	XURCIG	XCAB
2.2	Construct solid waste management system	XURCIG	XCAB
2.3	Construct wetlands in lakes and Kongmu River	XURCIG	XCAB
2.4	Landscape Works	XURCIG	XCAB
3	**Enhance flood and environmental risk coping capacity and knowledge dissemination**		
3.1	Develop capacity for flood and environmental management in Kongmu watershed	XURCIG, CWAB	XURCIG
3.2	Upgrade flood forecasting and warning system	XURCIG, XCWAB	XCWAB
3.3	Water quality monitoring system for Kongmu River and constructed wetlands	XURCIG, XCWAB	XCWAB

XCAB = Xinyu City Administration Bureau, XCWAB = Xinyu City Water Affair Bureau, XURCIG = Xinyu Urban and Rural Construction Investment Group Co. Ltd.

4. **Executing Agency.** Xinyu City Government (XCG) is the project Executing Agency (EA). The EA is responsible for communication with ADB, loan on-lending and repayment, as well as supervision and guidance of the Xinyu Project Management Office (PMO) and Implementing Agency (IA) during the project implementation.

5. **Project Leading Group.** A Project Leading Group (PLG) has been established, chaired by the executive vice mayor and comprises senior officials from relevant government agencies, to facilitate inter-agency coordination, and resolve any institutional problems affecting project implementation at municipal level.

6. **Project Management Office.** The EA has established a Project Management Office (PMO) in the Xinyu Urban & Rural Construction Investment Group (XURCIG). The PMO will conduct daily management and coordination during project implementation on behalf of PLG.

7. **PMO Environment Officer.** The PMO will have main EMP coordination responsibility. The PMO has appointed a PMO Environment Officer to be responsible for the environmental issues during the project implementation. The Officer will take charge of (i) coordinating the implementation of the EMP and developing implementation details; (ii) supervising the implementation of mitigation measures during project design, construction and operation; (iii) ensuring that environmental management, monitoring, and mitigation measures are incorporated into bidding documents, construction contracts and operation management plans; (iv) submitting semi-annual EMP monitoring and progress reports to ADB; (v) coordinating the grievance redress mechanism (GRM); and (vi) responding to any unforeseen adverse impacts beyond those mentioned in this EMP. The PMO Environmental Officer will be technically supported by the Loan Implementation Environment Consultant (LIEC).

8. Terms of Reference for key personnel are described in **Appendix 1**.

9. **Implementing Agency.** Xinyu Urban & Rural Construction Investment Group is the IA. Within the XURCIG, there are four functional departments: (1) Financial Section, (2) Chief Engineer Office; (3) Engineering Department; (4) The PMO. The XURCIG will: (i) engage and supervise engineering design institutes, tendering company and the project management consulting service during project implementation; and (ii) report on progress. The IA should also assign an environmental coordinator to assist the PMO Environment Officer.

10. **Loan Implementation Environment Consultant (LIEC).** A LIEC will be hired under the loan implementation consultant services. The LIEC will advise the PMO, IA, Contractors and Construction Supervision Companies (CSCs) on all aspects of environmental management and monitoring for the project. The LIEC will support: (i) updating the EMP and environmental monitoring program, as needed; (ii) implementation of the EMP; (iii) preparation of semi-annual progress reports by PMO, for submission to ADB in English and Chinese; (iv) training to the PMO, IA, and CSCs, on EMP implementation, GRM, relevant laws and policies, and ADB's SPS, EMP implementation; (v) identify any environment-related implementation issues, and propose necessary corrective actions; and (vi) undertake site visits for EMP inspection as required.

11. **Construction Contractors and Construction Supervision Companies (CSCs).** Construction contractors will be responsible for implementing relevant EMP mitigation measures during construction, under the supervision of the CSCs and IA. Contractors will develop site-specific EMPs on the basis of this project EMP. CSCs will be selected through the PRC bidding procedure by the IA. The CSCs will be responsible for supervising construction progress and quality, and EMP implementation on construction sites. Each CSC shall have at least one environmental engineer on each construction site to: (i) supervise the contractor's EMP implementation performance; and (ii) prepare the contractor's environmental management performance section in monthly project progress reports submitted to the IA and PMO.

12. **Environmental Monitoring Station (EMS).** XURCIG will contract the EMS under the local Environmental Protection Bureau to implement the external monitoring program defined in this EMP (Table EMP-5).

C. Potential Impacts and Mitigation Measures

13. Table **EMP-2** lists the potential project impacts and mitigation measures. The mitigation measures will be incorporated into the detailed design, bidding documents, construction contracts and operational management manuals, by the design institutes (during detailed design) and contractors (during construction), under the supervision of CSCs and IA, with technical support from the LIECs. The effectiveness of these measures will be evaluated based on environmental inspections and monitoring to determine whether they should be continued, improved or adjusted.

Table EMP-2. Potential Impacts and Mitigation Measures during Design, Construction and Operation Phases

Item	Potential issues	Mitigation measures	Implement	Supervise
A. DESIGN PHASE				
Detail design stage	Project site and route selection	• Confirm final designs and layout for project infrastructure, including landscaping and any required compensatory planting. In compliance with PRC Forestry Law, any compensatory planting must be the same as, or larger than, the area cleared. • Demarcate works sites in Kongmu River National Wetland Park. • Project lakes, canals, pipeline networks: select sites and routes in compliance with HSRND urban plan. As far as possible, locate sites >20 m from residential areas to protect housing foundations. • Project canals: utilize existing ditches as far as possible to minimize new earthworks. • Solid waste transfer stations: locate stations (i) at least 10 m from residences and public facilities; (ii) on appropriately zoned land. In Guanchao County, siting of the stations on farmland is forbidden.	PMO, IA, DI	EA, ADB
	Construction schedule	• Lakes, canals, constructed wetlands: September to December (dry season), to avoid erosion and flood risks in the wet season. • Plan daily schedules to minimize impacts to agricultural activities. • Consult with local residents on scheduling of noisy construction activities. • Maintain irrigation systems to meet agricultural needs. • Coordinate excavation and spoil disposal to minimize duration of temporary spoil piles.	PMO, IA, DI	EA, ADB
	Construction worker camp sites	• Rented houses will be used as far as possible. • Camps to be located ≥200 m away from residential areas, hospitals, schools and other environmentally sensitive sites, and located downwind of such sites. • Camps will not be built within the water source protection area and watershed zone of No.4 Water Supply Plant. • Sewage (domestic sewage and washing sewage) will not be discharged into the water source protection area of No.4 Water Supply Plant.	PMO, IA, DI	EA, ADB
	Dredged sludge drying and consolidation pond	• To be located in low-lying area. • At least 30 m from residential area and downwind. Farmlands are forbidden to be used. • Overflow water from the sludge drying and consolidation pond will be discharged back into the lake. The discharge water quality will meet the Class I of the PRC Integrated Wastewater Discharge Standard prior to discharge.	PMO, IA, DI	EA, ADB
	Dredged sediment management	• Detailed sediment survey to document lake bathymetry, sediment deposition and pollutants. Use information to design a sediment removal and management program. • Identify location of spoil sites: (i) in low-lying areas of wasteland/dryland. Farmlands are forbidden to be used; (ii) downwind and at least 200 m from residential areas.	PMO, IA, DI	EA, ADB
	Construction phase wastewater treatment measures	• Discharge water from the foundation of the lakes, canal engineering and concrete sewage: supplementary sedimentation tank will be built in permanently owned land (to avoid land acquisition). Utilize wastelands and dry lands as a priority. Farmlands are forbidden to be used;	PMO, IA, DI	EA, ADB

Item	Potential issues	Mitigation measures	Implement	Supervise
		• No sewage discharge outlet is allowed to be built near the Kongmu River. No treatment facilities will be placed in the first and second class water source protection zones.		
	Temporary construction road	• Temporary construction roads will not be built near residential areas, and should not destroy existing roads, rivers and other rural infrastructures.	PMO, IA, DI	EA, ADB
	Risk control	• Locate odor-generating and noise-producing facilities downwind from residential areas. • Climate adaptation measures should be incorporated into the detailed design of the project.	PMO, IA, DI	EA, ADB
Implementation Support	Institutional strengthening for EMP Implementation and supervision	• Within six months of Project effectiveness, appoint PMO Environmental Officer, IA Environment Officer, and LIEC. See TOR in Appendix 1. • Within six months of Project effectiveness, train staff for EMP implementation and supervision. • IA has contractual agreements with EMS to conduct environmental monitoring in this EMP. • Conduct training on this EMP for PMO, IA, contractors, and CSCs.	PMO, IA	EA, ADB
Construction Preparation	Update EMP	• Update mitigation measures defined in this EMP based on final detailed design. • Submit the updated EMP to ADB for review. • In case of major changes of project location and/or components, conduct EIA and public consultation. Submit to EPB and ADB for approval and disclosure.	PMO, LIEC	EPB, ADB
	Bidding and contract documents	• Incorporate mitigation measures in this EMP to bidding documents. • Bidding documents are sent to ADB for review. • Prepare environmental contract clauses for contractors.	PMO, IA, DI	LIEC, EPB, ADB
	Construction site management planning	• Prepare Site Environmental Management and Supervision Plan (SEMSP), including health and safety plan. • Assign site environmental health and safety officer. • IAs and PMO review and approve the SEMSP.	Contractors	IAs, PMO
	EMP training	• Provide training on implementation of this EMP to all relevant agencies, especially the IAs and contractors.	LIEC, PMO	EPD, ADB
	Establish GRM	• PMO and IA Environmental Officers and PMO Social Officer establish GRM with LIEC. • All PMO and IA personnel trained in GRM. • Distribute contact details for GRM on PMO and EPB public websites and construction sites.	IA, PMO	LIEC, ADB
B. CONSTRUCTION PHASE (PERIOD OF SITE PREPARATION, CONSTRUCTION and REFORMATION)				
Topography and Soils	Earthwork, soil erosion, soil contamination	• Prepare Site Drainage and Soil Erosion Management Plan before commencement of construction works. • Define spoil disposal sites and borrow pit locations in the construction tender documents. • Construct intercepting channels to prevent construction runoff entering waterways. • Divert runoff from sites to sedimentation ponds or existing drainage. • Limit construction and material handling during periods of rains and high winds. • Stabilize cut slopes, embankments, and other erosion-prone areas during works. • Minimize open excavation areas and use compaction techniques for pipe trenches.	Contractor, CSCs	IA, PMO

Item	Potential issues	Mitigation measures	Implement	Supervise
		• Rehabilitate all spoil disposal sites and construction sites. • Stabilize earthwork areas within 30 days after earthworks have ceased at the sites. • Preserve existing vegetation where no construction activity is planned.		
Ambient Air	Dust generated by construction activities	• Equip material stockpiles and concrete mixing equipment with dust shrouds. • Spray water on construction sites and earth/material handling routes. • Cover materials during truck transport. • All roads and tracks used by vehicles of the contractors or any subcontractors or supplier are kept clean and clear of all dust, mud, or extraneous materials dropped by vehicles.	Contractor, CSCs	IA, PMO
	Gaseous air pollution (SO_2, CO, NO_x) from construction machinery and asphalt pavement after pipeline laying	• Purchase pre-mixed asphalt for road surface paving after water diversion pipeline laying; if asphalt is heated and mixed onsite, asphalt mixers must be located ≥200 m from villages and other sensitive receptors. • Ensure emissions from vehicle and machinery comply with PRC standards of GB18352-2005, GB17691-2005, GB11340-2005, GB2847-2005, and GB18285-2005. • Equipment and machinery is maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment will be installed with tail gas purifiers to ensure emissions be in compliance with PRC-GB16297-1996. • Provide high-horsepower equipment with tail gas purifiers.	Contractor, CSCs	IA, PMO
	Odor from dredge spoil	• For odor impacts during sediment dredging, immediately transport spoil to disposal site after de-watering, in sealed containers. • Spoil management sites will be clearly demarcated.	Contractor, CSCs	IA, PMO
Noise	Noise generated from construction activities	• Ensure construction machinery conform to PRC standard of GB12523-90. • Properly maintain vehicles and PME to minimize noise. • The speed limit signs are proposed to be set 50 m ahead of the residential areas when the construction transport roads cross villages. The driving speed must not exceed 20 km/h and no whistle/horn is allowed. Avoid transport activities at night. • Prohibit construction activity between 22:00 and 08:00 (modified according to the residents' actual schedule and habits). • Sound barriers will be built in construction sites where construction noise will exceed the standard. • Utilize metal or synthetic materials for construction of sound barriers. Detachable structures are recommended, for re-use in different sites. • Height of the sound barriers will be ≥2 m. • At least 1,000 m of barriers will be prepared in advance for rapid deployment. • Monitor noise at sensitive areas and consult residents at regular intervals (EMP Monitoring Plan). If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation. • Conduct interviews with residents adjacent to construction sites to identify and resolve issues,	Contractor, CSCs	IA, PMO

Item	Potential issues	Mitigation measures	Implement	Supervise
		including adjustment of work hours of noise-generating machinery.		
Surface water pollution and dredging	Sediment and dewatering	• Conduct lake excavation and dredging of wetlands and canals in dry season (April–June). • Close lake outflow gates during excavation and/or dredging works. • Dewatering of dredged sediments will be in temporary, lined pits. Excess water will be drained off and the sediment will be disposed as per the spoil disposal plan in Table VI-2 of the IEE main report. • No sewage discharge directly to the first and second class water source protection zone of Kongmu River is allowed. The sewage will be discharged to the irrigation ditch first and further to the Kongmu River in order to minimize the adverse impact. • Water quality (for pollutants such as SS, COD_{cr}, NH_3-N and petroleum) in the project waterways will be monitored by local EMS during construction (see monitoring table in this EMP).	Contractor, CSCs	IA, PMO
	Domestic wastewater from construction sites	• Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols. • Labor camps will be located ≥300 m from waterways.	Contractor, CSCs	IA, PMO
	Construction wastewater (pouring concrete, repairs etc.) is managed	• Settling ponds and oil-water separators implemented. • Recycled water is used to spray for dust control. • All earthworks along waterways will be accompanied by measures to minimize sediment runoff, including sediment traps. • Residues are removed from site and disposed in municipal landfills.	Contractor, CSCs	IA, PMO
	Handling of hazardous and harmful materials	• Guidelines for handling and disposal, including spill responses, are prepared and included in the SEMSP. • Construct storage facilities (including fuel and oil storage), with bunds and clean-up equipment. • Fuel supplier is properly licensed and follows the proper protocol for transferring fuel, and complies with JT 3145-88 (Transportation, Loading and Unloading of Dangerous or Harmful Goods). • Park vehicles and equipment in designated areas to prevent contamination of soil and surface water. • Vehicle, machinery, and equipment maintenance and refueling are carried out so that spilled materials do not seep into the soil or into water bodies. • Locate storage / cleaning areas for fuel, machinery and vehicles ≥500 m from waterways. • Oil traps for service areas, and parking areas.	Contractor, CSCs	IA, PMO
Solid Waste	Management and remediation of spoil temporary storage site	• The temporary spoil ground is proposed to be set within the boundary of land permanently acquired for the Project. Avoid temporary land acquisition where possible. • The wastelands and dry lands are considered to be utilized in priority for spoil storage. The acquisition of farmland or woodland is not allowed. • Wind-proofing measures shall be taken in the temporary spoil ground. Water spray is required during dry days and the temporary intercepting ditch is proposed around the spoil ground in order to reduce soil erosion and landslide. • Topsoil will be stored separately and backfilled in sequence, which is beneficial for the recovery of	Contractor, CSCs	IA, PMO

Item	Potential issues	Mitigation measures	Implement	Supervise
		the farmland reclamation and plants.		
	Domestic waste from construction sites	• Provide appropriate waste collection and storage containers at locations away from surface water or sensitive receivers. • Arrange with municipal waste collection services for regular collection of waste. • Provide sufficient garbage bins at strategic locations and ensure that they are protected from birds and vermin, and emptied regularly by the municipal waste collection systems. • Burning of waste is strictly prohibited.	Contractor, CSCs	IA, PMO
	Construction waste management	• Construction waste that cannot be reused will be regularly transported off-site for disposal, and not allowed to accumulate on site over long periods. • Paving or vegetating shall be done as soon as the materials are removed to stabilize the soil.	Contractor, CSCs	IA, PMO
Biological resources	Protection of flora and fauna around construction sites	• Prior to construction, demarcate vegetated roadsides, trees, riverbanks. • As far as possible avoid clearance of any vegetation. • Prior to construction in the wetland park, inform workers of park rules and regulations. • Any fauna found during construction, will be immediately reported to the EPBs and PMO Environment Officer, photographed, and released on the same day in the nearest suitable habitat.	Contractor, CSCs	IA, LIEC
Socio-economic resources	Impact on physical cultural resources	• Establish chance-find procedures for physical cultural resources. • If a resource is detected, stop works immediately and notify local CHB and the IA.	Contractor, CSCs	IA, PMO
	Traffic management – all components	• Select haulage routes to reduce disturbance to regular traffic. • Trucks hauling treated dredge spoil to landfill will have light loads (not exceeding 10 t per trip), and fully covered. • Divert or limit construction traffic at peak traffic hours. • At all times, safe and convenient passage is given to community vehicles, pedestrians, and livestock to and from side roads.	Contractor, CSCs	IA, PMO
	Community health and safety	• Residents and businesses will be informed in advance through media and information boards of the construction activities, dates and duration of expected disruption. • Signs will be placed at construction sites informing people of the project GRM, potential dangers (e.g. moving vehicles, hazardous materials, excavations) and safety issues. • Heavy machinery will not be used at night. • All sites will be secured from unauthorized public access. • For residential areas next to construction (especially loud noise), ensure residents are aware of the duration and nature of works, potential hazards, and offer to provide basic safety equipment, such as acoustic screen.	Contractor, CSCs	IA, PMO

Item	Potential issues	Mitigation measures	Implement	Supervise
	Occupational health and safety	Prepare environmental, health and safety plan which complies with PRC State Administration of Worker Safety Laws and Regulations, including: • Clean and sufficient supply of fresh water for construction sites, camps, offices. • Sufficient latrines and other sanitary arrangements at construction sites and work camps. • Garbage receptacles and regular emptying. • Provide protective equipment and clothing (goggles, gloves, respirators, dust masks, hard hats, steel-toed boots) for construction workers and enforce their use. • Emergency response plan for accidents prepared and approved by IA and EPB. Establish emergency phone links with township hospitals and maintain a first-aid base in each construction camp. • Establish a records management system for occupational accidents, diseases, incidents. The records will be reviewed during compliance monitoring and audits. • Safety communication. Ensure that occupational health and safety matters are given a high degree of publicity to all persons on-site. Display posters prominently. • Training, awareness and competence. Train all workers in basic sanitation, health and safety matters, and work hazards. Implement awareness and prevention program for HIV/AIDS and other diseases – target the local community and construction workers.	Contractors	CSCs, IA
C. OPERATION PHASE				
Water quality	Performance testing of constructed wetlands	• Prior to commissioning, test the ability to achieve the required treatment standard. • Establish management and O&M system for the constructed wetlands, to ensure the water quality flow into Kongmu River can meet the national standard	Contractor, XCAB	PMO
	Water quality management in lakes and canals	• Develop guidelines for effective PRC Sponge City Planning in urban areas. • Implement closure, storage, and purification sewage treatment at the early stage to prevent sewage flowing into HSR New District lakes and canals. • Implement water quality monitoring program. • Strengthen urban management - such as urban stormwater management, wastewater collection and treatment management, solid waste management, etc. - of HSR New District and prevent sewage flowing into lakes and canals.	IA,PMO	Xinyu EPB
	Water source protection (Xinyu No.4 WTP)	• Apply regular water quality monitoring of water source protection range according to the monitoring plan in Table EMP-4 • Enhance management and education of staff at the water source protection zone, increase environmental protection awareness of water source protection zone, and place warning signs at water sources boundaries and all construction sites.	IA,PMO	Xinyu EPB
	Leachate Pollution Control at Waste Transfer Station	• Clear leachate by operating suction sewage vehicle in a daily routine. • Determine underground water seepage control measures to prevent leachate infiltration contamination of underground water.	IA,PMO	Xinyu EPB

Item	Potential issues	Mitigation measures	Implement	Supervise
		• Ensure that the Waste Incineration Plant has sufficient treatment capacity to receive leachate from Transfer Station, and discharge after meeting the national drainage standards. Note: the volume of leachate generation will be small. Centralized treatment in the inceration plant will be most cost effective and endure standardized treatment quality.		
Air	Odor from solid waste transfer station	• Equip odor generating facilities with ventilation or odor containment. • Institute regular check, repair and maintenance of all treatment facilities and equipment.	IA,PMO	Xinyu EPB
Flora and fauna	Manage the built habitats – landscaped embankments and constructed wetlands	• Project activities requiring plants, including embankments, constructed wetlands, landscaping, and post-construction rehabilitation, will only use native plant species from Xinyu City and which are locally sourced. See IEE Tables IV-16 to IV-18 for species suitable for planting. • Use of native species included as a project assurance. • Maintain the landscaping – watering, weeding, stabilizing, survival and growth of planted trees, shrubs and herbs, with replacement and corrective action as necessary. • Provide security and surveillance to guard against misuse, theft and littering. • Regularly remove litter and transport to landfill.	IA,PMO	Xinyu EPB
Emergency preparedness and response	Solid waste transfer station maintenance and health and safety of surrounding residents	• Prepare emergency preparedness and response plan before solid waste transfer station is operational. The plan will include staff training, resources, responsibilities, communication, procedures, and other aspects required to respond effectively to emergencies.	Solid waste station, IA	Xinyu EPB
Health and safety	Health and safety of solid waste transfer station facilities operating staff	• Compulsory use of safety equipment and clothing as necessary (e.g. non-slip boots, chemical resistant clothing, safety goggles, respiratory mask). • Safety instructions for storage, transport, handling or pouring of chemicals	Solid waste station, IA	Xinyu EPB
Social	Impacts to irrigation water supply	• Ensure that irrigation water needs are maintained for all areas within and outside the proposed HSRND which currently rely on water from lakes within the area of the proposed HSRND. • Construct new irrigation pipeline for lands south of the proposed HSRND. • Maintain outflow pipes in the existing lakes in the proposed HSRND for irrigation use as needed. • Outflow pipes will be installed in the new lakes to be constructed. This will enable the the provision of irrigation water supply for local users should this be needed. This potential needs assessment will be conducted by PMO during the detailed design and construction phase.	Contractor, CSCs, IA, XCAB	Xinyu EPB
Unexpected impacts	All areas	• If unexpected environmental impacts occur during project operations, inform the PMO immediately; assess the impacts; and update the EMP	IA,PMO	Xinyu EPB

Sources: ADB = Asian Development Bank, CSC = construction supervision company, EA = executing agency, EIA = environmental impact assessment, EMS = environmental monitoring Station, EPB = environment protection bureau, GRM = grievance redress mechanism, HSRND = High Speed Rail New District, IA = implementing agency, DI = design institute, LIEC = loan implementation environmental consultant, O&M = operation and maintenance, PMO = project management office, SEMSP = site environmental management and supervision plan, WTP = water treatment plant, WWTP = waste water treatment plant, XCAB = Xinyu City Administration Bureau.

D. Project Readiness

14. Prior to construction, the PMO will assess the project environmental readiness using **Table EMP-3** and review with ADB. If necessary, corrective actions will be identified to ensure that all requirements are met.

Table EMP-3. Project Readiness Assessment Indicators

Indicator	Criteria	Assessment	
		Yes	No
EMP update	The EMP was updated after technical detail design, and approved by ADB	☐	☐
Compliance with loan covenants	The borrower complies with loan covenants related to project design and environmental management planning	☐	☐
Public involvement effectiveness	• Meaningful consultation completed • GRM established with entry points	☐ ☐	☐ ☐
Environmental supervision in place	• LIEC is in place • Environment Officer appointed by PMO • EMS and CSCs contracted by XURCIG • EMS appointed by the XURCIG	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
Bidding documents and contracts with environmental safeguards	• Bidding documents and contracts incorporating the impact mitigation and environmental management provisions of the EMP.	☐	☐
Site construction planning (Environmental)	Site environmental management and supervision plan prepared for each work site by the XURCIG, and contractors.		
EMP financial support	The required funds have been set aside by contractors, and XURCIG to support the EMP implementation	☐	☐

Note. ADB=Asian Development Bank; CSCs = Construction Supervision Companies; EMS = Environment Monitoring Station, IA = Implementing Agency, LIEC = Loan Implementation Environmental Consultant, PMO = Project Management Office, XURCIG = Xinyu Urban & Rural Construction Investment Group.

E. Monitoring and Reporting

15. Three types of project monitoring will be conducted under the EMP: (i) internal monitoring – to be conducted by the IA and the construction supervision companies (CSCs); (ii) external monitoring – of air, water, noise and soil standards – to be conducted by the local EMS; and (iii) compliance monitoring – to be conducted by the LIEC, to ensure the EMP is being implemented. The project monitoring program is in Table EMP-4. Monitoring shall comply with the PRC standards for environmental monitoring and quality.

16. **Internal monitoring.** During construction, the IA and CSCs will be responsible for conducting internal environmental monitoring in accordance with the monitoring plan.

17. **External monitoring.** The IA will contract the Xinyu EMS to conduct environmental monitoring in accordance with the monitoring program. A detailed cost breakdown will be provided by the local EMS when the environmental monitoring program is updated at the start of each component implementation. Monitoring will be conducted during construction and operation period, until a project completion report (PCR) is issued. Semi-annual monitoring reports will be prepared by the EMS and submitted to PMO and the IA.

18. **Compliance monitoring for EMP and progress reporting.** The LIEC will review project progress and compliance with the EMP based on field visits, and the review of the

environmental monitoring conducted by the EMS. The findings of the LIEC will be reported to ADB through the annual EMP monitoring and progress reports. The reports will include (i) progress made in EMP implementation, (ii) overall effectiveness of the EMP implementation (including public and occupational health and safety), (iii) environmental monitoring and compliance, (iv) institutional strengthening and training, (v) public consultation (including GRM), and (vi) any problems encountered during construction and operation, and the relevant corrective actions undertaken. The LIEC will help PMO prepare the reports and submit the English report to ADB for appraisal and disclosure.

19. **Project completion environmental audits.** Within three months after each subproject completion, or no later than one year with permission of the local EPBs, environmental acceptance monitoring and audit reports of each subproject completion shall be (i) prepared by a licensed environmental monitoring institute in accordance with the PRC Guideline on Project Completion Environmental Audit (2001), (ii) reviewed for approval of the official commencement of individual subproject operation by environmental authorities, and (iii) finally reported to ADB through the annual EMP monitoring and progress reporting process.

20. **Quality Assurance (QA) /Quality Control (QC) for compliance monitoring.** To ensure accuracy of the monitoring, QA/QC procedures will be conducted in accordance with the following regulations:

i) Regulations of QA/AC Management for Environmental Monitoring issued by the State Environmental Protection Administration in July 2006;
ii) QA/QC Manual for Environmental Water Monitoring (Second edition), published by the State Environmental Monitoring Centre in 2001; and
iii) QA/QC Manual for Environmental Air Monitoring published by the State Environmental Monitoring Centre in 2001.

Table EMP-4. Environmental Monitoring Program

Subject	Parameter	Location	Frequency	Implement	Supervise
PRE-CONSTRUCTION					
Soil	pH, Pb, Hg, As, Cd, Cu, Ni, Cr, Zn	Spoil sites and borrow pits	Once before construction	IA	PMO
CONSTRUCTION STAGE					
Internal monitoring (contractors, CSCs, PMO environmental officer, IA)					
Ambient air quality	Dust mitigation measures in EMP; equipment maintenance	Visual inspection at all construction sites	Daily	Contractor, CSC	IA, PMO, LIEC, EPB
Solid waste	Garbage and construction waste	Visual inspection at all construction sites and work-camps	Daily	Contractor, CSC	IA, PMO, LIEC, sanitation bureau
Wastewater	Provision and operation of domestic and construction wastewater	Visual inspection at all construction sites and work-camps	Daily	Contractor, CSC	IA, PMO, LIEC, EPB
Soil erosion and re-vegetation	Soil erosion intensity	Visual inspection at spoil sites and all construction sites, especially roadsides, water pipelines, banks of canals, constructed wetlands	1 time / week; and immediately after heavy rainfall	Contractor, CSC	IA, PMO, LIEC, EPB
	Re-vegetation of spoil	Visual inspection at all sites	At least 4 times / year	Contractor, CSC	IA, PMO, LIEC, EPB

Subject	Parameter	Location	Frequency	Implement	Supervise
	temporary storage sites, construction sites				
Occupational health and safety	Camp hygiene, safety, availability of clean water, emergency response plans	Inspection at all construction sites and work-camps	1 time / month	Contractor, CSC	IA, PMO
EXTERNAL MONITORING (LOCAL ENVIRONMENT MONITORING STATION)					
Quality of sewage and discharge channels at work camps	pH, SS, NH_3-N, COD_{Cr}, BOD_5 oil, fecal coliforms	Domestic wastewater discharge at work-camps	4 times / year during construction in all active site	EMS	IA, PMO, EPB
Construction wastewater	SS, oil, pH	at wastewater discharge points of all construction sites	As above	EMS	IA, PMO, EPB
Surface water quality	pH, COD_{Cr}, NH_3-N, TN, TP, SS, Fe, Mn, SO_4^{2-}, NO_3^-, CI	(i) All the proposed lakes in HSRND, (ii) 200 m upstream and 500 m downstream of the intersection where the canal flow into Kongmu River, (iii) secondary protection area of water resource in No. 4 Water Supply Plant	2 times / year during construction in all active sites	EMS	IA, PMO, EPB
	SS, TN, TP	Discharge water from each dredge spoil treatment site	Once day per week during construction activity	EMS	IA, PMO, EPB
Ambient air quality	SO_2, NO_2、TSP、PM_{10}	All construction sites (at least 1 point upwind, 1 point downwind) and nearby sensitive receivers (described in Section IV of IEE)	4 times / year during construction	EMS	IA, PMO, EPB
Noise	LAeq	Boundaries of all construction sites and sensitive receivers (described in Section IV of IEE)	2 times / year (twice a day: once in day time and once at night time, for 2 consecutive days) during construction	EMS	IA, PMO, EPB
Solid waste (garbage, construction waste)	Work camps and construction waste at construction sites	Visual inspection at all construction sites and work-camps	Twice a year	LIEC	IA, PMO, EPB
Soil erosion and re-vegetation	Soil erosion intensity	Visual inspection at spoil sites and construction sites, especially water pipeline route and embankments of rivers, wetlands	Twice a year, and 1 after completion of construction	LIEC	IA, PMO, EPB

Subject	Parameter	Location	Frequency	Implement	Supervise
	Re-vegetation of spoil temporary storage sites and construction sites	Visual inspection at sites, and temporary occupied lands	Compliance Monitoring: Twice a year, and 1 after completion of construction	LIEC	IA, PMO, EPB
Occupational health and safety	Work camp hygiene, safety, availability of clean water, emergency response plans	Inspection at all construction sites and work-camps	Twice a year, and once after completion of construction	LIEC	IA, PMO, EPB
OPERATION PHASE					
Internal monitoring					
Occupational health and safety	Hygiene, safety, emergency response plans	At SWTS.	1 time / month	XCAB	IA, PMO, EPB
Watewater quality (leachate of SWTS after treatment)	pH, COD_{Cr}, NH3-N, TN, TP, SS, Fe, Mn, $SO4^{2-}$, NO^{3-}, CI	Leachate of SWTS after treatment	Continuous routine monitoring	XCAB	IA, PMO, EPB
External monitoring					
Uncontrolled leachate from stockpiled waste	pH, COD_{Cr}, NH3-N, TN, TP, SS, Fe, Mn, $SO4^{2-}$, NO^{3-}, CI	Leachate of SWTS after treatment	4 times during the first year of operation of each SWTS	EMS	IA, PMO, EPB
Odor	H_2S, NH_3	Boundary of SWTS	As above	EMS	IA, PMO, EPB
Surface water quality	Basic parameters: pH, COD_{Cr}, NH_3-N, TN, TP, SS; **and**, Parameters to guard down -stream drinking sources: Fe, Mn, SO_4^{2-}, NO_3^-, CI	(i) All the proposed lakes in HSRND, (ii) 200 m upstream and 500 m downstream of the intersection where the Tianyun Canal flows into Kongmu River, (iii) secondary protection area of water resource in No. 4 WTP, (iv) Inflow and outflow of 2-3 Lakes with Constructed Wetland Treatment Systems	4 times during the first year of operation	EMS	IA, PMO, EPB
Soil and Vegetation	Plant survival and coverage	All re-vegetated sites	Spot check, twice a year	IA	PMO, EPB
Flood level	Water levels	Lakes, canals and Kongmu River	During high flow event	EMS	IA, PMO, EPB

COD_{cr} = chemical oxygen demand; CSC = construction supervision company; EMS = environmental monitoring station; EPB = environmental protection bureau; IA = implementation agency; LAeq = equivalent continuous A-weighted sound pressure level; NH_3-N = ammonia nitrogen; NO_x = nitrogen oxides; PM_{10} = particles measuring ≤10μm; PMO = project management office; SO_2 = sulfur dioxide; SS = suspended solids; SWTS = solid waste transfer station; TSP = total suspended particle, ; XCAB = Xinyu City Administration Bureau.

21. Environmental reporting for the project will follow the program in **Table EMP-5**.

Table EMP-5. EMP Reporting Plan

Reports		From	To	Reporting Frequency
CONSTRUCTION PHASE				
Internal progress reports by contractors	Internal project progress report by construction contractors, including monitoring results by CSCs	IA Contractors, CSCs	PMO	Monthly (during construction season)
Environmental impact monitoring reports	Environmental impact monitoring report	Xinyu EMS	IA PMO	Quarterly (during construction season)
Reports to ADB	Project progress report (including section on EMP implementation and monitoring)	PMO with support of LIEC	ADB	Semi-annual
	Environment progress and monitoring reports	PMO with support of LIEC	ADB	Semi-annual
Acceptance reports	Environmental acceptance monitoring and audit report	Licensed institute	Xinyu EPB	Once for each engineering subcomponent, not later than one year after completion of physical works
OPERATION PHASE				
Environmental impact monitoring	Environmental impact monitoring report (during first year of operation)	Xinyu EMS	IA, PMO	Quarterly
Reports to ADB	Project progress report (including section on EMP implementation and monitoring)	PMO with support of LIEC	ADB	Semi-annually
	Environment progress and monitoring report	Xinyu EMS	IA, PMO	Quarterly
	Environmental progress report	PMO with support of LIEC	ADB	Once (after first year of operation)

ADB=Asian Development Bank; CSCs = Construction Supervision Companies; EMS = Environment Monitoring Station, IA = Implementing Agency, LIEC = Loan Implementation Environmental Consultant, PMO = Project Management Office.

F. Training

22. The project agencies have no previous experience with ADB-funded projects or safeguard requirements. A capacity building program will be implemented on EMP implementation, supervision, and reporting and other issues (Table EMP-6). Training will be provided by the LIEC with the support of other experts under the loan implementation consultant services. Trainees will include the PMO, IA, contractors, and CSCs. The PMO will arrange and support the training programs, supported by the loan implementation consultants.

Table EMP-6. Training Program

Training	Attendees	Contents	Times	Period (days)	No. of persons
EMP adjustment and implementation	PMO, IA, contractors, CSCs	Update / reconfirm EMP, roles and responsibilities, monitoring, supervision and reporting procedures, review of experience (after 12 months)	Twice - Once prior to, and once after one year of project implementation	2x0.5	16

Training	Attendees	Contents	Times	Period (days)	No. of persons
Grievance Redress Mechanism	PMO, IA, contractors, Xinyu EPB	Roles and responsibilities, Procedures, review of experience (after 12 months)	Once prior to, and once after one year of project implementation	2x0.5	16
Environmental protection and monitoring	PMO, IA, Xinyu EPB	Pollution control on construction sites (air, noise, waste water, solid waste)	Once (during project implementation)	1	20
Sponge City concepts and wetland O&M	PMO, IA, Xinyu EPB	Principles of Sponge City Design, design best practices, O&M	Once during detailed design stage	1	20

CSC = construction supervision company; EMS = environment monitoring station, IA = implementing agency, LIEC = loan implementation environmental consultant, O&M = operation and maintenance, PMO = project management office.

G. Public Consultation

23. Two rounds of public consultation were conducted during project preparation (Section VIII of the IEE). During construction, the project will continue to seek public consultation and raise awareness of project activities, especially those which may impact the public such as noise. The project public consultation plan is in Table EMP-7, and includes public participation in evaluating environmental benefits and impacts. The IA is responsible for public participation during project implementation. They will be supported by the PMO Environment and Social Officers and the LIEC.

Table EMP-7. Public Consultation and Participation Plan

Organizer	Approach	Times/Frequency	Subjects	Participants
CONSTRUCTION				
PMO, IA, LIEC	Public workshops	For each construction site, at least once before construction; and at least twice during peak construction	EMP implementation progress; construction impacts; adjusting mitigation measures if necessary; feedback	Residents, affected persons, social sectors
	Site visits and informal interviews	Frequent throughout construction	Construction impacts; adjusting mitigation measures if necessary; feedback	Workers, residents in construction areas
	Public satisfaction survey (questionnaire)	Once a year during peak construction	Construction impacts; adjusting mitigation measures if necessary; feedback	Workers, residents in construction areas
OPERATION				
PMO, IA, operators of project facilities	Site visits and informal interviews	At least once in first year of operation	Operation impacts; adjusting mitigation measures if necessary; feedback	Residents, affected persons, social sectors
	Public workshop	As needed based on public consultation of site visits and informal interviews	Effects of mitigation measures, impacts of operation, feedback	As above
	Public satisfaction survey (questionnaire)	At least once after one year of operation	Comments and suggestions	Project beneficiaries

IA = Implementing Agency, LIEC = loan implementation environmental consultant, PMO = project management office.

H. Grievance Redress Mechanism

24. A grievance redress mechanism (GRM) has been established as part of the project EMP to receive and manage any public environmental and/or social issues which may arise due to the project. The PMO will ensure that potentially affected communities are informed about the GRM at an early stage of the project. The PMO Environmental and Social Officers will coordinate the GRM. However, all project agencies and staff will be trained in the GRM and will take an active role in supporting these staff as and when necessary.

25. At the PMO level, the PMO Environmental and Social Officers will establish a GRM tracking and documentation system, conduct daily coordination with the IA officers, arrange meetings and conduct site visits as necessary, maintain the overall project GRM database, and prepare the reporting inputs for progress reports to ADB. At the IA level, the environment and social officers will instruct CSCs on the GRM procedures, and coordinate with the county EPBs and other government divisions as necessary. PMO and IA staff will be trained and supported by the LIEC and Loan Implementation Social Consultant (LISC).

26. The contact persons for different GRM entry points, such as the PMO and IA Environmental and Social Officers, contractors, Operators of Project Facilities (OPFs), and Xinyu EPB, will be identified prior to construction. The contact details for the entry points (phone numbers, addresses, e-mail addresses) will be publicly disclosed on information boards at construction sites and on the websites of the PMO and Xinyu EPB.

27. Once a complaint is received and filed, the PMO and IA officers will identify if complaints are eligible. Eligible complaints include those where (i) the complaint pertains to the project; and (ii) the issues arising in the complaint fall within the scope of environmental issues that the GRM is authorized to address. Ineligible complaints include those where: (i) the complaint is clearly not project-related; (ii) the nature of the issue is outside the mandate of the environmental GRM (such as issues related to resettlement, allegations of fraud or corruption); and (iii) other procedures are more appropriate to address the issue. Ineligible complaints will be recorded and passed to the relevant authorities, and the complainant will be informed of the decision and reasons for rejection. The procedure and timeframe for the GRM is as follows and also summarized in **Figure EMP-1**.

- **Stage 1 (5 days):** If a concern arises during construction, the affected person may submit a written or oral complaint to the contractor, IA, local EPB, or village committeeWhenever possible, the contractor will resolve the issue directly with the affected person. The contractor shall give a clear reply within five (5) working days. The contractor will keep the IA fully informed at all stages.

- **Stage 2 (5 days)**: If the issue cannot be resolved in Stage 1, after five days, the IA and/or PMO will take over responsibility. Eligibility of the complaint will be assessed and a recommended solution given to the complainant and contractors within five (5) working days. If the solution is agreed by the complainant, the contractors and/or facility operators will implement the solution within seven days. Written records will be made of all stages and outcomes.

- **Stage 3 (10 days)**: If no solution can be identified by the PMO and/or IA, and/or the complainant is not satisfied with the proposed solution, the PMO and/or IA will organize, within ten (10) days, a stakeholder meeting (including the complainant, contractor and/or operator of the facility, Xinyu EPB, IA, PMO). A solution acceptable to all shall be identified including clear steps. The contractors (during construction) and facility operators (during operation) will immediately implement the agreed solution. Written records will be made of all stages and outcomes.

28. The GRM does not affect the right of an affected person to submit their complaints to any agency they wish to, for example the local village committee, community leaders, courts, PMO, IA, and/or Asian Development Bank.

29. The PMO and IA shall bear any and all costs of implementing the GRM, including meeting, travel, and/or accommodation costs of the project staff or affected person. The GRM will be implemented throughout project construction and at least the first year of operation for each project facility.

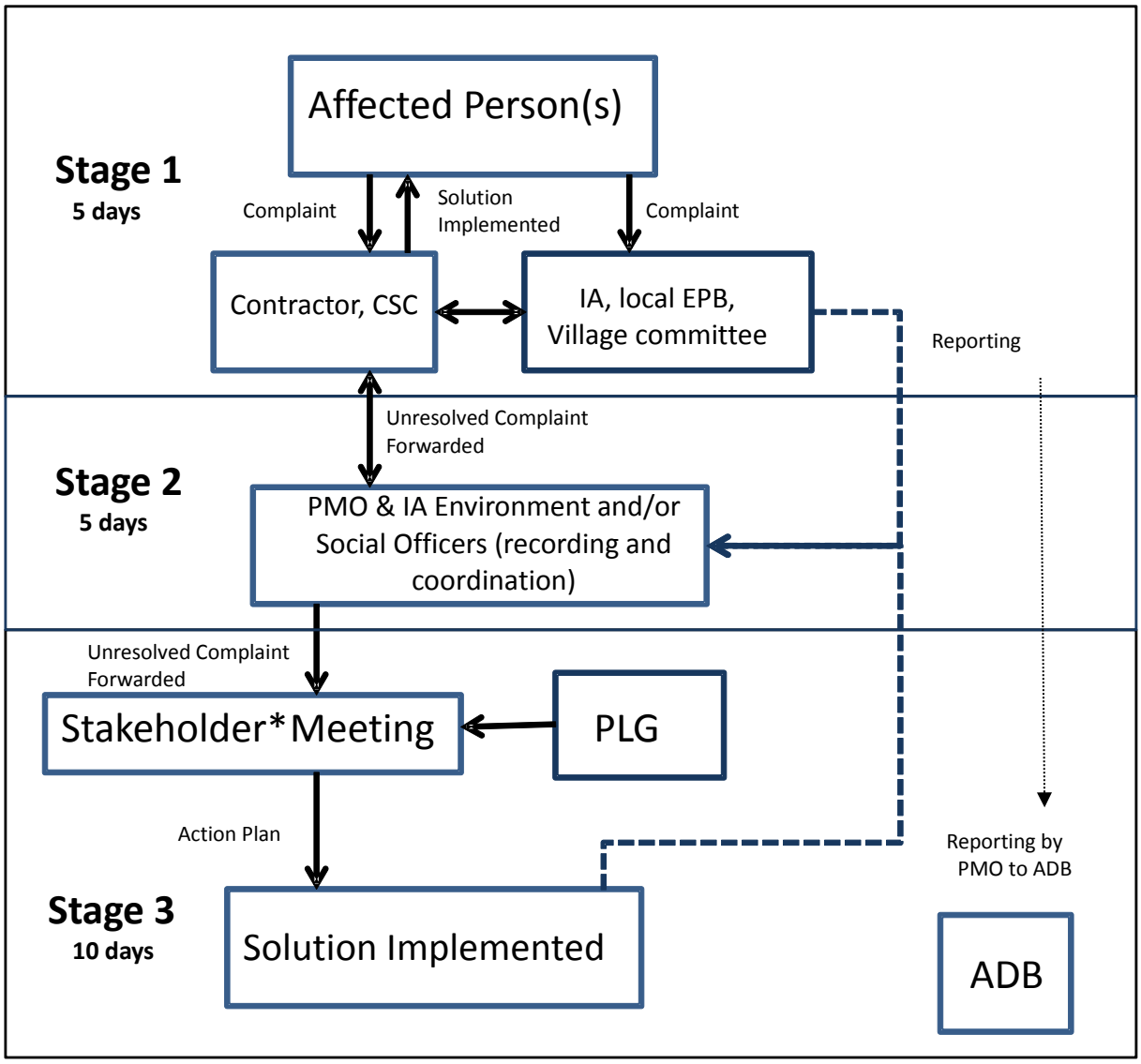

Figure EMP-1. Grievance Redress Mechanism

I. Cost Estimates

30. This section provides an estimate of the cost of EMP implementation. The cost comprises three categories: mitigation measures (Table EMP-2); monitoring (Table EMP-4); and training (Table EMP-6). Costs are presented for the construction phase of five years and the first year of operation i.e. a total of six years. The costs do not include: (i) detailed design revisions and adjustments; (ii) internal monitoring/inspection of solid wastes disposal, soil erosion and re-vegetation, occupational health and safety during construction, as this will be included in the construction supervision contracts; and (iii) salaries of PMO and IA staff. Costs

for mitigation measures and training are based on estimates in the domestic EIAs and/or the experience of the PPTA team from other projects. All costs were discussed with the PMO.

31. The total estimated cost for EMP implementation is CNY39.781 million ($5,991,114) for five years construction (Table EMP-8). The estimated cost for the PMO is CNY250,000 (0.63%) and for contractors is about CNY39,386,000 (99.0%). About CNY810,000 (0.2%) will be paid from ADB loan consulting services and remaining costs by the IAs. Total costs are small given the large scale of the project and when spread over five years.

Table EMP-8. Estimated Cost for EMP Implementation for Five Years of Construction and the First Year of Operation (xCNY10,000). Construction-phase costs will be paid by the contractors (as part of their contracts). **Operational-phase costs** will be paid by each implementing agency (IA).

Item	Unit cost	No. units	5-yr Cost (CNY)
MITIGATION (Table EMP-3)			
PRE-CONSTRUCTION			
1.1 Public consultations	5,000	2	10,000
1.2 LIEC	45,000	12 person-months	540,000
1.3 Constructed Wetland Specialist	45,000	6 person-months	270,000
1.4 GRM	5,000	1	5,000
Sub-total			**825,000**
CONSTRUCTION			
2.1 Domestic wastewater	60,000	1	60,000
2.2 Construction wastewater	180,000	1	180,000
2.3 Dust management	160,000	1	160,000
2.4 Vehicle emissions	60,000	1	60,000
2.5 Odor	60,000	1	60,000
2.6 Noise and vibration	150,000	1	150,000
2.7 Domestic waste	65,000	1	65,000
2.8 Construction waste	250,000	1	250,000
2.9 Soil erosion	37,500,000	1	37,500,000
2.10 Site hygiene	32,000	1	32,000
2.11 Community safety	32,000	1	32,000
2.12 Site safety	32,000	1	32,000
2.13 Public consultation	5000	1	5,000
Sub-total			**38,586,000**
3. MONITORING (Table EMP-4)			
CONSTRUCTION			
3.2 Internal monitoring	800,000	1	**800,000**
Ambient air quality	16,000	1	
Solid waste	16,000	1	
Wastewater	16,000	1	
Soil erosion and re-vegetation	16,000	1	
Occupational health and safety	16,000	1	
3.3 External monitoring			
3.3.1 PRE-CONSTRUCTION			
Spoil site testing	50,000	1	50,000
3.3.2 During construction			
Water Quality	16,000	5	80,000
Noise	4,000	5	20,000
Ambient air quality	12,000	5	60,000
3.3.3 During operation			
Water Quality	25000	1	25000
Ambient air quality	15000	1	15000
Sub-total			**250,000**
4. TRAINING (Table EMP-6)			

EMP Implementation	10000	2	20,000
GRM	5000	2	10,000
Environmental monitoring	5000	1	5,000
Solid waste transfer station-safeguards	5000	1	5000
Sub-total			**40,000**
GRAND TOTAL CNY			**39,781,000**
Total USD (USD1=CNY6.64)			**5,991,114**

EMS = Environmental Monitoring Station; GRM = Grievance Redress Mechanism; LIEC = Loan Implementation Environmental Consultant; PM = person-months.

J. Mechanisms for Feedback and Adjustment

32. Based on environmental inspection and monitoring reports, the PMO and IA shall decide, in consultation with the LIEC, whether (i) further mitigation measures are required as corrective actions, or (ii) some improvements are required for environmental management practices. The effectiveness of mitigation measures and monitoring plans will be evaluated by a feedback reporting system. Adjustment to the EMP will be made, if necessary. The PMO Environmental Officer will play a critical role in the feedback and adjustment mechanism.

33. If during inspection, substantial deviation from the EMP is observed or any changes are made to the project that may cause substantial adverse environmental impacts or increase the number of affected people, then the PMO and IA will immediately consult with ADB and form an environmental assessment team to conduct additional environmental assessment. If necessary, further public consultation will be undertaken. The revised domestic EIAs and project IEE, including this EMP, will be submitted to ADB for review, appraisal, and public disclosure. The revised EMP will be passed to the contractors, CSCs and OPFs for implementation.

APPENDIX 1. DRAFT TERMS OF REFERENCE FOR ENVIRONMENTAL POSITIONS

PMO ENVIRONMENT OFFICER

BACKGROUND

1. Development projects supported by the Asian Development Bank (ADB) routinely include a Project Management Office (PMO). The PMO is responsible for project implementation and comprises the provincial and/or municipal agencies involved in the project. Compliance with the Loan and Project Agreements includes implementation of an Environment Management Plan (EMP), which is prepared as part of the project environment impact assessment. The EMP is the critical guiding document to manage, monitor, and report upon potential project environmental impacts. Implementation of the EMP is a full-time task. For this reason, the PMO assigns at least one full-time officer for this role. These terms of reference describe the requirements for this officer.

SCOPE AND DURATION OF WORK

2. The officer will work on behalf of the PMO to implement the project EMP. The officer will report directly to the PMO. The position is for the entire project duration.

QUALIFICATIONS

3. The officer will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least five years of experience in environmental management, monitoring, and/or impact assessment; (iii) ability to communicate and work effectively with local communities, contractors, and government agencies; (iv) ability to analyze data and prepare technical reports; (v) willingness and health to regularly visit the project construction sites and in different seasons; and (vi) ideally, proficiency in spoken and written English.

DETAILED TASKS

4. The PMO Environment Officer will have a detailed understanding of the project EMP and supporting documents, including the domestic environmental reports, the project initial environmental examination (IEE), and project environmental assurances. The officer will have the following tasks.

(i) Assess whether the EMP requires updating due to any changes in project design which may have occurred after the EMP was prepared.

(ii) Distribute the Chinese language version of the EMP to all relevant agencies, including the implementing agencies, provincial and municipal agencies for environment protection. This should occur within three months of Project effectiveness

(iii) Conduct meetings with agencies as necessary to ensure they understand their specific responsibilities described in the EMP.

(iv) Ensure that relevant mitigation, monitoring and reporting measures in the EMP are included in the bidding documents, contracts and relevant construction plans.

(v) Confirm that the Implementing Agencies (IAs) responsible for the internal environment monitoring described in the EMP understand their tasks and will implement the monitoring in a timely fashion.

(vi) Within two months of Project effectiveness, establish and implement the project Grievance Redress Mechanism (GRM) described in the EMP. This will include: (a) prepare a simple table and budget identifying the type, number and cost of materials needed to inform local communities about the GRM and starting dates and scope of construction; (b) design, prepare and distribute these materials, and plan and conduct the community meetings; (c) prepare a form to record any public complaints; (d) prepare a summary table to record all complaints, including dates, issues, and how they were resolved; and (e) ensure that all relevant agencies, including contractors, understand their role in the GRM.

(vii) Prior to construction, ensure that IAs and their contractors have informed their personnel, including all construction workers, of the EMP requirements. This will include all mitigation measures relating to impacts to air, water, noise, soil, sensitive sites, ecological values, cultural

values, worker and community health and safety, respectful behavior when communicating with local communities, and responding to and reporting any complaints.

(viii) During project construction, make regular site visits with LIEC to assess progress, meet with contractors and/or local communities, and assess compliance with the EMP.

(ix) Ensure that all relevant agencies submit required progress reports and information, including environmental monitoring and reports of any issues or grievances.

(x) Compile, review, and store environmental progress reports from the IAs, records of any grievances, and any other relevant issues. Maintain digital copies of all information. When necessary, enter data into summary tables in digital format (e.g. to transfer records of grievances from hard copy forms). Ensure that all information is stored in the PMO filing system, backed up, and can be easily retrieved.

(xi) Prepare semi-annual environment progress reports.

(xii) Work closely with the PMO, IAs, loan implementation consultants, and other agencies and personnel as necessary to conduct these tasks.

REPORTING REQUIREMENTS

Semi-annual environment monitoring reports, using the template provided by ADB or a domestic format reviewed and approved by ADB.

LOGISTICAL SUPPORT PROVIDED BY PMO TO THE ENVIRONMENT OFFICER

(i) Provision of hard and soft copies of the project EMP, domestic and project environmental reports, feasibility study reports, loan and project agreements, maps, and other supporting materials as necessary to ensure the officer can implement the tasks.

(ii) Vehicle transport, office materials, and other logistical support as necessary for the officer to visit the project construction sites and local communities, arrange and conduct meetings, and prepare and distribute consultation materials.

(iii) Overall coordination, including review of the draft semi-annual monitoring reports and final responsibility for submission of the monitoring reports to ADB.

LOAN IMPLEMENTATION ENVIRONMENTAL CONSULTANT

I. BACKGROUND

1. The project will be coordinated by a Project Management Office (PMO), whose overall responsibility includes implementation of the project Environment Management Plan (EMP). At the field level, the project will be implemented by a Project Implementation Unit (PIU). The PMO and PIUs will be assisted by a Loan Implementation Consultant team. The Loan Implementation Environmental Consultant (LIEC) will be a part of this team and will support the PMO and PIUs to implement the project EMP.

II. SCOPE AND DURATION OF WORK

2. This is an independent position (recruited as part of a consultant team or individually) which is not part of the PMO in-house environmental team. The specialist will report to the PMO. The position is for the entire project duration (intermittent over six years). The LIEC will be recruited as soon as possible after loan effectiveness, as the first task is to confirm project environmental readiness.

III. QUALIFICATIONS

3. The specialist will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least eight years of experience in environmental management, monitoring, and/or impact assessment; (iii) familiarity with ADB project management requirements and national environmental management procedures; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; (vi) willingness and health to regularly visit the subproject sites; and (vii) proficiency in spoken and written English.

IV. TASKS

4. Working closely with the PMO and PIU Environmental Officers, the LIEC will do the following.

Before construction

(i) Ensure project environmental readiness, including: (i) all contractor contracts include, and will comply with, the EMP; and (iii) relevant sections of the EMP are incorporated in construction plans and contracts.
(ii) Assist the PMO and PIUs to implement the GRM, including: (i) establish and publicize the GRM; and (ii) collate and evaluate grievances received.
(iii) Develop procedures to: (i) monitor EMP implementation progress; (ii) collate and evaluate data collected in the EMP environmental monitoring program; and (iii) prepare and submit the semi-annual environmental monitoring reports to ADB (to continue until Project Completion Report).
(iv) Train project agencies in on-site ecological management and rehabilitation for the river dredging component, and, operation of the constructed wetlands.
(v) Provide hands-on support and on-the-job training to the PMO, IAs and contractors on the specific requirements of the EMP as required.

During project implementation

(i) Undertake site visits to all IAs during subproject construction and operating phase.
(ii) Assist in the ongoing public consultation process as described in the project IEE.
(iii) Conduct EMP compliance assessments, identify any environment-related implementation issues, and propose necessary responses in corrective action plans.
(iv) Undertake training of project agencies as required by the EMP training plan.
(v) Assist PMO to prepare semi-annual environmental monitoring progress reports for submission to ADB.

ENVIRONMENTAL ENGINEER

I. BACKGROUND

1. Asian Development Bank (ADB) is supporting the Xinyu City Government (XCG) to implement the Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project. The XCG Project Management Office (PMO) will be assisted by a Loan Implementation Consultant team, which will include an environmental engineer.

II. SCOPE AND DURATION OF WORK

2. The environmental engineer will support the XCG in the detailed planning and design of the proposed High Speed Rail New District (HSRND) by applying the PRC's "Sponge City Guidelines". The position is for six person-months over at least five years, and be involved in the detailed design, construction, and operational phases of the project.

III. QUALIFICATIONS

3. The specialist will have: (i) a master's degree or higher in environmental engineering or related field; (ii) at least 10 years' experience in the applied design of water sensitive urban design; (iii) demonstrated experience with the principals of "sponge city" and national guidelines for sponge city planning; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; and (vi) ideally, proficiency in spoken and written English.

IV. TASKS

4. Working closely with the XCG, PMO, other loan consultants, and other stakeholders as needed, the specialist will do the following.

During Design Stage

(i) Provide detailed inputs to the engineering designs of the proposed HSRND to ensure that the designs meet national requirements for Sponge City.
(ii) Arrange and facilitate planning meetings and workshops between the design institutes and all relevant XCG bureaus, including the XCG Administration Bureau, to ensure the designs achieve an integrated approach for Sponge City, landscaping and recreation, and urban design.
(iii) Support the XCG to prepare construction tenders which include Sponge City design elements and contractual requirements. In particular to ensure that: (a) contractors design the individual public and residential spaces with Sponge City design e.g. the inclusion of roof-top rainfall capture and bio-swales; and (b) engineering conformity between the different civil works e.g. connection between road-side drains and the subsequent canals and lakes.
(iv) Provide training on Sponge City principals to XCG agencies.

During project implementation

(v) Visit and inspect progress of construction for Sponge City design elements of the proposed HSRND. Assist the XCG to maximize effectiveness of water resource conservation and Sponge City principals.
(vi) Provide follow-up training on Sponge City principals to XCG agencies.
(vii) Provide progress reports with recommendations on any issues and/or lessons learned.

CONSTRUCTED WETLAND SPECIALIST

I. BACKGROUND

1. Asian Development Bank (ADB) is supporting the Xinyu City Government (XCG) to implement the Jiangxi Xinyu Kongmu River Watershed Flood Control and Environmental Improvement Project. The project includes the establishment of constructed wetlands ("surface flow" and "subsurface flow" designs), lakes and canals, for water quality treatment. These measures will be undertaken as part of overall efforts to achieve "Sponge City" planning for a new district, the proposed High Speed Rail New District (HSRND). The XCG Project Management Office (PMO) will be assisted by a Loan Implementation Consultant team, which will include a constructed wetland specialist.

II. SCOPE AND DURATION OF WORK

2. The specialist will support the XCG in the detailed planning, design, and monitoring of the constructed wetlands in the HSRND. The position is for six person-months over at least five years, and be involved in the detailed design, construction, and operational phases of the project.

III. QUALIFICATIONS

3. The specialist will have: (i) a master's degree or higher in constructed wetlands or related field; (ii) at least 10 years' demonstrated experience in the design of constructed wetlands, to achieve specific water quality standards and targets; (iii) professional understanding of wetland ecological systems and processes, and, selection of native flora for use in constructed wetlands; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; and (vi) ideally, proficiency in spoken and written English.

IV. TASKS

4. Working closely with the XCG, PMO, other loan consultants, and other stakeholders as needed, the specialist will do the following.

During Design Stage

(i) Review the existing proposed designs for constructed wetlands, water quality treatment, and flood management, for the project.
(ii) Prepare detailed engineering designs for the constructed wetlands, including within and adjacent to the project lakes and canals. The designs will be based on meeting specific water quality targets, and will include: (a) selection of native species for planting; (b) design specifications; and (c) operation and maintenance (O&M) plan, including costs and roles and responsibilities.
(iii) Ensure that the proposed designs conform with: (a) engineering specifications for other linked infrastructure in the proposed HSRND; and (b) PRC regulations for National Wetland Parks, Sponge City Guidelines, and other relevant policies.
(iv) Prepare a monitoring program for the project operational phase, to enable the XCG to monitor (a) condition of the constructed wetlands, and (b) the effectiveness of the wetlands in achieving the water quality standards and targets. The program will include methods, sites, roles, and costs.
(v) Arrange and facilitate planning meetings and workshops between the design institutes and all relevant XCG bureaus, to ensure the designs achieve an integrated approach for water quality treatment, Sponge City, landscaping and recreation, and urban design.
(vi) Support the XCG to prepare construction tenders which address the design requirements for construction and O&M.
(vii) Provide training on constructed wetlands, O&M, and reporting, to XCG agencies.
(viii) Review the possibility to include civil society organizations in the design and/or monitoring of the constructed wetlands, including local universities and/or schools.

During project implementation

(i) Support the XCG to initiate the monitoring program, and participate in the initial sessions.
(ii) Review the effectiveness of the constructed wetlands.
(iii) Provide progress reports, including identification of any issues, and lessons learned.