Environmental Impact Assessment (Final)

November 2014

People's Republic of China: Jiangxi Ji'an Sustainable Urban Transport Project

Prepared by the Ji'an Municipal Government for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 1 December 2013)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.16287
$1.00	=	CNY6.14

ABBREVIATIONS

ADB	–	Asian Development Bank
AQG	–	air quality guideline
As	–	arsenic
B	–	boron
BOD_5	–	five-day biochemical oxygen demand
BRT	–	bus rapid transit
C&D	–	construction and demolition
Cd	–	cadmium
CN	–	cyanide
CNY	–	Chinese yuan
CO	–	carbon monoxide
CO_2	–	carbon dioxide
CO_{2eq}	–	carbon dioxide equivalent
COD	–	chemical oxygen demand
CPS	–	country partnership strategy
Cr	–	chromium
Cu	–	copper
DDT	–	dichloro-diphenyl-trichloroethane
DO	–	dissolved oxygen
EA	–	executing agency
EHS	–	environmental health and safety
EIA	–	environmental impact assessment
EIR	–	environmental impact report
EIRF	–	environmental impact registration form
EIT	–	environmental impact table
EMP	–	environmental management plan
EPB	–	Environmental Protection Bureau
EPD	–	Environmental Protection Department
ESE	–	environmental supervision engineer
F^-	–	fluoride
FSR	–	feasibility study report
FYP	–	Five-Year Plan
GDP	–	gross domestic product
GEF	–	Global Environment Facility
GHG	–	greenhouse gas
GRM	–	grievance redress mechanism
HC	–	hydrocarbon
Hg	–	mercury
I_{Mn}	–	permanganate index
IA	–	implementing agency
IUCN	–	International Union for Conservation of Nature

JDEP	–	Jiangxi Department of Environmental Protection
JEPB	–	Ji'an Environmental Protection Bureau
JEPSRI	–	Jiangxi Environmental Protection and Scientific Research Institute
JMG	–	Ji'an Municipal Government
JIDC	–	Ji'an Urban Investment and Development Company, Ltd.
JPLG	–	Ji'an Project Leading Group
JPMO	–	Ji'an Project Management Office
JPTC	–	Ji'an Public Transport Co. Ltd.
JUCB	–	Ji'an Urban Construction Bureau
LDI	–	local design institute
LIC	–	loan implementation consultant
LIEC	–	loan implementation environmental consultant
MEP	–	Ministry of Environmental Protection
MOF	–	Ministry of Finance
MOT	–	Ministry of Transport
MV	–	motor vehicle
N	–	nitrogen
NDRC	–	National Development and Reform Commission
NH_3-N	–	ammonia nitrogen
Ni	–	nickel
NMT	–	non-motorized transport
NO_2	–	nitrogen dioxide
NO_x	–	nitrogen oxides
O&M	–	operation and maintenance
PAM	–	polyacryl amide
PAM	–	project administration manual
Pb	–	lead
$PM_{2.5}$	–	particulate matter with diameter ≤ 2.5 μm
PM_{10}	–	particulate matter with diameter ≤ 10 μm
PME	–	powered mechanical equipment
PRC	–	People's Republic of China
Se	–	selenium
SO_2	–	sulfur dioxide
SPS	–	safeguard policy statement
SS	–	suspended solid
STI	–	sustainable transport initiative
SWCR	–	soil and water conservation report
TN	–	total nitrogen
TP	–	total phosphorus
TPH	–	total petroleum hydrocarbon
TSP	–	total suspended particulate
VOC	–	volatile organic compound
WBG	–	World Bank Group
WCB	–	Water Conservancy Bureau
WHO	–	World Health Organization
WWTP	–	wastewater treatment plant
Zn	–	zinc

WEIGHTS AND MEASURES

^{o}C	–	degree Centigrade
cm	–	centimeter
dB	–	decibel
h	–	hour
ha	–	hectare
km	–	kilometer
km^2	–	square kilometer
m	–	meter
m^2	–	square meter
m^3	–	cubic meter
m^3/s	–	cubic meter per second
mg/kg	–	milligram per kilogram
mg/L	–	milligram per liter
mg/m3	–	milligram per cubic meter
mm	–	milliliter
t	–	metric ton
t/a	–	metric ton per annum
$\mu g/m^3$	–	microgram per cubic meter
µm	–	micrometer

NOTE

In this report, "$" refers to US dollars.

CONTENTS

吉安市城市建设投资开发公司

7 May 2014

Mr Steven Lewis-Workman
Senior Transport Specialist
Transport Division
East Asia Department
PRC Resident Mission
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Dear Mr. Lewis-Workman

Subject: PRC 45022: Jiangxi Ji'an Sustainable Urban Transport Project

The consolidated Environmental Impact Assessment (CEIA) and Environment Management Plan (EMP) for the captioned project were based on two domestic Environmental Impact Reports (EIR): a planning EIR prepared for the Western City Development Area; a project EIR that covers all project components (bus rapid transit, urban roads and Yudai River rehabilitation). The EIRs were prepared by the Jiangxi Environmental Protection and Scientific Research Institute. The project EIR is being updated in line with the ADB CEIA and will be approved by the Ji'an Environmental Protection Bureau.

This is to formally advise you that there is no objection to these documents being posted on the ADB website according to ADB disclosure procedures. We will implement all required actions as set out in the CEIA and EMP during project processing and implementation and accept ADB's supervision and inspection of EMP implementation.

We appreciate your support for our project processing.

Yours sincerely,

Deputy General Manager
Ji'an Urban Investment Company

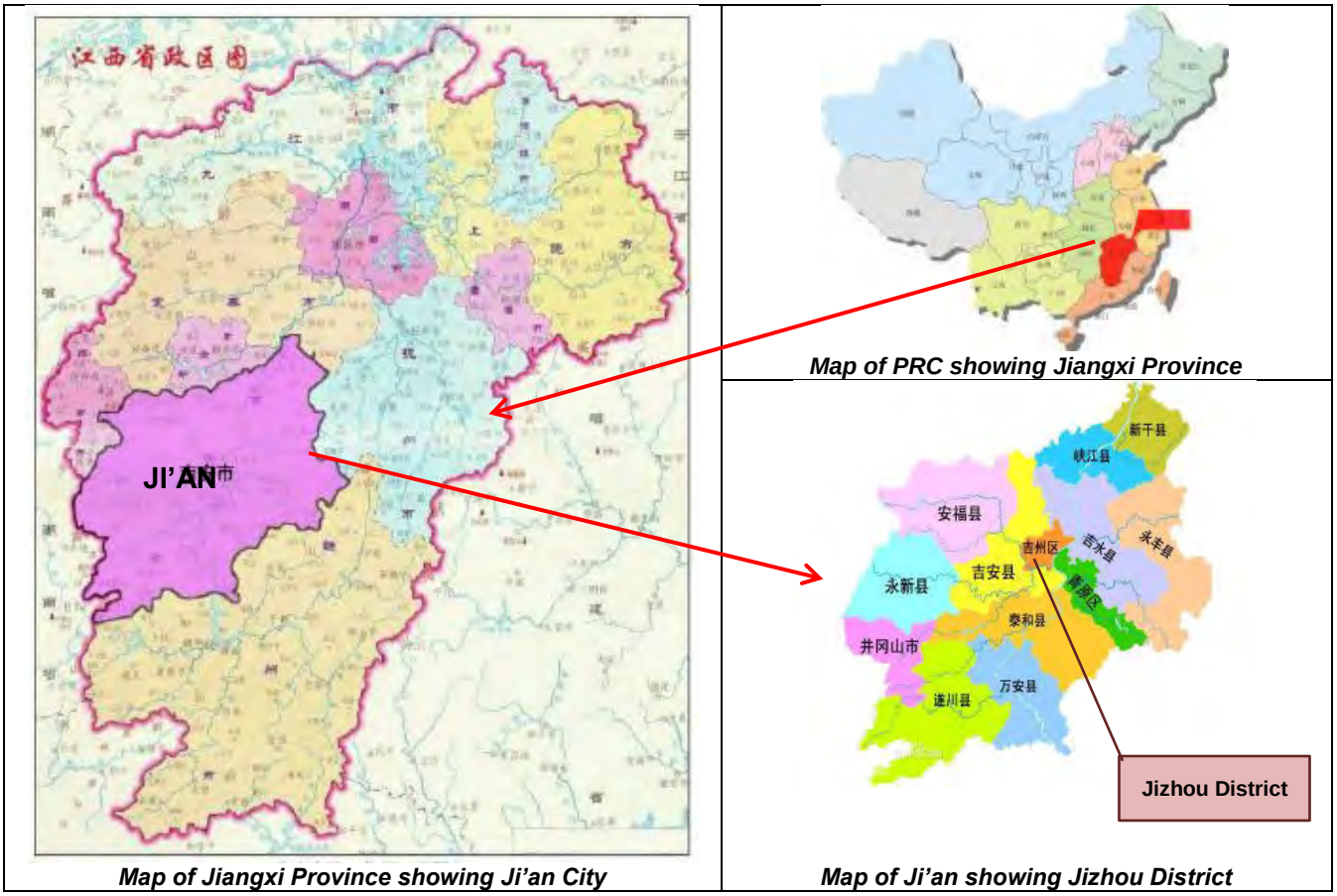
I. EXECUTIVE SUMMARY

A. Background

1. This environmental impact assessment (EIA) is for the proposed Jiangxi Ji'an Sustainable Urban Transport Project. This report was prepared based on two domestic Environmental Impact Reports (EIR); a planning EIR prepared for the Western City Development Area and a project EIR; supplemented with information from three domestic Feasibility Study Reports (FSRs) (for bus rapid transit (BRT), urban roads and Yudai River rehabilitation respectively) and the Soil and Water Conservation Report (SWCR) prepared for the project.

2. This project is in Ji'an City located in the mid-western region of Jiangxi Province (Figure I.1), along the mid-stream section of the Gan River, a major river flowing through Jiangxi into Poyang Lake. Its coordinates are latitudes 25°58'32"N to 27°57'50"N and longitudes 113°46'E to 115°56'E. The city extends 218 kilometers (km) from north to south and 208 km from east to west. Total administrative area is 25,300 square kilometers (km^2), accounting for approximately 15% of total area in the province. Total population is approximately 5 million.

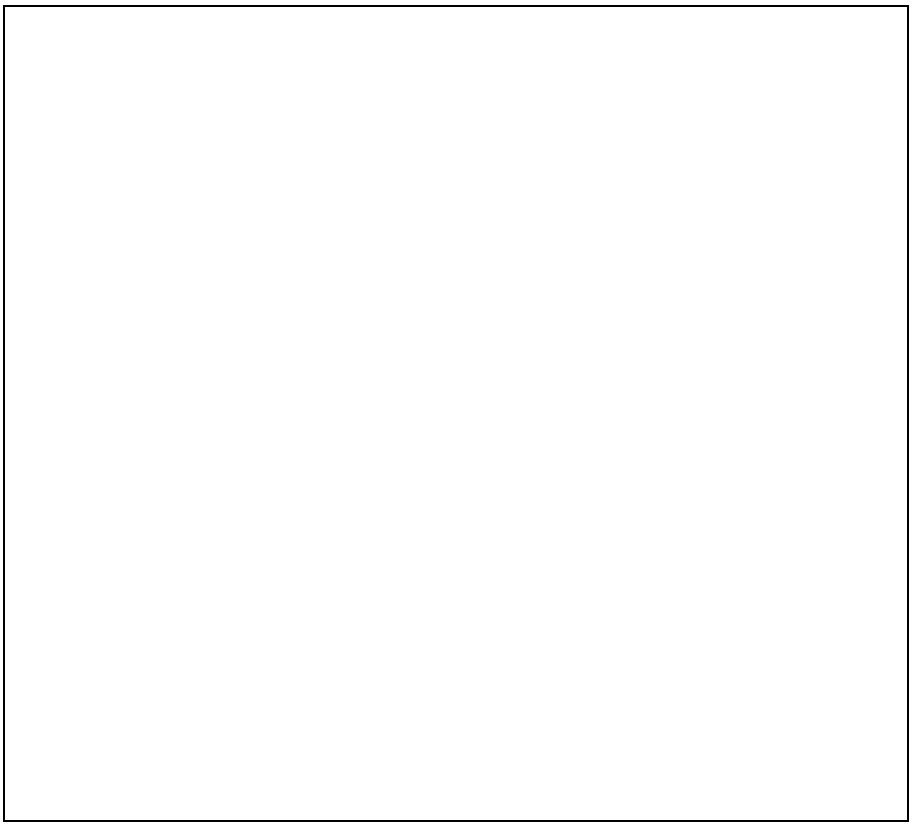
Figure I.1: Location of Ji'an City in the PRC



3. The urban center is in Jizhou District (see Figure I.1), which is located approximately 210 km south of Nanchang, the provincial capital. Jizhou District has a land area of 425 km^2 and a population of 343,200. The project sites are mostly located in Jizhou District (with a small section of the BRT corridor extending into the Qingyuan District to the south). The Project aims to improve Ji'an's urban transport network in a sustainable manner by improving public transport services and public safety, providing new urban roads linking the planned high speed rail station and new development area with the existing urban center and improving multimodal connections between the existing rail station and bus services. Proposed river rehabilitation works will improve flood protection and scenic and amenity resources in the new development area. Ji'an's urban development is constrained by its over-crowded urban center, mountainous topography and bisection by the Gan River with no room to improve the road network. The urban area needs to expand with new urban road networks, improved and safer public transport services, improved non-motorized transport and integration and more efficient multimodal interchange to alleviate existing issues in the urban center and to accommodate future growth in travel demand in a sustainable way.

4. To accommodate urban growth beyond the existing urban center, Ji'an's Urban Master Plan calls for the development of the new Western City Development Area located to the west of the existing urban center. The Western City Development Area is bound by the existing urban center to the east and by the high speed railway line to the west. It has a planned area of 52 km^2 and a projected population of 276,000 by 2020 and an ultimate population of 300,000. **Figure I.2** shows the new Western City Development Area and its linkage to the high speed railway line to the west and the old urban center to the east.

Figure I.2: Axial Development Plan of the New Western City Development Area



5. This project is aligned with Ji'an's Urban Master Plan as well as the key thrusts of ADB's assistance to the PRC under the PRC Country Partnership Strategy (CPS) in the areas of: (i) inclusive growth and balanced development—by promoting urbanization in less developed regions, and (ii) resource efficiency and environmental sustainability—by promoting efficient and sustainable urban transport and transit-oriented development. The focus on public transport and multi-modal integration fits well with ADB's Sustainable Transport Initiative (STI).

B. Project Design

6. The expected impact of the project will be an efficient, inclusive and sustainable urban transport system in Jiangxi Ji'an. The outcome of the project will be efficient multi-model access to major activity centers in Ji'an City including the new Western Development Area.

7. The Project outputs are (i) a 6.94 km bus rapid transit (BRT) corridor along Jinggangshan Road with 15 stations, plus improvement of the station square at the existing Ji'an Railway Station; (ii) rehabilitation of 8.02 km of Yudai River (5.3 km) and tributary (2.72 km); (iii) construction of five urban roads totaling 19.33 km in the Western City Development Area and traffic management improvement through the provision of coordinated signal system, central control system and traffic information collection system; and (iv) capacity development and institutional strengthening.

8. The whole BRT corridor is 14.7 km long with 24 stations to be implemented in two phases. The project output of 6.94 km with 15 stations represents Phase 1 to be funded by ADB. The remaining section (7.76 km) will be implemented in Phase 2 with funding from the municipal government. This EIA covers the whole 14.7 km of the BRT corridor.

9. The Project may include Global Environment Facility (GEF) funded activities consisting of the provision of diesel hybrid-electric BRT buses, evaluation and monitoring of hybrid bus performance and integrated transport/land use system planning and capacity building.

C. Project Benefits

10. The project will benefit a population of 550,000 residing in Jizhou and Qingyuan Districts. Urban road construction and Yudai River rehabilitation in the Western City Development Area will benefit a future population of 300,000 in the area.

11. The project will improve public transport services by introducing a BRT system along the main corridor of the city and improve non-motorized transport (NMT), pedestrian facilities and traffic management measures along the BRT corridor to provide safe and convenient accessibility to public transport. Benefits will include improved safety and on-time performance of urban transportation. The five proposed urban roads in the Western City Development Area provide important road links to the high speed railway station and the central urban area in Ji'an. These roads will facilitate socio-economic development in the Western City Development Area and in Ji'an City. The BRT system would lead to a reduction in carbon emissions of 11,000 tonnes/annum in 2030 compared to the no BRT scenario. The GEF funded activities will support the introduction of diesel hybrid-electric buses, adoption of low-carbon transport systems and improve capacity for integrated transport and land use planning. The Project combined with the GEF funded activities are estimated to avoid total GHG emissions (direct and indirect) of around 2.3-2.6 million tonnes over the project lifetime of 20 years.[1]

12. The Yudai River rehabilitation will involve works to alleviate flood risk, and landscaping to create a new riverside park and recreational resource for the city. The landscape design incorporates bank profiles, soft engineered protection techniques and species that are in keeping with natural wetland habitats.

13. Furthermore, the improved river is expected to create a more attractive environment for the city, improving quality of life while maintaining natural ecological systems and functions. The design concept is developed around the theme of a people-centered, low-carbon-sustainable development. This component would benefit the promotion of the image of the city as well as the land value. As this proposed area is strategically located in front of the planned high speed railway station, a synergy of benefits of the new urban roads, Yudai River rehabilitation, and the social and economic development of the city is also expected.

D. Project Impacts and Mitigation Measures

14. This Project was classified as category A for environment. Construction and operation of the project roads will have potentially significant impacts on the environment. The BRT corridor will be constructed on existing roads where there are existing noise and air quality sensitive receptors. There are also villages near the proposed urban road alignments that would also

[1] The carbon emission calculation in the domestic EIR was based on the current national fuel standards and tonnes of fuel per annum and does not take into account use of diesel hybrid electric buses. The GEF calculation is based on the GEF Manual for Calculating Greenhouse Gas benefits for GEF Transportation Projects and Transport Emissions Evaluation Models for Projects (TEEMP). It assumes use of hybrid diesel vehicles and a Project lifetime of 20 years for major infrastructure and 10 years for other interventions.

be affected. Dust and noise during the construction stage will need to be mitigated to reduce potential impacts to these sensitive receptors. No night time construction for the urban roads in the Western City Development Area will be allowed. Night time construction on the BRT corridor between 22:00 and 06:00 hours would be avoided. Recognizing that night time construction may be needed from time to time in the BRT corridor to avoid day time traffic congestion, night time construction will be kept to a minimum and nearby communities will be notified and consulted in advance.

15. The urban roads will involve the construction of four bridges across rivers and dredging of the Yudai River would affect water quality. The detailed design will consider appropriate drainage and discharge options to minimize pollution impacts from surface run-off. It will also incorporate appropriate waste management facilities for the riverside park. Mitigation measures for all works with impacts on water courses have been identified and described in this report and in the environmental management plan (EMP, see Appendix 1). Dredging in the Yudai River will be done in the dry season, with bunds placed around the dredging site and water pumped out. Sediment removal will be by mechanical excavator similar to earth moving works on land. Impact to water quality should be considerably reduced. Regular maintenance of drainage and removal of waste and debris will be important during operation.

16. Approximately 210 hectares (ha) of land will be permanently lost during construction of the urban roads and the Yudai River rehabilitation and riverside park development. The land is dominated by farmland and woodland which does not support any species of significant conservation value. Only one species, the Camphor Tree (*Cinnamomum camphora*) is under national Class II protection and was observed along or near three of the five proposed urban road alignments. The EMP requires that the detailed design of the urban road alignments should avoid the three locations with camphor trees near or on the proposed alignments as the primary mitigation measure, and if not possible, design transplant schemes for the ones affected.

17. Old camphor trees more than 100 years in age could be deemed as physical cultural resources under SPS (2009) definition. These were found to occur at three locations with one location on the proposed alignment of the urban road Junhua Avenue. The other two locations are near Junhua Avenue and Zhongshan West Road. The EMP requires that detailed design of all urban road alignments must avoid these old camphor trees, and that these trees shall be tagged, marked, and fenced off before commencement of construction to prevent damage.

18. One bird species, the Yellow-Breasted Bunting (*Emberiza aureola*), has been recorded as occuring in the project area of influence. It is listed on the International Union for Conservation of Nature (IUCN) red list as Endangered (recently upgraded from Vulnerable) due to very rapid population decline from trapping on wintering grounds. This species is described in the *Catalog of Life China 2013* as having wide distribution in over 20 provinces in the PRC. Two amphibian species, four reptile species, one mammal species and 16 bird species on the provincial protection list have been identified in the project area of influence but are described as having wide distribution. There are no protected areas and/or other physical cultural resources within the project area of influence. Should buried artifacts be discovered during construction, they will be dealt with in accordance with PRC's *Cultural Relics Protection Law*.

19. There is no critical habitat within the project area of influence. There is also no primary

woodland in the project area of influence due to human disturbance and urban development. The woodlands in the project area of influence could be deemed as secondary woodland dominated by common species. The project area of influence was found to be dominated by modified habitats such as farmland and village constructed land. The creation of the riverside park presents an opportunity to create new wetland and woodland habitats. A specialist wetland ecologist was appointed by ADB to work with the Design Institute to develop the preliminary and detailed design of the park to support the retention and rehabilitation of existing habitats and creation of new habitats of value for local flora and fauna. The draft technical report is included in Appendix 2. The final technical report will be produced after completion of detailed design in early 2015.

20. Land acquisition will affect 1,742 households and 6,789 people on collective land, and 14 government agencies and enterprises including 188 employees on government owned land. Rural house demolition will total 70,682 m^2, affecting 184 households and 806 people. Urban house demolition will total 9178 m^2, affecting 90 households and 360 people. Enterprise house demolition will total 14,795 m^2. Compensation will be in accordance with the Resettlement Plan and ADB SPS (2009) requirement.

21. Operation of the BRT and urban roads would cause air quality impacts from vehicle emissions and noise impacts from road traffic. One-hour average NO_2 levels from vehicle emissions were found to exceed the Class II air quality standard in 2030 within 15-30 m from the road side along some road sections including the BRT corridor. The EMP provides recommendations on buffer distances for future development along the road corridors. Peak hour traffic noise along the project roads was found to exceed applicable noise standards at most of the existing sensitive receptors, especially at night. Of the 32 existing noise sensitive receptors along the five proposed urban roads in the Western Development Area, 28 would experience noise level increases of >3dB(A) in year 2020 compared to the existing noise levels. In accordance with the World Bank Group Environmental Health and Safety guidelines, installation of ventilated double glazed windows at the first row of buildings facing the proposed roads will be required, unless they are resettled in or before 2020 as allocated in the *Conceptual Plan and Controlled Plan of Ji'an Western City Development Area*. Recommendations on buffer distances and mitigation measures for traffic noise for various types of sensitive uses (such as residential, school, hospital) along these roads for future developments are also provided. Noise levels would comply with the applicable standards with the implementation of these mitigation measures.

22. Carbon emissions from all the project roads were predicted to total 94,759 t/a in 2030. This is below the ADB threshold of 100,000 t/a. The EMP includes requirements for the Design Institutes to specify energy efficient lighting and cooling/heating systems and materials that are recycled, have recycled content or are from sustainable sources, particularly for street furniture and fixtures/fittings.

23. A climate risk and vulnerability analyses study was carried out to assess the vulnerability of the project to future climate change impacts. The project area is at risk from increased intensity and frequency of heavy rainfall events and flood. The study recommended that the detailed design considers adoption of higher factors of safety as the basis of design to ensure that the project is resilient to projected future climate change impacts. A detailed report is included in Appendix 3.

E. Information Disclosure, Consultation and Participation

24. Both the planning EIR and the project EIR carried out public consultation during their preparation. These events consisted of information disclosure on relevant government and enterprise web-sites, public posting of project information in affected communities, questionnaire survey of stakeholders in affected communities and a discussion forum with various stakeholders from government, enterprises and affected villages, towns and townships, which was also participated by the PPTA consultant.

25. The majority of participants in these consultation events agreed to the project and viewed the environmental issues to be minor. Most of the participants had no or little knowledge on the resettlement and compensation policy. This issue was also raised, discussed and responded to in the discussion forum. Such plans and policies have been explained to the local residents through further consultation under the Resettlement Plan.

F. Grievance Redress Mechanism

26. This report and the EMP describe a grievance redress mechanism (GRM) to document and resolve complaints from affected people. The proposed GRM was explained to the attendees of the discussion forum. The GRM will be coordinated by the Ji'an Project Management Office (JPMO), who will set up a complaint center with hotline for receiving environmental and resettlement grievances, and will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry and modes of access, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available.

G. Key EMP implementation Responsibilities

27. The Ji'an Municipal Government (JMG) is the Executing Agency (EA) and has established the Ji'an Project Management Office (JPMO), who on behalf of the EA will be responsible for the day-to-day management of the project. The JPMO will have overall responsibility for supervision of the implementation of environment mitigation measures, coordinate the project level GRM and report to ADB. The JPMO will appoint environment specialists on its staff to supervise the effective implementation of the EMP and to coordinate the project level GRM. The JPMO will engage the technical engineering design institutes, hire the loan implementation consultants (LIC) and the external environmental supervision engineer (ESE), and will manage the procurement process. For implementing environmental quality monitoring, JPMO will contract the Ji'an Environmental Monitoring Station (JEMS). To ensure that the contractors comply with the EMP provisions, JPMO with the help and technical support of a Loan Implementation Environmental Consultant (LIEC) and the tender agent, will prepare and provide the following specification clauses for incorporation into the bidding procedures: (i) a list of environmental management requirements to be budgeted by the bidders in their proposals; (ii) environmental clauses for contractual terms and conditions; and (iii) major items in the EIA and EMP. The JPMO will prepare semi-annual environment progress reports and submit them to ADB.

28. The Ji'an Urban Investment and Development Company, Ltd. (JIDC) (JMUCIDC) will be the Implementing Agency (IA) for the Project. JMUCIDC will assume the debt servicing responsibility as the end-user of the ADB loan. It will implement project components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control.

29. During the operational phase, the JMUCIDC will supervise the environmental management

and implementation of mitigation measures by the operators and maintenance units (O&M Units) for the project components. The cost of environmental monitoring and mitigation measures in this phase will be borne by the relevant O&M Units

H. Risks and Key Assurances

30. The main project risks include the low institutional capacity of the JPMO, JMUCIDC and O&M units and their failure to implement the EMP effectively during construction and operational stages. These risks will be mitigated by (i) providing training in environmental management and monitoring; (ii) appointing qualified project implementation consultants and qualified environmental staff, (iii) following appropriate project implementation monitoring and mitigation arrangements, and (iv) ADB conducting project reviews.

31. Key assurances cover ADB requirements in environmental safeguards during project implementation.

I. Overall Conclusion

32. This EIA shows that potentially significant impacts can be reduced to acceptable levels with appropriate mitigation. The EMP has specified what mitigation measures are to be implemented and by whom, and how the impacts are to be monitored during construction and operation. The project will have positive benefits for Ji'an, improving the urban road network, public transport services, multi-modal connectivity, road safety, flood protection, scenic, amenity and ecological value of the Yudai River corridor, promote socio-economic development and improve the quality of life in Ji'an. It will also contribute to significant reductions in greenhouse gas emissions.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Policy Framework

33. The project is located in Ji'an City, Jiangxi Province. Jiangxi is one of six provinces benefiting from the central government's "The Rise of Central China Plan," announced in 2006 by the State Council. The Plan aims at reducing inter-regional economic disparities by upgrading the central region's industrial structure and boosting industrialization and urbanization through better use of its geographic and industrial advantages. Ji'an is benefiting from this national policy and with Jinggang Mountain being the cradle of the red revolution, is also benefiting from a recent State Council initiative to assist and promote the socio-economic development of old revolutionary bases in the PRC. With the support of these national policy initiatives, urban population in Ji'an was projected to reach 730,000 in year 2020 according to the *Ji'an Urban Master Plan (2007-2020)*, compared to a population of 555,300 in 2012. The urban area will be increased from the present 63.72 km^2 to 75 km^2 by 2020. This project is supported by the *Ji'an Urban Master Plan (2007-2020)*'s actions on expansion of the urban area and improvements to the road network and public transport.

34. In 2012, a ***Conceptual Plan and Controlled Plan of Ji'an Western City Development Area*** was prepared to take advantage of the upcoming inter-city high speed railway development passing through the development area (**Figure II.1**). The urban roads and Yudai River components of this project are located within the Western City Development Area and are in accordance with the conceptual plan and controlled plan for the Western

City Development Area. The BRT component is located in the existing urban center to the southeast of the Western City Development Area.

Figure II.1: Conceptual Plan Showing the Western City Development Area

35. This project is aligned with the key thrusts of ADB's assistance to the PRC under the PRC Country Partnership Strategy (CPS)[2] in the areas of: (i) inclusive growth—by promoting urbanization in less developed regions, and (ii) environmentally sustainable growth —by promoting efficient and sustainable urban transport and transit-oriented development.[3] The focus on public transport and multi-modal integration fits well with ADB's Sustainable Transport Initiative (STI).[4]

36. **Climate change**. The PRC's National Development and Reform Commission (NDRC) in 2012 issued the *China's Policies and Actions for Addressing Climate Change*. The document describes PRC's policies and proposed actions for climate change mitigation and adaptation, but does not specifically address climate change adaptation in the transport

[2] ADB. 2012. PRC Country Partnership Strategy 2011-2015. Manila. http://www.adb.org/countries/prc/strategy
[3] Transit-oriented development refers to mixed-use residential and commercial areas designed to maximize access to public transport and facilitate pedestrian movement. A transit-oriented development is typically centered on a transit station (train station/metro station/bus terminal), surrounded by relatively high-density development with progressively lower-density development further from the high capacity public transport facility.
[4] The STI, approved by ADB management on 20 July 2010, has set a new direction for ADB's transport sector efforts to promote more environmentally and socially sustainable transport solutions in donor member countries in line with ADB's ***Strategy 2020***.

sector besides the selection of cities to pilot low carbon transport systems as a means to mitigate climate change. Nanchang in Jiangxi Province, was selected as one of the pilot cities.

37. ADB's climate change strategy aims to assist developing member countries and project teams to address the increasing challenges posed by climate change and to enhance the climate resilience of vulnerable sectors including the transport sector. The transport sector in Ji'an would be vulnerable to changes in temperature and extreme weather events. Changes in temperature, both a gradual increase in temperature and an increase in extreme temperatures, may impact road pavements and bridges resulting in heat induced heaving and buckling of expansion joints. Extreme weather events such as stronger and/or more frequent storm events may affect the capacity of the drainage and overflow systems and road bridge structures to deal with stronger or faster velocity flow and winds. For the transport sector, ADB has published a guideline for climate proofing road infrastructure projects.[5]

B. Legal and Administrative Framework

38. The administrative framework for environmental impact assessment in the PRC consists of national, provincial and local (city) environmental protection authorities. The national authority is the Ministry of Environmental Protection (MEP), who promulgates laws, regulations and technical guidelines on environmental impact assessment and pollution prevention and control. At the provincial level, Environmental Protection Departments (EPDs) are mandated with control and regulation of environmental impact assessment and pollution prevention and control in the province. They are also often delegated the authority by MEP to approve environmental impact assessment reports for construction projects in the provinces, except those with national interest and those that cross provincial boundaries that would need MEP approval. The local or city-level Environmental Protection Bureaus (EPBs) enforce environmental laws and conduct environmental monitoring within city limits. Local EPBs could be delegated the authority to approve environmental impact assessments by the provincial DEPs. The Ji'an Environmental Protection Bureau (JEPB) has approval authority for the domestic environmental impact reports for this project.

39. The PRC Environmental Impact Assessment Public Participation Interim Guideline in 2006 requires that the public are involved in the EIA process. This was further clarified under Technical Guidelines for Environmental Impact Assessment: Public Participation (public comment version, January 2011). Since August 2012, all domestic environmental impact reports for construction reports submitted for approval must include an abstract which is disclosed on the web-site of the approval authority (MEP Order No. [2012] 51).

C. Laws, Regulations, Guidelines and Standards

40. **PRC** requirements. Table II.1 lists PRC environmental laws, regulations, guidelines and standards relevant to this project. These comprehensive requirements cover pollution prevention and control on air, noise, water, ecology and solid waste and are supported by technical guidelines and standards for assessing atmospheric, noise, water and ecological impacts.

[5] Asian Development Bank. 2011. ***Guidelines for climate proofing investment in the transport sector: road infrastructure project***. xiv + 53 pp.

Table II.1: Relevant PRC Laws, Regulations, Guidelines and Standards

Laws and regulations	
1	*Environmental Protection Law*, December 26, 1989
2	*Atmospheric Pollution Prevention and Control Law*, September 1, 2000
3	*Noise Pollution Prevention and Control Law*, March 1, 1997
4	*Water Pollution Prevention and Control Law*, June 1, 2008
5	*Solid Waste Environmental Pollution Prevention and Control Law*, April 1, 2005
6	*Water Law*, October 1, 2002
7	*Water and Soil Conservation Law*, June 29, 1991, amended December 25, 2010
8	*Promotion of Clean Production Law*, January 1 2003
9	*Environmental Impact Assessment Law*, September 1, 2003
10	*Energy Conservation Law*, January 1, 1998
11	*Wild Animal Protection Law*, August, 2004
12	*Water and Soil Conservation Law,* March 1, 2011
13	*Cultural Relics Protection Law*, October 2002
14	*Cultural Relics Protection Implementation Regulation,* July 1, 2003
15	*Construction Project Environmental Protection and Management Regulation*, (State Department Order No. 253), November 29, 1998
16	*Plan Environmental Impact Assessment Regulation*, (State Department Order 559), October 1, 2009
Guidelines	
1	*Technical Guidelines for Plan Environmental Impact Assessment (on trial)* (HJ/T 130-2003)
2	*Technical Guidelines for Environmental Impact Assessment of Development Area* (HJ/T 131-2003)
3	*Directory for the Management of Different Categories of Construction Project Environmental Impact Assessment*, (MEP Order No. 2), October 1, 2008
4	*Circular on Strengthening the Management of Environmental Impact Assessment for Construction Projects Financed by International Financial Organizations*, (MEP Announcement No. [1993]324)
5	*Guidelines for Technical Review of Environmental Impact Assessment on Construction Projects* (HJ 616-2011)
6	*Technical Guidelines for Environmental Impact Assessment: General Program* (HJ 2.1-2011)
7	*Guidelines for Environmental Impact Assessment: Atmospheric Environment* (HJ 2.2-2008)
8	*Technical Guidelines for Noise Impact Assessment* (HJ 2.4-2009)
9	*Technical Guidelines for Environmental Impact Assessment: Surface Water Environment* (HJ/T 2.3-93)
10	*Technical Guidelines for Environmental Impact Assessment: Ground Water Environment* (HJ 610-2011)
11	*Technical Guideline for Environmental Impact Assessment: Ecological Impact* (HJ 19-2011)
12	*Environmental Impact Assessment Public Participation Interim Guideline*, (MEP Announcement No. [2006]28)
13	*Technical Guidelines for Environmental Impact Assessment: Public Participation (public comment version)*, (January 2011)
14	*Technical Guideline for Construction Project Environmental Risk Assessment* (HJ/T 169-2004)
15	*Technical Guideline on Environmental Monitoring Quality Management* (HJ 630-2011)
16	*Specifications for Road Construction Project Environmental Impact Assessment* (JTG B03-2006)
17	*Ground Level Traffic Noise Pollution Prevention Technical Policy* (MEP Announcement No. [2010]7)
18	*Environmental Supervision for Transport Projects* (MOT and MEP Announcement No. [2004]314)
19	*Environmental Supervision Method* (MEP Order No. [2012] 21)
20	*Requirements for Preparation of Abstract for Construction Project Environmental Impact Report* (MEP Order No. [2012]51)
Standards	

1	*Ambient Air Quality Standard (GB 3095-1996) and Amendment* (MEP Announcement No. [2000]1)
2	*Ambient Air Quality Standards (GB 3095-2012)* [to replace GB 3095-1996 on January 1, 2016]
3	*Air Pollutant Integrated Emission Standard (GB 16297-1996)*
4	*Environmental Quality Standard for Noise (GB 3096-2008)*
5	*Emission Standard for Community Noise (GB 22337-2008)*
6	*Emission Standard of Environmental Noise for Boundary of Construction Site (GB 12523-2011)*
7	*Technical Specifications to Determine the Suitable Areas for Environmental Noise of Urban Area, (GB/T 15190-94)*
8	*Environmental Quality Standards for Surface Water (GB 3838-2002)*
9	*Quality Standard for Ground Water (GB/T 14848-93)*
10	*Integrated Wastewater Discharge Standard (GB 8978-1996)*
11	*Environmental Quality Standard for Soils (GB 15618-1995)*
12	*Residential Building Sound Proof Design Specification* (GB 50118-2010)

41. There are two types of environmental impact assessment under PRC's *Environmental Impact Assessment Law* of 2003, for planning of new development areas (in this case, the Western City Development Area) and for project-specific activities (in this case, the urban roads, BRT and Yudai River rehabilitation respectively.

42. Two domestic environmental impact assessment reports have been prepared for this project:

(i) A planning environmental impact assessment report: *Planning Environmental Impact Assessment Report for the Ji'an Urban Center Western City Development Area*, was prepared by the Jiangxi Environmental Protection and Scientific Research Institute (JEPSRI). This report was approved by the JEPB on 22 August 2013 (JEPB document no. [2013] 149).

(ii) For assessing project-specific environmental impacts, a construction project environmental impact report (EIR)[6]: *Environmental Impact Report for Ji'an Urban Transport Project using ADB Fund*, was prepared by the JEPSRI. The EIR appraisal occurred in January 2014 and approval by the JEPB is expected in late March 2014.

43. In addition to the above EIRs, a SWCR and FSRs for the BRT, urban roads and Yudai River improvement were also prepared for this project. This project EIA is based on information and findings provided in the planning and construction project EIRs, the SWCR and the FSRs.

44. **ADB environmental safeguard requirements**. This Project is classified as Category A for environment on the basis of ADB's Rapid Environmental Assessment (REA), requiring the preparation of an EIA report. ADB's *Safeguard Policy Statement* (SPS) 2009 requires a number of considerations that are over and above the domestic EIR requirements. These include, among others: (i) project risks and respective mitigation measures and project assurances; (ii) project level grievance redress mechanism (GRM); (iii) definition of the

[6] The ***Directory for the Management of Different Categories of Construction Project Environmental Impact Assessment*** classifies environmental impact assessments for construction projects into 3 categories with different reporting requirements, based on the 'significance' of potential environmental impact due to the project and the environmental sensitivity of the project site as described in this Directory. An Environmental Impact Report (EIR) is required for construction projects with potential significant environmental impacts. An Environmental Impact Table (EIT) is required for construction projects with less significant environmental impacts. An Environmental Impact Registration Form (EIRF) is required for construction projects with the least significant environmental impacts.

project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements; (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of justification if local standards are used; (x) meaningful consultation and participation; and (xi) implementation schedule and (measurable) performance indicators in the EMP.

45. **Relevant international agreements.** The PRC is a signatory to a number of international agreements relevant to environment protection. Those relevant to the project, along with the date of signing by the PRC, are listed in Table II.2.

Table II.2: International Agreements with the PRC as a Signatory

No.	Name of Agreement	PRC Signing Date	Agreement Objective
1	***Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat***	21 December 1975	To stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the wetlands' ecological functions and their economic, cultural, scientific, and recreational values
2	***Montreal Protocol on Substances That Deplete the Ozone Layer***	1 January 1989	To protect the ozone layer by controlling emissions of substances that deplete it
3	***Convention on Biological Diversity***	29 December 1993	To develop national strategies for the conservation and sustainable use of biological diversity
4	***United Nations Framework Convention on Climate Change***	21 March 1994	To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system
5	***United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification***	26 December 1996	To combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements
6	***Kyoto Protocol to the United Nations Framework Convention on Climate Change***	23 February 2005	To further 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

D. Evaluation Standards

46. In PRC, ambient conditions of air, noise and water quality in the project area determine the appropriate category of emissions and effluent standards for the construction and operational phases of built infrastructure. However, the World Bank Group (WBG) Environmental Health and Safety (EHS) guidelines[7] (see below) are based on best practice construction and operational procedures. Both the PRC standards and EHS guidelines are used in the assessments and the PRC standards are used for compliance checking of potential impacts from this project.

47. **Air quality.** The PRC ranks air quality into three classes according to its *Ambient Air Quality Standard* (GB 3095-1996 and amendment in 2000), with Class I having the best air quality and Class III the worst air quality. The ambient air quality in the assessment area of this

[7] World Bank Group. 2007. Environmental, health and safety guidelines - General EHS guidelines. Washington D.C.

project has been assigned to meet GB 3095-1996 Class II standards. A new standard has been issued in 2012 (GB 3095-2012), which will become effective on January 1, 2016, replacing GB 3095-1996. GB 3095-2012 combines Classes II and III. It also introduces $PM_{2.5}$ standards and has more stringent NO_2 standards. The WBG adopted the World Health Organization (WHO) standards for its EHS standards for air quality.

48. On 10 September 2013, the State Council announced the *Air Pollution Prevention Action Plan* for the PRC (State Council [2013] No. 37). The action plan sets 2017 targets on reducing PM_{10} emissions in prefecture level cities by more than 10%; $PM_{2.5}$ emissions by approximately 25%, 20% and 15% in Beijing-Tianjin-Hebei region, Yangtze River Delta and Pearl River Delta respectively; and controlling annual average $PM_{2.5}$ levels in Beijing at around 60 μg/m^3. Among the 35 actions identified and described in the plan, the following are deemed to be applicable to this project:

- Strengthen control of aerial sources of pollution including controlling dust pollution during construction;
- Strengthen control of point source pollution including traffic management and prioritizing public and non-motorized modes of transportation;
- Strictly implement total emission pollution control, with compliance with such controls on SO_2, NO_x, dust and volatile organics as a pre-requisite in approving construction project EIRs;
- Optimize spatial pattern in urban and new district planning to facilitate better air pollutant dispersion;
- Strengthen laws, regulations and standards on controlling air pollution;
- Strengthen capacities in environmental management and supervision system;
- Increase environmental regulatory enforcement;
- Implement environmental information disclosure;
- Strictly enforce accountability;
- Establish monitoring warning system;
- Develop contingency plan; and
- Adopt timely contingency measures for public health protection during serious air pollution events.

49. The WHO sets up air quality guideline (AQG) standards for various air quality parameters for the protection of public health. Yet recognizing that progressive actions are needed to achieve these standards and the financial and technological limitations of some countries, cities or localities especially in developing countries, the WHO also established interim targets as intermediate milestones towards achieving the AQG.

50. Table II.3 compares the PRC's GB 3095-1996 Class II standards with the GB 3095-2012 standards and the World Bank Group's EHS standards which have adopted the WHO AQG.

Table II.3: Comparison of PRC and WBG Ambient Air Quality Standards

Air Quality Parameter	Averaging Period	PRC Class II (μg/m^3)		WHO/World Bank Group EHS[8] (μg/m^3)	
		GB 3095-1996	GB 3095-2012	Interim Targets	AQG
SO_2	1-year	60	60	n/a	n/a
	24-hour	150	150	50-125	20

[8] World Bank Group 2007, ibid.

Air Quality Parameter	Averaging Period	PRC Class II (μg/m^3)		WHO/World Bank Group EHS[8] (μg/m^3)	
		GB 3095-1996	GB 3095-2012	Interim Targets	AQG
	1-hour	500	500	n/a	n/a
TSP	1-year	200	200	n/a	n/a
	24-hour	300	300	n/a	n/a
PM_{10}	1-year	100	100	30-70	20
	24-hour	150	150	75-150	50
$PM_{2.5}$	1-year	n/a	n/a	15-35	10
	24-hr	n/a	150	37.5-75	25
	1-hour	n/a	350	n/a	n/a
NO_2	1-year	80	40	n/a	40
	24-hour	120	80	n/a	n/a
	1-hour	240	200	n/a	200
CO	24-hour	4,000	4,000	n/a	n/a
	1-hour	10,000	10,000	n/a	n/a

Note: n/a = not available

51. The longer averaging period such as 1-year as shown in Table II.3 is more applicable to assessing impacts from multiple as well as regional sources; while shorter averaging periods such as 24-hour and 1-hour are more applicable to assessing short term impacts from project related activities, such as from peak hour traffic or daily or peak construction activities.

52. Comparing the PRC Class II standards with the WHO/WBG's EHS standards, Table II.3 shows that for 24-hour SO_2, both GB 3095-1996 and 3095-2012 standards (150 μg/m^3) are less stringent than the upper limit of the EHS interim target (125 μg/m^3); for 24-hour $PM_{10.}$ Both GB 3095-1996 and 3095-2012 standards (150 μg/m^3) are the same as the upper limit of the EHS interim target (125 μg/m^3). For 24-hr $PM_{2.5}$. the GB 3095-2012 standard is twice the upper limit of the EHS interim target (75 μg/m^3). For 24-hour NO_2, the GB 3095-1996 standard (240 μg/m^3) is less stringent than, while the GB 3095-2012 standard (200 μg/m^3) is the same as, the AQG (200 μg/m^3).

53. Fugitive emission of particulate matter (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 ≤ 1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particulate matter particle diameter.

54. **Noise.** According to the *Technical Specifications to Determine the Suitable Areas for Environmental Noise of Urban Area* (GB/T 15190-94), the area within 200 m on both sides of road or road junction should comply with the corresponding provisions in *Environmental Quality Standard for Noise* (GB 3096-2008). GB 3096-2008 categorizes five functional areas based on their tolerance to noise pollution: from Category 0 to Category 4. Category 0 is for areas with convalescent facilities that are the least tolerant to noisy environment and therefore has the most stringent day and night time noise standards. Category 1 is for areas predominated by residential areas, hospitals and clinics, educational institutions and research centers. Category 2 is for areas with mixed residential and commercial functions. Category 3 is for areas with industrial production and storage and logistics functions. Category 4 is for regions adjacent to traffic noise sources such as major roads and

highways, and is subdivided into 4a and 4b with the former applicable to road and marine traffic noise and the latter applicable to rail noise. Standards for various functional area categories are compared with the WBG's EHS guidelines in Table II.4, showing that the EHS guidelines have lower noise limits for residential, commercial and industrial mixed areas but higher noise limits for industrial areas. The EHS guidelines do not have separate noise limits for trunk roads but apply the same noise limits based on whether the areas are for residential or industrial uses. In addition, the EHS guidelines set a limit of 3 dB (A) for noise level increase due to project activities and implementation.

Table II.4: Environmental Quality Standards for Noise (equivalent sound level L_{Aeq}: dB)

Noise Functional Area Category	Applicable Area	GB 3096-2008 Standards		WBG EHS[9] Standards	
		Day 06:00-22:00	Night 22:00-06:00	Day 07:00-22:00	Night 22:00-07:00
0	Areas needing extreme quiet, such as convalescence areas	50	40	55	45
1	Areas mainly for residence, hospitals, cultural and educational institutions, administration offices	55	45		
2	Residential, commercial and industrial mixed areas	60	50		
3	Industrial areas, warehouses and logistic parks	65	55	70	70
4a	Area on both sides of urban trunk road	70	55	55	45

55. PRC's *Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523-2011) regulates construction noise, limiting construction noise levels at the construction site boundary to 70 dB(A) in the day time (06:00 to 22:00) and 55 dB(A) at night (22:00 – 06:00). The WBG does not have standards for construction noise *per se*, but applies the same noise standards listed in Table II.4 above to the receptors during construction activities.

56. **Surface water quality.** For water quality assessment, the determining standard is PRC's *Environmental Quality Standards for Surface Water* (GB 3838-2002). It defines five water quality categories for different environmental functions. Category I is the best, suitable for head waters and national nature reserves. Category II is suitable for drinking water sources in Class I protection areas, habitats for rare aquatic organisms, breeding grounds for fish and crustaceans, and feeding grounds for fish fry. Category III is suitable for drinking water sources in Class II protection areas, wintering grounds for fish and crustaceans, migration routes, water bodies for aquaculture and capture fishery, and swimming activities. Category IV is suitable for general industrial use and non-contact recreational activities. Category V is the worst which is only suitable for agricultural and scenic water uses. These standards are set out in Table II.5. The WBG has guidelines on effluent quality standards but not ambient water quality, and recognizes the use of local ambient water quality criteria for EHS purpose.

Table II.5: Environmental Quality Standards for Surface Water GB 3838-2002

Parameter	Category

[9] World Bank Group 2007, Ibid.

	I	II	III	IV	V
pH	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9
Dissolved oxygen (DO) [mg/L]	90% saturation or ≥7.5	≥6	≥5	≥3	≥2
Permanganate index (I_{Mn}) [mg/L]	≤2	≤4	≤6	≤10	≤15
Chemical oxygen demand (COD) [mg/L]	≤15	≤15	≤20	≤30	≤40
5-day Biochemical oxygen demand (BOD_5) [mg/L]	≤3	≤3	≤4	≤6	≤10
Ammonia nitrogen (NH_3-N) [mg/L]	≤0.15	≤0.5	≤1.0	≤1.5	≤2.0
Total phosphorus (as P) [mg/L]	≤0.02	≤0.1	≤0.2	≤0.3	≤0.4
Lakes & reservoirs	≤0.01	≤0.025	≤0.05	≤0.1	≤0.2
Total nitrogen (lakes, reservoirs, as N) [mg/L]	≤0.2	≤0.5	≤1.0	≤1.5	≤2.0
Copper (Cu) [mg/L]	≤0.01	≤1.0	≤1.0	≤1.0	≤1.0
Zinc (Zn) [mg/L]	≤0.05	≤1.0	≤1.0	≤2.0	≤2.0
Fluoride (as F^-) [mg/L]	≤1.0	≤1.0	≤1.0	≤1.5	≤1.5
Selenium (Se) [mg/L]	≤0.01	≤0.01	≤0.01	≤0.02	≤0.02
Arsenic (As) [mg/L]	≤0.05	≤0.05	≤0.05	≤0.1	≤0.1
Mercury (Hg) [mg/L]	≤0.0005	≤0.0005	≤0.0001	≤0.001	≤0.001
Cadmium (Cd) [mg/L]	≤0.001	≤0.005	≤0.005	≤0.005	≤0.01
Chromium (Cr, hexavalent) [mg/L]	≤0.01	≤0.05	≤0.05	≤0.05	≤0.1
Lead (Pb) [mg/L]	≤0.01	≤0.01	≤0.05	≤0.05	≤0.1
Cyanide (CN) [mg/L]	≤0.005	≤0.05	≤0.2	≤0.2	≤0.2
Volatile phenol [mg/L]	≤0.002	≤0.002	≤0.005	≤0.01	≤0.1
Total petroleum hydrocarbon (TPH) [mg/L]	≤0.05	≤0.05	≤0.05	≤0.5	≤1.0
Anionic surfactant [mg/L]	≤0.2	≤0.2	≤0.2	≤0.3	≤0.3
Sulfide [mg/L]	≤0.05	≤0.1	≤0.2	≤0.5	≤1.0
Fecal coliform bacteria [number/L]	≤200	≤2000	≤10000	≤20000	≤40000

57. Discharge of wastewater from construction sites and supernatant water from dredged sediment disposal sites is regulated under PRC's *Integrated Wastewater Discharge Standard* (GB 8978-1996). Class I standards apply to discharges into Category III water bodies under GB 3838-2002. Class II standards apply to discharges into Categories IV and V water bodies. Class III standards apply to discharges into municipal sewers going to municipal wastewater treatment plants (WWTPs) with secondary treatment. Table II.6 shows these standards.

Table II.6: Wastewater Discharge Standards for Construction Sites and Dredged Sediment Disposal Sites According to GB 8978-1996

Parameter		Class I (for discharging into Category III water body)	Class II (for discharging into Categories IV and V water body)	Class III (for discharging into municipal sewer)
pH	no unit	6 ~ 9	6 ~ 9	6 ~ 9
SS	mg/L	70	150	400
BOD_5	mg/L	20	30	300
COD	mg/L	100	150	500
TPH	mg/L	5	10	20
Volatile phenol	mg/L	0.5	0.5	2.0
NH_3-N	mg/L	15	25	---
PO_4^{2-} (as P)	mg/L	0.5	1.0	---
LAS (= anionic surfactant)	mg/L	5.0	10	20

58. **Soil and river sediment quality.** Soil quality in the PRC is divided into three classes according to the *Environmental Quality Standard for Soils* (GB 15618-1995). Class I represents the best and Class III the worst. The PRC does not have quality standards for sediments in waterways such as rivers, lakes, reservoirs and the sea. GB 15618-1995 is sometimes used for assessing whether the sediment is suitable for land disposal. It is also acceptable for EIRs to adopt the *Control Standards for Pollutants in Sludges from Agricultural Use* (GB 4284-84) for assessing sediment quality. The rationale being that the physical nature of river sediment is similar to sludge. Table II.7 presents both GB 15618-1995 (soil) and GB 4284-84 (sludge for agricultural use) standards. The WBG does not have EHS standards for soil and sediment quality.

Table II.7: Comparison of Environmental Quality Standards for Soil and Control Standards for Pollutants in Sludge for Agricultural Use

Parameter		Maximum Allowable Concentration (mg/kg dry weight)						
		GB 15618-1995 (Soil)					GB 4284-84 (Sludge for Agricultural Use)	
		Class 1	Class 2			Class 3		
	Soil pH	Back ground	<6.5	6.5~7.5	>7.5	>6.5	<6.5	≥6.5
Cadmium (Cd)		0.20	0.30	0.30	0.60	1.0	5	20
Mercury (Hg)		0.15	0.30	0.50	1.0	1.5	5	15
Arsenic (As)	Paddy	15	30	25	20	30	75	75
	Dry land	15	40	30	25	40		
Copper (Cu)	Farmland	35	50	100	100	400	250	500
	Orchard	---	150	200	200	400		
Lead (Pb)		35	250	300	350	500	300	1000
Chromium (Cr)	Paddy	90	250	300	350	400	600	1000
	Dry land	90	150	200	250	300		
Zinc (Zn)		100	200	250	300	500	500	1000
Nickel (Ni)		40	40	50	60	200	100	200
Boron (B, soluable)		---	---	---	---	---	150	150
DDT		0.05	0.50			1.0	---	---
666 (Lindane)		0.05	0.50			1.0	---	---
Mineral oil		---	---	---	---	---	3000	3000
Benzo(a)pyrene		---	---	---	---	---	3	3

E. Assessment Area (Project Area of Influence), Assessment Period and Evaluation Standards for the Project

59. The following assessment areas and PRC evaluation standards were adopted for this project in the domestic planning EIR and project EIR in accordance with the requirements set forth by the Ji'an EPB (JEPB) (Table II.8). The assessment area for the planning EIR covers a planning area of 11.7 km^2 (and beyond depending on the environmental media) within the Western City Development Area while the project EIR covers the project area of influence. In this report, the use of "assessment area" refers to the 11.7 km^2 planning area (and beyond depending on the environmental media) included in the planning EIR, while the use of "project area of influence" refers to the area identified in the project EIR that would potentially be affected by this project but also taking into account the SPS (2009) definition of project area of influence, as shown in Table II.8. This project has no associated facility as defined in SPS (2009).

Table II.8: Assessment Areas and PRC Evaluation Standards Adopted for this Project

Type of Standard	Environmental Media	Applicable PRC Standard	Planning EIR Assessment Area	Project EIR Project Area of Influence
Environmental Quality Standard	Ambient air quality	Class II standards in *Ambient Air Quality Standard* (GB 3095-1996 and its revision for before 1 January 2016; and GB 3095-2012 for after 1 January 2016)	Up to 2 km beyond the E, W, N and S boundaries of the 11.7 km^2 planning area	- Within 200 m on both sides of the road center line - Within 300 m from both sides of the Yudai River
	Noise	*Environmental Quality Standard for Noise* (GB 3096-2008) • Functional Area Category 4a standards for areas within 35 m of road red line • Functional Area Category 2 standards for areas beyond 35 m of road red line	Within 200 m beyond the boundaries of the 11.7 km^2 planning area	- Within 200 m on both sides of the road center line
	Surface water quality	*Environmental Quality Standards for Surface Water* (GB 3838-2002), Category III standards	- Section of Yudai River within the 11.7 km^2 planning area and downstream to where it enters the Gan River - 500 m upstream to 5000 m downstream of the Ji'an Luozishan WWTP	- Section of Yudai River within the project area to downstream where it enters the Gan River - Gan River from 200 m upstream to 1500 m downstream of the Yudai River confluence
	Ecology	No applicable standards	11.7 km^2 planning area	Within 300 m from the center lines of the proposed roads and from the banks of Yudai River (including Yudai River) "Footprint" of the temporary engineering land take areas.
	Soil quality	*Environmental Quality Standard for Soils* (GB 15618-1995), Class 1 standards	11.7 km^2 planning area	Not applicable
	Yudai River sediment quality	*Control Standards for Pollutants in Sludges from Agricultural Use* (GB 4284-84)	Not applicable	Dredged sediment from Yudai River
	Physical cultural resources	No applicable standard but controlled under PRC's *Cultural Relics Protection Law*	Not applicable	"Footprint" of the permanent and temporary engineering land take areas
	Occupational health and safety	No applicable standard but controlled under PRC's *Labor Law*	Not applicable	Construction sites within the "footprint" of the permanent and temporary engineering land take areas
	Community health and safety	No applicable standard	Not applicable	Up to 200 m beyond the "footprint" of the permanent and temporary engineering land take areas
E... s s	Air pollutant	Air Pollutant Integrated Emission	11.7 km^2 planning area	Construction sites within

Type of Standard	Environmental Media	Applicable PRC Standard	Planning EIR Assessment Area	Project EIR Project Area of Influence
		Standard (GB 16297-1996), Class II and fugitive emission standards		the "footprint" of the permanent and temporary engineering land take areas
	Noise	Emission Standard of Environmental Noise for Boundary of Construction Site (GB 12523-2011)	11.7 km^2 planning area	Construction sites within the "footprint" of the permanent and temporary engineering land take areas
	Wastewater	*Integrated Wastewater Discharge Standard* (GB 8978-1996), Class I standard (for discharging into Category III water bodies)	11.7 km^2 planning area	Construction sites within the "footprint" of the permanent and temporary engineering land take areas
		Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB 18918-2002), Class 1(B) standard	Domestic wastewater within the 11.7 km^2 planning area	Not applicable

60. The assessment period covers both construction and operation stages of the project. The construction stage consists of 50 months from the second quarter in 2015 until the second quarter in 2019. The operational stage (for the roads) will be up to the design horizon of year 2030 (Table II.9). Construction of the BRT, Bo'an Avenue, Yangming West Road, Shalshan West Road and Zhongshan West Road would take approximately two years. Construction of Junhua Avenue would take three years. Yudai River rehabilitation and landscaping would also take approximately three years.

Table II.9: Implementation Schedule

Year & Quarter / Activity	2014		2015				2016				2017				2018				2019	
	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd
BRT Construction																				
Station Square Improvement																				
Rehabilitation of Yudai River																				
Landscaping of Yudai River																				
Junhua Road																				
Bo'an Road																				
Yangming West Road																				
Shaoshan West Road																				
Zhongshan West Road																				
Traffic Management																				
Land Acquisition and Resettlement																				

III. DESCRIPTION OF THE PROJECT

A. Project Rationale

61. **Background**. The project proposes four components: (i) a 6.94-km bus rapid transport (BRT) public transport corridor on Jinggangshan Avenue with improvements to the existing Railway Station Square; (ii) rehabilitation of the Yudai River in the new Western City Development Area; (iii) construction of five urban roads in the new Western City Development Area and traffic management; and (iv) capacity development. The project also includes proposed GEF funded activities consisting of the provision of diesel hybrid-electric BRT buses, evaluation and monitoring of hybrid bus performance and integrated transport/land use system planning.

62. Figure III.1 shows that the project area for the urban roads and Yudai River is in the Western City Development Area while the BRT corridor is in the western section of the existing urban center west of the Gan River. Figure III.2 shows the locations of the five urban roads, the Yudai River and the BRT corridor (on Jinggangshan Avenue). In conjunction with the proposed Chang-Ji-Gan high-speed passenger rail development aligning at the west edge (inter-city rail linking Nanchang, Ji'an and Ganzhou), the Western City Development Area will serve as the gateway to the old urban area and to the new railway station (not part of this project). The proposed inter-city railway will facilitate the flow of people, goods and services between the major cities of Jiangxi Province. This project will have a positive impact on Ji'an's economic and social development, such as accelerating the development of the region in a sustainable manner and closing the gap between Ji'an and more developed areas in the PRC.

Figure III.1: Map Showing the Project Areas

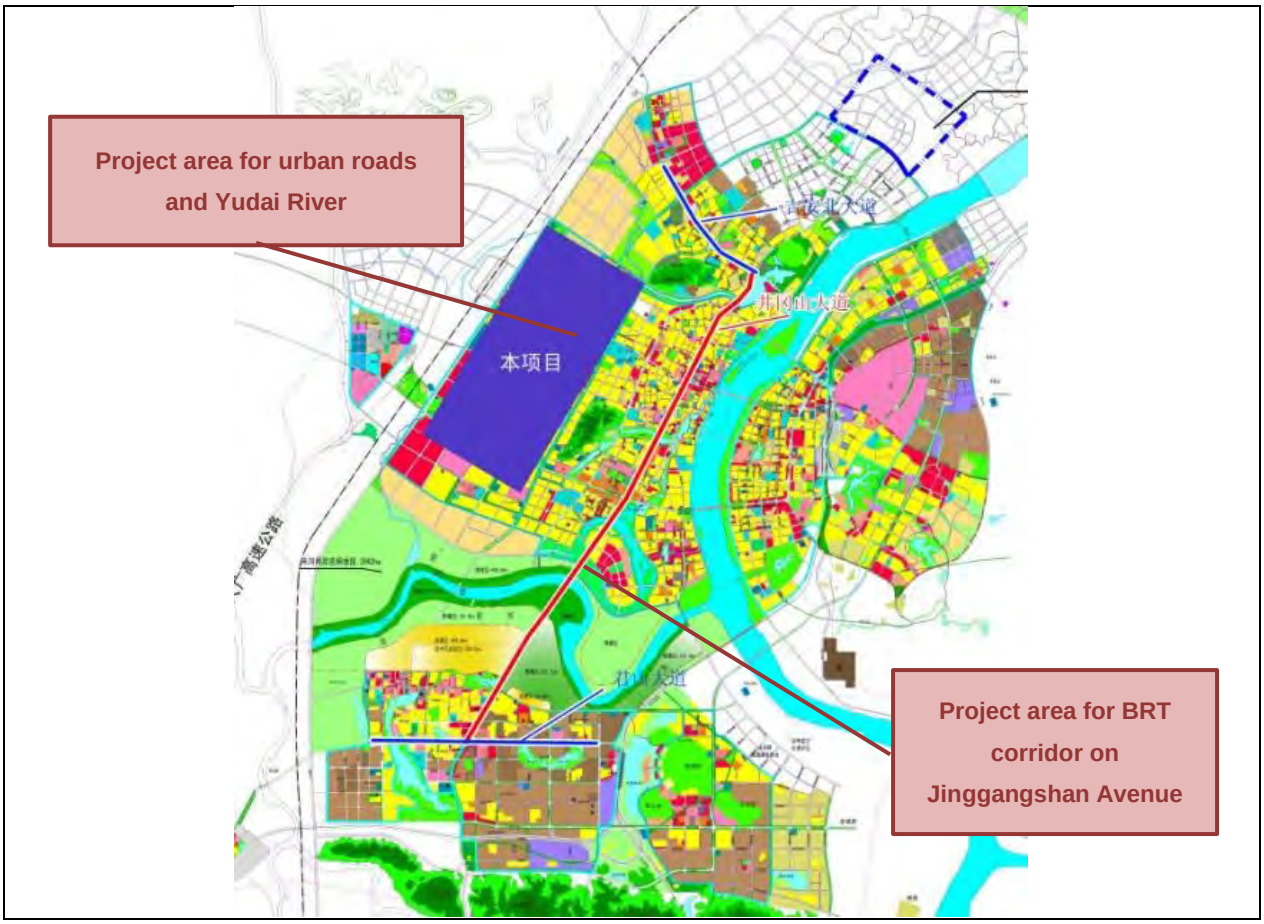
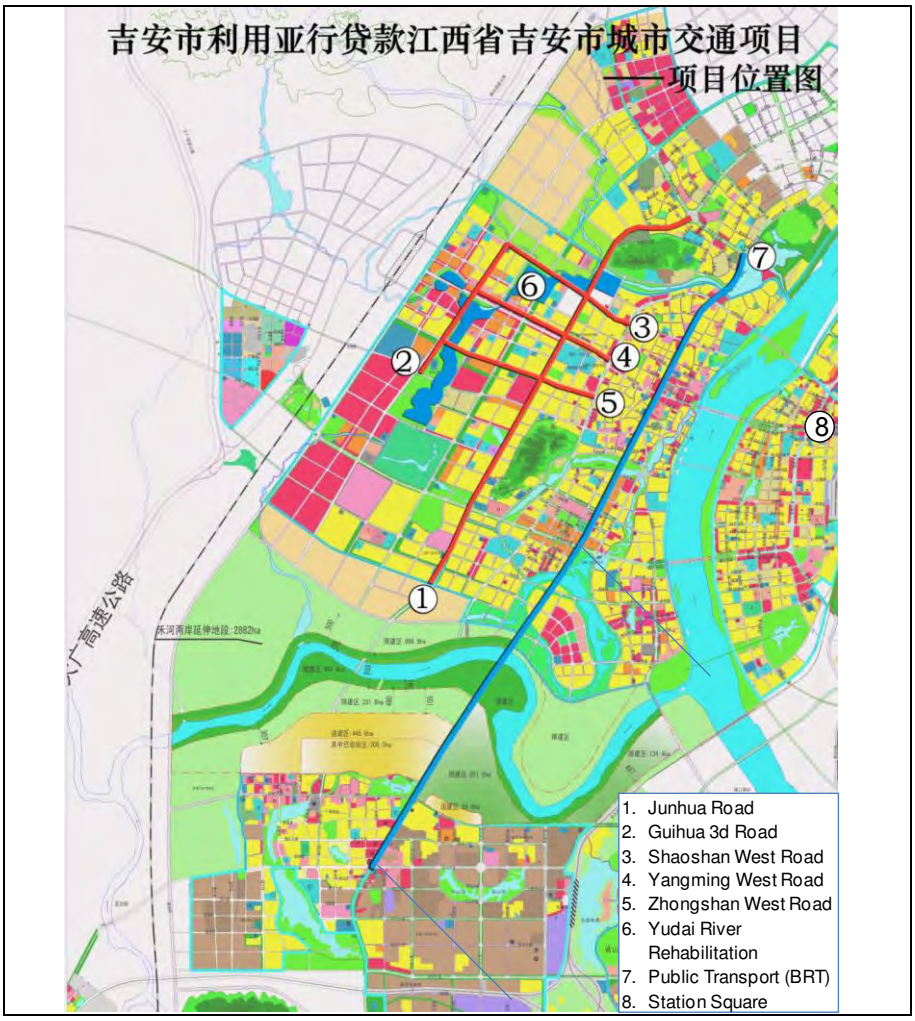
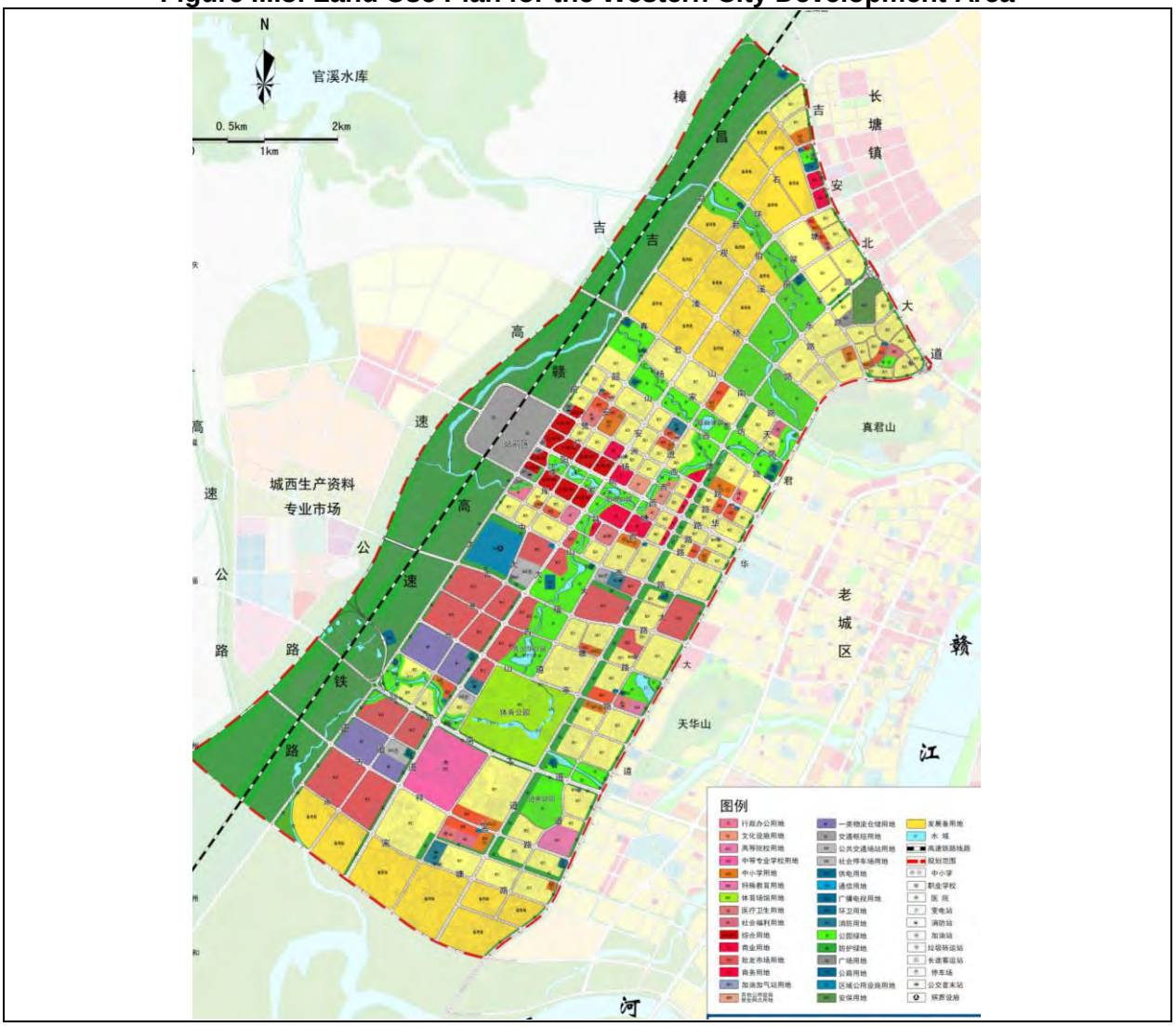


Figure III.2: Locations of Project Components



63. **Western City Development Area**. As part of the Ji'an urban development strategy, the Western City Development Area has been designated as a preferred location for future population expansion and land development. The planned area calls for 10 square kilometers of new mixed-used development along with a planned population of 300,000, which is around 19% of the total planned new urban area. It will consolidate commercial, residential, logistical, business services, and recreational development into an integrated, high-quality, efficient, and multi-functional new urban area. The area will be developed along a central axis connecting the new station and the old urban area and along the Yudai River ecological belt. The urban roads in this project form important backbones of the road network within the development area, with linkages to road networks outside the development area. The rehabilitation of Yudai River will improve flood protection in the development area and will also improve the scenic and aesthetic quality of the area for existing and future residents. Figure III.3 shows the land use plan for the development area.

Figure III.3: Land Use Plan for the Western City Development Area

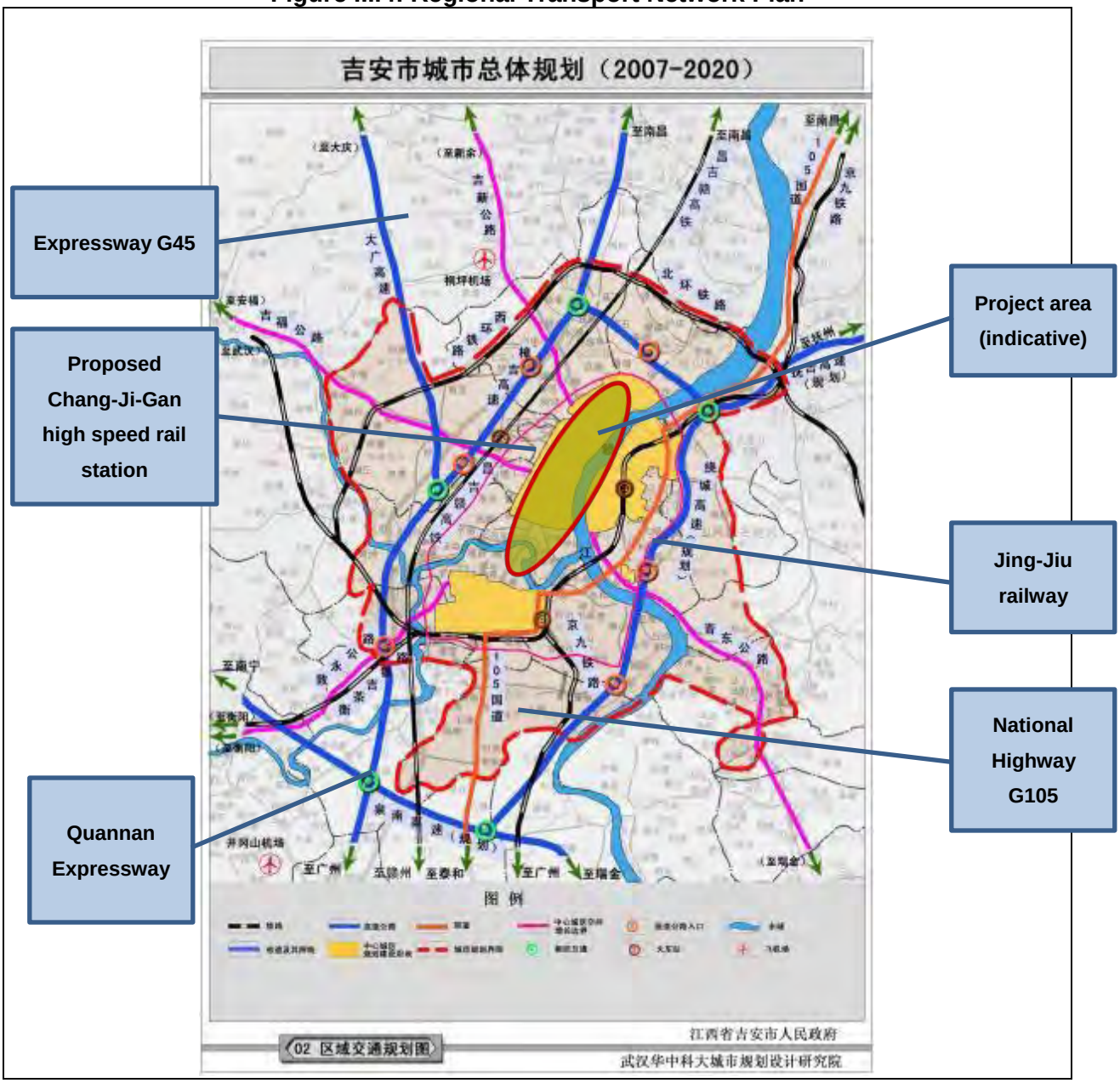


64. **Drainage and flood protection in the Western City Development Area**. The Yudai River is an inland river running through the main part of the Western City Development Area. It flows into the Luohu River then into Gan River. The existing river channel is winding with varying widths, and the soil embankments are unprotected. Bank collapses are prevalent and river channel sedimentation is severe, resulting in an elevated river bed, narrow cross sections, poor flood capacity and regular inundation. The farmland on both sides of the river floods frequently during the rainy season. Following the overall city planning scheme and expansion trends in the urbanized area, the new town development is taking place along two sides of the Yudai River. For this reason, the river needs to be improved to protect the new town from flooding. The proposed river rehabilitation project will improve the flood storage capacity of the inner urban area at the river reach and create a riverside park and promenade improving the quality of the urban environment. The adoption of soft engineered methods for bank protection and selection of appropriate species for landscaping will ensure that wetland habitats are maintained.

65. **Connectivity to regional transport network**. Located 210 km from Nanchang City in the north and 600 km from Guangzhou City in the south, Ji'an is situated along the north-south trunk corridor connecting Beijing to Hong Kong, which is an important corridor linking the coastal area and the more developed area of southern PRC. Ji'an is also the gateway to the inland, connecting Yangtze River Delta in the north and Minjiang Delta in the east. Within the region, the north-south corridors include Beijing–Kowloon Railway, Daguang Expressway and National Highway G105; while the east-west corridors include the Quannan Expressway and National Highway G319.

66. The existing Jing-Jiu Railway (Beijing–Kowloon, Hongkong) and G45 Expressway (Daqing–Guangzhou) have formed the backbone of the regional transport network in Ji'an Municipality. Major transport development, including the construction of the planned Chang-Ji-Gan high-speed passenger rail, Heng-cha-ji railway, Xinji, Mengxi-Central PRC (Qiuyang to Ji'an) railways and Fuji Expressway, will further strengthen the regional transport network in the future and reduce transport costs and improve accessibility. Figure III.4 presents the regional transport network as shown in the *Ji'an Urban Master Plan (2007-2020)*.

Figure III.4: Regional Transport Network Plan



67. **Urban roads**. The existing urban center in Ji'an lacks the capacity to meet further development need, therefore under the *Ji'an Urban Master Plan (2007-2020)*, there are plans to expand the urban area towards the west and south due to the physical constraints of river and mountains. The new urban and industrial areas are under intensive development at present. Figure III.5 compares the existing land use pattern with the planned land use for 2020.

68. The road network in the old city area has historically developed alongside the river. The existing road network in the urban area consists of three main horizontal and four main vertical trunk roads, forming a grid pattern. The three main east-west corridors are Daqiao

Road at Jianggangshan Bridge, Yangming West Road at Ji'an Bridge and Ji'an South Road at Ganjiang Bridge; the four north-south corridors are Jinggangshan Avenue, Jizhou Road, Binjiang (Riverside) Roads and Qingyuan Road. An incomplete road network has impeded the further development of the city due to reduced connectivity. As outlined in the *Ji'an Urban Master Plan (2007-2020)*, by 2020 the urban road network will be further expanded as presented in Figure III.6. To support the development of new urban area, provision of improved road infrastructure is a key priority. Links between the old city areas with new development areas will need to be strengthened and smooth inter-modal transfer encouraged.

Figure III.5: Comparison of Existing and Future Land Use Patterns

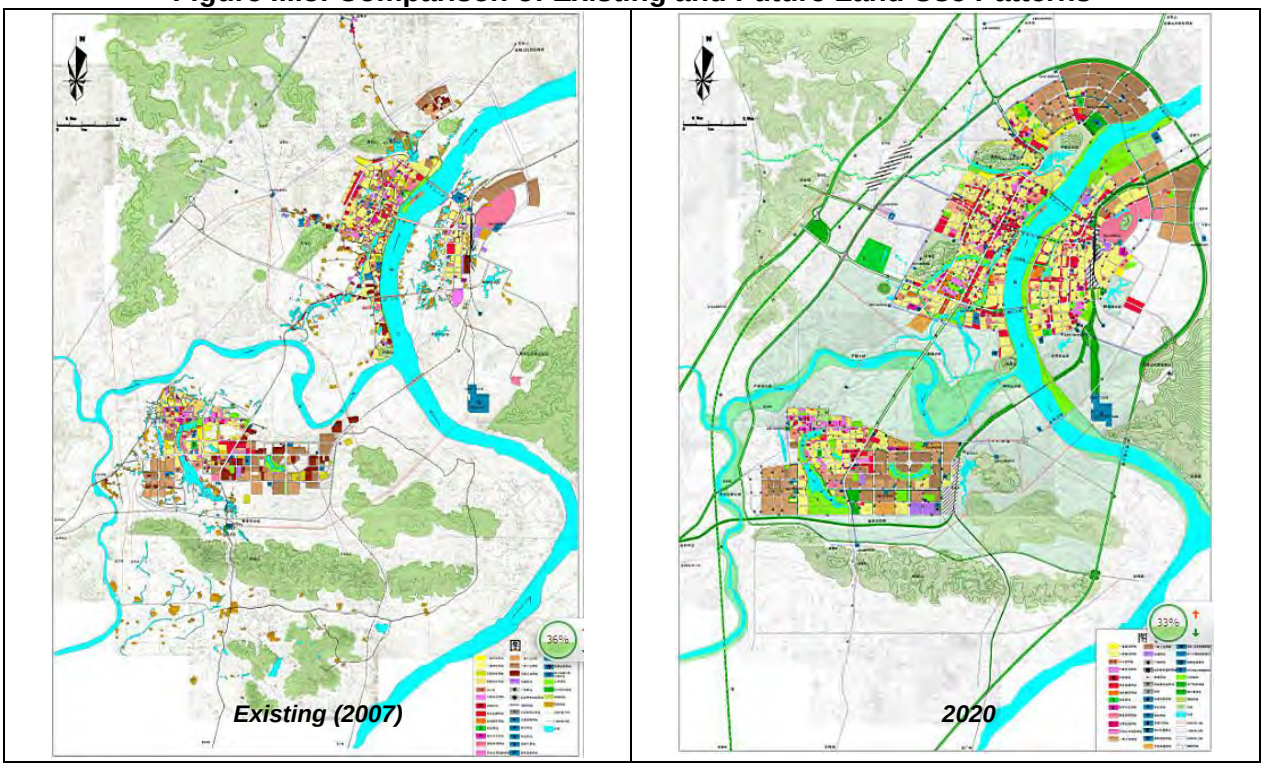
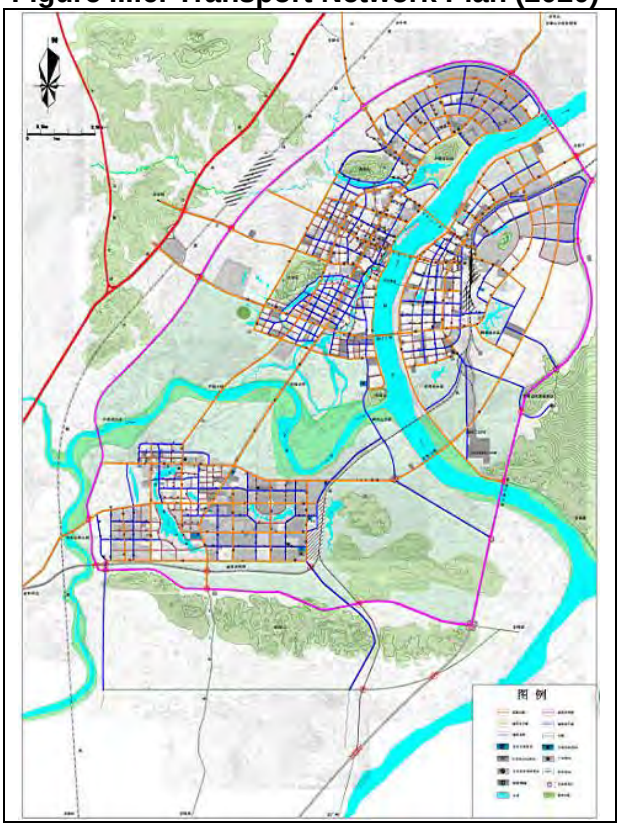
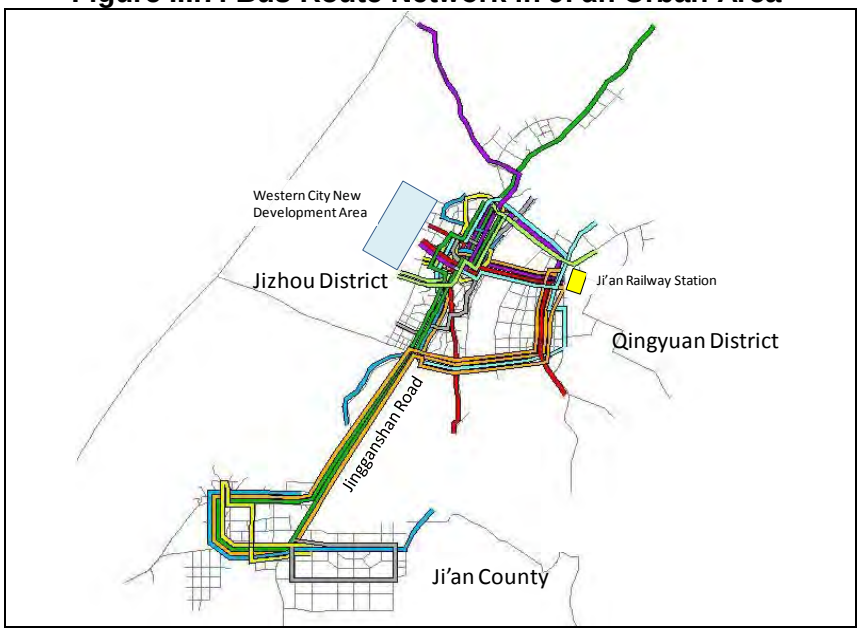


Figure III.6: Transport Network Plan (2020)



69. **Public transport system**. The Ji'an Public Transport Company operates passenger bus services on 31 routes in Jizhou District, Qinyuan District (Figure III.7) and Ji'an County. The company is owned jointly by Jiangxi Long Distance Bus Company (70% of its share) and Ji'an Municipality (30%). It owns 278 buses (8 meter, and 12 meter buses). Average age of bus fleets is about 6 years. Currently all of the bus fleet is powered by diesel engines but the introduction of GEF funded diesel hybrid-electric BRT buses is under consideration. There are three other bus companies who operate medium distance buses in three other counties in Ji'an.

Figure III.7: Bus Route Network in Ji'an Urban Area



70. Statistics on annual number of passengers have not been made available, but it is reported to be increasing annually by 10%. Of the 31 routes, 20 major routes together have been carrying approximately 90,000 passengers daily, with three routes each carrying more than 10,000 passengers per day. Morning peak hours are between 7:30 and 8:30 and evening peak 17:30–18:30. Operating hours are around 6:30 to 21:30 (21:00 during winter).

71. There are about 200 bus stops within the Ji'an urban area. Many of the bus stops have shelter facilitates along the main roads, constructed through a public-private-partnership scheme. The concessionaires build bus stops at their own cost and obtain rights for the advertisement space. Passenger waiting areas at these bus stops is, however, relatively small and usually there is no seating provision, or not enough seats provided. As a result, many passengers wait for buses on the vehicle carriageway, particularly when there are parked cars near the bus stops, reducing visibility for both passengers and approaching buses. This can cause safety issues and reduce the appeal of public transport use. It also indicates that the street space in the urban area is not efficiently used and there is a room for improvement through the design of urban streets, bus stops, or stricter regulation and enforcement to prevent stopping/standing/parking near bus stops.

72. **Muti-modal hub: Ji'an Railway Station Square**. The number of railway passenger arrivals and departures at Ji'an Railway Station has been steadily increasing over recent years. Between 2005 and 2012, passenger and freight traffic (arrivals and departures) increased to 5.45 million passengers and 3.8 million tons, with an annual increase of 14.3% and 9.4% respectively. Currently, 98 passenger trains per day (in each direction Beijing and Kowloon) stop at the Ji'an Railway Station. Figure III.8 shows the current aerial view of the station square.

Figure III.8: Existing Aerial View of the Railway Station Square

73. The existing station building is owned by the Ji'an Railway Construction Office, and has been recently renovated to improve passenger comfort. The square is located in front of Ji'an Railway Station. The upper level of the square is owned by the Ji'an Railway Construction Office and lower level by Qingyuan District. There is an underground passage which connects the rail platforms to the lower level of the square. This underground facility is not being used because of the need to relocate the building at the exit of the passage. The station square itself is currently serving many purposes, but not effectively serving passengers transferring from one mode to another. In addition, the monument and park area are not being effectively utilized. Part of this area is now being used for the display of buses for sale.

74. Buses and taxis (including motorcycle taxis) wait at the lower part of the square, and passengers especially the elderly, disabled or those with heavy luggage face a number of accessibility difficulties (Figure III.9). An overhaul in interchange provision is needed. For example, there should be either intermodal facilities on the same level and at a reduced distance, or potentially escalators or elevators should be provided. As many railway passengers travel with luggage, it is important for the BRT buses to have luggage space inside.

Figure III.9: Passengers with Luggage on Staircase and Boarding City Bus

75. **Traffic Management and Safety**. The number of registered vehicles in Jizhou District, Qingyuan District, and Ji'an County has been steadily increasing over the last decade. In 2012, there were approximately 180,000 vehicles of which 17% were private cars and more than 70% motorcycles. Electric powered motorcycles locally known as e-bikes are not included in this statistics as they have not been regulated until recently. Regulation on e-bikes, however, has been now been introduced and e-bikes have to register with the Traffic Police.

76. The increase of vehicle ownership is increasing urban traffic congestion. The Traffic Police claim that the average travel speed has decreased from about 40 km per hour to 30 km per hour in recent years, and now some intersections in the city center are chronically congested during peak hours.

77. Many intersections in the city center have already been improved with the introduction of signals, islands, and channelization which is clearly marked and generally observed by drivers. Markings for pedestrian crossings are often clearly indicated and signal phase for pedestrians and bicycles also provided. However, pedestrian crossings across the right-turn lane and service roads could be raised to the same level of sidewalk instead of the carriageway level. Alternatively, traffic humps or speed tables could be constructed to calm down the approaching traffic and alert drivers to the pedestrian crossing. There are also some major intersections that have not yet been improved.

78. **Pedestrian facilities**. Sidewalks are provided along most of the main urban roads. They range from about 2 to 8 meters. However, a significant number of sidewalks are occupied by parked cars, motorcycles, and sometimes street venders. They are also used as an extension of space for small shop owners. As a result, a substantial number of pedestrians are seen walking along service roads or the shoulder of vehicle carriageways, where there are even more parked cars and bicycles and e-bikes running causing safety problems.

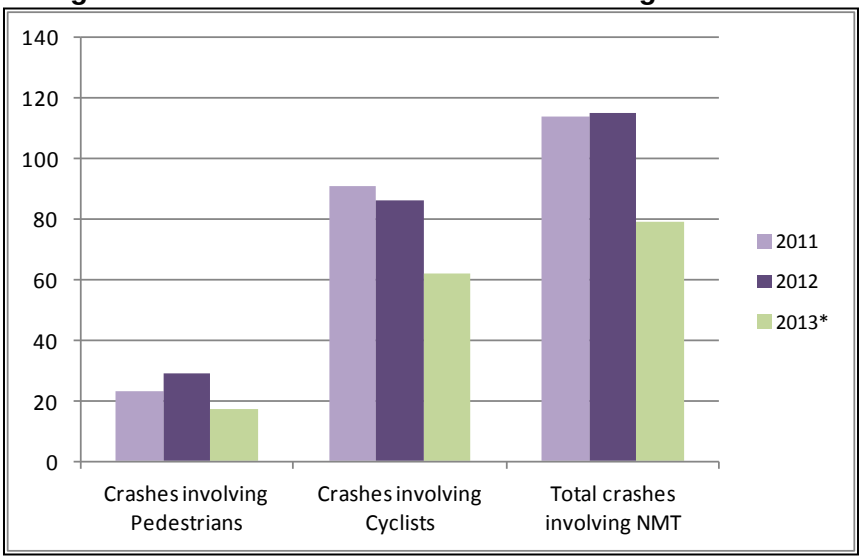
79. Pedestrians crossing at intersections are relatively well provided for with zebra crossings and signals for pedestrian and bicycles. However, the green phase for pedestrians may not be adequate for some users when crossing wider roads. Widths of the main road sections are typically 60 m with carriageway cross section of 40 m. There are a number of mid-section zebra crossings without pedestrian only traffic signals or refuge islands. These mid-

section crossings could be improved by the installation of pedestrian only traffic signals or refuge islands.

80. **Traffic accidents**. Annual traffic accident data for Ji'an (2008–2012) indicates a reduction in the number of accidents and injuries since 2008, with a small increase between 2011 and 2012. Fatalities have remained fairly consistent in recent years.

81. According to available data, accidents involving NMT users (pedestrians and cyclists) account for approximately 40% of all traffic accidents in Ji'an, and show an increasing trend in recent years (Figure III.10). Accident hot spots noted by the Ji'an Traffic Police are shown in Figure III.11.

Figure III.10: Number of Accidents Involving NMT Users



Note: 2013 includes data from January 1 to September 5, 2013.

Figure III.11: Traffic Accident Hot Spots in Ji'an

82. **Summary of urban transport issues**. Based on the above description and observations made, the main urban transport issues in the Ji'an central area are summarized in Table III.1.

Table III.1: Summary of Urban Transport Issues in Ji'an Central Area

Items	Issues
Road network	• Main roads in the old urban area are in relatively good condition but secondary and branch roads are in poor condition and in need of maintenance. • There is a lack of a functional urban road hierarchy. The mix of freight and through traffic is a major constraint on the existing road network. • Incomplete road network connectivity due to constraints of existing land use. • Urban road network development has been constrained by the physical constraints of the river and mountains. Therefore traffic is concentrated within a limited road network along a single constrained corridor. However this presents an opportunity for better utilisation of existing road space and encouraging a switch to public transport in an integrated corridor/network. • Roads in new urban areas are generally wide, speeding is prevalent, and lack of road safety facilities and NMT provision (e.g. refugee islands).
Public transport systems	• Municipal bus fleets are relatively old (average 6 years old) with diesel engines causing high pollutant and GHG emissions

Items	Issues
	• Air conditioning systems on buses are not always working • Operation and administration systems require improvement by the use of IT systems • Destinations and routes are painted on buses implying less efficient fleet utilizations • Bus routes are shown at each bus stop but there is no fixed schedule. • No bus priority on major corridors • Small bus stops sometimes with parked vehicles creating unsafe situations for people waiting for buses
Intermodal facilities	• The space in front of Ji'an Railway Station requires improvement for effectively integrating various modes of transport systems • Station entrance level and the bus/taxi arrival level are different and separated by staircase which is inconvenient for travelers with luggage. • Some of the long distance bus terminals are located outside the currently proposed BRT route. • Long and inconvenient walk distances between terminals/interchanges
Traffic management and safety	• Insufficient pedestrian signals at mid sections of wider roads • There are 300 CCTV installed and monitored but require more effective use for controlling traffic • There are traffic signals installed at over 100 intersections. These signals may have to be improved so as to provide coordinated signal indication based on real-time traffic conditions. • Allowing e-bike owners to ride without driver license • E-bikes behave like bicycles or pedestrians, which is dangerous for non-motorized mode users. • Pedestrian crossings across right turn lanes and service roads at major intersections are not raised to the same level as sidewalk. • Poor pedestrian visibility at bus stops. Encroachment of cars, poor regulation and enforcement. • Some of the key causes of traffic accidents in Ji'an include motor vehicle drivers speeding, illegally overtaking, lane encroachment, failing to give way, driving without a license, overcrowded vehicles and drunk-driving.

83. **Impact, Outcome and Output.**

84. The expected impact of the project will be an efficient, inclusive and sustainable urban transport system in Jiangxi Ji'an. The outcome of the project will be efficient multi-model access to major activity centers in Ji'an City including the new Western Development Area.

85. The project outputs are (i) a 6.94 km BRT corridor along Jinggangshan Road with 15 stations, plus development of an intermodal hub at the existing Ji'an Railway Station; (ii) rehabilitation of 8.02 km of Yudai River (5.3 km) and tributary (2.72 km); (iii) construction of five urban roads totaling 19.33 km in the Western City Development Area and traffic management improvement through the provision of coordinated signal system, central control system and traffic information collection system; and (iv) capacity development and institutional strengthening.

86. The whole BRT corridor is 14.7 km long with 24 stations to be implemented in two phases. The project output of 6.94 km with 15 stations represents Phase 1 to be funded by ADB.

The remaining section (7.76 km) will be implemented in Phase 2 with funding from the municipal government. This EIA covers the whole 14.7 km of the BRT corridor.

87. The Project may include Global Environment Facility (GEF) funded activities consisting of the provision of diesel hybrid-electric BRT buses, evaluation and monitoring of hybrid bus performance and integrated transport/land use system planning.

B. Component 1: Public Transport

88. This component consists of the development of a new BRT system and an intermodal hub at the existing Ji'an Railway Station in Qingyuan District. The proposed BRT corridor in Phase 1 is 6.94 km along Jinggangshan Road (see Figure III.2) between the northern road intersection (Jizhou District) and Yingbin Road intersection. The total number of BRT stations along the proposed corridor in Phase 1 is 15 with an average distance of 460 meters between stations (Figure III.12, showing all 24 stations for Phases 1 and 2).

89. The width of the BRT corridor will be 3.5 m, with two lanes (both directions) for general traffic having a lane width of approximately 3.5 m. Center lanes will be reserved for the BRT corridor to improve efficiency of BRT operation and passenger safety, reduce conflicts with general traffic and minimize weaving among BRT buses. Table III.2 shows the key characteristics of the proposed BRT system.

Figure III.12: Locations of BRT Stations on the BRT Corridor

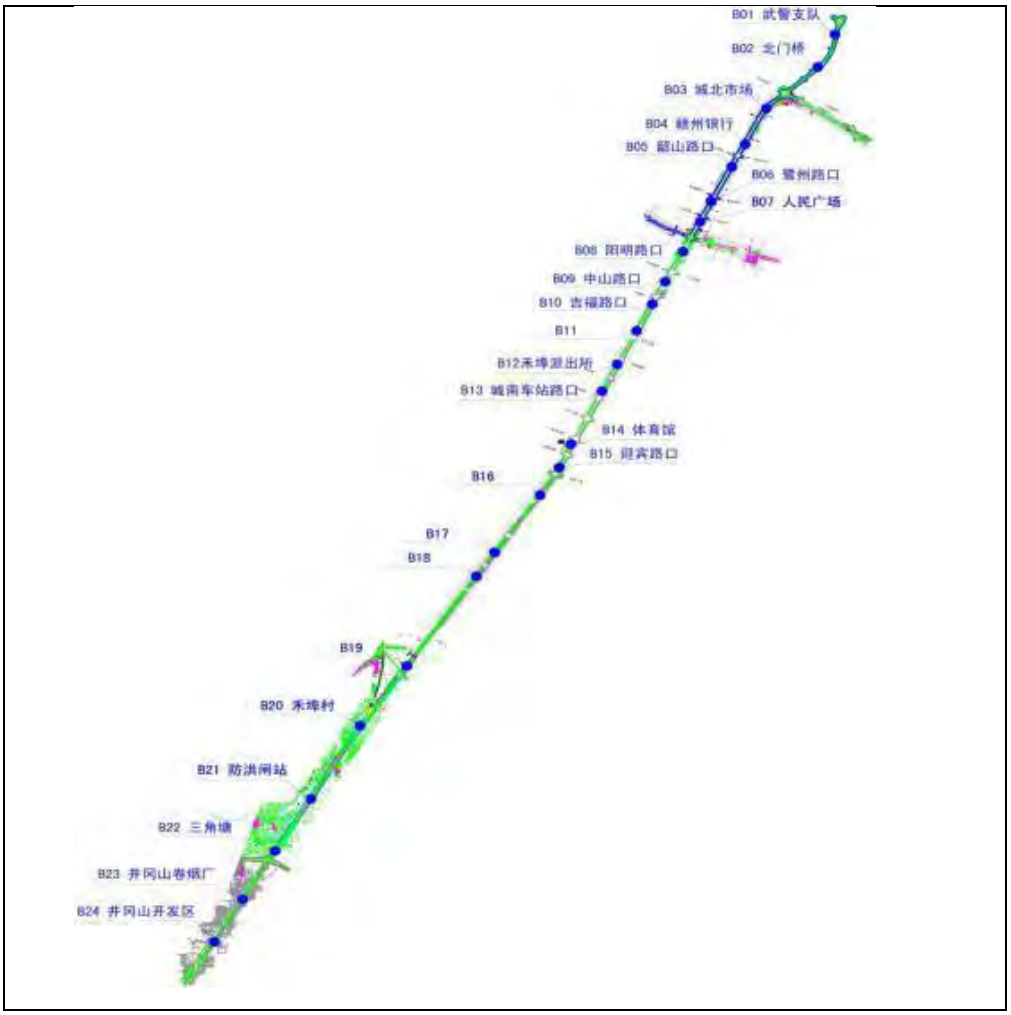


Table III.2: Key Characteristics of the Proposed Ji'an BRT System

Item	Design Parameter
Location	From the north of Ji'an City (Northern Avenue Intersection) to the south of the city (Yingbin Road Intersection) via Jinggangshan Avenue
Route length (Phase I)	6.94 km
Type of system	• Open system • Several bus routes share part of their service in the BRT corridor
Width of BRT lane (single-lane width)	3.5 m (3.2 m at critical locations)
Location of the BRT lanes (cross-sectional)	Center of the right-of-way
Pavement type	Asphalt concrete
Signalized intersections along the corridor	Coordinated traffic signals system will be implemented as part of the project
Number of bus routes to be included in the system (base year)	9 routes (out of 31routes considered)
Fare payment system	• Along the BRT corridor: pay at the entrance of the station • Outside the BRT corridor: pay on board
Assumed fare level	CNY 2.00 (single fare system with no transfer charges among BRT buses) with usual discounts
Mode of payment	Smartcard (or cash)
Number of BRT stations along the corridor	15 stations and average distance of 600 meters between stations
Type of BRT station	Island platform type at the center of lanes with the security doors

Item	Design Parameter
	installed
Dimension of BRT stations	Type A: 55 m x 5 m (standard) Type B: 55 m x 6 m Type C: 110 m x 5 m
Average distance between the stations	About 460 meters
Vehicle type	• Length: Type A: 18 m (carrying capacity 60–80 passengers); Type B: 12 m (120–170 passengers) • Both types of vehicles have doors on both sides • Fuel type to be determined: clean diesel or CNG • High floor type buses
Type and Number of vehicles to be operated on the BRT corridor (Phase I)	• 12 m buses with doors both sides. • Total 84 vehicles
Operating speed on the corridor	Average 26 km per hour was assumed based on international and domestic experience (compared to existing speed of 16 km per hour)
Vehicle operation parameters	• Vehicle dwell time at stations: 5–10 seconds • Acceleration and deceleration time: 13 seconds • Vehicle door opening/closing time: 2.5 seconds
Operator	Ji'an Public Transport Company (new operating unit to be established under the bus company)
Maintenance Arrangement	Corridor: by Construction Bureau, Ji'an Municipality Station Facilities: Ji'an Public Transport Company Buses: Ji'an Public Transport company
Frequency of service along the BRT corridor during peak hours	(varies by route)
Intermodal considerations	• Bicycle parking at the BRT stations • Sidewalk improvements near the BRT stations • NMT lanes along the corridor

Source: BRT FSR.

90. **Traffic demand forecast**. For the purpose of environmental impact assessment, the number of motor vehicles travelling on Jinggangshan Avenue with and without BRT were modeled for the near term (2020) and long term (2030). **Table III.3** presents the modeling results, indicating a reduction in vehicle numbers during peak and non-peak hours in both day time and night time with BRT. These results were used to assess impacts of vehicle emissions and traffic noise in this report.

Table III.3: Forecast of Number of Vehicles per hour with and without BRT

BRT Status	Vehicle Type	No. of Vehicles per Hour in Year 2020				No. of Vehicles per Hour in Year 2030			
		Day		Night		Day		Night	
		Peak	Non-peak	Peak	Non-peak	Peak	Non-peak	Peak	Non-peak
Without BRT	Small	5472	1824	1683	561	6508	2169	1953	651
	Mid-size	63	21	21	7	81	27	22	7
	Large	828	276	255	85	960	320	297	99
	Total	**6363**	**2121**	**1959**	**653**	**7549**	**2516**	**2272**	**757**
With BRT	Small	4992	1664	1533	511	5590	1863	1677	559
	Mid-size	57	19	18	6	63	21	21	7
	Large	753	251	231	77	825	275	255	85
	Total	**5802**	**1934**	**1802**	**594**	**6478**	**2159**	**1953**	**651**

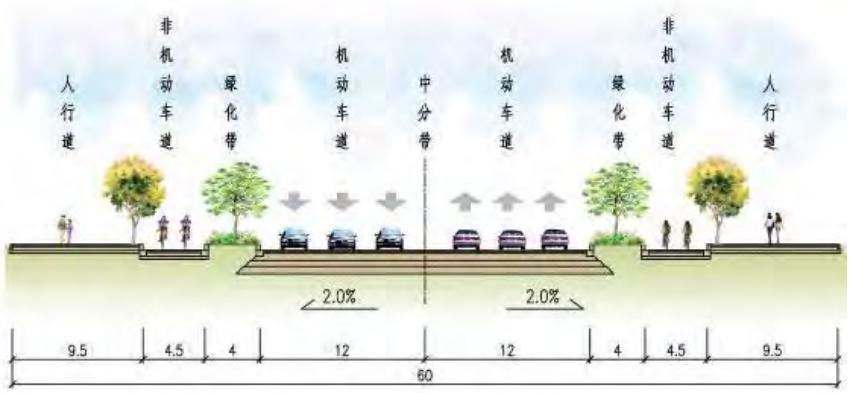
Source: Project EIR.

91. **Cross section design**. An example cross section of proposed BRT corridor (existing compared with proposed) is shown in Figure III.13. Vehicle carriageways for general traffic will be reduced from three lanes to two lanes. Greenway separation between the vehicle

carriageway and NMT lanes near BRT stations will be removed to accommodate the BRT stations and passing lanes.

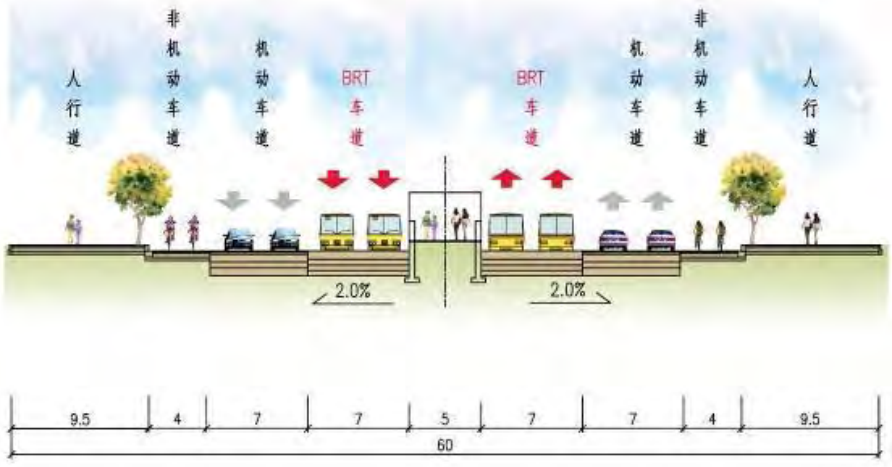
92.

Figure III.13: Proposed Cross Sections for the BRT Corridor between Jizhou Road and Yangming Road (K1+180~K3+370)



Existing Cross Section

Proposed Cross Section with Central BRT Lanes



Proposed Cross Section with BRT Station

Source: GMDRI, Feasibility Study for Ji'an BRT System, November 2013.

93. **BRT station**. An island type platform is proposed for the Ji'an BRT system with lengths of 55 and 110 meters with widths of 5 and 6 meters. A total of 24 stations are planned along the proposed corridor with an average distance between stations of 600 meters. A photomontage of the BRT station and platform design is shown in Figure III.14.

Figure III.14: Photomontage of a Proposed BRT Station

Source: GMDRI, Feasibility Study for Ji'an BRT System, November 2013.

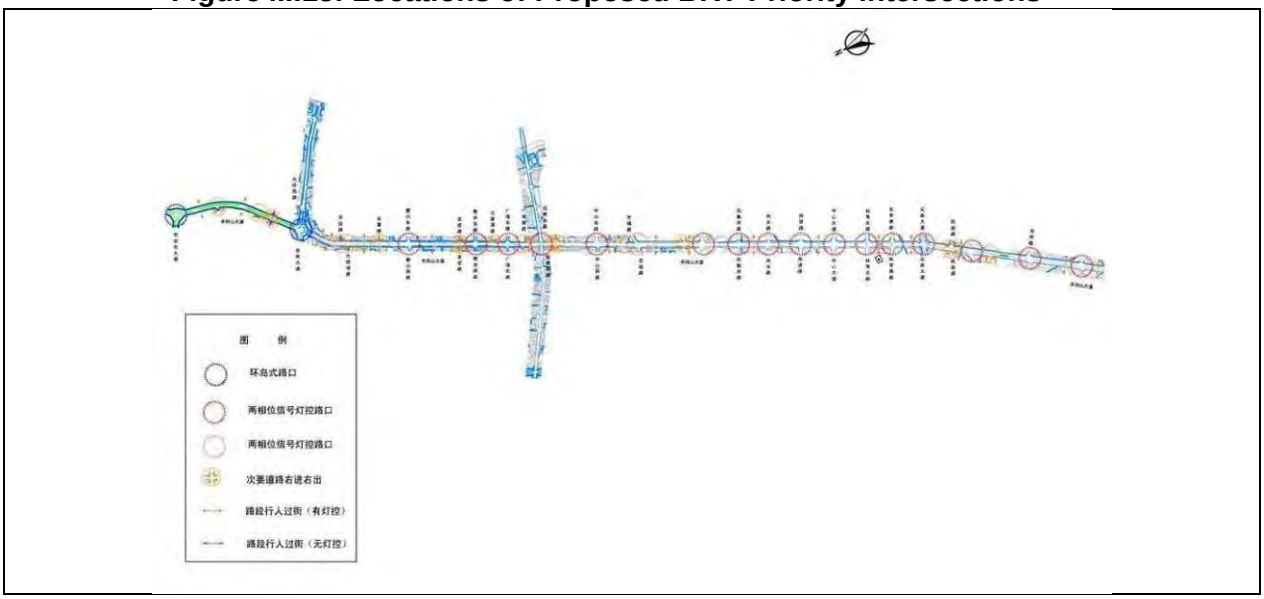
94. The principles adopted for the BRT station design are as follows:

- The station comprises of safety (refuge) island (when crossing the road), relief zone, ticket selling/checking area, boarding area and anti-collision safety island;
- The safety island forms the entrance and exit of the platform, connecting to the pavement via barrier-free access;
- The relief zone functions mainly during peak hours to mitigate impacts of heavy and intensive passenger flows;
- The ticket area is for selling and checking tickets, information and guidance. One end is connected to the boarding area while the other end connects to the safety island via the relief zone;
- The boarding area is the main area for passengers to board, get off and wait; its design should take into consideration the type (12m and 18m) and number of buses stopping;
- Barrier-free access and pavements for visually impaired users are provided; this type of pavement is continued throughout the functional zones;
- A wide emergency pass is designed at the ticket-checking gates; fire hydrants are provided in all sub-zones within the station and will comply to relevant fire protection regulations;
- The boarding area considers seats for vulnerable users (elderly, children, pregnant women, and disabled etc); and
- Security gates will be installed for safety purposes along both sides of platform.

95. Each station will have several bus bays on each side, depending on the number and frequency of the bus routes to be integrated into the Ji'an BRT system. Overtaking lanes have been recommended to secure sufficient capacity for the growth of demand along the corridor. Security doors and various types of information technology system for improving convenience of bus users and overall operational efficiency will be installed.

96. **BRT-priority intersections**. Restrictions on left turns will be introduced along the corridor at BRT-priority intersections. Similarly, street crossings along the BRT corridor will be restricted for traffic in/out of minor streets. Eleven intersections along the BRT corridor (Figure III.15) will be designated as BRT-priority intersections at which the movement of left-turning traffic will be restricted. This arrangement has been supported by the traffic police and is considered implementable. The detailed signs and markings required for traffic management at the relevant intersections will be designed at the preliminary design stage. The timing of the existing traffic signals will be redesigned to minimize delays at these intersections.

Figure III.15: Locations of Proposed BRT-Priority Intersections



97. **Vehicle specifications**. Based on the demand and future growth patterns in Ji'an, 12 m regular buses are recommended for the short term, and 18 m high-capacity buses for the medium to long term for the BRT system. All buses using the BRT corridor will have doors on both sides as the buses will operate in the BRT corridor as well as on non-BRT roads. With regard to vehicle technology, the Ji'an Public Transportation Company, a potential BRT bus operator, recommends petroleum-gas hybrid power.

98. **Railway Station Square**. The PPTA provided suggestions to improve the multi-modal connectivity at the railway station. Figure III.16 shows the proposed layout as a result of those suggestions. Table III.4 summarizes the key technical parameters of the civil works for the proposed station square improvements.

99. The proposed improvement at the station square will include:
   (i) A remodeled station plaza consisting of a multi-level plaza, re-designed public space, escalators or lifts, facilities for weather protection, integration of bus and long-hual coach transfers, proper signage for guiding direction and information, and re-arrangement of different transport modes,
   (ii) Two access roads to the upper plaza,
   (iii) Re-introduction of arrival tunnels,
   (iv) Re-introduction of departure roads,
   (v) Re-location of ticketing area to the northern part of the station,

(vi) Introduction of drop-off and pick up areas,
(vii) Introduction of ramps or escalators linking the lower an upper plaza areas,
(viii) Pedestrian waiting areas for buses and private cars with installation of weather protection shelters, and
(ix) Barrier free facilities consisting of yellow guiding tiles for visually impaired and slopes connecting carriageway and sidewalk installed for visually impaired, wheelchair users and elderly.

Figure III.16: Proposed Layout of the Ji'an Railway Station Square

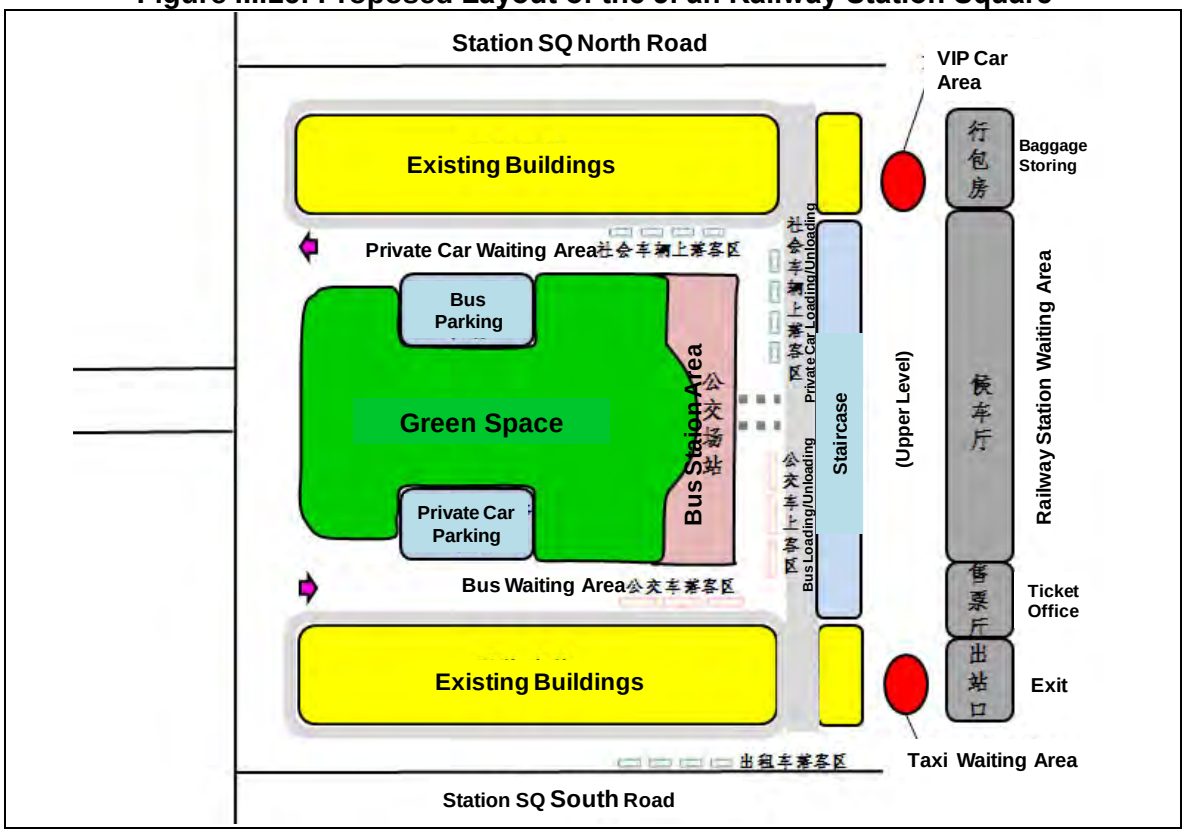


Table III.4: Key Technical Parameters of Civil Works for the Ji'an Railway Station Square

No.	Civil Work Item		Quantity	Notes
1	Total area		65,000 m^2	Station Plaza North Road, South Road, station building and Chengchi Road around the study area
		Green space	13,000 m^2	Status quo retained
		Reconstruction area	39,000 m^2	Road pavement and sidewalk reconstruction is required
		Area without modification	13,000 m^2	Area surrounding the station square will remain as it is without modification
2		Bus station	2,500 m^2	Parking area, channelization lanes, scheduling and ticket booth (30 m^2)
		Drop-off parking spaces	3	40~45 m^2/berth to increased bus waiting space, boarding and other facilities
		Boarding berths	3	
3	Weather protection shade		2,230 m^2	Construct around the he drop-off area and above the escalators

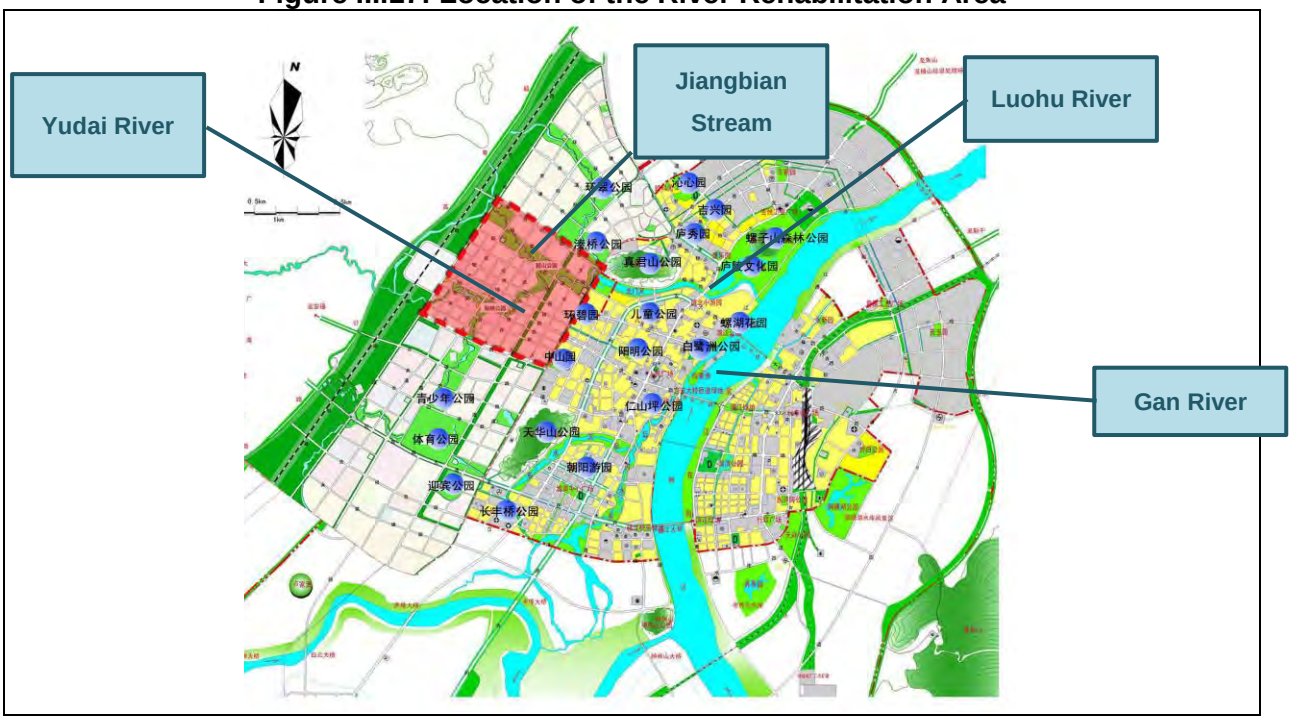
No.	Civil Work Item		Quantity	Notes
4	Escalator		4	Construct on existing landscaped area of stairs
5		Community vehicle drop-off area	8	Locate in the northeast corner of the station square, 15 m^2/ berth
		Community car parking	1,500 m^2	South of the square
		Bus parking	1,600 m^2	North of the square

Source: FSR.

C. Component 2: River Rehabilitation

100. The project site is located at the west of the urban area, south of Ji'an South Avenue, and north of Zhenjunshan Mountain (Figure III.17). River rehabilitation will total 8.02 km, consisting of 5.3 km of the Yudai River and 2.72 km of its tributary, the Jiangbian Stream. Permanent land take for this component will be 2214.66 mu (≈ 147.64 ha), consisting of 1839.6 mu (≈ 122.64 ha) land area and 375.06 m (≈ 25 ha) water surface area.

Figure III.17: Location of the River Rehabilitation Area

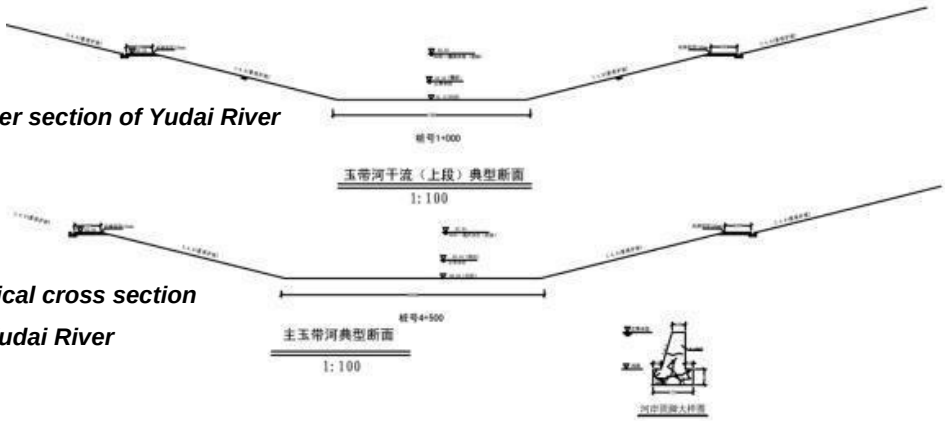


101. The scope of project includes flood control and landscaping works. The concept design for the river rehabilitation project is to alleviate flood risk and impacts and to improve the natural and urban environment. The flood protection works will involve river channel dredging, river bank renovation and slope protection and have been designed taking into account the wider watershed management program and the Western Development Area Detailed Plan. The landscaping works will create a riverside park and promenade, the design proposes soft engineered approaches and incorporation of ecological features to create a new amenity resource that is in keeping with the natural environment. The park will include woodland, and lawn areas, pedestrian paths, bicycle trails, a car park and associated facilities including lighting, service areas for leisure activities and street furniture.

102. **Flood protection works**. An integrated treatment is proposed for Yudai River and Jiangbian Stream tributary, including embankment treatment, main channel dredging, slope protection, cross-dike structures improvement, a water-lifting weir, and associated structures. The design flood return period is one in 20 years. Figure III.18 shows the cross sections of river protection works and Figure III.19 shows the layout.

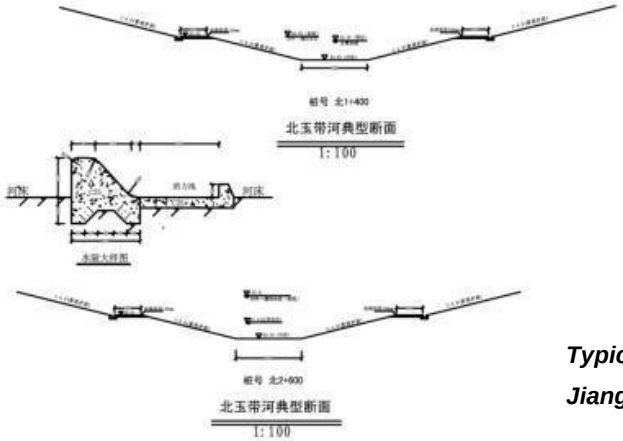
103. The river elevations at inflow and outflow will be the same as existing. Water depths under normal flow condition range from 0.6 – 1.2 m. River bed width ranges from 15 m in the upstream section to 20 m in the downstream section. Revetment will be 1.4 m in height constructed with stone mortar. To retain water in the river channel year round, five cofferdams will be constructed across Yudai River at sections 1+000, 2+000, 3+500, 4+500 and at Yudai confluence with Luohu River. The Jiangbian Stream (the name will be changed to North Yudai River) will have seven cofferdams at sections 0+200, 0+500, 0+800, 1+100, 1+400, 1+700, 2+000. A sluice gate will be constructed on either the left or right side of each cofferdam to allow sediment flushing and for flood water to pass.

Figure III.18: River Cross-Sections



Upper section of Yudai River

Typical cross section of Yudai River



Typical cross section of Jiangbian Stream

Typical cross section of Jiangbian Stream

Figure III.19: Layout of River and Landscape Design

104. **Landscape works**. The landscaping works will provide a riverside park for recreation and leisure activities. Figure III.20 shows photomontages of landscape and river front concept designs.

- Zone 1: Located around the main corridor, exiting the high speed rail station. Landscaping is styled as grand and open space.
- Zone 2: Located near Shaoshan Park. The section of river is wide and pedestrian flows would be high. There will be some commercial development around the river bank. In conjunction with Shaoshan Park, a riverfront park will be developed, and recreational facilities will be provided.
- Zone 3: Located at residential area where the water course is narrow. Ecological design principles will be adopted to minimize disruption to the natural environment. The creation of wetlands is proposed to follow the natural landform.

The river bank design as shown in Figure III.21 incorporates soft reinforcement methods using plants and wooden structures.

During the development of the preliminary design, a wetland ecologist was appointed by ADB to work with the Design Institute to review and strengthen the landscape proposals for the riverside park and river rehabilitation works. The proposals now integrate more of the existing habitat and landscape features and create more new habitats of ecological value for local flora and fauna and of benefit for water quality. The revised proposals zone the Yudai River into three functional areas (see Appendix 2 for more detailed report):

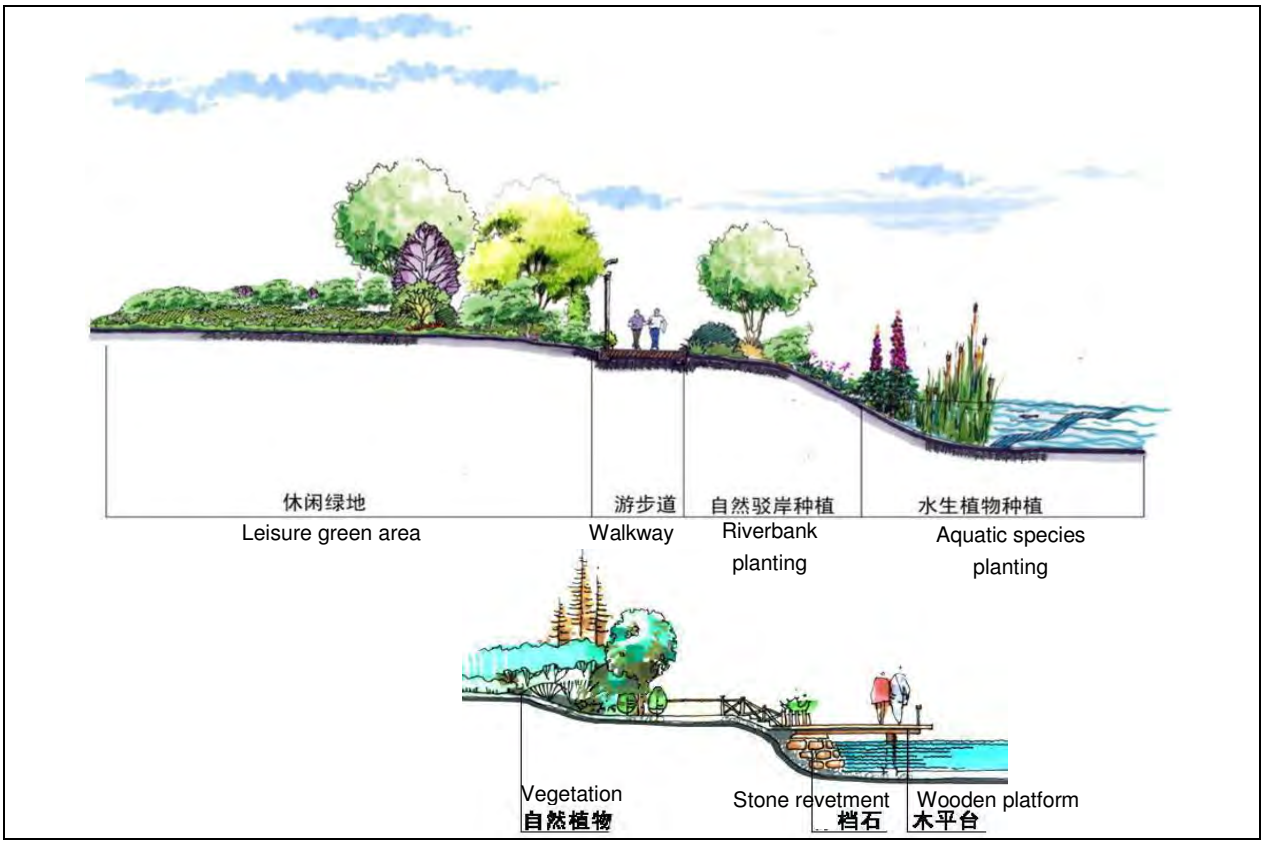
- Urban recreational zone: The area around the south branch of Yudai River will have water retention and storage, urban countryside park and shallow marsh and wetland functions. Landscaping will include grassland, woodland and wetland habitats.
- Wetland functional zone: New wetland habitats will be created around the main branch of the Yudai River. Plants specified include reed and cat's tail and trees such as willow and metasequoia that have water quality and habitat functions and value.
- Ecological agricultural zone: The area around the north branch of Yudai River will have natural conservation and organic orchard and agricultural zones. This area will retain and integrate existing habitat features and land uses.

Figure III.20: Photomontages of Landscape and Riverfront Concept Design

Greening and Landscape

Waterfront Pedestrian Path

Figure III.21: Ecological River Bank Treatment



D. Component 3: Urban Roads and Traffic Management

1. Urban Roads

105. The five sections of urban roads (see Figure III.2) totaling approximately 20 km proposed for ADB financing are among 23 new road sections in the Western City Development Area. Two are primary trunk roads with red line[10] width of 55 m. The other three are secondary trunk roads with red line width of 40 m. These roads will permanently take up approximately 97 ha of land. Table III.5 shows the key characteristics of these five roads. Shaoshan West Road, Yangming West Road and Zhongshan West Road are the extension of existing primary urban roads connecting to the new high speed rail station. Junhua Avenue and Bo'an Avenue are the major south-north trunk lines in the network, which are given top priority for construction.

Table III.5: Key Characteristics of Five Urban Roads

No.	Road	Section	Red Line Width (m)	Road Length (km)	No. of MV Lanes	Land Take (ha)	Road Class
1	Junhua Avenue	Jixiang West Road – Ji'an North Avenue	55	7.80	Dual 3	48.69	Primary trunk
2	Bo'an Avenue	Jifu Road – Shaoshan West Road	40	3.15	Dual 2	12.75	Secondary trunk
3	Shaoshan West Road	Ji'zhou Avenue – Bo'an Avenue	40	2.99	Dual 2	11.48	Secondary trunk

[10] The " red line" defines the construction corridor of a road.

No.	Road	Section	Red Line Width (m)	Road Length (km)	No. of MV Lanes	Land Take (ha)	Road Class
4	Yangming West Road	Junhua Avenue – Bo'an Avenue	55	2.05	Dual 3	11.00	Primary trunk
5	Zhongshan West Road	Ji'zhou Avenue – Bo'an Avenue	40	3.34	Dual 2	12.95	Secondary trunk
		Total		**19.33**		**96.87**	

Source: Project EIR.

106. **Traffic forecast**. For the purpose of environmental impact assessment, the number of motor vehicles travelling on the five proposed urban roads were modeled for the short term (2020) and the long term (2030) scenarios. Table III.6 presents the modeling results, which were used to assess vehicle emissions and traffic noise in this report.

Table III.6: Forecast of Number of Vehicles per hour on the Proposed Urban Roads

Name of Road	Vehicle Type	No. of Vehicles per Hour in Year 2020				No. of Vehicles per Hour in Year 2030			
		Day		Night		Day		Night	
		Peak	Non-peak	Peak	Non-peak	Peak	Non-peak	Peak	Non-peak
Junhua Avenue	Small	800	277	408	136	2350	810	1195	398
	Mid-size	229	79	116	39	671	231	341	114
	Large	114	40	58	19	336	116	171	57
	Total	**1143**	**396**	**582**	**194**	**3357**	**1157**	**1707**	**569**
Bo'an Avenue	Small	150	37	65	22	350	120	178	59
	Mid-size	43	10	19	6	100	34	51	17
	Large	21	5	9	3	50	17	25	8
	Total	**214**	**52**	**93**	**31**	**500**	**171**	**254**	**84**
Shaoshan West Road	Small	350	120	178	59	850	294	433	144
	Mid-size	100	34	51	17	243	84	124	41
	Large	50	17	25	8	121	42	62	21
	Total	**500**	**171**	**254**	**84**	**1214**	**420**	**619**	**206**
Yangming West Road	Small	850	294	433	144	1550	519	788	263
	Mid-size	243	84	124	41	443	148	225	75
	Large	121	42	62	21	221	74	75	38
	Total	**1214**	**420**	**619**	**206**	**2214**	**741**	**1088**	**376**
Zhongshan West Road	Small	600	207	305	102	1100	380	1120	373
	Mid-size	171	59	87	29	314	109	320	107
	Large	86	30	44	15	157	54	160	53
	Total	**857**	**296**	**436**	**146**	**1571**	**543**	**1600**	**533**

Source: Project EIR.

107. **Alignment design**. The proposed horizontal alignment has taken into consideration: (i) Urban Master Plan and detailed road network plan; (ii) traffic demand; and (iii) constraints imposed by existing and proposed land uses. The vertical alignment has been designed taking into account site formation, land use, drainage and other technical standards. The cross section is designed according to road functions, traffic volumes and any other political requirements. For each road, there are two schemes being considered. Alternatives were compared with and without median separations between dual motor vehicle lanes.

108. **Sub-grade and protection works**. The proposed roads in the new development area are situated west of existing Jizhou Avenue. The terrain tilts from the northeast to southwest and is dominated by gentle hills and farmland. The elevation of the site ranges from 59.1 m to 98.4 m. The designed sub-grade height ranges from 1-16 m. Storm water will be drained into the Yudai River and the need for pollution interception will be addressed during detailed design. Road embankment slope is designed at 1:1.5. For the cut section, the slope gradient is designed at 1:1. For embankments that are higher than 8 m and 2 m wide an

apron will be built and geo-textile will be laid down for stability. The embankment slope will generally be covered by grass. For sections where the embankment is higher than 2 m, hollow bricks and other similar types of hard surface will be laid to allow for vegetation growth and to strengthen slope stability.

109. Ground treatment measures will be based on different ground conditions. There are three typical ground treatment methods for soft and damp sections. In the first scenario where ground surface is dominated with cultivated soil, topsoil will need to be removed and backfilled with earth. In the second scenario where sludge and mud dominate, the ground will need to be dredged and backfilled with crushed stone or sand and gravel before laying down road sub-grade. In the third scenario where ground water level is high, the ground will be filled with stone to pack the sediment and mud down below the water level before road sub-grade.

110. **Bridge**. Four medium-sized bridges are proposed for the roads to cross the Yudai River as shown in Table III.7. Simple supported slab bridges will be adopted for short span bridges because of their relatively low cost and reduced construction issues.

Table III.7: List of Proposed Bridges

Location	Span (m)	Width (m)	Area (m^2)	Type of Upper Structure
Yangming West Road (K2+461.0)	2x20	55	2,585	Simple-supported voided slab
Juhua Road (K6+516)	4x20	55	4,785	Simple-supported voided slab
Bo'an Road (K1+775.0)	2x20	40	1,880	Simple-supported voided slab
Shaoshan West Road (K1+845)	2x20	40	2,068	Simple-supported voided slab

Source: FSR.

111. **Culvert.** A total of 28 culverts are proposed with consideration of current drainage conditions and future requirements (Table III.8). Total length of pipe culvert is 1,606 meters, while total length of slab culvert is 216 meters.

Table III.8: Characteristics of Proposed Culverts

Location	No. of Culvert	Length (m)	Type of Structure
Yangming West Road	1	60	Pipe culvert
	1	109	Slab culvert
Juhua Road	11	799	Pipe culvert
Bo'an Road	4	200	Pipe culvert
	1	55	Slab culvert
Shaoshan West Road	7	407	Pipe culvert
Zhongshan West Road	2	140	Pipe culvert
	1	52	Slab culvert

Source: FSR.

112. **Intersection**. For all the road sections, at-grade intersections instead of grade separated intersections have been proposed in consideration of the function of the urban roads serving all road users and to facilitate easy access for pedestrians and cyclists. Signalization will be provided when a primary road intersects another primary road. As

shown in Figure III.19, pedestrian and bicycle lanes are separated from the motor vehicle lanes, and traffic islands are proposed in order to increase intersection capacity. The right-of-way for intersections will be widened by adding an auxiliary lane to accommodate turning movements. Sufficient widths for rights-of-way will be provided for pedestrians including both sidewalks and crosswalks.

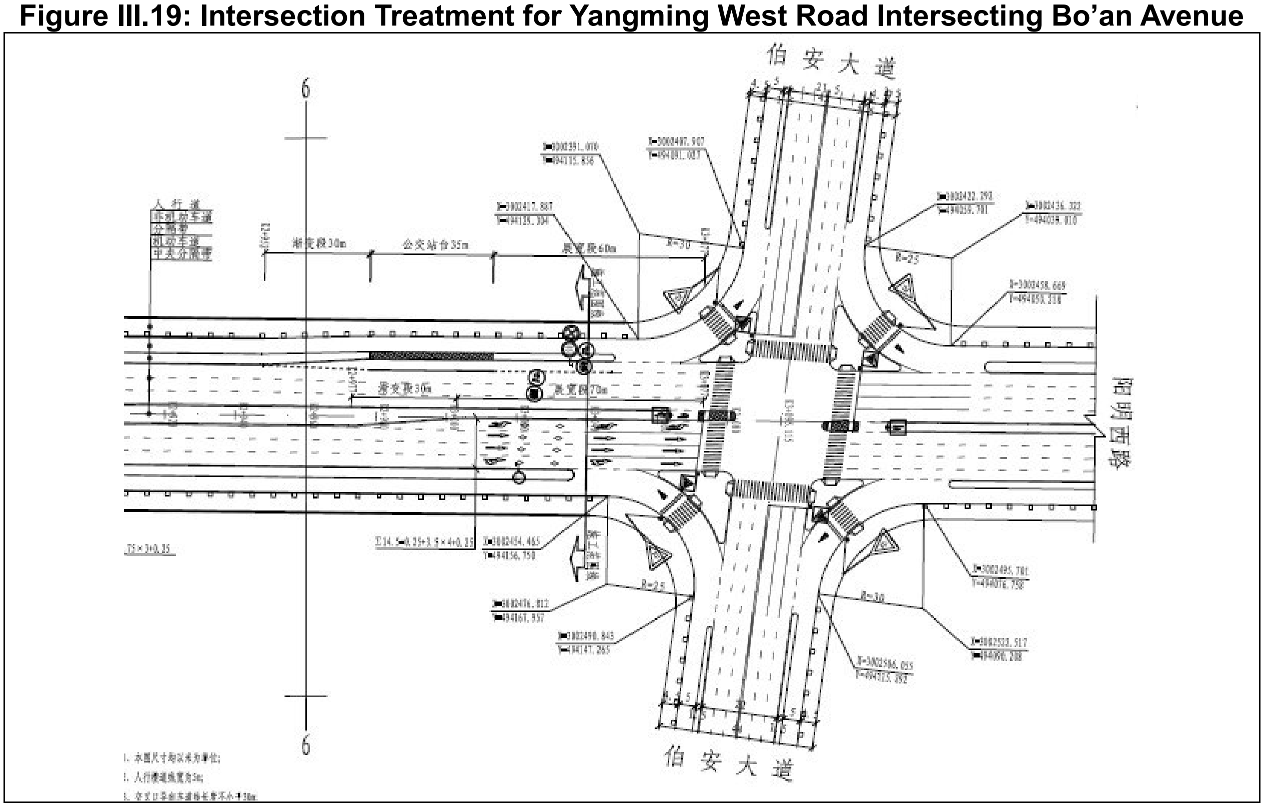
2. Traffic Management

113. Traffic management proposed by the Traffic Police Department includes three items: (i) coordinated signal system; (ii) central control system; and (iii) traffic information collection system.

114. **Coordinated signal system**. The proposed traffic signals for co-ordination at 37 intersections are shown in Figure III.20. Priorities will be given to the traffic flows of Jinggangshan Road and Yangming Road, and near where new municipal government building has been constructed. Existing signal equipment will be utilized as much as possible, but controllers will be replaced with the ones that are compatible with a centralized control system.

115. Instead of being locally controlled, the signals at these intersections will be centrally controlled and coordinated based on real time traffic data to minimize delays. Control data will be transmitted to each controller through the optical data communication systems along Jinggangshan Road, which already exists to operate the CCTV monitoring system.

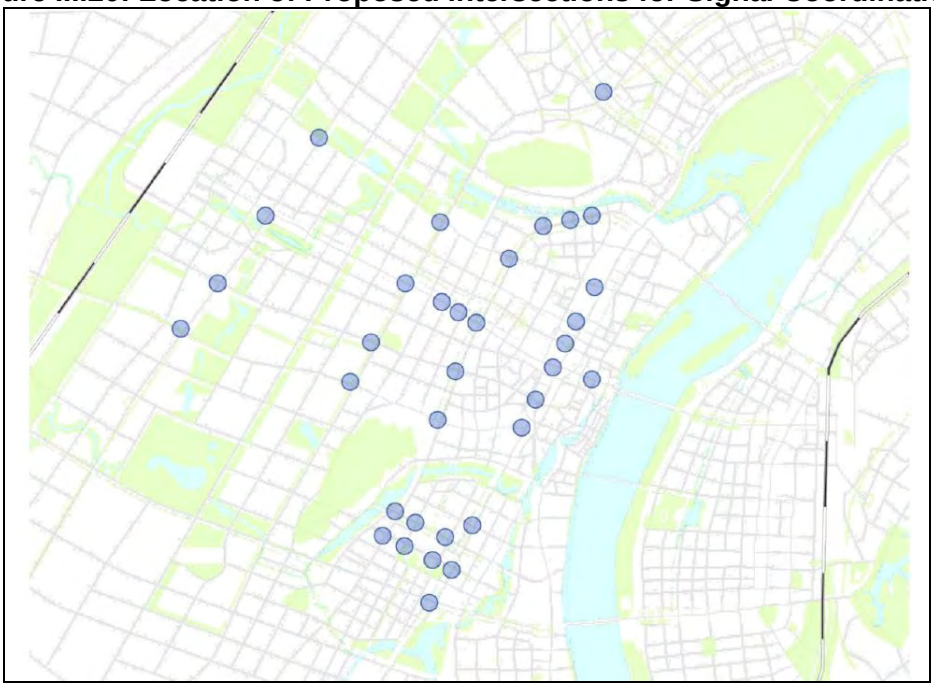
Figure III.19: Intersection Treatment for Yangming West Road Intersecting Bo'an Avenue



116. **Central control system**. A central control system will be installed at the traffic control

center at the Police Headquarters. The proposed system consists of several servers, switching systems, and relevant application software. The system will categorize the traffic status of the road network in five levels according to real-time traffic saturation: smooth, relatively smooth, slight congestion, moderate congestion and severe congestion, and the status can be viewed at the control center. At the central control center, a database system will be developed and utilized for various traffic management decisions.

Figure III.20: Location of Proposed Intersections for Signal Coordination



117. **Traffic information collection system**. The proposed data collection system mainly consists of microwave or loop vehicle detectors that constantly monitor traffic movements on site, and send the real-time traffic information to the central control system through the optical communication systems. At five strategic locations, real-time traffic information will be provided to road users on LED message display devices. Variable Message Signs are distributed on Jinggangshan Avenue and aim to divert traffic from the major congested roads to less congested ones improving network efficiency and safety.

E. Component 4: Capacity Building

118. The capacity development and institutional strengthening component will consist of: (i) resettlement monitoring, (ii) gender monitoring, (iii) environment monitoring, (iv) project management and road safety support, (v) BRT planning and implementation support, and (vi) capacity building in project implementation and management.

F. Global Environment Facility Funding Activities

119. The Global Environment Facility (GEF) provides grants to developing countries and countries with economies in transition, for projects related to, among several others, climate change and promoting sustainable livelihood. Urban public transport offers a range of important benefits over private car use particularly regarding efficient passenger carrying capacity and road space use, and reduced environmental pollution and energy

consumption. The aim is to induce modal shift from private vehicle use towards public transport through the development of an efficient, safe and integrated public transport system.

120. Co-financing by GEF for additional climate change mitigation aspects of the project was approved by the GEF Council in November 2011 as part of the Asian Sustainable Transport and Urban Development (ASTUD) program (amount is $2.55 million including project management cost). A draft document describing the GEF-funded components in detail for endorsement by the GEF CEO has been submitted to GEF.

121. The proposed GEF-funded activities include: (i) introduction of fuel efficient bus operations – hybrid buses; (ii) fuel efficient bus operations – evaluation and monitoring of hybrid bus performance; and (iii) integrated transport/land use system planning. The GEF-financed activities are designed to reduce the carbon intensity of the transport and urban system in Ji'an. These low carbon concepts will be integrated into the BRT system and road design to maximize GHG savings.

122. **Fuel efficient bus operations–hybrid buses**. Ji'an buses are currently 100% diesel of mixed age and condition and there is little awareness of concepts such as eco-driving/maintenance and fuel efficient bus operations. Proposed GEF activities will increase awareness of and capacity in energy efficient bus operations through the introduction and operation of 12 new diesel hybrid-electric buses and an associated eco-driving/maintenance program and fuel efficiency monitoring program. This is expected to be a key step towards transforming bus operations in Ji'an towards a low carbon future and accelerating diffusion of hybrid bus technology into Ji'an and similar smaller cities in less-advanced inland provinces of the PRC. The buses will have the latest hybrid technology in full production at the time of procurement and will be smaller 10.5m buses. This size provides optimal flexibility in terms of operating on all existing and planned bus routes in Ji'an, as well as on the baseline BRT and in a BRT feeder role. In combination with the bus procurement, the bus supplier(s) will also be required to provide hands-on training and supporting materials in eco-driving and maintenance techniques aimed at maximizing fuel efficiency on an ongoing basis.

123. **Fuel efficient bus operations – evaluation and monitoring of hybrid bus performance**. Ji'an has a wide range of bus operating conditions, from wide boulevards to narrow back streets; from congested major corridors to free-flowing streets; and with the baseline BRT project in operation, a mix of BRT, feeder and urban non-BRT services. Ji'an also has an existing fleet of diesel buses and new BRT buses to be procured under the baseline project to use for comparison. This provides an opportunity to use the hybrid buses to be procured to conduct a set of carefully-designed and controlled trials of hybrid buses under a range of conditions. This item will support (i) the design and supervision of carefully-designed and controlled trials of hybrid buses under a range of conditions, using a scientific methodology; (ii) the analysis of the results to extract general conclusions regarding the GHG performance of hybrid buses; (iii) documentation of the findings in English and Chinese in a range of forms suitable for professional and industry audiences; and (iv) preparation of the information resources and base data for sharing broadly through online knowledge sharing portals.

124. **Integrated transport/land use system planning**. This item will build local capacity in low carbon transport and urban planning and prepare associated demonstration projects for implementation by JMG. This will involve the following three key activities: (i) examine how

the baseline BRT project can be a catalyst for promoting transport/land use integration and transit-oriented development from a broad urban planning perspective; (ii) examine issues of NMT integration and links to the transit system in detail; and (iii) reinforce the capacity building impact by organizing workshops on key topics (low carbon planning principles, transit-oriented development and NMT integration) in Ji'an for city and provincial officials and other stakeholders.

G. Construction Activities

125. **Borrow pits and disposal sites**. The BRT corridor will be constructed on the existing Jinggangshan Avenue. Spoil materials will consist of small quantities of construction and demolition (C&D) waste which will be transported to a disposal site managed by the Ji'an Cityscape Management Department, who is responsible for managing all the disposal and re-use of earth cut materials from construction projects in the municipality. The construction of five urban roads and the rehabilitation of Yudai River would generate approximately 5.55 million m^3 of earth cut materials, of which approximately 3.40 million m^3 would be re-used in the project and the remaining 2.15 million m^3 would be transported to a disposal site designated by the Ji'an Cityscape Management Office. This project therefore does not require project-specific borrow pits and spoil disposal sites.

126. **Yudai River dredging**. Dredging of Yudai River would produce approximately 455,890 m^3 of dredged sediment and all would be re-used for landscaping in the Yudai River green belt. No dredged sediment disposal site will be required. Dredging will be done in the dry season and the dry dredging method will be adopted, where bunds or coffer dams will be built to enclose the dredging site (with the river flow diverted) and the water pumped out followed by using a mechanical excavator to remove the sediment similar to earth excavation works on land.

127. **Haul roads**. Construction traffic for the BRT and the urban roads will use existing roads and therefore will not require temporary haul roads. Rehabilitation of Yudai River will require the construction of approximately 12 km of temporary haul roads, which will be restored upon completion of construction works.

128. **Construction camps**. Construction workers will live in rental premises and this project does not require construction camps for providing living quarters to the construction workers.

129. **Construction staging areas**. Three construction staging areas will be set up for urban road construction. Each area will occupy approximately 2 ha of grassland of no ecological value.

130. **Asphalt mixing**. Already mixed asphalt will be purchased for paving the urban roads and no asphalt mixing station will be established in the project sites for the urban roads.

H. Institutional Arrangements for Construction and Operation

131. Table III.9 presents the institutional arrangement and roles and responsibilities for the construction and operational stages of the project.

Table III.9: Project Implementation Organizations, Roles and Responsibilities

Phase	Responsible Agency	Environmental Responsibility
Project preparation	Design Institutes on behalf of JPMO	● Prepare feasibility study reports (FSR), environmental impact reports (EIR), soil and water conservation report (SWCR), resettlement plan (RP)
	JPMO	● Review the FSRs, EIRs, SWCR and RP. ● Engage a staff environmental specialist
	JEPB	● Review and approve the EIRs
	JPWRB	● Review and approve the SWCR
	PPTA consultant	● Provide technical assistance ● Review domestic EIRs ● Conduct environmental due diligence ● Prepare project environmental impact assessment (EIA) report and environmental management plan (EMP)
	ADB	● Review and approve the EIA and EMP and disclose
Detailed design	Design Institutes on behalf of JPMO	● Incorporate mitigation measures defined in the EMP into engineering detailed designs
	JPMO	● Review mitigation measures defined in the EMP, update where necessary based on detailed design ● Engage the independent Environmental Supervision Engineer (ESE). ● Engage the Loan Implementation Environmental Consultant (LIEC) under the Loan Implementation Consulting Services
	ESE and LIEC	● Review detailed design to ensure inclusion of relevant mitigation measures ● Assist JPMO in updating the EMP where necessary
	ADB	● Approve updated EMP and disclose
Tendering, contracting and pre-construction	JPMO	● Incorporate EMP clauses into tender documents ● Commission JEMS for internal environmental quality monitoring during the construction phase ● Establish the project grievance redress mechanism with a complaint center and hotline
	ESE	● Review tender documents to ensure inclusion of EMP clauses ● Review contractor's method statements on implementation of mitigation measures
	LIEC	● Review tender documents to ensure inclusion of EMP clauses ● Conduct training for the staff from JPMO, IA, O&M units and contractors on environmental management, environmental monitoring and EMP implementation
	Contractors	● Prepare and submit tenders for the construction contracts, to include staffing and costs for environmental management to comply with the EMP ● Prepare method statements on implementation of mitigation measures
	ADB	● Review bid documents and confirm project's readiness
Construction	IA	● Develop project management procedures, implementation plan, and financial management ● Approve contractor's method statements on implementation of mitigation measures ● Undertake day-to-day project and EMP implementation activities for all infrastructure components ● Administer and monitor the contractors and suppliers ● Supervise EMP implementation to ensure compliance by contractors
	JPMO	● Coordinate with all involved agencies, departments, and institutes for project implementation ● Coordinate the project level grievance redress mechanism ● Conduct public consultations as indicated in the EMP ● Supervise EMP implementation ● Prepare project documents and report to JMG, JPLG and ADB ● Submit withdrawal applications and supporting documents to ADB ● Submit project implementation progress reports and safeguards monitoring

		reports to ADB ● Submit all procurement and disbursement documents to ADB for necessary approval ● Disclose project-related information and documents in accordance with ADB guidelines
	JEMS	● Conduct internal environmental quality monitoring in accordance with the EMP ● Recommend additional environmental quality monitoring when needed ● Prepare and submit monitoring results to JPMO, IA and JEPB monthly
	ESE	● Conduct external compliance monitoring of EMP implementation ● Review internal environmental quality monitoring data collected by JEMS ● Advise on mitigation measures when needed ● Assist JPMO and IA in preparing monthly progress reports
	LIEC	● Conduct compliance monitoring of EMP implementation ● Assist JPMO in preparing semi-annual environmental monitoring reports for submission to ADB
	JEPB	● Conduct periodic and random inspections of all construction projects relative to compliance with PRC regulations and standards
	ADB	● Review semi-annual environmental monitoring reports ● Undertake review missions
Operation	O&M units	● Operate and maintain the project facilities ● Engage JEMS in conducting environmental quality monitoring during the operational phase
	IA	• Coordinate and supervise EMP implementation
	JEMS	• Conduct internal environmental monitoring for the first year of operation according to the EMP
	ADB	• Conduct project completion review

Notes: ADB = Asian Development Bank; ESE = environmental supervision engineer; IA = Implementing Agency; JEMS = Ji'an Environmental Monitoring Station; JEPB = Ji'an Environmental Protection Bureau; JPMO = Ji'an Project Management Office; JPWRB = Jiangxi Provincial Water Resource Bureau; LIEC = loan implementation environmental consultant; O&M = operation and maintenance; PPTA = project preparation technical assistance

I. Associated Facilities

132. SPS (2009) defines associated facilities as "facilities that are not funded as part of a project but whose viability and existence depend exclusively on the project, or whose goods or services are essential for successful operation of the project." In this context, this project has no associated facility.

J. Climate Change Adaptation Considerations

133. According to recent ADB guidelines[11] on climate change risks to roads, risks may include reduced road safety and security, increased need for road maintenance due to landslides, and costly rehabilitation works as drainage is insufficient for peak rainfall events. Climate change parameters of significance for this Project would include the following:

i. Precipitation intensity,
ii. Peak rainfall events (for designing road drainage and Yudai River flood protection),
iii. Profiles of past extreme weather events,

[11] Asian Development Bank. 2011. Guidelines for climate proofing investment in the transport sector: road infrastructure projects. xiv + 53 pp.

iv. Changes to the onset of rainy seasons (for road maintenance and construction scheduling),
v. Wind and water flow speed during extreme weather events (for bridge design),
vi. Changes to snow fall events (for decisions on the need for snow removing equipment),
vii. Changes in temperature including both gradual increase and increase in extreme temperature (likely to impact road pavements), and
viii. Changes in precipitation (will impact road foundations).

134. Detailed design of the road subgrade, pavement, bridge structures, slope protection and drainage system for the urban roads and the flood control capacity of Yudai River will need to take account of climate change effects. Currently national design standards are proposed that are based on historical flood data and do not take account of projected climate change effects. A detailed climate risk and vulnerability analyses was carried out in August 2014 and adaptation measures to increase resilience to climate change were recommended for consideration during the detailed design phase. The detailed study is included as Appendix 3 to this EIA and recommendations have been incorporated into the EMP (Appendix 1).

135. The project should also consider climate change mitigation and energy efficient measures to minimize GHG emissions, such as the selection of hybrid buses and lower emission fuels for the bus fleet, and energy efficient street and station lighting. The FSR for the BRT also recommends energy saving features. These consist of the use of solar power for warning and traffic signs with cold light illuminator Light Emitting Diode (LED), and BRT station design features that maximize the use of natural light and ventilation. According to the FSR for urban roads, street lighting will use energy saving light fixtures, with the lighting control box located in the electric loading center and proper sizing of electric cables to minimize electricity loss during transmission.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

A. Existing Setting of the Project Sites

136. **BRT corridor**. The BRT corridor will be on the existing Jinggangshan Avenue, a major road in the urban center of Ji'an. This component will not involve permanent or temporary land take. The area of influence for the BRT is an urban setting as shown in Figure IV.1. The project sites for the BRT corridor and the Ji'an Railway Station Square do not have any biological resources of significance.

Figure IV.1: View of Jinggangshan Avenue

137. **Western City Development Area**. This is a new development area to the west of the current urban center, with a total area of 51 km^2. The planning EIR has defined an **assessment area** of 11.7 km^2 within the 51 km^2 which encompasses the urban road and Yudai River rehabilitation components. The assessment area is bound by Zhanlqian Avenue to the west, Junhua Avenue to the east, Zhenjunshan South Road to the north and Jifu Road to the south (longitudes 114°55'31.46"E to 114°58'21.84"E; latitudes 27°6'34.12"N to 27°9'1.11"N).

138. The setting in the assessment area could be described as suburban-rural but dominated by villages. The project sites for the five urban roads and Yudai River rehabilitation are in a suburban-rural setting that has been under human influence and disturbance. The planning EIR identified 27 villages within the assessment area, with a current population of 4,618 and 1,248 households. Table IV.1 shows that the existing land use within this 11.7 km^2 assessment area is dominated by farmland and woodland, followed by municipal public facilities and waterbodies such as rivers, streams, and man-made ponds and ditches. The roads within the assessment area are rural roads, with Jifu Road to the south of the assessment area being the main transport corridor to neighboring areas.

Table IV.1: Existing Land Use within the 11.7 km^2 Assessment Area

Land Use Type	Area (ha)	Percentage of Total
Village constructed land	150.08	12.83
Roads	26.50	2.26
Water area	234.94	20.08
Farmland and woodland	476.04	40.69
Municipal public facilities	282.44	24.14
Total	**1170**	**100.00**

Source: Planning EIR.

B. Existing Sensitive Receptors

139. Based on field surveys, the project EIR identified various types of sensitive receptors that currently exist within the project area of influence as defined in Table II.8. **Table IV.2** identifies ecological, water quality and social sensitive receptors. Among these are three locations with old Camphor Trees, which fall under national Class II protection, and 23 species of wildlife that are under provincial protection. For air quality and noise, the project EIR identified 13 sensitive receptors consisting of residential households, schools and hospitals or health clinics along the BRT corridor (Table IV.3), 32 sensitive receptors within the area of influence of the five urban roads (Table IV.4), and 9 sensitive receptors within the area of influence of Yudai River rehabilitation (Table IV.5).

Table IV.2: Ecological, Water Quality and Social Sensitive Receptors in the Project Area of Influence

Media	Sensitive Receptor and Status
Ecology	● Camphor Tree (*Cinnamomum camphora*) at 3 locations (see section on physical cultural resources) ● 23 provincially protected wildlife species ● IUCN vulnerable and Class II national protection bird species present in the wider project area ● River and wetland habitats of local value ● No significant wetland, nature reserve, fish spawning and wintering ground, no fish migration routes
Water quality	● Luohu River and Gan River downstream of Yudai River ● No drinking water intake within the project area of influence
Social	● Residents and employees affected by land acquisition and resettlement

Source: Project EIR.

Table IV.3: Existing Air Quality and Noise Sensitive Receptors in the Proposed BRT Corridor's Project Area of Influence

No.	Name of Sensitive Receptor Location	First Row Distance to Center Line	Noise Functional Area				Remark
			Category 4a		Category 2		
			First Row Distance to Red Line	No. of Households (HH) / people	First Row Distance to Red Line	No. of Households (HH)/ people	
1	Luochuan Village 螺川村	60 m	30 m	20 HH	50 m	120 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
2	Beimen village 北门村	70 m	---	---	40 m	200 HH	6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue and Qaqiao West Road.
3	Jinggangshan University Affiliated Hospital 井冈山大学附属医院	40 m	---	---	10 m	≈200 people	Brick buildings facing the road. Presently affected by traffic noise from Jinggangshan Avenue.
4	Ji'an City Center People's Hospital 吉安市中心人民医院	40 m	---	---	10 m	≈600 people	Brick buildings facing the road. Presently affected by traffic noise from Jinggangshan Avenue.
5	Guangfeng Village 广丰村	80 m	---	---	50 m	150 HH	3-6 storey brick buildings at slant angle to road. Presently affected by

No.	Name of Sensitive Receptor Location	First Row Distance to Center Line	Noise Functional Area				Remark
			Category 4a		Category 2		
			First Row Distance to Red Line	No. of Households (HH) / people	First Row Distance to Red Line	No. of Households (HH)/ people	
							traffic noise from Jinggangshan Avenue.
6	Taqian Village 塔前村	50 m	20 m	20 HH	50 m	100 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
7	Jiangjiafang 江家坊	40 m	10 m	20 HH	50 m	110 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
8	Xinfeng Village 新丰村	40 m	10 m	30 HH	20 m	110 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
9	Dianqian Village 店前村	80 m	---	---	50 m	90 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
10	Lijia Village 李家村	100 m	---	---	70 m	100 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
11	Dingjia Village 丁家村	110 m	---	---	80 m	90 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
12	Nankeng Village 南坑村	50 m	20 m	40 HH	30 m	100 HH	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.
13	Jinggangshan National Economic Development Zone 井冈山国家经济开发区	50 m	20 m	200 people	---	---	3-6 storey brick buildings at slant angle to road. Presently affected by traffic noise from Jinggangshan Avenue.

Source: Project EIR.

Table IV.4: Existing Air Quality and Noise Sensitive Receptors in the Five Proposed Urban Roads' Project Area of Influence

No.	Name of Sensitive Receptor Location	Affected by		First Row Distance to Center Line	Noise Functional Area				Remark
					Category 4a		Category 2		
		Road	Chainage		First Row Distance to Red Line	No. of House-holds	First Row Distance to Red Line	No. of House-Holds / People	
1	Baitang Village	Shaoshan We	K0+220/ri	26~45 m	6 m	26 HH	36 m	120 HH	3-4 storey brick buildings fac

No.	Name of Sensitive Receptor Location	Affected by		First Row Distance to Center Line	Noise Functional Area				Remark
					Category 4a		Category 2		
		Road	Chainage		First Row Distance to Red Line	No. of House-holds	First Row Distance to Red Line	No. of House-Holds / People	
	白塘村	st Road	ght						ing the proposed road. Presently affected by traffic noise from the existing section of Shaoshan West Road and Jizhou Avenue
2	Jinluhuayuan 金鹭花园	Shaoshan West Road	K0+240/left	24 m	4 m	90 HH	37 m	325 HH	Residential community with 7-storey brick buildings. Presently affected by traffic noise from the existing section of Shaoshan West Road and Jizhou Avenue
3	Wuli Village Zoujia Village Group 五里村邹家村组	Shaoshan West Road	K0+600/both sides	Left 25 m Right 27 m	Left 5 m Right 7 m	31 HH	Left 37 m Right 38 m	153 HH	Proposed road will traverse through village with 3-5 storey brick buildings. No other noise source.
4	Wuli Primary School 五里小学	Shaoshan West Road	K0+400/right	100 m	---	---	80 m	260 teachers & students	3-storey brick building at slant angle to road. No other noise source.
5	Xiazhou Village 下洲村	Shaoshan West Road	K1+640/left	147 m	---	---	127 m	18 HH	3-5 storey brick buildings at slant angle to road. No other noise source.
6	Jiangbian Village 江边村	Shaoshan West Road	K2+985.559/ facing the end of the road	115 m	---	---	95 m	10 HH	3-5 storey brick buildings at the intersection of proposed Shaoshan West Road and Bo'an Avenue. Mainly affected by traffic noise from Bo'an Avenue. No other noise source.
		Bo'an Avenue	K3+000/left	48 m	28 m	3 HH	36 m	89 HH	
7	Renjia Village 仁家村	Bo'an Avenue	K2+740/right	75 m	---	---	55 m	35 HH	3-5 storey brick buildings. No other noise source.
8	Luogang Village 螺冈村	Bo'an Avenue	K2+740/left	30 m	10 m	2 HH	47 m	9 HH	2-3 storey brick buildings at slant angle to road. No other noise source.
9	Chengshang Village 城上村	Bo'an Avenue	K2+220/left	30 m	10 m	12 HH	37 m	16 HH	3-4 storey brick buildings. No other noise source. Will be traversed by the planned Guangchang West Road.
10	Maobei Village 毛背村	Bo'an Avenue	K1+696/right	33 m	13 m	3 HH	38 m	9 HH	3-4 storey brick buildings. No other noise source. Will be bisected by the planned Liji atang Road.
11	Luotang Village	Bo'an Avenue	K0+800/left	59 m	---	---	39 m	12 HH	3-4 storey brick buildings at the intersection of Zhongsha

No.	Name of Sensitive Receptor Location	Affected by		First Row Distance to Center Line	Noise Functional Area				Remark
					Category 4a		Category 2		
		Road	Chainage		First Row Distance to Red Line	No. of House-holds	First Row Distance to Red Line	No. of House-Holds / People	
	罗塘村	Zhongshan West Road	K3+337/road end	76 m	---	---	56 m	9 HH	n West Road and Bo'an Avenue. No other noise source. Will be mainly affected by traffic noise from Bo'an Avenue.
12	Shiliwangjia 十里王家	Zhongshan West Road	K2+740/right	100 m	---	---	80 m	6 HH	2-3 storeys of scattered brick buildings at slant angle to road. No other noise source.
13	Chaobailing Village 朝拜岭村	Zhongshan West Road	K2+620/left	65 m	---	---	45 m	80 HH	3-5 storey brick buildings at slant angle to road. No other noise source.
14	Pengxia Village 棚下村	Zhongshan West Road	K1+940/left	61 m	---	---	41 m	77 HH	3-5 storey brick buildings. No other noise source.
			K1+605/left	64 m					
15	Baitang Primary School 白塘小学	Zhongshan West Road	K0+880/right	56 m	---	---	36 m	200 teachers & students	With back of building facing road and separated by the Anqian Old Village. No other noise source.
16	Anqian Old Village 案前老村	Zhongshan West Road	K0+724/right	23 m	3 m	9 HH	40 m	35 HH	3-5 storey brick buildings. No other noise source.
17	Anqian New Village 案前新村	Zhongshan West Road	K0+220/right	24 m	4 m	13 HH	48 m	16 HH	3-5 storey brick buildings of mixed residential and commercial uses. Minor traffic noise impact from Jizhou Avenue as well.
18	Ji'an City Disease Prevention and Control Center 吉安市疾病预防控制中心	Zhongshan West Road	K0+060/right	35 m	---	---	15 m	76 staff & 31 retirees	7-storey brick building at the intersection of Zhongshan West Road and Jizhou Avenue. Will also be affected by traffic noise from Jizhou Avenue.
19	Yangminghuayuan 阳明花园	Zhongshan West Road	K0+420/ both sides	Left 25 m Right 28 m	Left 5 m Right 8 m	90 HH	38 m	360 HH	Residential community of 5-7 storey brick buildings. No other noise source.
20	Dujiafang Village 杜家坊村	Yangming West Road	K1+140/right	141 m	---	---	111 m	15 HH	2-4 storey brick buildings. No other noise source.
		Junhua Avenue	K5+060/left	38 m	10 m	5 HH	40 m	17 HH	2-4 storey brick buildings. No other noise source.
21	Nan'an Village 南岸村	Yangming West Road	K2+220/right	37 m	9 m	12 HH	37 m	70 HH	2-5 storey brick buildings. No other noise source.
22	Dongtou Village 冻头村	Yangming West Road	K2+680/ both sides	Left 32 m Right 33 m	4 m	33 HH	36 m	102 HH	2-5 storey brick buildings. No other noise source.
23	Laoyangjia Vill	Junhua Avenu	K0+820/ b	Left 34 m	6 m	33 HH	40 m	68 HH	Proposed road will traverse t

No.	Name of Sensitive Receptor Location	Affected by		First Row Distance to Center Line	Noise Functional Area				Remark
					Category 4a		Category 2		
		Road	Chainage		First Row Distance to Red Line	No. of House-holds	First Row Distance to Red Line	No. of House-Holds / People	
	age 老杨家村	e	oth sides	Right 33 m					hrough village with 2-5 storey brick buildings. No other noise source.
24	Zengjia Village 曾家村	Junhua Avenue	K1+380/left	148 m	---	---	120 m	7 HH	2-3 storey brick buildings. No other noise source.
25	Jiaojialing Village 焦家岭村	Junhua Avenue	K2+740/both sides	Left 34 m Right 40 m	6 m	25 HH	40 m	83 HH	Proposed road will traverse through village with 2-4 storey brick buildings. No other noise source.
26	Jinggangshan University Ji'an City Health College 井冈山大学吉安市卫生学校	Junhua Avenue	K3+300/right	39 m	---	---	11 m	5200 students and206 teachers	Proposed road will traverse through the boundary wall of the 5-storey school building. Presently affected by traffic noise from Jifu Road.
27	Baiyunshan Village 白云山村	Junhua Avenue	K3+540/left	130 m	---	---	102 m	63 HH	3-5 storey brick buildings. Presently affected by traffic noise from Jifu Road.
28	Baitang Village Xuanshang Village Group 白塘村玄上村组	Junhua Avenue	K4+320/right	125 m	---	---	97 m	73 HH	3-5 storey brick buildings. No other noise source.
29	Zhaojiashan 赵家山	Junhua Avenue	K5+160/right	160 m	---	---	132 m	15 HH	3-5 storey brick buildings. No other noise source.
30	Zhoujiapi 洲家陂	Junhua Avenue	K6+320/left	125 m	---	---	98 m	18 HH	3-5 storey brick buildings. No other noise source.
31	Ji'an City Drug Rehabilitation Institution 吉安市戒毒所	Junhua Avenue	K7+960/right	115 m	---	---	87 m	1000people	2-3 storey brick buildings. Proposed road will affect some boundary walls. No other noise source.
32	Shihuling Village 石虎玲村	Junhua Avenue	K8+600/both sides	134 m	---	---	102 m	80 HH	Proposed road will traverse through village of 3-5 storey brick buildings. Presently affected by traffic noise from Ji'an North Avenue to the north.

Source: Project EIR.

Table IV.5: Existing Air Quality and Noise Sensitive Receptors in the Yudai River's Project Area of Influence

No.	Name of Sensitive Receptor	No. of House-	No. of People	Distance to	Relative to Yudai River	Environmental Sensitivity

		holds		Yudai River Red Line		Air Quality	Noise
1	Xiazhou Village 下洲村	20	100	90	South of Yudai River	√	√
2	Dongtou Village 冻头村	9	45	70	South of Zhongqi Stream, a Yudai River major tributary	√	√
3	Qiaotou Village 桥头村	15	70	80	South of Zhongqi Stream, a Yudai River major tributary	√	√
4	Maobei Village 毛背村	25	120	100	South of Zhongqi Stream, a Yudai River major tributary	√	√
5	Xianantang 下南塘	30	150	160	North of Zhongqi Stream, a Yudai River major tributary	√	√
6	Dongjietang 东界塘	30	120	130	South of Zhongqi Stream, a Yudai River major tributary	√	√
7	Cunqian 村前	8	40	230	West of Jiangbianxi Stream	√	---
8	Chengshang Village 城上村	22	110	220	North of Zhongqi Stream, a Yudai River major tributary	√	---
9	Liangyuan Village 良源村	12	60	210	North of Zhongqi Stream, a Yudai River major tributary	√	---

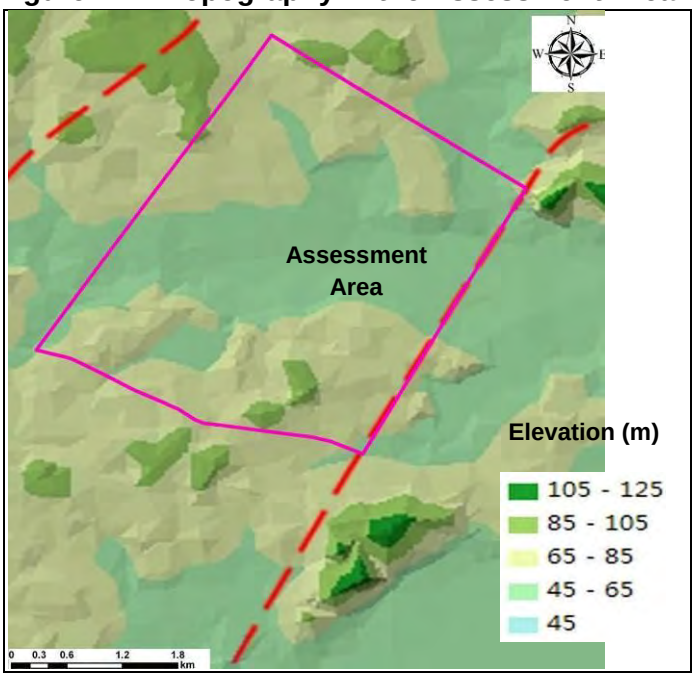
Source: Project EIR.

C. Physical Setting

140. **Geography and geology**. Ji'an is located in the mid-western region of Jiangxi Province, along the mid-stream section of the Gan River. Its coordinates are latitudes 25°58'32"N to 27°57'50"N and longitudes 113°46'E to 115°56'E. The city extends 218 km from north to south and 208 km from east to west. Total administrative area is 25,300 km^2, accounting for approximately 15% of total area in the province. The urban center is located approximately 210 km south of Nanchang, the provincial capital.

141. Ji'an's topography is dominated by hills and mountains, accounting for 51% of the area. The southern, eastern and western regions of the municipality are mountainous while the central and northern regions are plains. The terrain in the urban center slopes from west to east. Figure IV.2 shows that the terrain within the assessment area of the Western City Development Area consists of hilly regions in the south and north, with lowland extending from east to west through the central region.

Figure IV.2: Topography in the Assessment Area



142. **Geology**. Ji'an is located in the eastern section of the Guangxi, Hunan and Jiangxi folded belt of the South China Caledonian geosyncline folded system. Geological strata in the city consist of Sinian, Cambrian and Quaternary sequences, with well-developed outcrops, relatively frequent tectonic and magmatic events, and complex geological structures.

143. The soil in Ji'an, including the project sites, is dominated by red soil distributed from low hills at 80 m elevation to mountains at 600 m elevation. Other soil types include purple soil developed on purple sand shale, purple paddy field soil, black lime soil developed on calcareous carbon shale, and alluvial tidal sand and mud from rivers.

144. **Seismicity**. According to the *China Seismic Ground Motion Parameters Zoning Map* (GB 18306-2001), the seismic intensity in Ji'an's urban center is Grade VI. The PRC classifies seismic intensity into 12 classes under the *China Seismic Intensity Table* (GB/T 17742-2008), from Class I to Class XII based on the severity of "shaking" of the earth surface and the extent of potential impact. Class VI is intermediate in severity with most people unable to stand still and furniture falling.

145. **Climate**. The project area is located in the Central Asia sub-tropical monsoon climatic zone, with mild and humid climate and distinct seasons under the influence of the southeast monsoon. Table IV.6 shows Ji'an's weather statistics.

Table IV.6: Ji'an's Weather Statistics

Parameter	Value
Annual average temperature	18.3 °C
Lowest monthly average temperature	6.2 °C
Highest monthly average temperature	28.2 °C

Parameter	Value
Extreme lowest temperature	-8 °C
Extreme highest temperature	40.2 °C
Annual average frost free days	277 days
Annual average sunshine hours	1,812 h
Predominant wind during the year	Northerly
Annual average precipitation	1,458 mm
Highest 24-h precipitation	188.1 mm
Highest 1-h precipitation	50.2 mm

Source: Planning EIR.

146. **Air quality**. Baseline ambient air quality monitoring for environmental impact assessment for road projects in the PRC generally consists of monitoring of SO_2, NO_2, TSP and PM_{10} on seven consecutive days. For this project, the Ji'an Environmental Monitoring Station (JEMS), a subsidiary of the Ji'an Environmental Protection Bureau and an authorized entity for conducting environmental monitoring,[12] undertook baseline ambient air quality monitoring at two locations in the project area of influence from 22 to 28 June, 2013. Figure IV.3 shows the monitoring locations (also showing baseline monitoring locations for noise, surface water quality, ground water quality, soil and Yudai River sediment quality).

147. Table IV.7 presents the monitoring results, indicating that on the days of monitoring, all parameters monitored at the two locations complied with GB-3095-1996 Class II standard. Both PM_{10} and SO_2 were better than the lower limit of the EHS interim targets but slightly over the AQG standard.

[12] In the PRC, only monitoring data collected by an authorized entity will be recognized by the environmental authority.

Figure IV.3: Map Showing Baseline Environmental Monitoring Locations

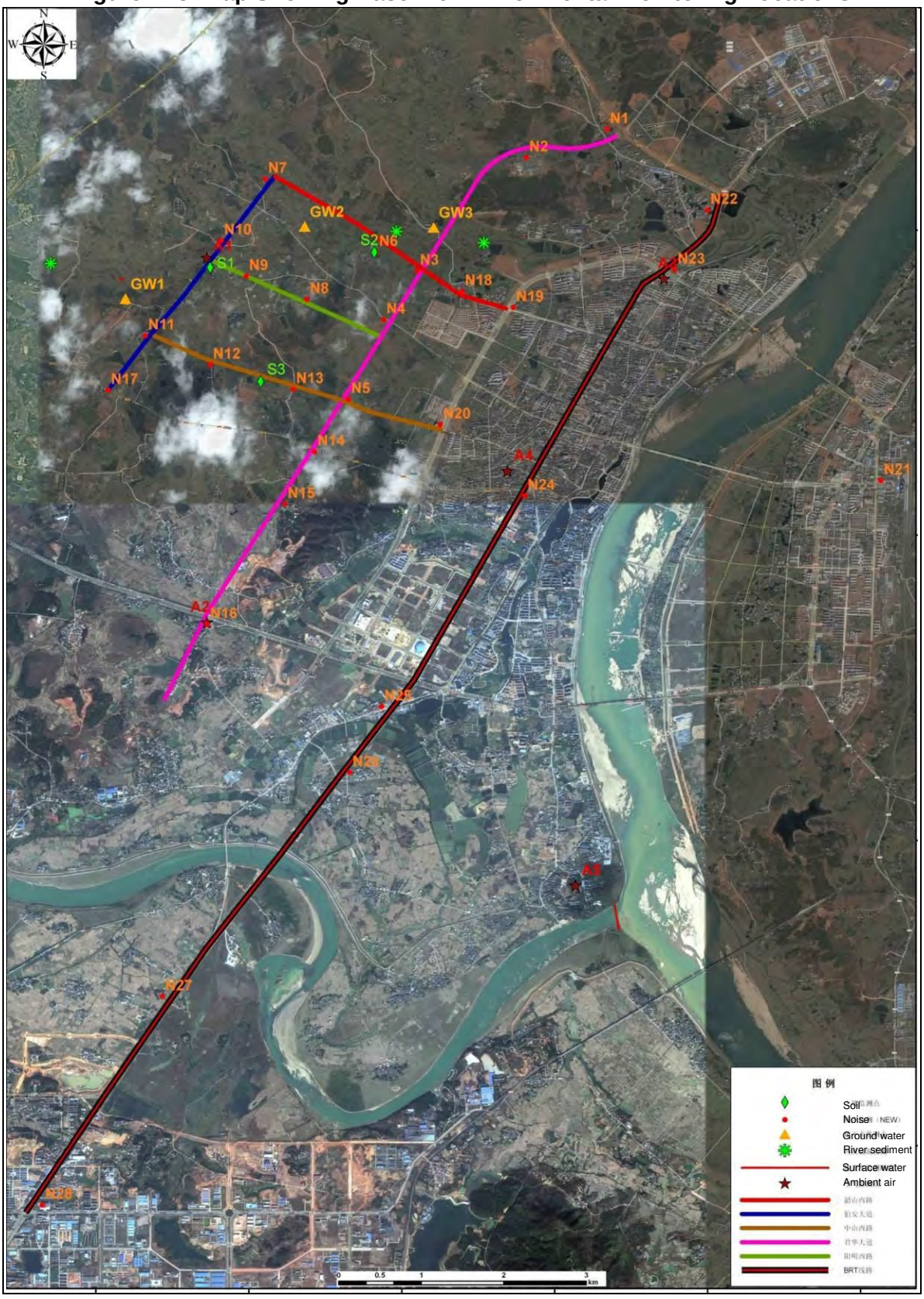


Table IV.7: Baseline Ambient Air Quality Monitoring Results from 22-28 June 2013

Monitoring Location		Daily Average Concentration (mg/m^3)			
No.	**Location**	**TSP**	**PM_{10}**	**SO_2**	**NO_2**
A1	Intersection of proposed Yangming West Road and Bo'an Avenue	0.104-0.109	0.052-0.062	0.03-0.036	0.029-0.034
A2	Laoyangjia Village	0.102-0.109	0.053-0.061	0.032-0.038	0.029-0.032
	GB 3095-1996 Class II standard	0.300	0.150	0.150	0.120
	WBG EHS standard Interim targets	n/a	0.075-0.150	0.050-0.125	n/a
	AQG	n/a	0.050	0.020	n/a

Note: n/a = not available.
Source: Project EIR.

148. **Acoustic environment**. Baseline noise monitoring for environmental impact assessment in the PRC generally consists of noise monitoring on two consecutive days, with noise measurements taken both during the day time and at night on each day. For this project, JEMS undertook noise monitoring on 26 and 27 June, 2013 at 28 selected sensitive receptor locations (20 for the urban roads, 7 for the BRT corridor and one at the Ji'an Railway Station Square) (see Figure IV.3).

149. Table IV.8 presents the monitoring results. Category 4a standards apply to those sensitive receptors near major roads. Since the urban roads have not been built and the sensitive receptors are in a rural setting, they were assigned Category 1 standards for their existing acoustic environment. However, for impact assessment of road noise after the roads are built and the Western City Development Area changes to an urban setting, their noise functional area category will be changed to Category 2 (or 4a if they are within 35 m of the roads).

150. Comparisons made with PRC's GB 3096-2008 standards (which are as stringent as (for Category 1) or more stringent than [for Category 4a] the EHS standards) show that most exceedance occurred at night in Category 1 functional areas (because of more stringent night time noise standard) except at Shili Village and the Railway Station Square where day time exceedance also occurred. Night time exceedance was most serious at the Railway Station Square, with noise levels that were 8 dB(A) above the noise standard. No day time and night time noise exceedance occurred at the sensitive receptors selected for the BRT corridor (because of less stringent noise standards for Category 4a) except slight night time exceedance at the Jinggangshan National Economic Development Zone building.

Table IV.8: Baseline Noise Monitoring Results from 26-27 June 2013

Monitoring Location			Noise Levels [dB(A)] according to Functional Area Category							
			Category 1				Category 4a			
No.	**Location**	**Location relative to Proposed Road**	**Day Time**		**Night Time**		**Day Time**		**Night Time**	
			Day 1	**Day 2**	**Day 1**	**Day 2**	**Day 1**	**Day 2**	**Day 1**	**Day 2**
N1	Shihuling	Junhua Avenue R 50m	---	---	---	---	61.5	60.2	54.0	53.7
N2	Ji'an City Drug Rehabilitation Institution	Junhua Avenue R 70m	52.6	51.4	49.8	48.3	---	---	---	---
N3	Planned residential community	Intersection of Junhua Avenue and Shaoshan West Road	---	---	---	---	61.5	60.2	54.0	53.7
N4	Dujiafang Village	Junhua Avenue R 60m	47.3	46.2	42.0	41.3	---	---	---	---
N5	Planned residential	Intersection of Zhongshan	50.6	50.4	43.9	42.7	---	---	---	---

Monitoring Location			Noise Levels [dB(A)] according to Functional Area Category							
			Category 1				Category 4a			
No.	Location	Location relative to Proposed Road	Day Time		Night Time		Day Time		Night Time	
			Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
	community	West Road and Junhua Avenue								
N6	Xiazhou Vilalge	Shaoshan West Road L 70m	54.4	53.7	47.0	46.5	---	---	---	---
N7	Jiangbian Village	Intersection of Shaoshan West Road and Bo'an Avenue	52.0	51.2	46.1	45.7	---	---	---	---
N8	Planned residential community	Yangming West Road R 60m	48.4	47.5	42.0	41.5	---	---	---	---
N9	Dongtou Village	Yangming West Road R 50m	47.5	46.8	41.8	40.7	---	---	---	---
N10	Chengshang Village	Bo'an Avenue R 40m	49.0	48.5	44.2	42.3	---	---	---	---
N11	Luotang Village	Intersection of Zhongshan West Road and Bo'an Avenue	53.0	52.8	47.4	46.5	---	---	---	---
N12	Shili Village	Zhongshan West Road R 60m	57.3	56.2	50.0	49.3	---	---	---	---
N13	Village	Zhongshan West Road L 70m	---	---	---	---	46.8	46.2	42.7	42.5
N14	Jinggangshan University Ji'an City Health College	Junhua Avenue R 30m	---	---	---	---	53.9	52.6	48.7	47.8
N15	Jiaojialing Village	Junhua Avenue R 35m	45.1	44.7	42.3	41.8	---	---	---	---
N16	Laoyangjia Village	Junhua Avenue R 35m	---	---	---	---	48.4	48.2	45.6	44.3
N17	Intersection of JifuRoad and proposed Bo'an Avenue	Bo'an Avenue L 40m	---	---	---	---	50.5	49.8	45.1	44.3
N18	Wuli Village	Shaoshan West Road L 30m	49.0	48.3	42.8	42.5	---	---	---	---
N19	Residential community	Shaoshan West Road L 30m	---	---	---	---	56.3	55.2	51.0	50.8
N20	Ji'an Siyuan Experimental School	Zhongshan West Road R 35m	---	---	---	---	49.5	48.4	46.3	45.2
N21	Railway Station Square	Railway Station Square	---	---	---	---	70.2	69.3	63.8	62.7
N22	Luochuan Village	BRT L 15m	---	---	---	---	65.8	61.7	54.7	53.4
N23	Beimen Village	BRT R 25m	---	---	---	---	62.1	59.8	51.6	50.0
N24	Guangfeng Village	BRT R 25m	---	---	---	---	57.0	56.8	49.0	48.3
N25	Taqian Village	BRT L 15m	---	---	---	---	56.8	55.7	46.3	47.2
N26	Jiangjiafang Village	BRT R 15m	---	---	---	---	51.3	53.0	45.6	44.6
N27	Dingjia Village	BRT L 15m	---	---	---	---	50.0	51.2	44.7	45.3
N28	Jinggangshan National Economic Development Zone building	BRT R 30m	---	---	---	---	57.9	58.1	56.0	55.7
		GB 3096-2008 standard	55		45		70		55	
		WBG EHS standard	55		45		70		70	

Monitoring Location			Noise Levels [dB(A)] according to Functional Area Category							
			Category 1				Category 4a			
No.	Location	Location relative to Proposed Road	Day Time		Night Time		Day Time		Night Time	
			Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2

Note:

exceed GB & EHS standards exceed GB standard L = left R = right

Source: Project EIR.

151. **Hydrology and surface water quality**. Rivers within the project area of influence include the Gan River, Luohu River, Yudai River and its tributary Jiangbian Stream, and the Heshui River where the BRT corridor on Jinggangshan Avenue will cross.

152. The Gan River (or Ganjiang[13]) is the major river flowing through Ji'an with a catchment area of 22,500 km^2 and water resource of 19.675 billion m^3 within Ji'an.

153. The Luohu River is one of 28 tributaries in Ji'an flowing into the Gan River. It originates from the upstream of Guanxi reservoir in Xingqiao, and flows into Gan River at Luohu Bridge near Wenhuasi Temple in Jizhou District. It is 22.5 km long with a catchment area of 101.2 km^2. The terrain of the catchment area is hilly plain. The existing stream has many meanders. The banks are unprotected and garbage and waste often block the waterway. Its water surface width is 40-70 m, and river bed width is 8-16 m, with a water depth of 6-7 m. Its average flow rate is 6.5 m^3/s.

154. Yudai River flows into the downstream section of the Luohu River. It has a catchment area of 39.3 km^2 and multi-year average water quantity of 43 million m^3. The existing river banks are very irregular, with the width varying and both sides of the embankment are naturally formed without any slope protection. The width of the stream is generally 10–20 meters; the annual average water channel is about 10 meters wide. The current designated water function for Yudai River is for irrigation use. Upon the development of the Western City, its water function will be changed to scenic use.

155. The Jiangbian Stream is a tributary of Yudai River with a catchment area of 10 km^2. The width of the stream is generally 2–4 meters, and the annual average water channel is about 2 m wide. Villages and farmlands are situated along the stream. There are two water-carrying weirs for irrigation.

156. The Heshui River is the largest tributary in the mid-stream section of the Gan River. It is 256 km long with a catchment area of 9,103 km^2.

157. Baseline surface water quality monitoring for environmental impact assessment in the PRC generally consists of water quality monitoring on three consecutive days. For this project, JEMS undertook measurements of pH, SS, permanganate index, BOD_5, NH_3-N, TPH, TP and volatile phenol at three locations on the Yudai River (see Figure IV.3) from 26 to 28 June, 2013. Table IV.9 presents the monitoring results, indicating that on the days of monitoring and at the monitoring locations on the Yudai River, the parameters measured complied with GB 3838-2002 Category II water quality standards.

[13] "Jiang" in Chinese means river. Therefore the name of the river should be either Gan River or Ganjiang, but not Ganjiang River.

Table IV.9: Baseline Surface Water Quality Monitoring Results for Yudai River from 26-28 June 2013

Monitoring Location		Monitoring Date	Surface Water Quality Parameter Concentration							
No.	Location		pH (no unit)	SS mg/L	BOD_5 mg/L	Permanganate Index mg/L	NH_3-N mg/L	TPH mg/L	TP mg/L	Volatile Phenol mg/L
SW1	Yudai River upstream	2013.06.26	7.90	16	1.4	1.51	0.263	0.037	0.10	0.0015
		2013.06.27	7.86	15	1.3	1.36	0.223	0.037	0.08	0.0014
		2013.06.28	7.92	14	1.3	1.31	0.242	0.038	0.11	0.0015
SW2	At Dongtou Village	2013.06.26	7.45	18	1.5	1.73	0.235	0.034	0.07	0.0015
		2013.06.27	7.40	17	1.6	1.49	0.208	0.033	0.06	0.0015
		2013.06.28	7.35	16	1.4	1.42	0.213	0.033	0.09	0.0015
SW3	At Wuli Village	2013.06.26	7.39	19	1.4	1.40	0.192	0.035	0.06	0.0015
		2013.06.27	7.41	18	1.2	1.26	0.180	0.036	0.07	0.0015
		2013.06.28	7.44	18	1.4	1.24	0.248	0.037	0.05	0.0014
GB 3838-2002 Category II standard			6-9	n/a	⩽3	⩽4	⩽0.5	⩽0.05	⩽0.1	⩽0.002

Notes: n/a = not available; pH = a measure of acidity and alkalinity, SS = suspended solids, BOD_5 = 5-day biochemical oxygen demand; NH_3-N = ammonia nitrogen, TPH = total petroleum hydrocarbon; TP = total phosphorus

Source: Project EIR.

158. **Soil and sediment quality**. For this project, the JEMS collected soil samples from three locations (see Figure IV.3) on 26 June 2013 and Yudai River sediment samples from two locations (see Figure IV.3) on 26 June and 13 August, 2013.

159. Table IV.10 presents the baseline soil quality monitoring results for the three locations, indicating compliance with GB 15618-1995 Class II standards for the parameters measured except pH. The sample collected at Maobei Village showed low pH, indicating acidic soil, and the project EIR attributed this to acid rain that has been occurring in Ji'an.

Table IV.10: Baseline Soil Monitoring Results from 26 June 2013

Monitoring Location		Soil Quality Parameter Concentration				
No.	Location	pH (no unit)	Cd mg/kg	Cu mg/kg	Pb mg/kg	As mg/kg
A1	Maobei Village	4.81	0.28	32.8	30	13.2
A2	Xiazhou Village	7.23	0.28	18.3	90	22.58
A3	Baitang Village	7.15	0.25	13.0	12.5	10.88
GB 15618-1995 Class II standard		< 6.5	⩽0.30	50	250	40
		6.5 – 7.5	0.30	100	300	30

Notes: pH = a measure of acidity and alkalinity; Cd = cadmium; Cu = copper; Pb = lead; As = arsenic

Source: Project EIR.

160. Table IV.11 presents Yudai River baseline sediment monitoring results, indicating that based on the parameters measured, sediment quality at the two locations complied with GB 15618-1995 Class II standards, meaning suitability for land disposal of dredged sediment. The sediment also showed relatively low levels of nutrients (Total Phosphorus and Total Nitrogen).

Table IV.11: Yudai River Baseline Sediment Monitoring Results from 26 June and 13 August 2013

Monitoring Location		Sediment Quality Parameter Concentration												
No.	Location	pH (no unit)	Ni mg/kg	Cd mg/kg	Cu mg/kg	Pb mg/kg	Zn mg/kg	As mg/kg	Hg mg/kg	TP mg/kg	TN mg/kg	Cr^{+6} mg/kg	Lindane mg/kg	DDT mg/kg
1	Dongtou Village	7.18	32.5	0.25	27.5	47.5	117.5	15.0	0.155	316	0.131	0.25	0.015	⩽0.0008
2	Zhoujiapi Village	7.34	45.0	0.28	34.3	65.0	132.5	16.7	0.135	458	0.153	0.16_L	0.103	⩽0.0008
GB 15618-1995 Class II standard		6.5-7.5	50	0.3	100	300	250	30	0.50	n/a	n/a	n/a	0.50	0.50

Notes: pH = a measure of acidity and alkalinity, Ni = nickel; Cd = cadmium; Cu = copper; Pb = lead, Zn = zinc; As = arsenic; Hg = mercury; TP = total phosphorus; TN = total nitrogen; Cr^{+6} = hexavalent chromium; DDT = dichloro-diphenyl-trichloroethane

Source: Project EIR.

D. Biological Resources, Ecology and Biodiversity

161. **Vegetation**. Table IV.1 above indicated that 40% of the 11.7 km^2 assessment area was farmland and woodland. Vegetation in the project area of influence (as defined in Table II.8) was investigated by specialists from JEPSRI for this project, based on field surveys and literature review. Table IV.12 shows the study results, indicating that the habitat types represented in the project area of influence, according to *Flora of China*[14] include warm climate coniferous woodland, broad leaf woodland, evergreen broad leaf woodland, bamboo woodland, shrubbery, shrub-grass land, as well as planted vegetation consisting of timber woodland, orchards, food crops and economic crops.

[14] Flora of China. Published by the Science Publishing Company. (www.floraofchina.org)

Table IV.12: Characterization of Vegetation Types in the Project Area of Influence

Vegetation Group	Vegetation Type	Representative Species	Associated Species	Distribution	Photo
Coniferous woodland	Warm climate coniferous woodland	Masson's Pine ***Pinus massoniana***	***Liquidambar formosana*** ***Castanea sequinii*** ***Sapium sebiferum*** ***Dalbergia hupeana*** ***Cinnamomum camphora*** ***Lagerstroemia indica*** ***Rosa laevigata*** ***Glochidion puberum*** ***Melia azedarach*** ***Vitex negundo*** ***Eurya loquiana*** ***Loropetalum chinense*** ***Boehmeria nivea*** ***Veronica polita*** ***Kalimeris indica*** ***Osmunda japonica*** ***Arthraxon hispidus***	Shihuling Village, Zhenjunshan Park, Tianhuashan Park, hill slope behind Pengxia Village	
Broad leaf woodland	Deciduous broad leaf woodland	Chinaberry ***Melia azedarach***	***Rubus corchorifolius*** ***Viburnum setigerum*** ***Ilex cornuta*** ***Loropetalum chinense*** ***Clerodendrum cyrtophyllum*** ***Vitex negundo*** ***Lygodium japonicum*** ***Trachelospermum jasminoides*** ***Galium aparine*** var. ***tenerum*** ***Carpesium abrotanoides*** ***Digitaria sanguinalis***	Scattered in Dongtou Village	
		Paper Mulberry ***Broussonetia papyrifera***	***Paliurus ramosissimus*** ***Morus alba*** ***Glochidion puberum*** ***Rubus lambertianus*** ***Itea chinensis*** ***Rosa cymosa*** ***Lindera aggregate*** ***Arthraxon hispidus*** ***Anemone hupehensis*** ***Arachniodes rhomboidea*** ***Themeda japonica*** ***Dicranopteris pedata*** ***Smilax*** sp.	Scattered in Baitang Village and Shili Village	

Vegetation Group	Vegetation Type	Representative Species	Associated Species	Distribution	Photo
	Evergreen broad leaf woodland	Camphor Tree ***Cinnamomum camphora***	***Rhus chinensis*** ***Vitex negundo*** ***Symplocos sumuntia*** ***Sapium sebiferum*** ***Pteris multifida*** ***Lycoris radiate*** ***Miscanthus sinensis*** ***Dicranopteris pedata*** ***Imperata cylindrical*** ***Setaria viridis*** ***Lygodium japonicum*** ***Brassica rapa*** ***Paederia scandens*** ***Erigeron annuus*** ***Buxus harlandii*** ***Carpesium abrotanoides***	Hill slope behind Pengxia Village （N27° 7′ 38.6″ E114° 57′ 15.9″）。	
	Bamboo woodland	***Phyllostachys viridis***	***Trachycarpus martianus*** ***Vitex negundo*** ***Lindera glauca*** ***Glochidion puberum*** ***Miscanthus floridulus*** ***Nepeta cataria*** ***Setaria viridis*** ***Houttuynia cordata*** ***Perilla frutescens***	Near villages	
		Water Bamboo ***Phyllostachys heteroclada***		Hill slopes and alongside ditches	
Shrubbery and shrub-grass land	Shrubbery	Five-leaved Chaste ***Vitex negundo***	***Lindera glauca*** ***Rubus leucanthus*** ***Glochidion puberum*** ***Rosa cymosa*** ***Dalbergia hupeana*** ***Conyza canadensis*** ***Imperata cylindrica*** ***Erigeron annuus*** ***Justicia procumbens*** ***Setaria viridis*** ***Cynodon dactylon*** ***Arthraxon hispidus*** ***Carpesium abrotanoides*** ***Digitaria sanguinalis*** ***Senecio scandens*** ***Brassica*** sp. ***Artemisia annua*** ***Dendranthema indicum***	Mainly distributed on hill slopes and alongside ditches. Mostly formed after the cutting and removal of Masson's Pine woodlands.	

Vegetation Group	Vegetation Type	Representative Species	Associated Species	Distribution	Photo
		Grayblue Spicebush ***Lindera glauca***	***Rhus chinensis*** ***Pyracantha fortuneana*** ***Staphylea bumalda*** ***Vitex negundo*** ***Conyza Canadensis*** ***Erigeron annuus*** ***Arthraxon hispidus*** ***Cirsium japonicum***	Ji'nan Village and also scattered in hilly areas	
		Chinese Sumac ***Rhus chinensis***	***Glochidion puberum*** ***Elaeagnus pungens*** ***Vitex negundo*** ***Imperata cylindrica*** ***Arthraxon hispidus*** ***Digitaria sanguinalis*** ***Prunella vulgaris*** ***Chrysanthemum indicum*** ***Dicranopteris linearis*** ***Xanthium sibiricum***	A common shrubbery in the project area of influence, with relatively wide distribution on hilly slopes.	
		Elderflower Rose ***Rosa cymosa***		Scattered in hilly areas and road-side	
	Shrub-grass land	Cogon Grass ***Imperata cylindrica***	***Vitex negundo*** ***Rhus chinensis*** ***Imperata cylindrica*** ***Eremochloa ophiuroides*** ***Cirsium japonicum*** ***Arthraxon hispidus***	On barren land and along earthen paths between farmlands	

Vegetation Group	Vegetation Type	Representative Species	Associated Species	Distribution	Photo
		Canadian Fleabane ***Conyza canadensis***	***Cynodon dactylon*** ***Kummerowia striata*** ***Polygonum orientale*** ***Polygonum perfoliatum*** ***Rorippa indica*** ***Digitaria sanguinalis*** ***Setaria viridis*** ***Artemisia annua*** ***Alternanthera philoxeroides***	Widely distributed grass in the project area of influence, on barren land and hilly slopes as well as along earthen paths between farmlands	
		Bermuda Grass ***Cynodon dactylon***		Widely distributed in the project area of influence	
		Phalaris arundinacea		Along earthen paths between farmlands, and low lying areas along the Yudai River banks	
		Siberian Cocklebur***Xanthium sibiricum***	***Setaria viridis*** ***Salvia plebeian*** ***Arthraxon hispidus*** ***Phalaris canariensis*** ***Pueraria lobata***	Near villages on barren land and alongside earthen paths between farmlands	
		Kiss Me over the Garden Gate ***Polygonum orientale***		Along pond edges	
		Dicranopteris pedata		On barren land and road-side	
Economic woodland	Timber woodland	Slash Pine ***Pinus elliottii***		On hilly slopes	
	Orchard	***Camellia oleifera***, ***Citrus reticulate***, ***Prunus persica,*** ***Ziziphus jujube***、***Diospyros kaki***, ***Prunus salicina***, ***Prunus armeniaca***			
Farmland	Food crop	***Oryza sativa, Zea mays***			
	Economic crop	***Brassica rapa***、***Gossypium spp***、***Sesamum indicum***、***Arachis hypogaea***			

Source: Project EIR.

162. These vegetation types were dominated by common plant species, with only the Camphor Tree (*Cinnamomum camphora*) being a protected species (national Class II protection).[15] Camphor Tree colonies were found to be among the dominant species in the evergreen broad leaf woodlands in the project area of influence. Camphor trees are commonly and widely planted in PRC cities for urban landscaping and greening. The *Catalogue of Life China 2013* describes Camphor Trees as widely distributed in southern and southwestern PRC. Old and/or wild camphor trees could be deemed as physical cultural resources and those within the project area of influence worthy of protection are described in the section on Physical Cultural Resources later in this chapter.

163. **Amphibians, reptiles and mammals**. These were investigated by specialists from JEPSRI in September 2013 for this project, based on field surveys, interviews with local specialists and literature review. Table IV.13 lists the amphibians recorded in the project area of influence and their protection status, including national, provincial and International Union for Conservation of Nature (IUCN) protection status.[16] Table IV.13 shows that six species of toads and frogs have been recorded in the project area of influence. Two species, the Zhoushan Toad and the Black-spotted Pond Frog are on the provincial protection list. None of the species are under national or IUCN protection status.

Table IV.13: Amphibians Recorded in the Project Area of Influence

Scientific Name	Common Name	Relative Abundance	Data Source		Protection Status	
			Field Survey	Literature	PRC	IUCN
Bufonidae	蟾蜍科 (true toads)					
Bufo gargarizans	Zhoushan Toad 中华蟾蜍	+++	√		P	
Microhylidae	姬蛙科 (narrow-mouthed frogs)					
Microhyla ornata	Ornamented Pygmy Frog 饰纹姬蛙	+	√			
Microhyla pulchra	Beautiful Pygmy Frog 花姬蛙	+		√		
Ranidae	蛙科 (true frogs)					
Fejervarya limnocharis	Asian Grass Frog 泽陆蛙	+++		√		
Hylarana guentheri	Gunther's Amoy Frog 沼水蛙	++		√		
Pelophylax nigromaculatus	Black-spotted Pond Frog 黑斑蛙	+++	√		P	

Note：P = provincial.
Source: Project EIR.

164. Table IV.14 lists the reptile species recorded in the project area of influence. Of the ten species recorded, four species of snakes are under provincial protection. None of the species are under national or IUCN protection status.

[15] The national protection status, which is divided into Class I and Class II, is based on the ***List of Wild Flora under Nationally Emphasized Protection*** – ***First Batch*** and its revision.

[16] The IUCN red list classifies threatened status into 6 categories (other than Extinct) in descending order of protection importance: Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) and Least Concern (LC). Those that are EW, CR, EN and VU are deemed by IUCN to warrant protection.

Table IV.14: Reptiles Recorded in the Project Area of Influence

Scientific Name	Common Name	Relative Abundance	Data Source		Protection Status	
			Field Survey	Literature / interview	PRC	IUCN
Serpentes	蛇目蛇目 (snakes)					
Deinagkistrodon acutus	Sharp Nosed Viper 尖吻蝮	+		both	P	
Dinodon rufozonatum	Red-banded Snake 赤练蛇	+		interview		
Enhydris chinensis	Chinese Water Snake 中国水蛇	+		interview		
Elaphe carinata	King Ratsnake 王锦蛇	++		both	P	
Elaphe taeniura	Beauty Ratsnake 黑眉锦蛇	+		literature	P	
Zaocys dhumnades	Black-striped Snake 乌梢蛇	++	√		P	
Squamata	有鳞目 (scaled reptiles)					
Eumeces chinensis	Chinese Skink 中国石龙子	++		literature		
Gekko japonicus	Japanese Gecko 多疣壁虎	++		both		
Lygosoma indicum	Writhing Skink 蝾蜓	++		literature		
Takydromus septentrionalis	Northern Grass Lizard 北草蜥	+		literature		

Note: P = provincial.

Source: Project EIR.

165. Table IV.15 lists the mammal species recorded in the project area of influence. Of the eight mammal species recorded, the Siberian Weasel is under provincial protection. None of the species are under national or IUCN protection status.

Table IV.15: Mammals Recorded in the Project area of Influence

Scientific Name	Common Name	Relative Abundance	Data Source		Protection Status	
			Field Survey	Literature / interview	PRC	IUCN
Carnivora	食肉目 (meat eating)					
Mustela sibirica	Siberian Weasel 黄鼬	++		interview	P	
Chiroptera	翼手目 (bats)					
Pipistrellus abramus	Japanese Pipistrelle 东亚伏翼	++		literature		
Vespertilio orientalis	Orienteal Frosted Bat 东方伏翼	++		literature		
Lagomorpha	兔形目 (hares and rabbits)					
Lepus sinensis	Chinese Hare 华南兔	++		both		
Rodentia	啮齿目 (rodents)					
Apodemus agrarius	Striped Field Mouse 黑线姬鼠	++		literature		
Mus musculus	House Mouse 小家鼠	+++		both		
Rattus norvegicus	Brown Rat 褐家鼠	+++		both		
Rattus tanezumi	Asian House Rat 黄胸鼠	+++		literature		

Note: P = provincial

Source: Project EIR

166. **Birds**. Birds were investigated by specialists from JEPSRI in September 2013 for this project, based on field surveys and literature review. Table IV.16 shows that 34 bird species have been recorded in the project area of influence. Of these, over half (53%) were resident species, with winter and summer migrants each accounting for 24% of the number of species. Sixteen species are on the provincial protection list but none are on the national protection list. One species, the Yellow-breasted Bunting, was recently upgraded from Vulnerable to Endangered by the IUCN because it has undergone a very rapid population

decline owing mainly to trapping on wintering grounds.[17] This species is locally abundant. *Catalogue of Life China 2013* states that the Yellow-breasted Bunting is distributed in Jilin, Tianjin, Xinjiang, Guangxi, Heilongjiang, Fujian, Guangdong, Sichuan, Hubei, Inner Mongolia, Hunan, Liaoning, Shandong, Ningxia, Shaanxi, Shanxi, Macau, Shanghai, Zhejiang, Henan, Qinghai, Hebei, Gansu, Anhui, Yunnan, Hong Kong, Guizhou, Beijing, Hainan, Jiangxi, Jiangsu and Chongqing.

Table IV.16: Birds Recorded in the Project Area of Influence

Scientific Name	Common Name	Relative Abundance	Seasonal Type				Data Source		Protection Status	
			R	W	S	P	Field Survey	Literature	PRC	IUCN
Podiciediformes	Grebes 鸊鹈目									
Tachybaptus ruficollis	Little Grebe 小䴙䴘	++	√					√	P	
Ciconiformes	鹳形目									
Ardeola bacchus	Chinese Pond Heron 池鹭	+++			√			√	P	
Bubulcus ibis	Cattle Egret 牛背鹭	+++			√		√		P	
Egretta garzetta	Little Egret 小白鹭	+++			√		√		P	
Anseriformes	雁形目									
Mergus merganser	Goosander 普通秋沙鸭	++		√				√	P	
Gruiformes	鹤形目									
Amaurornis pheonicurus	White-breasted Waterhen 白胸苦恶鸟	++			√			√		
Charadriiformes	鸻形目									
Tringa nebularia	Common Greenshank 青脚鹬	+		√				√		
Tringa ochropus	Green Sandpiper 白腰草鹬	++		√				√		
Columbiformes	鸽形目									
Sterna chinensis	Spot-necked Dove 珠颈斑鸠	++	√					√		
Streptopelia orientalis	Oriental Turtle Dove 山斑鸠	++	√					√	P	
Cuculiformes	鹃形目									
Cuculus micropterus	Short-winged Cuckoo 四声杜鹃	++			√			√	P	
Coraciiformes	佛法僧目									
Alcedo atthis	Common Kingfisher 普通翠鸟	++	√				√			
Ceryle rudis	Lesser Pied Kingfisher 斑鱼狗	++	√					√		
Upupiformes	戴胜目									
Upupa epops	Eurasian Hoopoe 戴胜	++	√					√	P	
Passeriformes	雀形目									
Acridotheres cristaltellus	Crested Myna 普通八哥	++	√					√		
Alauda arvensis	Eurasian Skylark 云雀	+		√				√		
Anthus spinoletta	Water Pipit 水鹨	+		√				√		
Carduelis sinica	Grey-capped Greenfinch 金翅雀	+	√					√		
Corvus corone	Carrion Crow 小嘴乌鸦	+	√					√		
Cyanopica cyana	Grey Tree Magpie 灰喜鹊	+	√					√	P	
Dicrurus marcocercus	Black Drongo 黑卷尾	++			√			√	P	
Emberiza aureola	Yellow-breasted Bunting 黄胸鹀	+		√		√		√		EN
Emberiza spodocephala	Black-faced Bunting 灰头鹀	+		√				√		
Garrulax canorus	Chinese Hwamei 画眉	++	√					√	P	
Hirundo daurica	Red-rumped Swallow 金腰燕	++			√		√		P	
Hirundo rustica	Barn Swallow 家燕	+++			√		√		P	

[17] http://www.birdlife.org/datazone/speciesfactsheet.php?id=8954

Scientific Name	Common Name	Relative Abundance	Seasonal Type				Data Source		Protection Status	
			R	W	S	P	Field Survey	Literature	PRC	IUCN
Lanius schach	Rufous-backed Shrike 棕背伯劳	+	√					√	P	
Motacilla alba	White Wagtail 白鹡鸰	+		√			√			
Parus major	Great Tit 大山雀	++	√					√	P	
Passer montanus	Eurasian Tree Sparrow 麻雀	++	√				√			
Pica pica	Black-billed Magpie 喜鹊	++	√				√		P	
Pycnonotus sinensis	Chinese Bulbul 白头鹎	++	√					√		
Sturnus nigricollis	Black-collared Starling 黑领椋鸟	++	√				√			
Turdus merula	Eurasian Blackbird 乌鶇	++	√					√		

Seasonal Type: R = resident; W = winter migrant; S = summer migrant; P = passing migrant; Protection Status: P = provincial EN = Endangered.
Source: Project EIR.

167. A wetland ecologist was appointed by ADB to carry out a more detailed study to inform the landscape proposals for the river rehabilitation and riverside park. The detailed report is included in Appendix 2. This study identified some additional bird species to those listed in Table IV.16 that may be found in the wider project area. The data from Suichuan Bird Banding Station (100km from project area) includes three species, Fairy Pitta (*Pitta nympha),* Black-throated robin (*Poecilodryas albonotata*) and Brown-chested jungle flycatcher (*Rhinomyias brunneatus*), that are listed as vulnerable by IUCN. The Fairy Pitta and six additional species, Spotted scops owl (*Otus spilocephalus*), Collared scops owl (*Otus lettia*), Oriental scops owl (*Otus sunia*), Collared pygmy owl (*Glaucidium brodiei*), Cuckoo owl (*Speotyto cunicularia*) and Brown Hawk Owl (*Ninox scutulata*) have class II national protection. The revised landscaping proposals incorporate woodland, shrub, grassland, wet meadow, deep and shallow marshes and aquatic habitats to take account of habitat requirements of the species of conservation value that have been identified in the wider project area.

168. **Aquatic biota**. The project EIR describes the aquatic vascular plants in the project area of influence were dominated by Lotus (*Nelumbo nucifera*), Common Reed (*Phragmites australis*), Bullrush (*Typha orientalis*), Water Caltrop (*Trapa natans*), Alligator Weed (*Alternanthera philoxeroides*), Tape Grass (*Vallisneria natans*)，Three-leaf Arrowhead (*Sagittaria trifolia*)， Common Duckweed (*Lemna minor*) and Greater Duckweed (*Spirodela polyrhiza*). None of these are under IUCN protection status. The Lotus is under national Class II protection. The *Catalogue of Life China 2013* describes the Lotus as occurring “all throughout the country.”

169. The EIR recorded 28 species of phytoplankton and 27 species of zooplankton in the project area of influence. Phytoplankton species were dominated by green algae (Chlorophyta) with 12 species and diatoms (Bacillariophyta) with 11 species. Zooplankton species were dominated by protozoa, rotifers, cladocerans and copepods.

170. Benthic organisms were dominated by annelid worms and chironomid larvae, snails such as *Cipangopaludina cahayensis* and *Bellamya quadrata,* and clams and mussels such as *Limnoperna lacustris*, *Hyriopsis cumingii*, *Unio douglasiae* and *Corbicula largillierti*.

171. Fish species in the project area of influence, were identified based on interviews with local specialists and literature review. These comprised 26 common and cultured species

dominated by the carp family (carps, minnows and loaches) with 20 species. Cultured species include the Black Carp (*Mylopharyngodon piceus*), Grass Carp (*Ctenopharyngodon idellus*), Bighead Carp (*Aristichthys nobilis*), Silver Carp (*Hypophthalmichthys molitrix*), Goldfish (*Carassius auratus*), and White Bream (*Parabramis pekinensis*). None of the species are under any protection status.

172. **Protected area**. There are no protected areas, fish spawning ground, concentrated bird feeding and wintering grounds, wetlands of importance and nature reserves within the project area of influence.

E. Socio-economic Conditions

173. Information on the socio-economic profile of Ji'an is based on the Social and Poverty Assessment Report prepared by the PPTA consultant.

174. **Demographic profile**. The Ji'an urban area is comprised of Jizhou District, Qingyuan District and Ji'an County. The project sites for the urban roads and Yudai River rehabilitation in the Western City Development Area are located in Jizhou District. The BRT corridor extends from Jizhou District to Qingyuan District. Table IV.17 summarizes and compares the demographic profiles of Jizhou and Qingyang Districts, Ji'an City, and Jiangxi Province, with national profiles included for reference.

Table IV.17: Demographic Profiles in 2011

Administrative Unit	Area (km^2)	Population	Density (population/km^2)	Male	Female	Urbanization
Jizhou District	425	343,200	808	51.2%	48.8%	61.1%
Qingyuan District	916	207,400	226	52.6%	47.4%	18.2%
Ji'an City	25,283	5,015,600	198	52.5%	47.5%	22.4%
Jiangxi Province	166,900	44,884,400	269	51.5%	47.5%	26.8%
PRC	9,600,000	1,354,040,000	141	51.3%	48.7%	

Source: Social and Poverty Assessment Report, PPTA consultant.

175. Ji'an had a population of 5.01 million by the end of 2011, which accounted for 11% of the population in Jiangxi Province. Populations in Jizhou and Qingyuan Districts accounted for 6.8% and 4.1% of the population in Ji'an. Poverty population was estimated at 6.78% for Jizhou District and 7.8% in Qingyuan District, compared to 13.88% for Ji'an City.

176. **Economic profile**. Table IV.18 summarizes and compares the 2011 economic profiles of Jizhou District, Ji'an City and Jiangxi Province, with the national profile also included for reference. The gross domestic product (GDP) of Jizhou District was approximately 9% of that of Ji'an City, dominated by the tertiary sector. The GDP for Qingyuan District was approximately 6.1% of that of Ji'an City but dominated by the secondary sector. Ji'an City's GDP was approximately 7.7% of that of Jiangxi Province, dominated by the secondary sector. GDP per capita in both Jizhou and Qingyan Districts were higher than the Ji'an City average, with Jizhou District lower and Qingyuan District higher than the provincial average. The urban per capita disposable income was similar among the four, while Jizhou District had the highest rural per capita net income among the four which was 13% higher than the provincial average.

Table IV.18: Economic Profiles in 2011

Administrative Unit	GDP (billion)	GDP % composition by Sector			GDP per capita	Urban per Capita Disposable Income	Rural per Capita Net Income
		Primary	Secondary	Tertiary			
Jizhou District	$1.466	9.4%	38.3%	52.3%	$4,272	$3,279	$1,441
Qingyuan District	$1,002	11.7%	61.0%	27.3%	$4,829	$3,279	$1,169
Ji'an City	$16.388	18.0%	51.7%	30.3%	$3,268	$3,279	$1,157
Jiangxi Province	$210.888	11.7%	53.8%	34.5%	$4,699	$3,235	$1,275
PRC	$8,458.000	4.3%	42.5%	39.2%	$6,247	$4,001	$1,289

Source: Social and Poverty Assessment Report, PPTA consultant.

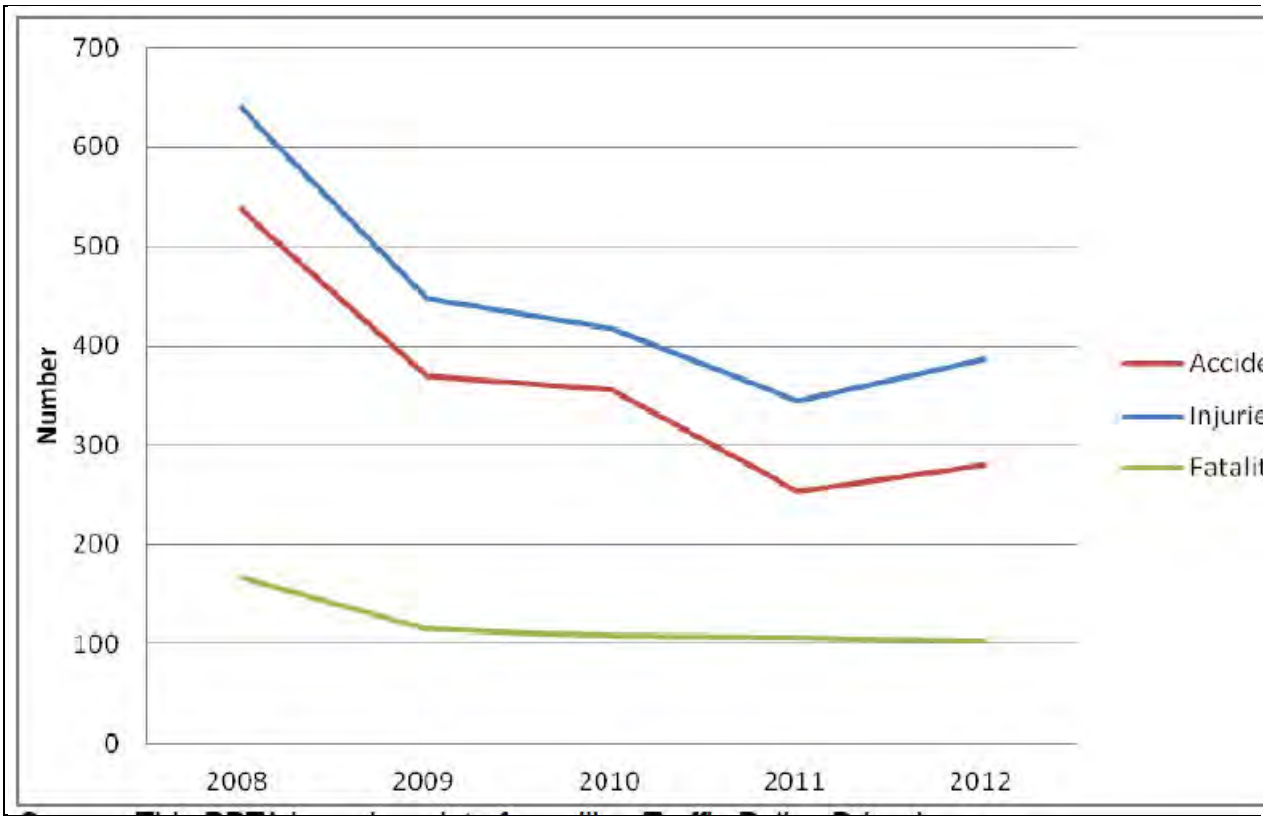
177. **Traffic conditions**. Ji'an is situated along the north-south trunk corridor connecting Beijing to Hong Kong, which is a significant corridor linking the coastal area and the more developed area of southern PRC. Ji'an is also the gateway to the inland, connecting Yangtze River Delta in the north and Minjiang Delta in the east. Within the region, the north-south corridors include Beijing–Kowloon Railway, Daguang Expressway and National Highway G105; while the east-west corridors include the Quannan Expressway and National Highway G319. The existing Jing-Jiu Railway (Beijing–Kowloon, Hong Kong) and G45 Expressway (Daqing–Guangzhou) have formed the backbone of the regional transport network in Ji'an Municipality.

178. Jizhou and Qingyuan Districts are connected by three river crossing bridges, namely Ji'an Bridge, Jinggangshan Bridge and Ganjiang Bridge. The road network in the old city area in Jizhou District has historically developed alongside the Gan River. The existing road network in the urban area consists of three main horizontal and five main vertical trunk roads, forming a grid pattern. The three main east-west corridors are Daqiao Road at Jianggangshan Bridge, Yangming West Road at Ji'an Bridge and Ji'an South Road at Ganjiang Bridge; the five north-south corridors are Jinggangshan Road, Jizhou Road, Binjiang (Riverside) Roads, and Qingyuan Road.

179. An incomplete road network has impeded the further development of the city due to reduced connectivity, and the existing urban area in Ji'an lacks the capacity to meet further development need. The number of registered vehicles in Jizhou District, Qingyuan District, and Ji'an County is steadily increasing over the last decade. In 2012, there were approximately 180,000 vehicles of which 17% were private cars and more than 70% motorcycles. Electric powered motorcycles locally known as e-bikes are not included in these statistics as they have not been regulated until recently. Regulation on e-bikes, however, has now been introduced and e-bikes have to register with the Traffic Police. The increase of vehicle ownership is increasing urban congestion. The Traffic Police claim that the average travel speed decreased from about 40 km per hour to 30 km per hour in recent years, and now some intersections in city center are chronically congested during peak hours.

180. **Road safety**. Annual traffic accidents data for Ji'an (2008–2012) indicates a reduction in number of accidents and injuries since 2008, with a small increase between 2011 and 2012. Fatalities have remained fairly consistent in recent years. Figure IV.4, extracted from the PPTA consultant's draft Road Safety Report, shows the traffic accident trend from 2008 to 2012.

Figure IV.4: Annual Traffic Accidents in Ji'an from 2008 to 2012



F. Physical Cultural Resources

181. Literature review and field inspection by JEPSRI identified nine old camphor trees within the project area of influence that meet the SPS (2009) description of physical cultural resources. These nine camphor trees were found at 3 locations as shown in Table IV.19. They are all more than 100 years old, and none of them have been tagged. The seven trees in Laoyangjia Village would be located on the proposed Junhua Avenue alignment.

Table IV.19: Locations of Old Camphor Trees in the Urban Roads Project Area of Influence

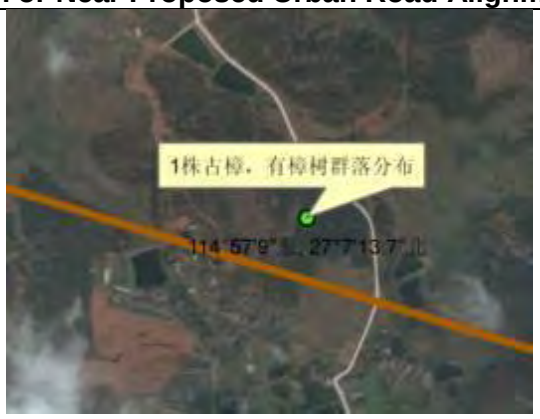
Location	Coordinates		Relative to Road Alignment	Remark	Photo
	Latitude	Longitude			
Huling Village in Changtang Town 吉安市吉州区长塘镇虎岭村	27° 8′ 49.2″ N	114° 59′ 2.9 ″ E	30 m from the proposed Junhua Avenue	No. of trees: one Age: ≈ 120 years Height: 11 m Trunk width: 102 cm Condition: good Tree tag: none	
Pengxia Village in Baitang Township 吉安市吉州区白塘乡棚下村			150 m from the proposed Zhongshan West Road	No. of trees: one Age: ≈ 150 years Height: 12 m Trunk width: 120 cm Condition: good Tree tag: none	
Laoyangjia Village in Hebu Township 吉安市吉州区禾埠乡老杨家村	27° 5′ 36.9″ N	114° 56′ 23.7 ″ E	On the proposed alignment of Junhua Avenue	No. of trees: seven scattered in the village Age: > 100 years	

Source: Project EIR.

182. Camphor Tree (*Cinnamomum camphora*) is under national (Class II) protection. In addition to the above old camphor trees that are deemed to have physical cultural resource significance, the EIR recorded distribution of camphor trees at the locations shown in Figure IV.5, which warrant protection although they are not classified as old trees.

Figure IV.5: Distribution of Camphor Trees on or Near Proposed Urban Road Alignments

10 camphor trees in Laoyangjia Village on the proposed Junhua Avenue alignment



Group of camphor trees in Pengxia Village near the proposed Zhongshan West Road alignment

5 camphor trees on the hilly slope behind Pengxia Village on the proposed Yangming West Road alignment

G. Greenhouse Gas Emissions and Climate Change

183. To combat climate change, Jiangxi Province established the Climate Change Monitoring and Assessment Center in 2009, headed by the Jiangxi Weather Center. In 2010, a Jiangxi Climate Change Expert Panel was established, and was under the management of the Provincial Development and Reform Commission.

184. In 2013, the Jiangxi Provincial Development and Reform Commission published a 12th FYP for dealing with climate change in the province. The plan indicated that Jiangxi emitted 260 million tons of carbon dioxide (CO_2) in 2009, with the burning of fossil fuels accounted for 67% and industrial emissions 23%. Climate change mitigation mainly focused on energy conservation and increased use of renewable energy to reduce carbon emissions. Climate change adaption was broadly discussed, with focus on agriculture, forestry, water resources and Poyang Lake. The plan had little discussion of the transport sector, only proposed actions on the acceleration of eliminating old trains, cars and trucks; and the establishment of an energy saving census system in the transport sector.

185. A climate risk and vulnerability analyses study was carried out to assess the vulnerability of the project to future climate change impacts. The project area is at risk from increased intensity and frequency of heavy rainfall events and flood. The study recommended that the detailed design considers adoption of higher factors of safety as the basis of design to ensure that the project is more resilient to projected future climate change impacts. A detailed report is included in Appendix 3.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

186. **Beneficiaries**. The project will provide a step-change in urban public transport development in Ji'an. A more comprehensive, higher quality public transport system will link the new railway station and development area with the existing railway station in the existing urban center. This will bring accessibility, and connectivity benefits, as well as travel time savings, congestion relief, improved safety and NMT provision. This project will directly benefit a population of 550,600 residing in the Jizhou and Qingyuan Districts. The five proposed urban roads and Yudai River rehabilitation will directly benefit a projected population of 300,000 in the Western City Development Area.

187. **Jinggangshan Avenue BRT corridor**. Provision of dedicated lanes for BRT buses will improve traffic flow since these buses will no longer have to compete for lanes with other motor vehicles when pulling in and out of stops, resulting in better road safety and faster travel time for passengers. Travelling on dedicated lanes will reduce stop-and-go in congested traffic, allowing the buses to travel at faster and more constant speed. This will result in less carbon emissions per vehicle per mile travelled. The BRT corridor will also provide important and efficient connections for the passengers from feeder bus services from the existing railway station, the future Western City Development Area and the planned high speed railway station. As discussed in more detail later in this chapter, the provision of BRT on Jinggangshan Avenue will lead to a reduction of 11,000 t carbon emission per year in 2030 compared to the no BRT scenario.

188. **Urban roads**. The five proposed urban roads in the Western City Development Area provide important road links to the high speed railway station and the central urban area in Ji'an. These roads will facilitate socio-economic development in the Western City Development Area.

189. **Yudai River rehabilitation**. The proposed river rehabilitation project will improve the flood storage capacity of the inner urban area at the river reach and create a riverside park and promenade improving the quality of the urban environment. The adoption of soft engineered methods for bank protection and selection of appropriate species for landscaping will ensure that wetland habitats are maintained.

190. Furthermore, the improved river is expected to create a more attractive environment for the city, improving quality of life whilst maintaining natural ecological systems and functions. The design concept is developed around the theme of a people-centered, low-carbon-sustainable development. This component would benefit the promotion of the image of the city as well as the land value. As the proposed area is strategically located in front of the planned high speed railway station, there will be a synergy of benefits between the project components and the social and economic development of the city.

B. Impacts Associated with Project Location, Planning and Design

191. The project roads and the rehabilitation of Yudai River will result in temporary and permanent land take.

192. Land will be used temporarily for staging construction works or for the storage and disposal of excavated spoil to be later restored. Construction of the BRT stations on the

BRT corridor on Jinggangshan Road would be staged on and within the existing carriageway. The SWCR estimated that for the urban roads and Yudai River rehabilitation the temporary land take area would total 31.64 ha, consisting of construction staging areas (11.21 ha), haul roads (5.18 ha), borrow area (8.13 ha), and spoil disposal area (7.12 ha).[18]

193. The Project will result in permanent loss of 210 ha of land (**Table V.1**), with 51% by Yudai River rehabilitation and 49% by the five urban roads. The BRT would not need permanent land take since it will be constructed on the existing Jinggangshan Road. Existing land use is dominated by farmland consisting of paddy fields and dry cultivated land which account for 57% of permanent land lost. Farmland and woodland in the permanent land take areas would total approximately 140 ha, which would account for approximately 29% of the farmland and woodland areas in the 11.7 km^2 assessment area within the Western City Development Area (see Table IV.1). Man-made ponds and ditches account for approximately 7% of land take.

194. Approximately 20 ha of woodland will be permanently lost. As described in Chapter IV, the woodlands are dominated by common species of trees, shrubs and grassland. None of the habitats or associated species are protected except the Camphor Tree, which are representative species of broad-leaf evergreen woodland and which has national (Class II) protection, and some mature camphor trees are also deemed of physical cultural resource significance. The design of urban road alignments must avoid these trees. The design of urban roads and the riverside park must incorporate appropriate drainage and discharge options to minimize pollution impacts from surface run-off.

195. The creation of the riverside park presents an opportunity to create new wetland and woodland habitats. During the development of the preliminary design, a wetland ecologist was appointed by ADB to work with the Design Institute to review and strengthen the landscape proposals for the riverside park and river rehabilitation works. The proposals now integrate more of the existing habitat and landscape features and create more new habitats of ecological value for local flora and fauna and of benefit for water quality. The draft technical report is included in Appendix 2. The final technical report will be produced after completion of detailed design in early 2015

[18] Spoil disposal area will not be specifically established for this project, but will be a site designated by the Ji'an Cityscape Management Department for the storage, disposal and re-use of excavated materials from development projects in Ji'an.

Table V.1: Permanent Land Take Areas

Item			Land Type and Area (in ha)									
Component	Road	Section	Paddy Field	Dry Cultivated Land	Plantation	Woodland	Pond	Ditch	Grave Site	Residential Site	Road	Government Owned	Total Area (ha)
Urban Roads	Junhua Avenue	Jixiang West Road – Ji'an Avenue	12.500	3.137	0.053	2.943	3.169	0.162	0	3.800	0.382	22.586	48.731
	Bo'an Avenue	Jifu Road – Shaoshan West Road	6.356	0.838	0	2.040	1.113	0.087	0	1.928	0.212	0.181	12.755
	Shaoshan West Road	Jizhou Avenue – Bo'an Avenue	5.659	0.928	0	0.877	0.575	0.180	0	1.347	0.038	1.876	11.479
	Yangming West Road	Jizhou Avenue – Junhua Avenue	0	0	0	0	0	0	0	0	0	5.385	5.385
		Junhua Avenue – Bo'an Avenue	4.662	3.047	0	1.355	0.770	0.107	0	0.495	0.164	0.405	11.004
	Zhongshan West Road	Jizhou Avenue – Bo'an Avenue	2.266	1.104	0	2.566	0.418	0.003	0	1.267	0.092	5.230	12.945
BRT		Railway Station - Bo'an Avenue	0	0	0	0	0	0	0	0	0	0	0
Yudai River			73.929	5.072	0.219	10.483	4.521	3.784	0.198	1.257	1.787	6.884	108.133
		Total:	105.372	14.126	0.272	20.264	10.566	4.322	0.198	10.093	2.675	42.547	210.434
		Percentage of total:	50.1%	6.7%	0.1%	9.6%	5.0%	2.1%	0.1%	4.8%	1.3%	20.2%	100%

Note: The grave sites are not considered physical cultural resources and are addressed in the Resettlement Plan.

C. Measures during Detailed Design and Pre-construction

196. **Measures during detailed design.** The following environmental measures will permanently become part of the infrastructure and need to be included in the detailed design of facilities by the design institutes:

i. Technical design of roads must ensure public health and safety, promote non-motorized traffic, and incorporate universal design principles (usable by people with diverse abilities).
ii. Technical design of the road subgrade, pavement, road-side slopes, bridge structures and drainage system must consider adaptive measures to climate change such as increase in temperature and precipitation, and intensity and frequency of extreme weather events;
iii. Technical design of urban road alignments must avoid the old camphor trees at the three locations shown in Table IV.19 of this EIA.
iv. Technical design of urban road alignments must first endeavor to avoid camphor trees at locations shown in Figure IV.5 of this EIA. Where avoidance is not possible, transplant schemes for these trees must be detailed during the design stage.
v. Technical design of the flood control function of Yudai River must take into consideration extreme storm events due to climate change.
vi. Technical design of road drainage to ensure that drainage design and discharge locations minimize risk of pollution of rivers and waterbodies. Need for pollution interceptors and treatment should be considered.
vii. Technical design of embankments on the Yudai River must be adequate and stable enough to withstand the strong force of heavy storm water flow but at the same time maximize the adoption of eco-friendly soft engineered embankment designs.
viii. Design of the riverside park to retain and incorporate natural habitat features where possible, where not possible, compensate through creation of new habitats. Ecologist to review and provide specialist inputs into the detailed design of the riverside park.
ix. Design of the riverside park to ensure adequate provision of waste management facilities away from the river that provides options for waste segregation, recycling and reuse.
x. Design of the riverside park to provide drainage for car park and other areas of hard standing and ensure that attenuation and discharge points are appropriate.
xi. Specify species that are in keeping with local environment and are of local provenance.
xii. Specify energy efficient lighting and cooling/heating systems
xiii. Specify materials that are recycled, have recycled content or are from sustainable sources, particularly for street furniture and fixtures/fittings.

197. **Measures during pre-construction**. A number of environmental management measures will be implemented in the pre-construction phase to ensure project's environment management readiness. These include:

i. Institutional strengthening: including (a) appointment of one qualified environment specialist within the JPMO; (b) hiring of loan implementation environmental consultant (LIEC) within loan implementation consultant (LIC) services by the JPMO; (c) contracting of environmental monitoring station by JPMO to conduct environment quality monitoring; and (d) contracting of external environmental supervision engineer (ESE) by JPMO to conduct independent monitoring and verification of EMP implementation.

ii. Updating the EMP: Mitigation measures defined in this EMP will be updated based on final technical design. This will be the responsibility of the JPMO, using the local design institute and/or the LIEC.
iii. Land-take confirmation: The Resettlement Plan will be updated with final inventory. This will be the responsibility of JMUCIDC, using the local design institute.
iv. Contract documents: Environmental issues can potentially arise if the bidding documents are prepared without access to or use of this project EIA, particularly the EMP. As such, no bid documents will be prepared without the authors having incorporated a copy of the EMP (translated into Chinese), which shall be included in the safeguard clauses of the Technical Specifications in the contracts. This will be the responsibility of the JPMO with the support of the tender agent.
v. Contractors' method statements. Contractors shall prepare method statements for implementation of mitigation measures on construction sites. These method statements shall be submitted to the ESE and the LIEC for review and approval.
vi. Environmental protection training: The loan implementation consultant services (mainly but not exclusively through the LIEC) will provide training on implementation and supervision of environmental mitigation measures to contractors, the JPMO and JMUCIDC.

D. Impacts and Mitigation Measures during the Construction Stage

198. **Impact screening.** Potential impacts during road construction will include air quality, noise, water quality, solid waste and occupational health and safety. Potential air quality impacts could occur due to fugitive dust generated on the construction site from stockpiles of uncovered earth materials and vehicles travelling on unpaved haul roads; as well as fumes from asphalt mixing plants. The use of powered mechanical equipment (PME) during construction activities will generate noise. Construction activities will generate process wastewater and construction workers will produce wastewater. Construction works will produce construction and demolition (C&D) wastes including excavated earth materials. Workers will face occupational health and safety issues working on construction sites, such as during road paving when workers are near the asphalt mixing plant and exposed to fumes from the plant. These potential impacts are assessed and addressed below. Land contamination would not be an issue in this project since there has been no industrial activity within the construction footprint of the project roads.

199. The rehabilitation of Yudai River will involve dredging and embankment works. These activities will affect water quality, natural hydrological regimes and channel and bankside habitats and species. The storage and/or disposal of dredged sediment might cause secondary pollution at the storage/disposal sites depending on the sediment quality.

1. Impacts and Mitigation Measures on Physical Resources

200. **Air Quality.** Main air pollutants during the construction stage in this project include (i) fugitive emissions of dust during earth works, (ii) fumes from asphalt mixing during road paving and exhaust from movements of construction vehicles and machinery, and (iii) odor during dredging, transport and disposal of Yudai River sediment.

201. Based on testing results from similar road projects, the project EIR predicted that fugitive dust impact from the mixing of road sub-grade and paving materials, including asphalt, would be confined to within 300 m downwind of the mixing activities, and ambient air quality Class II standard would be achieved beyond 300 m. Fugitive dust during earth works, on

haul roads and from uncovered stockpiles was estimated to affect a downwind area of up to 50 m. Of the 32 sensitive receptors near the urban road alignments, 16 are located within 50 m of the alignments (see Table IV.4). Of the 13 sensitive receptors along the BRT corridor, 11 are located within 50 m of the corridor (see Table IV.3). Mitigation measures will be needed to suppress fugitive dust emission.

202. Asphalt paving will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH). Concrete batching for bridge structures will produce TSP. *Air Pollutant Integrated Emission Standard* (GB 16297-1996) controls the emission of air pollutants from these activities. Asphalt fumes generated during road paving would be considerably less than fumes generated during mixing, and once the paved asphalt is cooled to <82^{o} C, asphalt fumes would be reduced substantially and then totally when the asphalt is solidified. The impact from asphalt fumes during road paving is therefore of short duration. However, asphalt fumes could affect construction workers doing the road paving and personal protective equipment is needed for their occupational health and safety.

203. Odors emitted during sediment dredging, transportation and treatment could impact the surrounding environment. Odor intensity is classified based on odor threshold values. Odor intensity is classified into six levels based on international practice. The limitation criteria are generally equivalent to class 2.5-3.5 of odor intensity. Based on these criteria, the project EIR predicted that the odor impact area would be confined to within 30 m downwind of the odor source, such as the dredged sediment disposal site. There will not be any permanent dredged sediment disposal site for this project. The dredged sediment, which was shown based on baseline monitoring data to be uncontaminated, would be stored temporarily in low lying areas along the banks of Yudai River, then used for landscaping along Yudai River in this project. Of the six sensitive receptors identified for the Yudai River rehabilitation, none are located within 30 m of the river (see Table IV.5). The nearest one is 70 m from the river. No odor impact to these sensitive receptors during dredging and temporary storage of dredged sediment is expected.

204. The Contractor shall include all necessary mitigation measures to reduce air pollution and dust and odor development that would impact public health, by implementing the following air quality control measures. Some of these measures are generic measures that are applicable to all construction sites and construction activities. Yet these are effective measures and are also described in WBG's EHS guidelines.

- Provide dust masks to operating personnel;
- Spray water regularly on hauling and access roads(at least once a day) to suppress dust; and erect boarding around dusty activities;
- Minimize the storage time of construction and demolition wastes on site by regularly removing them off site;
- Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions. Additionally, site asphalt mixing stations at least 300 meters downwind of the nearest residential household;
- Mount protective canvasses on all trucks which transport material that could generate dust;
- Build access and hauling roads at sufficient distances from residential areas, particular, from local schools and hospitals;
- Assign haulage routes and schedules to avoid transport occurring in the central areas,

traffic intensive areas or residential areas. For the areas with high-demand on environmental quality, transport should be arranged at night.

- Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use;
- Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin;
- Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads;
- In periods of high wind, dust-generating operations shall not be permitted within 200 m of residential areas. Special precautions need to be applied in the vicinity of sensitive areas such as schools, kindergartens and hospitals;
- Equip material stockpiles and concrete mixing equipment with dust shrouds. For the earthwork management for backfill, measures will include surface press and periodical spraying and covering. The extra earth or dreg should be cleared from the project site in time to avoid long term stockpiling. The height of stockpiles should be less than 0.7m;
- To avoid odor impacts caused by channel cleaning, prior to dredging, transport the removed trash quickly to the local landfill. Transport of dredged sediments will be undertaken in closed tank wagons to prevent scattering along the way and impacting the urban area;
- Site temporary dredged sediment storage locations at least 50 m downwind of the nearest residential household;
- Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.

205. These measures are defined in the EMP. Contractors will be required to ensure compliance with relevant PRC emission standards. Air quality monitoring will be carried out by contractors (internal) and a licensed environmental monitoring entity (external) during the construction period.

206. The air quality impacts during the construction stage would be of short duration. Road construction and river dredging are linear activities. When a road section is constructed and paved, or a river section is dredged, the construction and dredging activities move on and away from nearby sensitive receptors. Potential sensitive receptors will therefore be exposed to short term, localized impacts. With the above mitigation measures in place, potential air quality impacts during the construction stage would be reduced to acceptable levels.

207. **Noise**. Noise is emitted by PME used during construction. Based on the cumulative power levels of PMEs used for different construction activities, the project EIR predicted that noise impact from both road construction and river dredging would affect a distance of 60 m in the day time (based on 70 dB(A) according to GB 12523-2001) and a distance of 200 m at night (based on 55 dB(A) according to GB 12523-2001) from the noise source. Of the 32 noise sensitive receptors identified (see Table IV.4) for the urban roads, 21 would be within 60 m of the proposed road alignments and would be affected by construction noise. Noise mitigation measures will be required and no night time construction shall be allowed. Eleven of the 13 sensitive receptors along the BRT corridor are within 50 m of the corridor and would be affected by construction noise. Contractors will be required to implement the following mitigation measures for construction activities to meet PRC construction site and

WBG recommended noise limits and to protect sensitive receptors. Some measures are generic and are applicable to all construction sites and activities. Yet they are effective measures and are also in line with WBG's EHS guidelines.

- During daytime construction, the contractor will ensure that: (i) noise levels from equipment and machinery conform to the PRC standard for Noise Limits for Construction Sites (GB12523-2011) and the WBG EHS Standards, and properly maintain machinery to minimize noise; (ii) equipment with high noise and high vibration are not used near village or township areas and only low noise machinery or the equipment with sound insulation is employed; (iii) sites for asphalt-mixing plants and similar activities will be located at least 300 m away from the nearest sensitive receptor; and (iii) temporary anti-noise barriers or hoardings will be installed around the equipment to shield residences when there are residences within 50 m of the noise source;
- For all the urban roads, there will be no night time (between 2200 and 0600 hours) construction;
- For the BRT corridor, night time construction shall be avoided. Yet, recognizing that construction (e.g. BRT stations) 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 on the BRT corridor if needed should prevent using high sound power level equipment and nearby residents should be notified of such night time activities well beforehand
- Regularly monitor noise at sensitive areas (refer to the monitoring plan). If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation;
- Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health protection law of the PRC;
- Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition;
- Limit the speed of vehicles travelling on site (less than 8 km/hr), forbid the use of horns unless absolutely necessary, minimize the use of whistles;
- Maintain continual communication with the villages and communities along the road alignments and Yudai River.

208. The World Bank Group's EHS guideline also provides the following guidance to mitigate noise and vibration impacts caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people during construction and decommissioning activities:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise and vibration are planned during periods of the day that will result in least disturbance;
- Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines; and
- Avoiding or minimizing project transportation through community areas.

209. Noise impacts during the construction stage would be of short duration. Road construction and river dredging are linear activities. When a road section is constructed and paved, or a river section is dredged, the construction and dredging activities move on and away from nearby sensitive receptors. Potential sensitive receptors will therefore be

exposed to short term, localized impacts. With the above mitigation measures in place, potential noise impacts during the construction stage would be reduced to acceptable levels.

210. **Water quality**. Uncontrolled wastewater and muddy runoff from construction sites and work camps could potentially pollute nearby water bodies and clog up drains. Construction of the foundations for the four bridges could disturb river sediment and increase suspended solid (SS) concentration in the Yudai River. Dredging in Yudai River will also disturb the bottom sediment and increase SS concentration in the water column.

211. Bridge foundation construction will be by bore piling. Barriers such as sand bags or earth bunds will be built to surround the piling locations to minimize the dispersion of SS. The EIR predicted that with such measures, the SS level at 100 m downstream of the piling location would not exceed 50 mg/L.

212. Dredging in the Yudai River will be done in the dry and during the dry season (between October to March the following year). Earth bunds will be constructed around the dredging location. The river flow will be diverted to outside the bunded area. The water within the bunded area will then be pumped out and the sediment will be removed using an excavator, similar to earth moving works on land. During water pumping, the slurry could contain high levels of SS estimated by the EIR to be approximately 300-400 mg/L, which would affect water quality downstream. Baseline sediment monitoring showed that the sediment was not contaminated and the impact would be confined to elevated SS levels downstream.

213. The contractors will implement the following mitigation measures to prevent water pollution:

- Portable toilets and small package wastewater treatment plants will be provided on construction sites 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;
- Sedimentation tanks will be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide (PAM) will be used to facilitate sedimentation;
- Construction of road bridge foundations will avoid the rainy season from May to October to minimize potential water quality impact. Mitigation measures such as placement of sandbags or berms around foundation works to contain muddy water runoff will be adopted. Slurry from pile drilling in the river bed will be pumped to shore and properly disposed of. This will reduce the disturbance of sediments and the impact on water quality. Pier construction in Yudai River will be planned and laid out to ensure adequate opening for water flow;
- Dredging in Yudai River will be done in the dry and during the dry season from October to March to minimize potential water quality impact. Sand bags or berms placed around the dredging area will be planned and laid out to ensure adequate opening for water flow;
- Construction machinery will be repaired and washed at designated locations. No onsite machine repair and washing shall be allowed;
- Storage and refueling facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces, and provided with bunds and cleanup kits;
- The contractors' fuel suppliers must be properly licensed, follow proper protocol for

transferring fuel, and must be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88);

- Material stockpiles will be protected against wind and runoff waters which might transport them to surface waters;
- Any spills are to be cleaned up according to PRC norms and codes within 24 hours of the occurrence, with contaminated soils and water treated according to PRC norms and codes. Records must be handed over without delay to the JPMO and JEPB;
- Mitigation of water quality impact during water pumping and sediment removal at each dredging location will be based on water quality monitoring results. The water quality monitoring approach at each dredging location will include one control station upstream of the location and one impact station downstream of the location. When the monitoring result shows that the SS level at the downstream impact station is 130% higher than that at the upstream control station, it is indicative of bottom sediment being stirred up and discharged downstream by water pumping or during sediment excavation. The contractor shall reduce the pumping or excavation rate and/or pump the slurry to a sedimentation pond first for settling of SS, until the downstream SS level is less than 130% above the upstream SS level;
- A similar monitoring approach will be adopted for mitigating water quality impact during road bridge construction, where upstream and downstream monitoring stations will be set up and SS levels monitored. When the SS levels at the downstream impact station is 130% higher than the SS levels at the upstream control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the downstream SS level is less than 130% above the upstream SS level.

214. **Solid waste and earth work**. Solid waste generated during construction will include C&D waste dominated by excavated spoil during earth works for the urban roads, embankment construction and dredged sediment from Yudai River as well as refuse generated by construction workers on construction sites. If not properly disposed, such wastes will create community health and sanitation problems.

215. Table V.2 shows the earth cut and fill quantities. The BRT component would not involve earth cut and fill. The earth cut quantity from urban road construction and Yudai River rehabilitation would total 5,550,320 m^3. Of this, 2,369,590 m^3 would be re-used on site for back fill. Of the remaining 3,180,730 m^3, 1,031,700 m^3 would be exported to other sites in this project for backfill. The remaining C&D waste of 2,149,030 m^3, which includes 52,800 m^3 of waste from demolition of buildings and structures, will be transported to a disposal site designated by the Ji'an Cityscape Management Department, who is responsible for the management of C&D waste disposal and re-use in the city. Since the C&D waste is common solid waste without toxic or harmful content, it can be used for filling and foundations of other construction works specified by the municipal and planning departments. Generally, C&D waste including disposal is not anticipated to have adverse environmental impacts.

Table V.2: Earth Cut and Fill Balance

Item		Earth Quantities (m^3)						Remark
		Cut (1)	On-site Re-use (2)	Excess (3) = (1-2)	Disposal (4)	Export (5) = (3-4)	Import [from (5)]	
Urban road	Bo'an Avenue	565,830	124,050	441,780	176,710	265,070		265,070 m^3 exported to Shaoshan West Road
	Zhongshan West Road	1,339,830	135,670	1,204,160	1,019,150	185,010		185,010 m^3 exported to Yudai River

Item		Earth Quantities (m^3)						Remark
		Cut (1)	On-site Re-use (2)	Excess (3) = (1-2)	Disposal (4)	Export (5) = (3-4)	Import [from (5)]	
	Shaoshan West Road	35,780	25,050	10,730	10,730		717,040	Imported from Bo'an Aveue, Yangming West Road and Junhua Avenue
	Yangming West Road	1,069,250	237,470	831,780	452,600	379,180		249,530 m^3 exported to Shaoshan West Road; 129,650 m^3 exported to Yudai River
	Junhua Avenue	2,172,740	1,590,530	582,210	379,770	202,440		202,440 m^3 exported to Shaoshan West Road
Yudai River	River channel	96,890	67,820	29,070	29,070		97,660	Imported from Zhongshan West Road and Yangming West Road
	Landscape	270,000	189,000	81,000	81,000		217,000	
Total:		**5,550,320**	**2,369,590**	**3,180,730**	**2,149,030**	**1,031,700**	**1,031,700**	

Source: Project EIR.

216. The dredged sediment totaling approximately 455,890 m^3 from the Yudai River will be temporarily stored in low lying areas within the permanent land take areas along the river banks for re-use in landscaping later. No dredged sediment will require permanent disposal and no dredged sediment disposal site is needed.

217. The following mitigation measures will be implemented to manage earthworks:

- Spoil disposal site management and restoration plans will be developed, to be approved by JEPB; a protocol will be established between the contractors and Ji'an Cityscape Management Department to clarify the spoil quantity and a permit for the clearance of excavated earthwork shall be obtained;
- Site restoration will follow the completion of works in full compliance with all applicable standards and specifications, and will be required before final acceptance and payment under the terms of contracts.

218. **Soil erosion**. Runoff from construction sites is one of the largest sources of sediment in urban areas under development. Soil erosion removes over 90% of sediment by tonnage in construction of urban areas. If uncontrolled, eroded sediment from construction sites creates many problems, including adverse impacts on water quality, navigation (Gan River) and recreational activities. Table V.3 shows that the estimated soil erosion from this project would total 35,860 t, with 26,291 t directly contributed by the project.

Table V.3: Soil Erosion during the Construction Stage

Project Site	Soil Erosion Quantity (t)					
	Background		Predicted		Total	
	Pre-construction & Construction	Recovery	Pre-construction & Construction	Recovery	Pre-construction & Construction	Recovery
Permanent land take sites	3209.62	5349.36	7972.27	13287.12	11181.89	18636.48
Temporary staging areas	140.57	234.29	666.55	1110.91	807.12	1345.20
Haul roads	55.32	92.20	305.21	508.68	360.53	600.88
Borrow areas	97.56	162.60	487.80	813.00	585.36	975.60

Project Site	Soil Erosion Quantity (t)					
	Background		Predicted		Total	
	Pre-construction & Construction	Recovery	Pre-construction & Construction	Recovery	Pre-construction & Construction	Recovery
Spoil disposal sites	85.44	142.40	427.20	712.00	512.64	854.40
Subtotal:	3588.51	5980.85	9859.03	16431.71	13447.54	22412.56
Total	9569.36		26290.74		35860.10	

Source: SWCR.

219. Soil erosion protection measures including engineering, planting and temporary measures as agreed in the SWCR are presented in Table V.4. These measures have been incorporated into the EMP and will be included as contractual obligations for contractors. The most effective erosion control will be interception drainage to protect disturbed surfaces from surface flows, and sedimentation ponds to remove silt and sand from construction site runoff.

Table V.4: Soil Erosion Protection Measures

Project Site	Engineering Measure	Planting Measure	Temporary Measure
Permanent land take sites	Top soil back fill		Store stripped top soil for site restoration Drainage ditches Sedimentation ponds
Temporary staging areas	Site levelling of 11.21 ha Top soil back fill 22,420 m^3	Grass seeding of 11.21 ha	835 m of drainage ditches 20 sedimentation ponds
Haul roads	Site levelling of 5.18 ha Top soil back fill 10,360 m^3	Grass seeding of 5.18 ha	569 m of drainage ditches 15 sedimentation ponds
Borrow areas	270 m of intercepting drainage ditch on hill side slope upgradient of the borrow area Site leveling of 8.13 ha Top soil back fill 24,390 m^3 9 sedimentation ponds	Planting of 1,700 trees for site restoration Grass seeding of 8.13 ha	Top soil stripping of 24,390 m^3 312 m earthen-bag retaining wall Tarpaulin cover of 6,097.5 m^2
Spoil disposal sites	253 m of intercepting drainage ditch Site leveling of 7.12 ha Top soil back fill of 21,360 m^3 8 sedimentation ponds	Planting of 1,500 trees for site restoration Grass seeding of 7.12 ha	Top soil stripping of 21,360 m^3 292 m earthen-bag retaining wall Tarpaulin cover of 5,340 m^2

Source: SWCR.

2. Impacts and Mitigation on Biological Resources, Ecology and Biodiversity

220. **Vegetation**. This project will result in permanent loss of vegetation and habitats from approximately 210 ha of land and temporary loss from 32 ha of land. Temporary land take areas will be re-vegetated and landscaped after completion of construction works. The project sites for the BRT corridor and the Ji'an Railway Station Square are in the central urban area with no biological resources of significance. The project sites for the five urban roads and Yudai River rehabilitation are in a suburban-rural setting that has been under

human influence and disturbance. The vegetation and habitats that will be lost from these sites are dominated by farmland and secondary woodlands (see Table V.1). The vegetation survey undertaken for this project and described in Chapter IV indicates that the woodlands were dominated by common tree, shrub and grass species. Review of national, provincial and IUCN protection status of these species showed that the Camphor Tree (*Cinnamomum camphora*) is the only protected species (national Class II). Old camphor trees, which could be deemed as physical cultural resource of significance, were recorded at three locations, with one location situated on the proposed Junhua Avenue alignment. The EMP specifies that these trees must be protected and that the detailed design of all urban roads must avoid all old camphor trees. For other camphor trees which were recorded at three other locations, avoidance shall be the first principle during detailed design of the urban road alignments, followed by transplant if avoidance is found to be not possible.

221. The project will result in the direct loss of approximately 20ha of secondary woodland. This project will provide approximately 1.18 million m^2 (118 ha) of green landscaped areas along the Yudai River. A wetland ecologist worked with the Design Institute to review and strengthen the landscape proposals for the riverside park and river rehabilitation works. The proposals now integrate more of the existing habitat and landscape features and create more new habitats of ecological value for local flora and fauna and of benefit for water quality. The draft technical report is included in Appendix 2. The final technical report will be produced after completion of detailed design in early 2015.

222. **Dredging**. River dredging will affect aquatic and benthic organisms inhabiting these rivers. Aquatic organisms include phytoplankton dominated by green algae and diatoms; zooplankton dominated by protozoa, rotifers, cladorcerans and copepods. Benthic organisms are dominated by annelid worms, small clams and snails, and chironomid larvae. Fish include pollution-tolerant species of carps, minnows and loaches, and other cultured species. These are ubiquitous organisms with no significant conservation value and dredging works would not have irreversible impacts on their population dynamics and community structure. Upon completion of dredging works, these communities should be able to recover. Benthic communities will recolonize the riverbed. Impact is therefore temporary. Future communities would benefit from better water and sediment quality.

223. **Protected species**. The Yellow-Breasted Bunting (IUCN: Endangered), according to the *Catalog of Life China 2013*, occurs in over 20 provinces in the PRC. There is no nationally protected species other than the camphor tree. Two amphibian species, four reptile species, one mammal species and 16 bird species are on the provincial protection list. No endangered species was recorded during field surveys or from literature within the project area of influence. A more detailed ecology study was carried out to inform the project landscape proposals to ensure that they are responsive to habitat requirements of species of conservation value. The EMP will specify that the construction workers are prohibited from capturing wildlife from the project sites during the construction stage.

224. **Protected area**. There is no protected area within the project area of influence.

225. **Critical, natural and modified habitats**. In view of the common and wide distribution of the habitats recorded in the area, there is no habitat within the project area of influence that is critical to any of these species. The natural woodlands are secondary woodlands dominated by common species with the exception of one tree species, the Camphor Tree, which is under national class II protection, and there is no primary woodland in the project

area of influence. Modified habitats in the project area of influence are dominated by farmland, especially paddy fields, followed by constructed land for village inhabitants and municipal public facilities.

3. Impact and Mitigation on Socio-economic Resources

226. **Land acquisition and resettlement**. Land acquisition will total 199.4 ha, affecting 1,742 households and 6,789 people. The acquisition of government owned land will affect 14 government agencies and enterprises, including 188 employees.

227. Rural house demolition will total 70,682 m^2, affecting 184 households and 806 people. Urban house demolition will total 9178 m^2, affecting 90 households and 360 people. Enterprise house will total 14,795 m^2. Compensation will be in accordance with the Resettlement Plan and ADB SPS (2009) requirement.

228. **Physical cultural resources**. Should buried artifacts of archaeological significance be uncovered during the construction stage within the project areas, construction will be stopped and immediately reported to the Ji'an Cultural Bureau in accordance with PRC's *Cultural Relics Protection Law*.

229. Old camphor trees were recorded at three locations (see Table IV.19) with one location on the proposed alignment of Junhua Avenue. Mitigation measures will include (i) avoiding these trees during the detailed design of all urban road alignments, and (ii) tagging, marking and fencing off all old camphor trees before commencement of construction to prevent damages to these trees by construction activities.

230. **Occupational Health and Safety**. Due to its nature the construction industry is considered to be one of the most hazardous industries where a number of potentially hazardous operations are carried out. The civil works contractors will implement adequate precautions to protect the health and safety of construction workers. Contractors will manage occupational health and safety risks by applying the following measures:

- Construction site sanitation: (i) Each contractor shall provide adequate and functional systems for sanitary conditions, toilet facilities, waste management, labor dormitories and cooking facilities. Effectively clean and disinfect the site. During site formation, spray with phenolated water for disinfection. Disinfect toilets and refuse piles and timely removal of solid waste; (ii) Exterminate rodents on site at least once every 3 months, and exterminate mosquitoes and flies at least twice each year; (iii) Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and appoint designated staff responsible for cleaning and disinfection; (iv) Work camp wastewater shall be discharged into the municipal sewer system or treated on-site using a portable system.
- Occupational safety: (i) Provide personal protective equipment (safety hats and shoes and high visibility vests) to all construction workers; (ii) Provide safety goggles and respiratory masks to workers doing asphalt road paving; (iii) Provide ear plugs to workers operating and working near noisy PME.
- Food safety: (i) Inspect and supervise food hygiene in canteen on site regularly. Canteen workers must have valid health permits. If food poisoning is discovered, implement effective control measures immediately to prevent it from spreading.
- Disease prevention, health services: The following disease prevention measures and

health services will be undertaken: (i) All contracted labor shall undergo a medical examination which should form the basis of an (obligatory) health/accident insurance and welfare provisions to be included in the work contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged; (ii) Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents; (iii) Specify (by the IA and contractors) the person responsible for health and epidemic prevention and education and training on food hygiene and disease prevention to raise the awareness of workers.

- Social conflict prevention: No major social risks and/or vulnerabilities are anticipated as a result of the project. The project construction workers will be engaged locally. Civil works contracts will stipulate priorities to (i) employ local people for works, (ii) ensure equal opportunities for women and men, (iii) pay equal wages for work of equal value, and to pay women's wages directly to them; and (iv) not employ child or forced labor.

231. **Community Health and Safety**. Temporary traffic diversions, continual generation of noise and dust on hauling routes, and general hindrance to local accesses and services are common impacts associated with construction works within or nearby local settlements.

232. The project may also contribute to road accidents, for example, through the use of heavy machinery on existing roads and temporarily blocking pavements for pedestrians. Although new urban roads are being constructed in the Western City Development Area, the existing roads in the area are predominantly narrow rural roads and heavy construction traffic and large dump trucks travelling on these rural roads and through villages with pedestrians and no side walk would cause traffic congestion and risk of accidents. The potential impacts on community health and safety will be mitigated through a number of activities defined in the EMP.

233. The contractors will implement the following measures:

- Traffic management: A traffic control and operation plan will be prepared together with the Ji'an traffic police prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning in advance.
- Information disclosure: Residents and businesses will be informed in advance through media of the road improvement activities, given the dates and duration of expected disruption.
- Construction sites: Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues. Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night. All sites will be made secure, discouraging access by members of the public through appropriate fencing, signage and/or security personnel, as appropriate.

234. **Utilities provision interruption.** Construction may require relocation of municipal utilities such as power, water, communication cables. Temporary suspension of services (planned or accidental) can affect the economy, industries, businesses and residents' daily life. **Mitigation** of impacts on utilities provision will be through a number of activities defined

in the EMP, to be incorporated in the tender documents and construction contracts:

- Contractors will assess construction locations in advance for potential disruption to services and identify risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities is subject to full compensation, at the full liability of the contractor who caused the problem.
- If temporary disruption is unavoidable the contractor will, in collaboration with relevant local authorities such as power company, water supply company and communication company, develop a plan to minimize the disruption and communicate the dates and duration in advance to affected persons.
- Construction billboards, which include construction contents, schedule, responsible person and complaint phone number, will be erected at each construction site.

E. Impacts and Mitigation Measures during the Operation Stage

235. **Impact screening.** Operation of the BRT corridor and the five urban roads will have potential impacts on physical resources such as air quality and noise; socio-economic conditions such as public safety due to traffic accidents and climate change resilience (river rehabilitation) and mitigation (BRT and improvements for non-motorized modes).

236. Main impacts to air quality will be from the exhaust emitted by motor vehicles travelling on the project roads. Air pollutants in the exhaust include NO_2, CO, hydrocarbon (HC) and PM. Of these, the critical air pollutant is NO_2, meaning that if NO_2 complies with the applicable standard, other pollutants such as CO, HC and PM should also comply with their respective standards. Vehicle exhaust emissions contain GHGs which contribute to climate change. Noise impacts are due to traffic noise from vehicles travelling on the roads. Runoff from the roads into the road drainage system during rainfall could potentially affect the water quality of the receiving water bodies. Traffic accidents on roads and bridges have social issues related to public safety. These potential impacts are assessed and addressed below.

237. Operation and maintenance of the Yudai River and park would not generate adverse environmental impact, other than vegetation refuse from maintenance of the landscaped areas and general refuse from people using the park. The park will have a refuse collection station where green waste (vegetation refuse) will be separated from general refuse. General refuse will be transported to municipal landfill for disposal. Green waste will be transported to a planned composting facility in Ji'an, which will have a treatment capacity of 500 t/d for composting food waste and green waste with electricity generation. This planned facility is at the site selection stage and will be tendered using the built-operate-transfer mechanism. Flood control measures will improve the Yudai River flow, which only constitute a minute portion of the Gan River flow and should have no impact on the latter.

238. Operation of the project components would not have adverse impacts on biological resources, ecology and biodiversity, and physical cultural resource and may have some benefits if opportunities to create new habitats are maximised during detailed design. The EMP requires urban road drainage design to include interceptors and sand traps for treating road runoff discharging into the Yudai River during storm events.

1. Impacts and mitigation relating to operation of the BRT

239. Air quality. Table V.5 presents the air quality modeling results for NO_2 and CO in the project EIR based on day time peak hour traffic flow in 2030, compared with GB 3095-2012 Class II standards. Both with and without BRT scenarios were modelled. The data showed that (i) NO_2 compliance would be achieved within 35 m of the road red line, (ii) CO compliance would be achieved at the road red line, (iii) both NO_2 and CO concentrations with the BRT scenario are lower than the respective concentrations without the BRT scenario. The modeling results demonstrate air quality improvement in terms of motor vehicle emissions with the implementation of BRT.

Table V.5: Dispersion of Air Pollutants along the BRT Corridor in 2030

Distance from Road Red Line (m)	1-hr Average Concentration (mg/m^3)			
	NO_2		CO	
	With BRT	No BRT	With BRT	No BRT
5	0.360	0.474	3.875	4.563
10	0.307	0.361	2.954	3.477
35	0.145	0.161	1.320	1.554
50	0.108	0.125	1.023	1.205
100	0.060	0.069	0.566	0.666
GB 3095-2012 Class II Standard	0.2		10	

Note: data represented the highest concentration among 5 wind directions
Source: Project EIR

240. **Noise**. Motor vehicles travelling on project roads will generate traffic noise. Table V.6 shows traffic noise modeling results for the BRT corridor in 2030 presented in the project EIR. According to the noise functional area classification in PRC's *Environmental Quality Standard for Noise* (GB 3096-2008), the area within 35 m from the road's red line is classified as Functional Area Category 4a with day time and night time noise limits of 70 dB(A) and 55 dB(A) respectively; while the area between 35 m to 200 m from the road's red line is classified as Functional Area Category 2, with day time and night time noise limits of 60 dB(A) and 50 dB(A) respectively.

241. Table V.6 shows that road traffic noise would increase substantially in 2030 compared to the existing condition due to traffic growth. All sensitive receptors within 35 m from the road red line would experience noise exceedance in both day time and night time. Most of the sensitive receptors beyond 35 m from the road red line would also experience noise exceedance, especially at night.

242. The project EIR compared the effectiveness and costs of various noise mitigation measures, including direct measures (at the source) such as building noise barriers and tree planting as noise buffer, and indirect measures (at the receptor) such as installation of double-glazed windows. Such comparison is shown in Table V.7.

Table V.6: Predicted Noise Levels at Existing Sensitive Receptors during Operation of the BRT in 2030

No.	Sensitive Receptor	Existing Noise Level (dB)		Noise Function Area Category 4a			Noise Functional Area Category 2		
				Distance of First Row from Red Line (m)	Peak Hour Noise Level (dB)		Distance of First Row from Red Line (m)	Peak Hour Noise Level (dB)	
		Day Time	Night Time		Day Time	Night Time		Day Time	Night Time
1	Luozhou Village	50.0	44.7	30	71.7	63.8	40	56.9	49.7
2	Beimen Village	50.0	44.7				40	71.0	63.1
3	Jinggangshan University Affiliated Hospital	50.0	44.7				10	59.0	51.5
4	Ji'an City Center People's Hospital	50.0	44.7				10	59.0	51.5
5	Guangfeng Village	50.0	44.7				50	70.4	62.5
6	Taqian Village	50.0	44.7	20	72.5	64.5	30	56.5	50.2
7	Jiangjiafang	50.0	44.7	10	73.4	65.5	20	57.5	50.7
8	Xinfeng Village	50.0	44.7	10	73.4	65.5	20	57.5	50.7
9	Dianqian Village	50.0	44.7				50	70.4	62.5
10	Lijia Village	50.0	44.7				70	69.5	61.5
11	Dingjia Village	50.0	44.7				80	69.0	61.1
12	Nankeng Village	50.0	44.7	20	72.5	64.5	30	57.5	50.2
13	Jinggangshan National Economic Development Zone Management Committee	50.0	44.7	20	72.5	64.5	100	55.8	48.7
GB 3096-2008 standard					**70**	**55**		**60**	**50**

Note:

exceed the standard Peak hour day time = 07:00-09:00 and 17:00-19:00 Peak hour night time = 22:00-24:00

Source: Project EIR

Table V.7: Comparison of Noise Mitigation Measures

Measure	Suitability	Noise Reduction	Cost Estimate	Pros	Cons
Noise barrier	Concentrated sensitive receptors near carriageway and with serious exceedance	5 – 12 dB(A)	CNY500-2000/m depending on material, barrier height and structural form	Effective with wide applicability and easy implementation	Expensive and has visual impact
Wall	Low rise sensitive receptors near carriageway with slight exceedance	3 – 5 dB(A)	CNY300-400/m	Moderately effective and lower cost	Limited noise reduction and suitability
Double glazed window	Scattered sensitive receptors farther away from carriageway and with serious exceedance	6 – 15 dB(A)	CNY300-400/m^2	Effective with moderate cost, good suitability with little impact on residents	No ventilation. Sometimes difficult to implement especially in villages
Ventilated double glazed window	Scattered sensitive receptors farther away from carriageway and with serious exceedance	8 – 20 dB(A)	CNY400-500/m^2	Effective, reduces noise and provides ventilation at the same time, moderate cost	Sometimes difficult to implement especially in villages.
Noise reduction woodland buffer	Concentrated sensitive receptors with minor exceedance	20 m wide buffer could reduce 2 – 3 dB(A)	CNY200-500/m	Reduces noise and at the same time provides landscape	Application limited due to large land take and small noise reduction
Resettlement	Sensitive receptors near carriageway and with serious exceedance that cannot be mitigated with other measures	No longer relevant	Depends on local conditions	Completely solve the noise problem	Relatively high cost with potential impact to residents from relocation.

Source: Project EIR.

243. Based on the degree of noise exceedance, the proposed noise mitigation measures are presented in Table V.8, consisting of installation of both regular and ventilated double glazed windows, and planting of woodland buffer. The total cost for implementing these measures was estimated at approximately $140,000.

Table V.8: Operational Noise Mitigation Measures for Existing Sensitive Receptors along the BRT Corridor

No.	Sensitive Receptor	Mitigation Measure	Noise Reduction [dB(A)]	Estimated Cost
1	Luochuan Village	Install ventilated double glazed window for 10 households (100 m^2)	Up to 15	CNY 50,000
2	Beimen Village	Install ventilated double glazed window for 50 households (500 m^2)	Up to 15	CNY 250,000
3	Ji'an City Center People's Hospital	Install double glazed window for the road facing facade (150 m^2)	Up to 15	CNY 60,000
4	Guangfeng Village	Install ventilated double glazed window for 10 households (100 m^2)	Up to 15	CNY 50,000
5	Taqian Village	Install ventilated double glazed window for 20 households (130 m^2)	Up to 15	CNY 65,000
6	Jiangjiafang Village	Install ventilated double glazed window for 15 households (100 m^2)	Up to 15	CNY 50,000
7	Xinfeng Village	Install ventilated double glazed window for 10 households	Up to 15	CNY 40,000

No.	Sensitive Receptor	Mitigation Measure	Noise Reduction [dB(A)]	Estimated Cost
		(80 m^2)		
8	Dianqian Village	Install ventilated double glazed window for 10 households (80 m^2)	Up to 15	CNY 40,000
9	Lijia Village	Install ventilated double glazed window for 18 households (180 m^2)	Up to 15	CNY 90,000
10	Dingjia Village	Install ventilated double glazed window for 10 households (80 m^2)	Up to 15	CNY 40,000
11	Nankeng Village	Install ventilated double glazed window for 5 households (50 m^2)	Up to 15	CNY 25,000
12	Jinggangshan National Economic Development Zone Management Committee	Plant 5-m wide woodland buffer (10-m long)	Up to 3	CNY 5,000
Total:		Double glazed window: 1 location, 150 m^2 Ventilated double glazed window: 10 locations, 1,400 m^2 5-m wide woodland buffer: 1 location, 10 m	3 - 15	CNY855,000 [=$139,251]

Source: Project EIR.

2. Impact and Mitigation on Operation of the Urban Roads

244. **Air quality**. Table V.9 presents the air quality modeling results for NO_2 and CO in the project EIR based on day time peak hour traffic flow in 2030, compared with GB 3095-2012 Class II standards. The data showed that CO would comply with the Class II standard at the road red line on all urban roads. NO_2, however, would exceed the Class II standard within approximately 20 m from the road red line on Junhua Avenue and within approximately 15 m from the road red line on Yangming West Road. The other three urban roads would achieve NO_2 compliance at the road red line.

245. Based on these modeling results, it is recommended that future developments along Junhua Avenue should have a buffer distance of 20 m from the road red line, and future developments along Yangming West Road should have a buffer distance of 15 m from the road red line.

Table V.9: Dispersion of Air Pollutants along the Urban Roads in 2030

Distance from Road Red Line (m)	1-hr Average Concentration (mg/m^3) on Urban Roads									
	NO_2					CO				
	Junhua Avenue	Bo'an Avenue	Shaoshan West Road	Yangming West Road	Zhongshan West Road	Junhua Avenue	Bo'an Avenue	Shaoshan West Road	Yangming West Road	Zhongshan West Road
5	0.360	0.052	0.128	0.271	0.175	3.453	0.447	1.089	1.981	1.458
10	0.307	0.048	0.119	0.231	0.162	2.631	0.384	0.935	1.702	1.252
35	0.145	0.022	0.054	0.109	0.074	1.176	0.189	0.461	0.838	0.616
50	0.108	0.017	0.041	0.081	0.056	0.912	0.144	0.350	0.638	0.469
100	0.060	0.009	0.023	0.045	0.031	0.504	0.079	0.193	0.351	0.259
GB 3095 - 2012 Class II Standard	0.2					10				

Note: data represented the highest concentration among 5 wind directions.
Source: Project EIR.

246. **Noise**. Table V.10 shows traffic noise modeling results for the five urban roads presented in the project EIR for 2020. Based on the WBG EHS guideline of no more than 3 dB(A) noise level increase due to project implementation compared to the existing noise level, only four existing sensitive receptors would meet such requirement. These are the Ji'an City Drug Rehabilitation Institution, Shihuling Village, Shiliwangjia and Chaobailing Village. Of the other 28 existing sensitive receptors, 15 show noise level increases between 5 to 10 dB(A) and 10 show noise level increases more than 10 dB(A). The highest noise level increase was predicted to occur at Dujiafang Village, with 16.0 dB(A) during peak hour in the day time and 17.7 dB(A) during peak hour at night.

247. According to the planning EIR, the ***Conceptual Plan and Controlled Plan of Ji'an Western City Development Area*** has allocated 11 parcels of land within the development area for the resettlement of all existing residents during the urbanization process of the Western City Development Area, including the population from the 32 existing sensitive receptors shown in Table V.10. However the timing is not yet determined. This EIA and EMP therefore requires interim mitigation measures of installation of ventilated double glazed windows for the first row of buildings facing the new urban roads at the 28 existing sensitive receptors with noise level increases of >3dB(A) compared to the existing noise levels, if their resettlement does not occur in or before year 2020. The total cost for implementing these measures was estimated at approximately $140,000.

Table V.10: Predicted Noise Levels at Existing Sensitive Receptors during Operation of Urban Roads in Western City Development Area in 2020

No.	Sensitive Receptor	Relative to Proposed Road	Existing Noise Level [dB(A)]		Year 2020 Predicted Peak Hour Noise Level [dB(A)]			Increase over Existing Noise Level [dB(A)]	
			Day Time	Night Time	First Row Distance from Red Line (m)	Day Time	Night Time	Day Time	Night Time
1	Dujiafang Village	Junhua Ave K5+060 L	46.2	41.3	10	62.2	59.0	16.0	17.7
		Yangming West Rd K1+140 R	46.2	41.3	111	52.5	48.5	6.3	7.2
2	Laoyangjia Village	Junhua Ave K0+820 L&R	48.2	44.9	6	58.0	54.1	9.8	9.2
3	Zengjia Village	Junhua Ave K1+380 L	45.1	42.0	120	55.4	52.4	10.3	10.4
4	Jiaojialing Village	Junhua Ave K2+740 L&R	45.1	42.0	6	55.7	52.8	10.6	10.8
5	Ji'an City Health College	Junhua Ave K3+300 R	53.0	48.1	11	61.4	56.5	8.4	8.4
6	Baiyunshan Village	Junhua Ave K3+540 L	45.1	42.0	102	55.0	50.3	9.9	8.3
7	Baitang Village Xuanshang Village Group	Junhua Ave K4+320 R	46.2	41.3	97	55.3	50.3	9.1	9.0
8	Zhaojiashan	Junhua Ave K5+160 R	48.6	42.8	132	54.1	49.3	5.5	6.5
9	Zhoujiapi	Junhua Ave K6+320 L	48.6	42.8	98	55.7	51.4	7.1	8.6
10	Ji'an City Drug Rehabilitation Institution	Junhua Ave K7+960 R	51.8	48.3	87	54.9	50.8	3.1	2.5
11	Shihuling Village	Junhua Ave K8+600 L&R	51.8	48.3	102	52.5	48.6	0.7	0.3
12	Nan'an Village	Yangming West Rd K2+220 R	47.5	41.5	9	61.4	56.4	13.9	14.9
13	Dongtou Village	Yangming West Rd K2+680 L&R	46.8	40.7	4	62.0	57.0	15.2	16.3
14	Jiangbian Village	Bo'an Ave K3+000 L	46.2	41.3	28	54.0	48.5	7.8	7.2
		Shaoshan West Rd K2+986	46.2	41.3	95	55.5	50.7	9.3	9.4
15	Renjia Village	Bo'an Ave K2+740 R	48.2	44.9	55	52.0	47.5	3.8	2.6
16	Luogang Village	Bo'an Ave K2+740 L	48.2	44.9	10	52.6	49.1	4.4	4.2
17	Chengshang Village	Bo'an Ave K2+220 L	45.1	42.0	10	55.1	49.8	10.0	7.8
18	Maobei Village	Bo'an Ave K1+696 R	48.1	45.1	13	57.4	53.1	9.3	8.0
19	Luotang Village	Bo'an Ave K0+800 L	46.2	41.3	39	52.0	46.5	5.8	5.2
		Zhongshan West Rd K3+337	52.8	46.5	56	56.3	50.5	3.5	4.0
20	Shiliwangjia	Zhongshan West Rd K2+740 R	56.2	49.3	80	58.0	51.5	1.8	2.2
21	Chaobailing Village	Zhongshan West Rd K2+620 L	56.2	49.3	45	57.2	50.6	1.0	1.3
22	Pengxia Village	Zhongshan West Rd K1+605 L	47.5	41.5	41	53.0	47.3	5.5	5.8
23	Baitang Primary School	Zhongshan West Rd K0+880	47.5	41.5	36	54.2	48.6	6.7	7.1

No.	Sensitive Receptor	Relative to Proposed Road	Existing Noise Level [dB(A)]		Year 2020 Predicted Peak Hour Noise Level [dB(A)]			Increase over Existing Noise Level [dB(A)]	
			Day Time	Night Time	First Row Distance from Red Line (m)	Day Time	Night Time	Day Time	Night Time
		R							
24	Anqian Old Village	Zhongshan West Rd K0+724 R	50.4	42.7	3	60.5	54.7	10.1	12.0
25	Anqian New Village	Zhongshan West Rd K0+220 R	50.4	42.7	4	60.3	54.6	9.9	11.9
26	Ji'an City Disease Prevention and Control Center	Zhongshan West Rd K0+060 R	48.4	45.2	15	59.1	54.6	10.7	9.4
27	Yangminghuayuan	Zhongshan West Rd K0+420 L&R	48.4	45.2	5	60.4	56.0	12.0	10.8
28	Baitang Village	Shaoshan West Rd K0+220 R	55.2	50.8	6	61.0	56.5	5.8	5.7
29	Jinluhuayuan	Shaoshan West Rd K0+240 L	55.2	50.8	4	60.2	55.1	5.0	4.3
30	Wuli Village Zoujia Village Group	Shaoshan West Rd K0+600 L&R	48.3	42.5	5	59.0	53.5	10.7	11.0
31	Wuli Primary School	Shaoshan West Rd K0+400 R	48.3	42.5	80	54.0	48.4	5.7	5.9
32	Xiazhou Village	Shaoshan West Rd K1+640 L	48.3	42.5	126	52.2	46.5	3.9	4.0

Notes:

>3-5 dB(A) increase

>5-10 dB(A) increas

>10 dB(A) increase

Source: Project EIR

248. To prevent road traffic noise from affecting future residents and sensitive uses, mitigation requirements for future developments near these urban roads in the Western City Development Area are listed in Table V.11. These requirements are based on predicted 2030 traffic noise levels and are aimed at the first row of buildings facing these roads, including provision of adequate buffer distance and/or double glazed windows.

Table V.11: Mitigation Requirements for Future Developments Near the Urban Roads in the Western City Development Area

Road	Time Period	Compliance Distance from Road Red Line Noise Functional Area Category 4a Within 35 m from road red line Day time noise limit: 70 dB Night time noise limit: 55 dB	Category 2 Beyond 35 m from road red line Day time noise limit 60 dB Nigh time noise limit: 50 dB	Mitigation for Road Facing Facade
Junhua Avenue	Day	Compliance at road red line	78 m	• No health facility within 35 m from road red line • First row of residential and school buildings within 35 m of road red line shall be fitted with double-glazed windows • First row of residential, school and health facility buildings beyond 35 m from road red line shall be fitted with double-glazed windows if they have a direct line of sight to the road
	Night	No compliance within 35 m	400 m	
Bo'an Avenue	Day	Compliance at road red line	Compliance within 35 m	• First row of residential, school and health facility buildings within 35 m of road red line shall be fitted with double-glazed windows • First row of residential, school and health facility buildings between 35 - 65 m from road red line shall be fitted with double-glazed windows if they have a direct line of site to the road
	Night	3 m	65 m	
Shaoshan West Road	Day	Compliance at road red line	Compliance within 35 m	• No health facility within 10 m from road red line • First row of residential buildings within 10 m of road red line shall be fitted with double-glazed windows • First row of residential and health facility buildings between 35 - 65 m from road red line shall be fitted with double-glazed windows if
	Night	10 m	65 m	

Road	Time Period	Compliance Distance from Road Red Line Noise Functional Area Category 4a Within 35 m from road red line Day time noise limit: 70 dB Night time noise limit: 55 dB	Category 2 Beyond 35 m from road red line Day time noise limit 60 dB Nigh time noise limit: 50 dB	Mitigation for Road Facing Facade
				they have a direct line of site to the road
Yangming West Road	Day	Compliance at road red line	45 m	• No health facility within 35 m from road red line • First row of residential and school buildings within 35 m of road red line shall be fitted with double-glazed windows
	Night	No compliance within 35 m	300 m	• First row of residential, school and health facility buildings beyond 35 m from road red line shall be fitted with double-glazed windows if they have a direct line of sight to the road
Zhongshan West Road	Day	Compliance at road red line	Compliance within 35 m	• No health facility within 15 m from road red line • First row of residential buildings within 15 m of road red line shall be fitted with double-glazed windows
	Night	15 m	110 m	• First row of residential and health facility buildings between 35 - 65 m from road red line shall be fitted with double-glazed windows if they have a direct line of site to the road

Source: Project EIR and PPTA consultant.

3. Greenhouse Gas Emissions

249. The project EIR calculated carbon emissions for 2013, 2020 and 2030 using the methodology described in IPCC (2006),[19] based on fuel consumption from traveling distances of various vehicle types on the project roads. Table V.12 presents the results, indicating emissions from all the project roads in 2030 would total 94,759 t CO_2 equivalent. This is below the ADB threshold of 100,000 t/a. In addition, Table V.13 shows that implementation of BRT would reduce carbon emissions by 11,000 t in 2030 compared to the no BRT scenario.

[19] IPCC. 2006. 2006 IPCC guidelines for national greenhouse gas inventories. This is based on the current PRC fuel standards, more stringent standards in the future or more advanced fuel technologies may reduce GHG emissions futher. This represents the worst case.

Table V.12: Carbon Emissions from the Proposed Urban Roads and BRT Corridor

Project Roads	Carbon Emission (CO_{2eq} in t/a) in Various Years		
	2013	2020	2030
Urban roads:			
Junhua Avenue	---	6362	18656
Bo'an Avenue	---	363	992
Shaoshan West Road	---	941	2294
Yangming West Road	---	1381	2516
Zhongshan West Road	---	1807	3319
Urban roads sub-total	---	10854	27777
BRT:			
No BRT	20103	67254	77982
With BRT	---	61302	66982
Project roads total:			
No BRT	20103	78108	105759
With BRT	---	72156	94759
BRT contribution to carbon emission	---	(5952)	(11000)

Source: Project EIR.

4. Climate Change Impacts

250. A detailed climate risk and vulnerability assessment was carried out in October 2014. The projections indicate that:

- There could be an average increase in rainfall of 1.5 to 4.5% by 2050 and 3 to 9% by 2100. The 1:50 year annual maximum rainfall event intensity could increase by 8% by 2050 and 16% by 2100. This increase in average rainfall, intensity and frequency is likely to result in a more severe flood risk for the project area.
- Annual average temperature is projected to increase by 1.3ºC by 2050 and 2.5ºC by 2100. The minimum temperatures, both average and extreme low are expected to increase.
- No significant risks from snow loading, onshore Category 1 storms, decreased precipitation, wind speed increase and solar radiation change were identified. In fact, a reduced frost period and reduced snow fall are projected reducing the significance of those risk factors in the future.

251. The study reviewed the key design standards adopted for the project:

- 1:2 year rainfall event intensity was adopted for the design of the stormwater drainage for the urban roads. It was determined that the 1:2 year rainfall event intensity may increase from 88.92mm to 92.40mm by 2050.
- 1:20 and 1:50 year 24 hour rainfall intensity standards were adopted for urban floodwater drainage system design.
- The road design criteria is a 1:50 year flood level, however, the actual height is 59masl (metres above sea level) along most sections owing to local topography so flooding of the road network is unlikely even under a high emissions scenario climate change projection as the current 1:200 year flood water level is 55.42masl.
- 1:50 year flood water level was adopted for Yudai River flood protection design. The largest flow height observed in Ji'an over a 30 year period was in 2010 when was a flood

water height of 53.14masl was recorded. By 2050, an increase of 0.45m is projected and by 2100, an increase of 0.85m. The flood protection works have been designed based on a historical 1:50 year flood event (54.41m) plus a 0.5m safety factor.

- In addition the Ji'an Government plan to enhance the Gan River dykes for flood protection to the current 1:100 year flood height of 54.93 m and in the future for a 1:200 year flood height.

252. The study made the following recommendations for the detailed design:

- Current design criteria for stormwater drainage for urban roads and urban floodwater drainage may not be adequate by 2050. For drainage components that would be difficult to replace or repair it is recommended that the high emissions scenario climate change projections are adopted as the basis for design. A drainage capacity increase of between 6 to 10% is estimated to cost CNY10 Million (~US$1.6 Million). More drainage capacity may be required beyond 2050.
- The road drainage network is designed to drain into the Gan River. During periods when flood of the Gan River coincides with heavy rainfall in the urban area, stormwater cannot drain to the Gan River which may result in waterlogging of the urban area. It is recommended that a flood water pumping station is considered.
- The current design criteria for the flood protection works already incorporate a factor of safety of 0.5m so it is considered that this design standard is adequate for low and middle emission scenario climate change projections of 0.5 m flood height increase. This design standard may be inadequate in the event of a high climate change scenario and/or after 2050 when projections indicate a flood height increase of 0.85m. However, given the key infrastructure components of the project will be designed with sufficient height (59 masl), risk from future climate change impacts will likely be limited to the landscape and greenspace components along the Yudai River.
- The Ji'an Government proposes to enhance the flood protection capacity of the Gan River dykes, which will effectively alleviate the risk of Gan River flood on the project. The Gan River watershed includes reservoirs and dams that have significant flood storage capacity, and the Wan'an Reservoir has further potential to adjust the flood height at Ji'an when it operated at its full capacity. In addition, the effectiveness of these hydraulic facilities for flood management is heavily dependent on accurate and real-time hydro-meteorological information. The Ji'an Government has included the development of a comprehensive hydro-meteorological prediction system in the current Twelfth Five Year Development Plan. It is recommended that this system is linked to an early warning system and integrated climate and disaster risk management action plan to ensure that critical transport infrastructure is protected and continuity of services maintained during a severe weather event.

253. The Government has agreed to take account of these recommendations in the detailed design and will confirm if/which measures are adopted and if there is an incremental cost for adaptation measures.

5. Risk from Traffic Accidents

254. This impact can be mitigated through strict enforcement of traffic laws and regulations, especially speed limits, overloading of trucks and trucks carrying hazardous materials. The project EIR estimated that the probability of traffic accidents involving trucks carrying hazardous materials travelling on Jinggangshan (BRT corridor) road in 2030 would be 0.0183 per year. Similar probabilities for the five urban roads in 2030 would range from

0.0004 per year on Bo'an Avenue to 0.0069 per year on Junhua Avenue. This project includes a traffic management component which would improve traffic management in Ji'an contributing to reducing the risk of traffic accidents. The EMP includes a requirement for Operation and Maintenance Units to develop a spill response plan.

F. Cumulative Impacts

255. Cumulative impacts would mainly be from other projects particularly road projects and buildings being constructed concurrently with the construction stage of this project. The BRT corridor is in the central urban area where there might be other building construction or road construction works that might overlap with the construction stage of this project. The Western City Development Area is a new development area with active construction activities which might also overlap with the urban road construction and Yudai River rehabilitation periods in this project. At this time no information is available on potential construction works that could overlap with the construction stage of this project.

256. Construction related cumulative impacts will be effectively minimized by adopting proper mitigation measures, including: (i) coordination between all project components and other projects in the area of influence in terms of construction schedule, possible access road and borrow/disposal sites sharing; (ii) contractors will develop material transport plan with consultation of local road management authority and local community; (iii) enforcement of good construction management to minimize dust, noise and waste generation; (iv) education of construction workers to minimize social disturbance and cultural conflict; (vi) provision of temporary access to local traffic; (vii) proper maintenance of the access roads and timely restoration/strengthening upon completion. With effective implementation of good construction management measures, these common construction-related cumulative impacts can be adequately mitigated to acceptable levels.

257. Development of the Western City Development Area will eventually affect the existing population of approximately 30,000 (within the 51km^2 area). Their resettlement and compensation will be similar to the scheme established for this project. Urbanization will result in changes to livelihoods, however, with proposed compensation and skills training proposed through resettlement plans and strategies for urbanized areas, impact to the existing population will mostly be positive, with improved urban environmental quality and better socio-economic opportunities.

G. Indirect and Induced Impacts

258. The construction of new roads (such as the five urban roads) where none existed before has the potential to influence land use development patterns, traffic volumes and consequent developments on adjacent roads. The proposed roads as well as future traffic volumes on these roads have been examined in the context of the *Conceptual Plan and Controlled Plan of Ji'an Western City Development Area* in the FSR. The proposed urban roads will induce developments in the Western City Development Area and will provide transport linkage to the high speed railway station. The BRT corridor will improve transport among Jizhou District, Qingyuan District and the central urban area. Their individual contributions to, and influence on the district and neighborhood traffic flows, have therefore been assessed within the context of the relevant plans and are considered appropriate.

259. The potential impact of developments in the Western City Development Area have been examined in the planning EIR, which indicated that the existing and planned infrastructure

such as water supply, wastewater collection and treatment, municipal solid waste collection and disposal would be adequate to accommodate the population intake in the Western City Development Area. Impacts on the environment from air emissions, traffic and community noise, and treated effluent discharge have also been assessed in the planning EIR to be acceptable and within the carrying capacities of the environmental media.

260. Negative indirect and induced impacts from this project are not expected.

VI. ANALYSIS OF ALTERNATIVES

A. No Project Alternative

261. Without this project, the population of over half a million residing in the Jizhou and Qingyuan Districts would not benefit from a sustainable, more efficient and safer transport system and would continue to suffer congestion and traffic accident risks along Jinggangshan Avenue. Ji'an would not have an efficient public transport system that reduces the costs of transport, serve the central urban area or facilitate intermodal interchange, or provide better accessibility to employment and services in the city. Ji'an would also lose the benefits of behavioral change with respect to road safety and traffic management.

262. The Ji'an urban area now has 31 bus routes. The BRT system would streamline the public transport operation making bus services more efficient with dedicated lanes and stops. Without the BRT corridor, public buses would continue to fight for lanes with other motor vehicles when getting in and out of stops in congested traffic, resulting in road safety risks and slower travel time for the passengers.

263. Without the BRT system, carbon emissions on Jinggangshan Avenue from road traffic in year 2030 would be 11,000 t/a more than with the BRT system.

264. Without the urban roads and Yudai River rehabilitation, developments in the Western City Development Area could be delayed due to incomplete road network, lack of connectivity with the high speed railway station, and flooding risk from the Yudai River during storm events. Future residents would also lack public open space with of scenic, aesthetic and recreational value. All these could affect the socio-economic development in the Western City Development Area, employment opportunities for residents and quality of living conditions and environment. Delay in developing the Western City Development Area would also affect the urbanization of Ji'an, putting pressure on the old central urban area to accommodate new migrants.

B. Alternatives Considered

265. Various alternatives have been considered for each of the components in this project. Alternatives eventually selected were due to either being the least cost or the best environmental option, or both.

266. **BRT corridor**. Three corridor options (Yangming Road, Jizhou Road and Jinggangshan Avenue) were considered as shown in **Figure VI.1**. Based on the assessment results summarized in **Table VI.1**, the Jinggangshan Avenue option was selected.

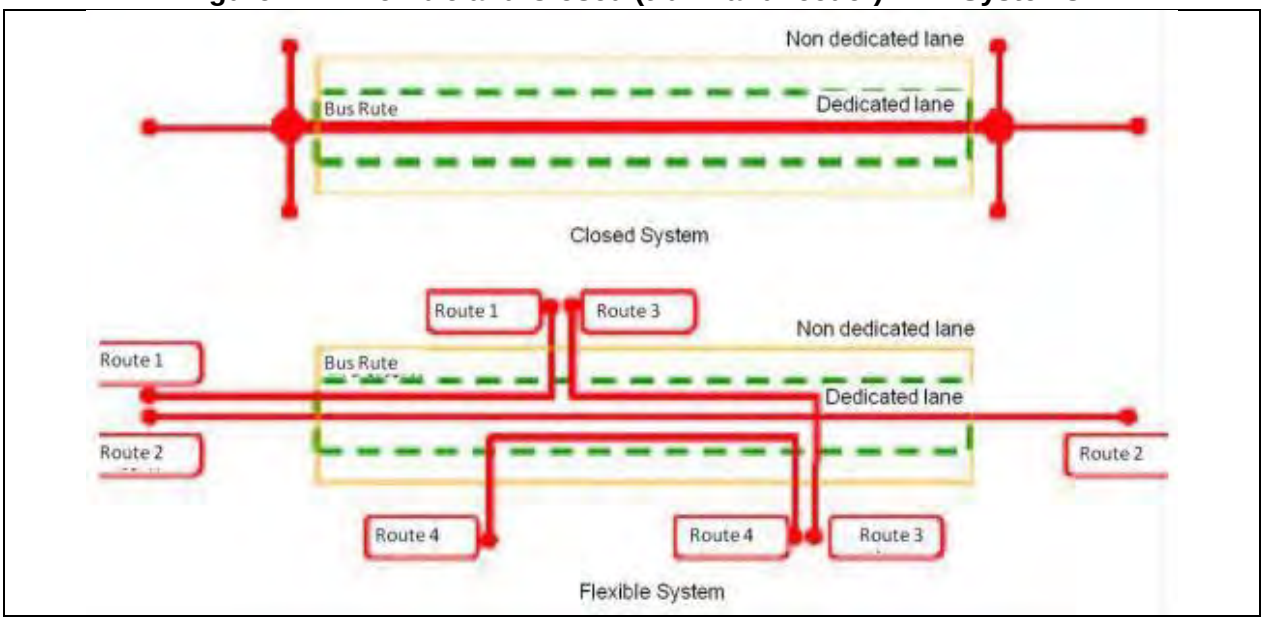
Figure VI.1: BRT Corridor Alternative Options

Figure VI.1: Summary Evaluation Results of BRT Corridor Alternatives

BRT Corridor Alternative	Assessment
Jinggangshan Road	Highest ridership Simple to construct Economically viable – high returns
Jizhou Road	Lower ridership Simple to construct Not economically viable – though potential to be a good corridor in future
Yangming Road	Lower ridership Hard to construct on narrower road and bridge Not economically viable – needs bridge expansion
Source: PPTA consultant	

267. **BRT operation system**. A BRT trunk and feeder system and a flexible system were examined. Figure VI.2 shows a flexible system and a closed (trunk and feeder) system.

Figure VI.2: Flexible and Closed (trunk and feeder) BRT Systems



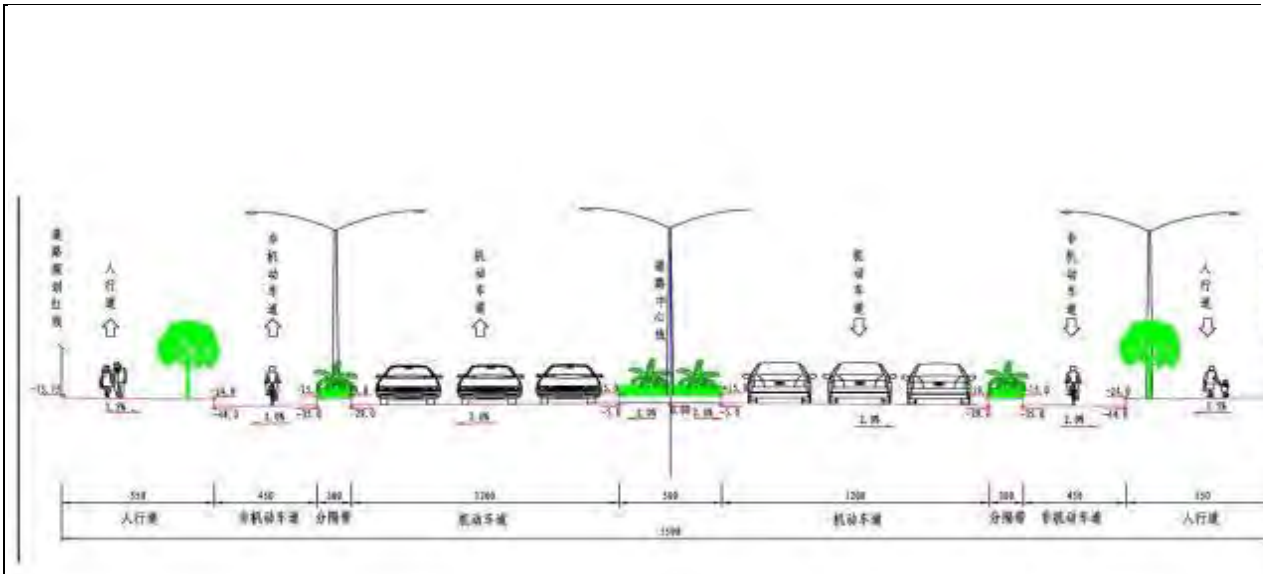
268. The trunk and feeder system would provide a substantially higher capacity, but the system was not adopted as a number of major disadvantages of this system were noted including that:

- the system would require large-scale transfer terminals at both ends of the BRT corridor;
- the construction period would be relatively long and would require land acquisition for the construction of terminals;
- the majority of system users would need to change buses to reach their destinations;
- the time saving benefits would be lower compared with a flexible route system; and
- feeder routes would need to be considered, which would require more vehicles.

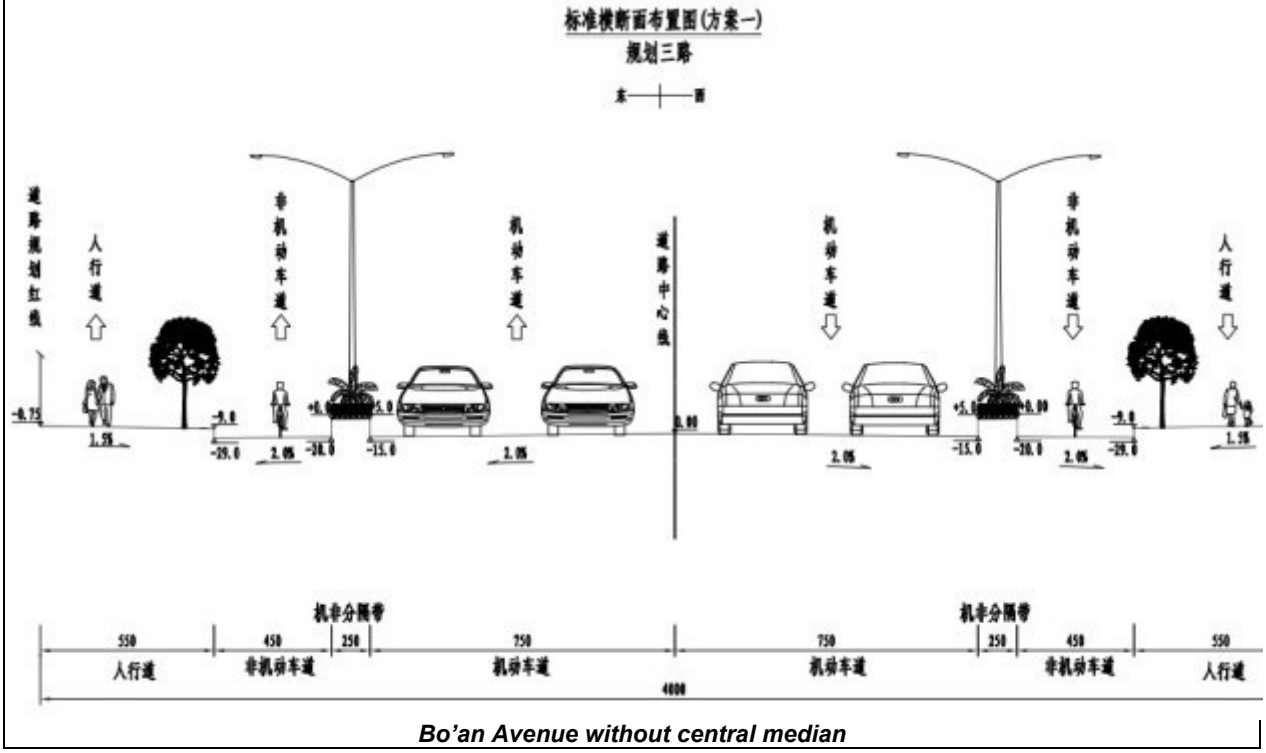
269. Consequently, by considering the relatively dispersed passenger patterns, relatively less effort is required for route restructuring, and a relatively shorter construction period with a lower investment cost, so a flexible system was adopted for Ji'an.

270. **Urban road cross-section**. Two options were examined: with central median and without central median. Basically, road sections with red line widths more than 40 m adopted the option with the central median and road sections with 40 m red line length adopted the option without the central median. Both options would provide lanes for non-motorized traffic and pedestrians. Figure VI.3 shows examples of road sections with and without the central median.

Figure VI.3: Cross-section of Urban Road Showing Examples with and without Central Median



Junhua Avenue with central median



Bo'an Avenue without central median

271. **Noise mitigation measures**. A number of measures were considered for mitigating noise from road traffic. These included direct measures that would be applied at the noise source, such as noise barriers and woodland buffers, as well as indirect measures that would be applied at the sensitive receptors such as regular or ventilated double glazed windows (see Table V.7). Factors governing the application of these measures include the distance between the road and the sensitive receptor and the extent of noise exceedance.

VII. INFORMATION DISCLOSURE, PUBLIC CONSULTATION AND PARTICIPATION

A. Legislative Framework

272. Meaningful participation and consultation in the evaluation of project planning, feasibility study, design and implementation is an important environment safeguards requirement; it can directly reflect the public's perceptions of environmental quality in the project's area of influence.

273. Relevant provisions in the *Environmental Protection Law* of PRC and the *Regulations on the Administration of Construction Project Environmental Protection* (Order of the State Council, No. 253) require that the "Environmental Impact Report formulated by the construction unit shall be in accordance with relevant laws to solicit the opinions of units concerned and inhabitants of project construction site". In January 2011, the MEP circulated the draft *Technical Guidelines for Environmental Impact Assessment: Public Participation* for public commenting, which specifies the requirements of information disclosure and stakeholder opinion survey. Since 2012, MEP also requires that abstracts of EIRs should be posted on the web-sites of local EPBs during the approval process (MEP Order No. [2012]51).

274. ADB's Safeguard Policy Statement also requires meaningful participation, consultation and information disclosure. The consultation processes for this project follow both the PRC and ADB requirements.

275. Information disclosure and public consultation have been conducted during preparation of the domestic planning and project EIRs and this EIA. Information disclosure and consultation included: disclosure on the internet, public posting, informal communication with key stakeholders which include residents, local authorities and sector specific institutions and authorities; questionnaire survey; and discussion forum attended by affected people and other concerned stakeholders.

B. Information Disclosure

276. **Planning EIR**. Information disclosure during the preparation of the planning EIR included (i) disclosure of project and environmental impact assessment information twice, once on the JMG web-site from 28 April to 15 May, 2013, and once on the JMUCIDC web-site from 4-17 July, 2013 (Figure VII.1), and (ii) public posting of project and environmental impact assessment information in the communities in the assessment area from 27 April to 14 May, 2013 (Figure VII.2). No adverse comment was received.

Figure VII.1: Website Information Disclosure of the Planning EIR

JMG web-site

JMUCIDC web-site

Figure VII.2: Public Posting of Project Information of the Planning EIR

Ji'nan Primary School

Wuli Primary School

Dongtou Village

Luotang Village

277. **Project EIR**. Information disclosure during the preparation of the project EIR also included web-posting and public posting. Web-posting was conducted twice. The first time was from 12-25 August, 2013 on both the JMG and MOF web sites, and the second time was from 15-30 November, 2013 on the JMG web-site after completion of the draft project EIR (Figure VII.3). Project information was also publicly posted in affected communities from 10-24 August 2013 (Figure VII.4).

Figure VII.3: Website Information Disclosure by the Project EIR

first time posting on JMG web site

first time posting on MOF web site

second time posting on JMG web site

Figure VII.4: Public Posting of Project Information for the Project EIR

Zhaogongtang Village

Intersection of Jizhou Ave & Shaoshan West Road

Ji'an City No. 3 People's Hospital

Jinggangshan University

C. Questionnaire Survey

278. **Planning EIR**. Questionnaire surveys were conducted from 5-16 July 2013 targeting the residents of affected communities in the assessment area. The questionnaire focused on the development of the Western City Area from a planning perspective. Eighty questionnaires were distributed and all were returned. Of the 80 participants, 37.5% were farmers with the others having various occupations, ages ranged from 25 to 69, 65 males and 15 females. Table VII.1 summarizes the survey results, indicating that the majority support the development of the Western City Development Area, with one person against it from an environmental perspective. The majority deemed it to be beneficial to improving their socio-economic and living conditions. Air and water quality were deemed to be the key environmental issues in the Western City Development Area, but about half viewed the problems to be minor. Only one-third of the respondents understood the resettlement policy and about half slightly understood the policy. The majority would prefer nearby resettlement with house compensation.

Table VII.1: Summary of Planning EIR Questionnaire Survey Results

Opinion Surveyed		Respondent	
		Number	Percentage
Do you agree with the development of the Western City Area?	Agree	72	90%
	Disagree	5	6.25%
	Uncertain	3	3.75%
Is the development of Western City Area beneficial to the economic development of the area?	Very beneficial	66	82.5%
	Average beneficial	11	13.75%
	Not beneficial	1	1.25%
	Uncertain	2	2.5%
Will the development beneficial to enhancing the living quality of the local residents?	Very beneficial	65	81.25%
	Average beneficial	13	16.25%
	Not beneficial	2	2.5%
	Uncertain	0	0%
Is the geographic location of the Western City Area reasonable?	Reasonable	64	80%
	Not reasonable	1	1.25%
	Uncertain	15	18.75%
What is the impact to the Western City Area from the surrounding?	Wastewater	25	31.25%
	Air pollutant emission	23	28.75%
	Noise	28	35%
	Other	15	18.75%
What is your environmental concern related to the Western City Area?	Air quality	28	35%
	Water quality	31	38.75%
	Visual	10	12.5%
	Other	19	23.75%
Do you understand the land acquisition and resettlement compensation policy?	Understand	29	36.25%
	Slightly understand	38	47.5%
	Do not understand	13	16.25%
What is your requirement on demolition and resettlement?	Nearby resettlement	52	65%
	Difference region resettlement	2	2.5%
	Cash compensation	6	7.5%
	Housing compensation	20	25%
What is the extent of environmental impact during development?	Large	1	1.25%
	Average	24	30%
	Minor	39	48.75%

Opinion Surveyed		Respondent	
		Number	Percentage
	Uncertain	15	18.75%
What is your attitude towards the development from an environmental perspective?	Support	61	76.25%
	Conditionally support	6	7.5%
	Does not matter	12	15%
	Against	1	1.25%

Source: Planning EIR.

279. During the questionnaire surveys, local villagers were also selected for interviews. Five people from the Baitang Street were not in favor of the development with the concern that the development would acquire their farmland affecting their livelihood. The villages had little information on land acquisition and resettlement and the majority, as reflected in the questionnaire survey, had little understanding of the resettlement and compensation policy. No government agency had explained and consulted them on land acquisition and resettlement due to the development of the West City Area.

280. **Project EIR**. Questionnaire surveys were conducted from 5-16 November 2013 targeting the residents of affected communities in the project area of influence. The questionnaire focused on the project and its potential environmental impacts. Eighty-two questionnaires were distributed and all were returned. Of the 82 participants, 47.6% were farmers with the others having various occupations, 46.3% was within the age group of 40-49 years old, 7 males and 5 females. Table VII.2 summarizes the survey results, indicating that no one disagreed with implementation of the project. The majority deemed it to be beneficial to improving their socio-economic and living conditions. Close to 75% thought that the existing environmental condition in the area is relatively good to good. Air and water quality were deemed to be the key environmental concerns during project implementation, but about half viewed the problems to be minor. Close to 80% of the respondents were uncertain or only slightly understood the resettlement policy. The majority would prefer nearby resettlement with house compensation. The questionnaire survey was conducted before the resettlement plan for the project was completed. Since then, stakeholders have been consulted and are better informed about the project's resettlement plan.

Table VII.2: Summary of Project EIR Questionnaire Survey Results

Opinion Surveyed		Respondent	
		Number	Percentage
Do you agree with the implementation of this project?	Agree	77	93.9%
	Disagree	0	0.0%
	Uncertain	5	6.1%
Will this project be beneficial to the economic development of the area?	Very beneficial	67	81.7%
	Average beneficial	8	9.8%
	Not beneficial	0	0.0%
	Uncertain	6	7.3%
Will this project beneficial to enhancing the living quality of the local residents?	Very beneficial	65	79.3%
	Average beneficial	8	9.8%
	Not beneficial	0	0.0%
	Uncertain	8	9.8%
Is the geographic location of project area reasonable?	Reasonable	69	84.1%
	Not reasonable	2	2.4%
	Uncertain	10	12.2%
What is your view of the existing	Good	44	53.7%

Opinion Surveyed		Respondent	
		Number	Percentage
environmental condition in the area?	Relatively good	16	19.5%
	Average	14	17.1%
	Relatively bad	3	3.7%
What is your environmental concern related to this project?	Air quality	53	64.6%
	Water quality	27	32.9%
	Visual	22	26.8%
	Other	4	4.9%
Do you understand the land acquisition and resettlement compensation policy?	Understand	16	19.5%
	Slightly understand	37	45.1%
	Do not understand	27	32.9%
What is your requirement on demolition and resettlement?	Nearby resettlement	64	78.0%
	Difference region resettlement	2	2.4%
	Cash compensation	2	2.4%
	Housing compensation	11	13.4%
What is the extent of environmental impact during project implementation?	Large	12	14.6%
	Average	18	22.0%
	Minor	25	30.5%
	Uncertain	25	30.5%
Will the rehabilitation of Yudai River improve the water environment?	Will improve	54	65.9%
	Will not improve	1	1.2%
	Uncertain	25	30.5%

Source: Project EIR.

D. Discussion Forum

281. **Project EIR**. A discussion forum was conducted on 5 November 2013 during the preparation of the project EIR. A total of 28 people attended representing the JPMO, JMUCIDC, JEPSRI, PPTA consultant, Ji'an Lands Bureau, Ji'an Planning Bureau, Ji'an Agriculture Bureau, Ji'an Forestry Bureau, and affected villages, towns and townships. Figure VII.5 shows the discussion forum. Key discussions centered on resettlement and construction impact. Table VII.3 summarizes the responses from the relevant participants on these two items.

Figure VII.5: Photos of the Discussion Forum

Table VII.3: Key Issues and Responses from the Discussion Forum

Comment / Question	Response
Land acquisition and resettlement should be compensated according to national policy. Resettlement should in a centralized nearby area, with resettlement completed before demolition.	Resettlement and compensation will strictly follow ADB's SPS (2009) and JMG document [JMG No. (2011)62], and a resettlement plan has been prepared. The project proponent has commissioned the Jiangxi Social Science Institute to conduct a resettlement survey. The resettlement plan is as follows: (i) Affected households in Xingqiao Town Jiangbian Village Committee, Baitang Street Chengshang Village Committee and Baitang Street Ji'nan Village Committee will be resettled in the Huayaocheng Resettlement Community. It has a planned area of 10.01 ha, with a constructed area 260,000 m^2. The planned number of units will be 2,600 (each with average constructed area of 100 m^2), with 333 units allocated for resettlement from this project. (ii) Affected households in Hebu Township Jifeng Village Committee and Baitang Street Baitang Village Committee will be resettled in the Hengruihuayuan Resettlement Site on Jifu Road. It has a planned area of 11.3382 ha with a constructed area of 300,000 m^2. The planned number of units will be 2,100 (each with average constructed area of 150 m^2), with 408 units allocated for resettlement from this project. This community is under construction. (iii) Affected households in Xingqiao Town Luotang Village Committee will be resettled in the Wunikeng Resettlement Community. It has a planned area of 77,900 m^2 with a constructed area of 155,800 m^2. The planned number of units will be 1,600 (each with average constructed area of 100 m^2), with 104 units allocated for resettlement from this project. (iv) Affected households in Baitang Street Wuli Village Committee will be resettled

Comment / Question	Response
	in the Baitang Street Wuli Community Resettlement Zone. It has a planned area of 32,900 m^2 with a constructed area of 65,800 m^2. The planned number of units will be 658 (each with average constructed area of 100 m^2), with 100 units allocated for resettlement from this project. (v) The one affected household in Changtang Town Miaobei Village Committee will either be cash compensated or through market purchase.
How will dust and C&D waste be dealt with during construction?	During construction, the road sub-grade will be compacted by layers in a timely fashion, with watering to suppress dust. Vehicles transporting loose earth materials will be covered with tarpaulin. Overloading of these vehicles will be prohibited to prevent spillage of loose earth materials onto roads during transit. Hoardings will be erected around the perimeters of the construction sites, with the installation of interception ditches. Construction site management will be strengthened. Stockpiles will be centralized to reduce the impact area of dust. Backfilling will be done in a timely fashion to minimize dust impact. Environmental supervision will be carried out during the construction stage, to supervise and monitor dust, wastewater, C&D waste and ecological impacts throughout the construction stage. The public could also address their questions related to construction environmental issues to the environmental supervision unit.

Source: Project EIR.

E. Future Plans for Public Participation

282. Meaningful consultation to safeguard the environment and local residents will continue throughout detailed design, construction and operation phases. The JPMO and JMUCIDC will be responsible for organizing the public consultations, with the support of the LIEC of the loan implementation consultancy services. The contractors will be required to communicate and consult with the communities in the project area of influence, especially those near road alignments. Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractors, JMUCIDC), and the project level Grievance Redress Mechanism (GRM). Contact information of all GRM entry points and the JPMO will be disclosed on the construction site information boards. Consultation will focus on public complaints about public nuisances from construction and operation activities, such as noise, asphalt fume nuisance, dust, traffic disturbance, as well as public concerns about the environment and resettlement.

283. Future consultation and participation will also include (i) involvement of affected people during inspection and monitoring of EMP implementation during construction and operation phases; (ii) participatory evaluation on the environmental and social-economic benefits and impacts; and (iii) consultation with the public after the project completion. The EMP provides plans for future public participation. The EMP for this Project is included as attachment to this report.

284. The project environmental information will be disclosed by ADB as follows: (i) this EIA will be available for review at www.adb.org 120 days before ADB Board consideration; (ii) copies of the domestic planning and project EIRs (in Chinese) are available on request at the JPMO; and, (iii) environment progress will be reported in the quarterly project progress reports and the semi-annual environmental monitoring reports which will be disclosed on ADB's project website (www.adb.org).

VIII. GRIEVANCE REDRESS MECHANISM

285. Public participation, consultation and information disclosure undertaken as part of the local EIR process, assessment and development of resettlement plans, and consultations undertaken by the project consultants have discussed and addressed major community concerns. Continued public participation and consultation have been emphasized as a key component of successful project implementation. As a result of this public participation and safeguard assessment during the initial stages of the project, major issues of grievance are not expected. However, unforeseen issues may occur. To settle such issues effectively, a transparent grievance redress mechanism (GRM) for lodging complaints and grievances has been defined for environment related issues.

286. The GRM has been designed to help achieve the following objectives: (i) open channel for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) prevent and mitigate any adverse environmental impacts on communities caused by project construction and operations; (iii) improve mutual trust and respect and promote productive relationships with local communities; and (iv) build community acceptance of the project.

287. The JPMO will establish a complaints center with hotline for receiving both environmental and resettlement grievances. The details of the GRM are described in the EMP (Attachment EMP), and were also explained during public consultation with the participants of the public forum. The GRM will be operational prior to commencement of construction works.

288. In addition to the GRM described above, ADB's overall accountability mechanism (2012) applies.[20] The mechanism provides opportunities for people adversely affected by ADB-financed projects to express their grievances; seek solutions; and report alleged violations of ADB's operational policies and procedures, including safeguard policies. ADB's accountability mechanism comprises two separate, but related, functions: (i) consultation, led by ADB's special project facilitator, to assist people adversely affected by ADB-assisted projects in finding solutions to their problems; and (ii) providing a process through which those affected by projects can file requests for compliance review by ADB's Compliance Review Panel.

[20] The revised accountability mechanism became effective on 24 May 2012.

IX. ENVIRONMENTAL MANAGEMENT PLAN

289. An environmental management plan (EMP) has been prepared for the project. It will provide the mechanism of implementation of mitigation and monitoring measures. The full EMP is presented in Attachment EMP. It will also be attached to the Project Administration Manual (PAM) of the project. The EMP defines mitigation measures and describes the involved institutions and mechanisms to monitor and ensure compliance with environmental regulations and implementation of the mitigation measures. Such institutions and mechanisms will seek to ensure continuous improvement of environmental protection activities during preconstruction, construction, and operation of the project in order to prevent, reduce, or mitigate adverse impacts. The EMP draws on the domestic project EIR, this project EIA, the SWCR, and on the PPTA discussions and agreements with the relevant government agencies. The EMP will be reviewed and updated at the end of the detailed design in order to be consistent with the final detailed design. The updated EMP will be disclosed on ADB's project website.

X. CONCLUSION AND RECOMMENDATIONS

A. Expected Project Benefits

290. This project will directly benefit a population of 550,000 in the Jizhou and Qingyuan Districts in Ji' an, as well as a future population of 300,000 in the Western City Development Area.

291. The project will improve public transport, urban road network, multi-modal logistics, pedestrian facilities, non-motorized transport and road safety through the provision of a BRT system, five urban roads, improvements to the existing railway station layout and traffic management systems. The BRT will improve traffic flow on Jinggangshan Avenue, and will be an important connection for feeder buses from the existing railway station and the planned high speed railway station and the new Western City Development Area. The rehabilitation of Yudai River will improve flood protection and will provide a riverside park of aesthetic and recreational value for residents in the Western City Development Area.

292. The provision of BRT would contribute to a reduction in carbon emission of 11,000 t/a in 2030 compared to the no BRT scenario. The GEF funded activities will support the introduction of diesel hybrid-electric buses, adoption of low-carbon transport systems and improve capacity for integrated transport and land use planning. The Project combined with the GEF funded activities are estimated to avoid total GHG emissions (direct and indirect) of around 2.3-2.6 million tonnes over the project lifetime of 20 years.

B. Adverse Impacts and Mitigation Measures

293. This project will result in permanent loss of 210 ha of land and temporary loss of 32 ha of land which is primarily secondary woodland and farmland dominated by common trees, shrubs and grasses which are not of conservation value. Land acquisition and resettlement will affect 1,742 households and 6,789 people on collective land, and 14 government agencies and enterprises including 188 employees on government owned land. Rural house demolition will total 70,682 m^2, affecting 184 households and 806 people. Urban house demolition will total 9178 m^2, affecting 90 households and 360 people. Enterprise demolition will total 14,795 m^2.

294. The camphor tree, which is under national Class II protection, was found at a number of locations on or near the proposed urban road alignments. Avoidance of these locations during the detailed design of the urban road alignments shall be the primary mitigation measure. If avoidance is not possible, transplant schemes shall be developed.

295. Old camphor trees were recorded at three locations with one location on the proposed Junhua Avenue alignment. Detailed design of urban road alignments must avoid these locations. These old camphor trees shall also be tagged, conspicuously marked and fenced off prior to commencement of construction.

296. During construction, potential impacts mainly relate to earthwork road paving, BRT station construction, sediment dredging, and construction of embankments and road bridges. The project may have soil erosion, air quality, noise, water quality, ecology, solid waste and occupational health and safety impacts. Potential air quality impact may occur due to fugitive dust generated on the construction site from stockpiles of uncovered earth materials and vehicles travelling on unpaved haul roads, as well as fumes from asphalt cement during road paving. The use of powered mechanical equipment during construction activities will generate noise. Construction activities will generate process wastewater and construction workers will produce wastewater. Dredging will stir up and re-suspend the sediment, affecting water quality as well as aquatic biota. Earthwork and construction activities will remove vegetation and ecological habitats, causing disruption and disturbance to nearby biota. Construction works will produce C&D wastes including excavated earth materials and dredged sediment. Workers will face occupational health and safety issues working on construction sites. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas for construction staging areas, haul roads and borrow pits will be vegetated and landscaped upon completion of the construction stage.

297. Ecological surveys showed that the flora and fauna in the project area of influence are common species. Besides the camphor tree, protected species recorded in the project area of influence consist of the Yellow-Breasted Bunting (IUCN: Endangered) and two amphibian species, four reptile species, one mammal species and 16 bird species that are on the provincial protection list. These species have been described in literature as having wide distribution and the project sites are not the type locality of any of these species. The EMP specifies that the construction workers will be prohibited from capturing wildlife on construction sites. A more detailed ecology study was carried out to inform the project landscaping proposals, three bird species with vulnerable status and an additional six national Class II protected bird species were identified in the wider project area. The ecologist worked with the detailed design team to ensure that landscape proposals are responsive to habitat requirements of species of conservation value in the wider project area.

298. There are no protected areas or physical cultural resource other than the old camphor trees within the project area of influence. The creation of the riverside park presents an opportunity to create new wetland and woodland habitats of value for local biodiversity and local communities. The revised landscaping proposals incorporate woodland, shrub, grassland, wet meadow, deep and shallow marshes and aquatic habitats to take account of habitat requirements of the species of conservation value that have been identified in the wider project area. A more detailed report on these proposals is included in Appendix 2.

299. Operation of the BRT and urban roads would generate vehicle emissions and road traffic noise. Mitigation measures for existing sensitive receptors and for future developments have been specified. Carbon emissions from all the project roads would total 94,759 t/a in 2030, which is below the ADB threshold of 100,000 t/a. The EMP includes requirements for the Design Institutes to specify energy efficient lighting and cooling/heating systems and materials that are recycled, have recycled content or are from sustainable sources, particularly for street furniture and fixtures/fittings.

300. Based on information gathered and assessments performed by the domestic environmental design institutes, it is concluded that environmental impacts during the construction and operational stages of the project would be acceptable and in compliance with PRC regulations and standards and ADB's SPS (2009) if the prepared EMP is implemented and monitored diligently. The EMP defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. Appropriate environmental safeguards for the planned works are proposed and form part of a comprehensive set of project management documents.

C. Risks and Assurances

301. The Project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the components. From an environment safeguards point of view, the main risk relates to the failure of the JPMO, JMUCIDC and O&M units to monitor environmental impacts and implement the EMP during construction and operational stages. This risk will be mitigated by (i) providing training in environmental management under the project; (ii) appointing qualified project implementation consultants, (iii) following appropriate project implementation monitoring and mitigation arrangements, (iv) ADB conducting regular project reviews; and (v) project assurances covenanted in the loan and project agreement with ADB.

302. General and specific environmental project assurances are required to ensure that the project can achieve its envisaged outcome. The following sections define the assurances that will be included in the loan and project agreements.

303. **General environmental assurances**. JMG will ensure and cause the IA to ensure that the preparation, design, construction, implementation, operation, maintenance, monitoring and decommissioning of the project and project facilities comply with (i) all applicable laws and regulations of the Government environment, health, and safety; (ii) the Environmental Safeguards (i.e. principles and requirements set forth in ADB's Safeguard Policy Statement (2009); and (iii) all measures and requirements set forth in the domestic environmental impact reports (EIR), this EIA and environmental management plan (EMP) for the project; and any corrective or preventive actions (a) set forth in a safeguards monitoring report, or (b) which are subsequently agreed between ADB and the Government. JMG will cause the IA to prepare, at the outset of component implementation, detailed internal monitoring programs to be implemented by the contractors during construction and operation phases, and to incorporate such mitigation and monitoring measures into the design of components, relevant bidding documents and construction contracts. Throughout project implementation, JMG and the IA will review any changes to the project design that may potentially cause negative environmental impacts, and in consultation with ADB, update EIA and EMP by revising mitigation measures as necessary to assure full environmental compliance.

304. JMG and JMUCIDC will ensure that sufficient resources and full time personnel are provided for monitoring EMP implementation, under the guidance of JEPD, and making appropriate use of external independent environmental monitoring centers. JMG will ensure that JMUCIDC is obliged to provide semi-annual environmental monitoring reports throughout the construction period to the JPMO, which will in turn prepare and submit to ADB semi-annual environmental monitoring reports in a format acceptable to ADB.

305. **Specific environmental assurances**. JMG will ensure that within 60 days from the loan effectiveness, JPMO establishes the project grievance redress mechanism relating to safeguards in line with the EMP and Resettlement Plan and establishes a task force functioning effectively to: (a) review and document eligible complaints of project stakeholders; (b) proactively address grievances; (c) agree with the complainants the chosen mechanism for redress; and (d) prepare periodic reports to summarize the number of complaints received and resolved, and final outcomes of the grievances and chosen actions and make these reports available to ADB on request. Eligible complaints include those related to the Project, any of the service providers, any person responsible for carrying out the Project, complaints on misuse of funds and other irregularities and grievances due to any safeguard issues, including resettlement, environment, and gender.

306. JMG will ensure that the detailed design of all urban road alignments in the Western City Development Area will avoid locations with old camphor trees as listed in this report, and that all old camphor trees shall be tagged, conspicuously marked and fenced off before the commencement of construction.

307. JMG will ensure that the detailed design of all urban road alignments in the Western City Development Area will avoid locations with camphor trees as the primary objective. If full avoidance is not possible, transplant schemes for these camphor trees shall be developed during detailed design and inserted into tender documents.

308. JMG will ensure that all excavated spoil and construction and demolition waste generated during construction will be temporarily stored or permanently disposed of at designated locations only and that these locations shall be at least 500 m from any water body.

309. JMG will ensure that measures described in this EMP for traffic noise mitigation will be implemented. These measures include the planting of woodland buffer at one location along the BRT corridor where land has to be made available, the installation of double-glazed windows for affected existing households along the BRT corridor and the five proposed urban roads, and establishment of adequate buffer distances or provision of noise insulation for future developments along the project roads.

D. Overall Conclusion

The domestic planning and project EIRs and this EIA conclude that all identified environmental impacts can be mitigated to acceptable levels if the measures defined in the EMP and assurances are carefully implemented and monitored. The project is feasible from an environmental safeguards point of view and will contribute to significant reductions in greenhouse gas emissions.

ENVIRONMENTAL MANAGEMENT PLAN

May 2014

People's Republic of China: Jiangxi Ji'an Sustainable Urban Transport Project

Prepared by the Ji'an Municipal Government for the Asian Development Bank.

CONTENTS

A. Introduction

1. This Environmental Management Plan (EMP) is developed for the Jiangxi Ji'an Sustainable Urban Transport Project (the project). It identifies the potential project environmental impacts and defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. It also defines the institutional arrangements and mechanisms, the roles and responsibilities of different institutions, procedures and budgets for implementation of the EMP. The EMP seeks to ensure environmental protection activities during preconstruction, construction, and operation continuously improve in order to prevent, reduce, or mitigate adverse environmental impacts and risks. The EMP draws on the findings of the project EIA, the domestic Environmental Impact Reports (EIR), Soil and Water Conservation Plan (SWCP), the Project Preparation Technical Assistance (PPTA) reports, and discussions and agreements with relevant government agencies and the Asian Development Bank (ADB).

2. This EMP is based on proposed project designs as of December 2013. Detailed engineering designs are yet to be finalized and may require subsequent impact assessment and/or revisions to this EMP. The Ji'an Municipal Government (JMG) will provide the detailed designs to ADB for review to determine if the EMP requires revision. The final EMP will be disclosed on the ADB public website (www.adb.org) and included in the Project Administration Manual (PAM). The final EMP will also be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to include EMP implementation costs in their bids for project works.

3. The EMP includes an environmental monitoring program. The monitoring results will be used to evaluate (i) the extent and severity of actual environmental impacts against the predicted impacts, (ii) the performance of the environmental protection measures and compliance with relevant laws and regulations, (iii) trends of impacts, and (iv) overall effectiveness of the project EMP.

B. Institutional arrangements and responsibilities for EMP implementation

4. As Executing Agency (EA), the Ji'an Municipal Government (JMG) will be responsible for the overall implementation and compliance with loan assurances and the EMP (including Environmental Monitoring Plan).

5. **Ji'an Project Leading Group (JPLG).** The JPLG has been established for the project comprising of senior officials from relevant government agencies, to facilitate inter-agency coordination, and to resolve any institutional problems affecting project implementation at a municipal level.

6. The EA has established the **Ji'an Project Management Office (JPMO),** who will be responsible, on behalf of the EA, for the day-to-day management of the project. The JPMO will have the overall responsibility to supervise the implementation of environment mitigation and monitoring measures, coordinate the project level Grievance Redress Mechanism (GRM) and report to ADB. JPMO will (i) appoint at least one environmental specialist on its staff to coordinate and manage EMP implementation, (ii) contract the Ji'an Environmental Monitoring Station (JEMS) to conduct environmental impact monitoring during the construction stage, (iii) engage the loan implementation consultants (LIC) services, (iv) contract an external Environmental Supervision Engineer (ESE) to conduct independent verification of EMP

implementation and environmental impact monitoring results during the construction and operational stages of the project, and (v) supervise the procurement process. The JPMO environmental specialist will (i) supervise contractors and their compliance with the EMP; (ii) conduct regular site inspections; (iii) act as local entry point for the project GRM; (iv) submit environmental impact monitoring results provided by the JEMS to the JPMO and JEPB for verification and confirmation. JPMO will prepare quarterly project progress reports and semi-annual environment monitoring reports and submit them to ADB.

7. **Implementing Agency (IA).** The Ji'an Urban Investment and Development Company, Ltd. (JIDC) (JMUCIDC) will be the IA for the project. It will hire the technical engineering design institutes (DI), implement project components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control. To ensure that the contractors comply with the EMP provisions, JMUCIDC with the help and technical support of a Tendering Agent and the Loan Implementation Environmental Consultant (LIEC) under the LIC services, will prepare and provide the following specification clauses for incorporation into the bidding procedures: (i) a list of environmental management and monitoring requirements to be budgeted by the bidders in their proposals; (ii) environmental clauses for contractual terms and conditions; and (iii) major items in the EIA, and the full EMP.

8. **Construction contractors** will be responsible for implementing the mitigation measures during construction under the supervision of JMUCIDC (through the ESE) and JPMO. In their bids, contractors will be required to respond to the environmental management and monitoring requirements defined in the EMP. Each contractor will be required to develop site specific EMPs and will assign a person responsible for environment, health and safety. After project completion, environmental management responsibilities will be handed over to O&M units.

9. **O&M Units.** During the operational phase, JMUCIDC and the JEPB will periodically verify and monitor (through a licensed monitoring entity) the environmental management and implementation of mitigation measures by the operators (O&M Units) of the project components. The cost of mitigation measures in this phase will be borne by the relevant O&M Units.

10. **Loan Implementation Environmental Consultant (LIEC).** Under the loan implementation consultancy (LIC) services, a LIEC will support the project. Terms of reference for this external environmental monitoring consultant is provided in the Project Administration Manual. The LIEC will be contracted by the JPMO, and will:

- assess the project components' environmental readiness prior to implementation based on the readiness indicators defined in Table EMP-3 in the EMP;
- support JPMO in updating the EMP including monitoring plan as necessary to revise or incorporate additional environmental mitigation and monitoring measures, budget, institutional arrangements, etc., that may be required based on the detailed design; submit to ADB for approval and disclosure; ensure compliance with the PRC's environmental laws and regulations, ADB's Safeguard Policy Statement (2009) and Public Communications Policy (2011);
- if required, update the EIA and EMP reports for changes in the project during detailed design or project implementation (for example if there is a minor or major scope change) that would result in adverse environmental impacts not within the scope of the approved EIA/EMP;
- assist the JMG and JPMO to establish a Grievance Redress Mechanism (GRM), and provide training for the JPMO and GRM access points (including, but not limited to,

JMUCIDC and contractors);

- conduct regular EMP compliance assessments, undertake site visits as required, identify any environment-related implementation issues, and propose and oversee implementation of necessary corrective actions;
- assist the JPMO to prepare semi-annual environmental monitoring and progress reports to ADB;
- provide training to JPMO, JMUCIDC, O&M units and contractors on environmental laws, regulations and policies, SPS 2009, EMP implementation, and GRM in accordance with the training plan defined in the EMP (Table EMP-7); and
- assist the JPMO and JMUCIDC in conducting consultation meetings with relevant stakeholders as required, informing them of imminent construction works, updating them on the latest project development activities, GRM.

11. **Environmental Supervision Engineer (ESE).** The environment performance of the project will be verified by an independent ESE, to be contracted by JPMO. The ESE will review EMP implementation and monitoring activities and results, assess EMP implementation performance, visit the project sites and consult potentially affected people, discuss assessment with the JPMO and JMUCIDC; and suggest corrective actions. The ESE will prepare monthly reports for submission to JPMO which will be reviewed by the JPMO during the preparation of the quarterly project progress reports for ADB and by the LIEC during the preparation of the semi-annual environment monitoring reports for ADB.

12. Overall environmental responsibilities are outlined in Table EMP-1.

Table EMP-1: Environmental responsibilities

Phase	Responsible Agency	Environmental Responsibility
Project preparation	Design Institutes on behalf of JPMO	● Prepare feasibility study reports (FSR), environmental impact report (EIR), soil and water conservation report (SWCR), resettlement plan (RP)
	JPMO	● Review the FSRs, EIRs, SWCR and RP. ● Engage a staff environmental specialist
	JEPB	● Review and approve the EIR
	JPWRB	● Review and approve the SWCR
	PPTA consultant	● Provide technical assistance ● Review domestic EIR ● Conduct environmental due diligence ● Prepare project environmental impact assessment (EIA) report and environmental management plan (EMP)
	ADB	● Review and approve the EIA and EMP and disclose
Detailed design	Design Institutes on behalf of JPMO	● Incorporate mitigation measures defined in the EMP into engineering detailed designs
	JPMO	● Review mitigation measures defined in the EMP, update where necessary based on detailed design ● Engage the independent Environmental Supervision Engineer (ESE). ● Engage the Loan Implementation Environmental Consultant (LIEC) under the Loan Implementation Consulting Services
	ESE and LIEC	● Review detailed design to ensure inclusion of relevant mitigation measures ● Assist JPMO in updating the EMP where necessary
	ADB	● Approve updated EMP and disclose

Phase	Responsible Agency	Environmental Responsibility
Tendering, contracting and pre-construction	JPMO	● Incorporate EMP clauses into tender documents ● Commission JEMS for internal environmental quality monitoring during the construction phase ● Establish the project grievance redress mechanism with a complaint center and hotline
	ESE	● Review tender documents to ensure inclusion of EMP clauses ● Review contractor's method statements on implementation of mitigation measures
	LIEC	● Review tender documents to ensure inclusion of EMP clauses ● Conduct training for the staff from JPMO, IA, O&M units and contractors on environmental management, environmental monitoring and EMP implementation
	Contractors	● Prepare and submit tenders for the construction contracts, to include staffing and costs for environmental management to comply with the EMP ● Prepare method statements on implementation of mitigation measures
	ADB	● Review bid documents and confirm project's readiness
Construction	IA	● Develop project management procedures, implementation plan, and financial management ● Approve contractor's method statements on implementation of mitigation measures ● Undertake day-to-day project and EMP implementation activities for all infrastructure components ● Administer and monitor the contractors and suppliers ● Supervise EMP implementation to ensure compliance by contractors
	JPMO	● Coordinate with all involved agencies, departments, and institutes for project implementation ● Coordinate the project level grievance redress mechanism ● Conduct public consultations as indicated in the EMP ● Supervise EMP implementation ● Prepare project documents and report to JMG, JPLG and ADB ● Submit withdrawal applications and supporting documents to ADB ● Submit project implementation progress reports and safeguards monitoring reports to ADB ● Submit all procurement and disbursement documents to ADB for necessary approval ● Disclose project-related information and documents in accordance with ADB guidelines
	JEMS	● Conduct internal environmental quality monitoring in accordance with the EMP ● Recommend additional environmental quality monitoring when needed ● Prepare and submit monitoring results to JPMO, IA and JEPB monthly
	ESE	● Conduct external compliance monitoring of EMP implementation ● Review internal environmental quality monitoring data collected by JEMS ● Prepare monthly environmental monitoring reports ● Advise on mitigation measures when needed

Phase	Responsible Agency	Environmental Responsibility
		• Assist JPMO and IA in preparing monthly and quarterly project progress reports • Support LIEC with preparation of semi-annual environmental monitoring reports
	LIEC	• Conduct compliance monitoring of EMP implementation • Assist JPMO in preparing semi-annual environmental monitoring reports for submission to ADB • Prepare environmental completion report for ADB
	JEPB	• Conduct periodic and random inspections of all construction projects relative to compliance with PRC regulations and standards
	ADB	• Review semi-annual environmental monitoring reports • Undertake review missions
Operation	O&M units	• Operate and maintain the project facilities • Engage JEMS in conducting environmental quality monitoring during the operational phase
	IA	• Coordinate and supervise EMP implementation
	JEMS	• Conduct internal environmental monitoring for the first year of operation according to the EMP
	ADB	• Conduct project completion review
Notes: ADB = Asian Development Bank; ESE = environmental supervision engineer; IA = Implementing Agency; JEMS = Ji'an Environmental Monitoring Station; JEPB = Ji'an Environmental Protection Bureau; JPMO = Ji'an Project Management Office; JPWRB = Jiangxi Provincial Water Resource Bureau; LIEC = loan implementation environmental consultant; O&M = operation and maintenance; PPTA = project preparation technical assistance		

C. Summary of potential impacts and mitigation measures

13. Potential environmental issues and impacts during the pre-construction, construction and operation phases, and corresponding mitigation measures, are summarized in Table EMP-2. These include two types of mitigation measures:

(i) Measures that will permanently become part of the infrastructure such as landscape planting, road signage and markings should be included within the main civil work contract costs, and are not double-counted as part of the EMP costs. The only exception for this project is $247,000 for the provision of traffic noise mitigation measures consisting of planting woodland buffers and installing regular and ventilated double glazed windows.

(ii) Temporary measures during the construction stage (e.g. dust suppression by watering, use of quiet / low noise powered mechanical equipment, flocculants used to facilitate sedimentation of suspended solids in construction site runoff, etc) will need to be included in the tender documents to ensure that contractors include in their budgets.

14. The mitigation measures defined in the EMP will be (i) checked and where necessary re-designed by the design institutes and the EMP subsequently updated; (ii) incorporated into tender documents (where appropriate), construction contracts, and operational management plans; and (iii) implemented by contractors and IAs under supervision of JPMO. The effectiveness of these measures will be evaluated based on the results of the environmental impact monitoring conducted by JEMS, and through EMP compliance verification conducted by the ESE and LIEC.

Table EMP-2: Summary of Potential Impacts and Mitigation Measures

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
Detailed Design Stage						
Conservation of natural resources	Soil resources	Loss of land and topsoil and increased risk of erosion	• Minimize permanent and temporary land take for development. • Retain/incorporate landscape features of interest in design. • Optimize balance between cut and fill and avoid deep cuts and high embankments to minimize earthworks. • Maximize reuse of spoil within the construction or adjacent construction works. • Agree spoil disposal sites, management and rehabilitation plan with local Environment Protection Bureau and the Cityscape Department • Remove and store topsoil (10-30cm) for restoration works prior to main earthworks. • Specify vegetation that serves specific bioengineering functions. • Design appropriate drainage systems for slopes to reduce soil erosion.	Design Institute	JPMO	Included in design contract
	Materials	Efficient use of resources	• Specify energy efficient lighting and cooling/heating systems. • Specify materials that are recycled, have recycled content or are from sustainable sources, particularly for street furniture and fixtures/fittings. • Specify the use of renewable energy (such as photovoltaic panels) for stations, signs, lighting, where appropriate. • Specify grey water collection and water conservation, where possible • Maximize the use of natural lighting and ventilation in BRT station design			
Design of road alignment, road surface,	Extreme weather event due to climate change	Landslide and flooding due to torrential rainfall	• Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts. • Adopt appropriate protective	Design Institute	JPMO	Included in design contract

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
drainage, flood control and lighting			measures such as vegetation cover, geotextiles, settling basins, permeable paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches to reduce the speed of surface run-off. ● Take account of recommendations made in Climate Risk and Vulnerability Analysis study to adopt the high emissions scenario climate change projections as the basis of design for drainage components that would be difficult to replace or repair.			
		Flood control capacity of Yudai River	● Consider potential impacts from extreme storm events due to climate change in designing the flood control capacity of Yudai River. ● Take account of recommendation made in Climate Risk and Vulnerability Analysis study to increase urban drainage capacity and consider the need for a flood water pumping station.	Design Institute	JPMO	Included in design contract
	Ecology	Loss of camphor trees (under national Class II protection) (see Figure IV.5 in the EIA report)	● Technical design of the urban road alignments will avoid the removal of these trees as the primary objective. ● If avoidance is not possible, design replanting schemes for these trees.	Design Institute	JPMO	Included in design contract
	Physical cultural resource	Preservation of old camphor trees (see Table IV.19 in the EIA report)	● Technical design of the urban road alignments MUST avoid all locations with old camphor trees as shown in Table IV.9 in the EIA report.	Design Institute	JPMO	Included in design contract
	Health and safety	Promotion of non-motorized transport, protection of vulnerable road users	● Design must ensure public health and safety. ● Promote non-motorized traffic. ● Ensure barrier-free design for disabled people.	Design Institute	JPMO	Included in design contract
	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance.	Design Institute	JPMO	Included in design contract
	Noise	Road traffic noise	● Technical design of urban roads will include the planting of road-	Design Institute	JPMO	Included in design

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			side woodland buffer for noise mitigation as indicated in the project Environmental Impact Report and Tables V.8 and V.11 in the EIA report			contract
	Water quality	Polluted run-off into Yudai River	● Technical design of urban road drainage to ensure that drainage design and discharge locations minimise risk of pollution of Yudai River. Need for pollution interceptors and treatment should be considered.	Design Institute	JPMO	Included in design contract
Design of Riverside Park	Ecology	Loss of natural habitats	● Retain and incorporate natural habitat features and create new habitats that incorporate requirements of species of conservation value that have been identified in project area of influence. Ecologist to review and provide specialist inputs into the design of the riverside park. ● Adopt soft engineered bankside protection methods where possible. ● Specify species that are in keeping with local environment and are of local provenance.	Design Institute	JPMO	Included in design contract
	Water quality and waste management	Dumping of waste and run-off	● Ensure adequate provision of waste management facilities away from the river that provide options for waste segregation, recycling and reuse. ● Segregate green waste (vegetation waste from park maintenance) from general refuse for composting. ● Provide drainage for car park and other areas of hard standing and ensure that attenuation and discharge points are appropriate.	Design Institute	JPMO	Included in design contract
Pre-construction Stage						
Institutional strengthening	-	Lack of environmental management capacities within JPMO, JMUCIDC and O&M units	● Appoint qualified environment specialist on staff within the JPMO ● Contract loan implementation environment consultant (LIEC) within loan administration consultant services; Conduct environment management training.	JPMO	ADB	JMG
	-	Lack of environmental monitoring	● Contract Ji'an Environmental Monitoring Station (JEMS) to conduct project impact monitoring	JPMO	ADB	JPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
		capability and qualification	during construction.			
			● Contract JEMS to conduct project impact monitoring during the operational stage.	O&M units	JPMO	O&M units
EMP Update	-	-	● Review mitigation measures defined in this EMP, update as required to reflect detailed design, disclose updated EMP on project website.	JPMO, LIEC	ADB	JPMO, Loan implementation TA
Tender documents	Air quality	Dust (TSP) impact to sensitive receptors	Put into tender documents dust suppression measures: ● Provide dust masks to operating personnel; ● Spray water regularly on hauling and access roads to borrow pits (at least once a day) to suppress dust; and erect hoarding around dusty activities; ● Minimize the storage time of construction and demolition wastes on site by regularly removing them off site; ● Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions. Additionally, site asphalt mixing stations at least 300 meters downwind of the nearest residential household; ● Mount protective canvasses on all trucks which transport material that could generate dust; ● Build access and hauling roads at sufficient distances from residential areas, particular, from local schools and hospitals; ● Assign haulage routes and schedules to avoid transport occurring in the central areas, traffic intensive areas or residential areas. For the areas with high-demand on environmental quality, transport should be arranged at night. ● Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use; ● Vehicles with an open load-carrying case, which transport	Design Institute	JPMO; LIEC	Included in tendering agency contract

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin; ● Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads; ● In periods of high wind, dust-generating operations shall not be permitted within 200 m of residential areas. Special precautions need to be applied in the vicinity of sensitive areas such as schools, kindergartens and hospitals; ● Equip material stockpiles and concrete mixing equipment with dust shrouds. For the earthwork management for backfill, measures will include surface press and periodical spraying and covering. The extra earth or dreg should be cleared from the project site in time to avoid long term stockpiling. The height of stockpiles should be less than 0.7m; ● To avoid odor impacts caused by channel cleaning, transport the removed trash quickly to the local landfill. Transport of dredged sediments will be undertaken in closed tank wagons to prevent scattering along the way and impacting the urban area; ● Site temporary dredged sediment storage locations at least 50 m downwind of the nearest residential household; ● Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.			
	Noise	PME noise impact	Put into tender documents the	Design	JPMO;	Included in

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
		to sensitive receptors	following noise mitigation measures: ● During daytime construction, the contractor will ensure that: (i) noise levels from equipment and machinery conform to the PRC standard for Noise Limits for Construction Sites (GB12523-2011) and the WBG EHS Standards, and properly maintain machinery to minimize noise; (ii) equipment with high noise and high vibration are not used near village or township areas and only low noise machinery or the equipment with sound insulation is employed; (iii) sites for asphalt-mixing plants and similar activities will be located at least 300 m away from the nearest sensitive receptor; and (iii) temporary anti-noise barriers or hoardings will be installed around the equipment to shield residences when there are residences within 50 m of the noise source; ● For all the urban roads, there will be no night time (between 2200 and 0600 hours) construction; ● For the BRT corridor, night time construction shall be avoided. Yet, recognizing that construction (e.g. BRT stations) 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 on the BRT corridor if needed should prevent using high sound power level equipment and nearby residents should be notified of such night time activities well beforehand ● Regularly monitor noise at sensitive areas (refer to the monitoring plan). If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the	Institute	LIEC	tendering agency contract

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			situation; ● Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health protection law of the PRC; ● Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition; ● Limit the speed of vehicles travelling on site (less than 8 km/hr), forbid the use of horns unless absolutely necessary, minimize the use of whistles; ● Maintain continual communication with the villages and communities along the road alignments and Yudai River.			
	Water quality	Construction site wastewater, bridge construction and dredging impact on water bodies	Put into tender documents the following measures to treat wastewater and runoff from construction sites and to contain suspended solids dispersion during bridge construction and dredging: ● Portable toilets and small package wastewater treatment plants will be provided on construction sites 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; ● Sedimentation tanks will be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide (PAM) will be used to facilitate sedimentation; ● Construction of road bridge foundations will avoid the rainy season from May to October to minimize potential water quality impact. Mitigation measures such as placement of sandbags or berms around foundation works to	Design Institute	JPMO; LIEC	Included in tendering agency contract

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			contain muddy water runoff will be adopted. Slurry from pile drilling in the river bed will be pumped to shore and properly disposed of. This will reduce the disturbance of sediments and the impact on water quality. Pier construction in Yudai River will be planned and laid out to ensure adequate opening for water flow; ● Dredging in Yudai River will be done in the dry and during the dry season from October to March to minimize potential water quality impact. Sand bags or berms placed around the dredging area will be planned and laid out to ensure adequate opening for water flow; ● Construction machinery will be repaired and washed at special repairing shops. No onsite machine repair and washing shall be allowed; ● Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces, and provided with bunds and cleanup kits; ● The contractors' fuel suppliers must be properly licensed, follow proper protocol for transferring fuel, and must be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88); ● Material stockpiles will be protected against wind and runoff waters which might transport them to surface waters; ● Any spills are to be cleaned up according to PRC norms and codes within 24 hours of the occurrence, with contaminated soils and water treated according to PRC norms and codes. Records must be handed over without delay to the HPMO and HEPB; ● Mitigation of water quality impact during water pumping and			

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			sediment removal at each dredging location will be based on water quality monitoring results. The water quality monitoring approach for dredging works will include, at each dredging location, one control station up current of the location and one impact station down current of the location. When the monitoring result shows that the suspended solids (SS) level at the down current impact station is 130% higher than that at the up current control station, it is indicative of bottom sediment being stirred up and discharged downstream by water pumping or during sediment excavation. The contractor shall reduce the pumping or excavation rate and/or pump the slurry to a sedimentation pond first for settling of SS, until the down current SS level is less than 130% above the upstream SS level; ● Similar monitoring approach will be adopted for mitigating water quality impact during road bridge construction, where up current and down current monitoring stations will be set up and SS levels monitored. When the SS levels at the down current impact station is 130% higher than the SS levels at the up current control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the down current SS level is less than 130% above the upstream SS level.			
	Ecology	Impact on trees and wildlife	Put into tender documents the following ecological mitigation measures: ● All camphor trees at the 3 locations identified in this EIA (see Figure IV.5) must be tagged, conspicuously marked and fenced off before commencement of construction ● Construction workers are prohibited from capturing any	Design Institute	JPMO; LIEC	Included in tendering agency contract

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			wildlife anywhere in the project area and from damaging the camphor trees			
	Physical cultural resources	Preservation of old camphor trees	Put into tender documents the following ecological mitigation measures: ● All old camphor trees at the 3 locations identified in this EIA (see Table IV.19)) must be tagged, conspicuously marked and fenced off before commencement of construction ● Construction workers are prohibited from damaging the old camphor trees	Design Institute	JPMO; LIEC	Included in tendering agency contract
	Solid waste	Disposal or storage of excavated spoil and construction and demolition waste	Specify in tender documents the following mitigation measures: ● Locations of approved spoil disposal and storage sites, other sites cannot be used unless authorized by appropriate agency. ● Approved storage and disposal sites for construction and demolition waste, other sites not to be used.	Design Institute	JPMO; LIEC	Included in tendering agency contract
	Health & safety	Occupational health & safety of workers	Specify in tender documents the provision of personal safety and protective equipment such as safety hats and shoes, eye goggles, respiratory masks, etc. to all construction workers.	Design Institute	JPMO; LIEC	Included in tendering agency contract
Construction traffic	Traffic	Construction vehicles causing traffic congestion	Plan transport routes for construction vehicles and specify in tender documents to forbid vehicles from using other roads and during peak traffic hours.	Design Institute, Local traffic police	JPMO; LIEC	Included in tendering agency contract
Estimated cost for Design and Pre-construction stage: Included in detailed design and contract tender fees						
Construction Stage						
Construction site good practice	Soil resources	Spoil disposal	● Strip and store topsoil in a stockpile for reuse in restoration. ● Use spoil disposal sites approved by YEPB and manage in accordance with approved plan. ● Avoid side casting of spoil on slopes. ● Co-ordinate with water resources bureau monitoring station on effectiveness of soil erosion prevention measures and any need for remedial action. ● Rehabilitate and restore spoil	Contractors	JMUCIDC, ESE, LIEC	Included in the implementation of the approved Soil and Water Conservation Plan

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			disposal sites in accordance with agreed plan. ● Conduct project completion audit to confirm that spoil disposal site rehabilitation meets required standard, contractor liable in case of non-compliance.			
		Soil erosion	● Ensure contractors aware of all soil erosion requirements as set out in the approved plan in the Soil and Water Conservation Report and have developed appropriate method statements and management proposals. ● Avoid rainy season. If necessary, construct berms to direct rainwater runoff away from exposed surface. ● Install drainage ditches and sedimentation tanks in temporary construction areas to prevent soil erosion and to manage run-off. ● Stabilize all cut slopes, embankments and other erosion-prone working areas while works are ongoing. Implement permanent stabilization measures as soon as possible, at least within 30 days. ● Pay close attention to drainage provision and establishment of vegetation cover on backfilled areas to prevent soil erosion. ● If restoration is carried out during periods of hot or extreme weather, ensure adequate aftercare to maximize survival.	Contractor	JMUCIDC, ESE, LIEC	Included in the implementation of the approved Soil and Water Conservation Plan
		Soil contamination	● Properly store petroleum products, hazardous materials and wastes on impervious. ● Develop spill response plan. Keep a stock of absorbent materials (e.g. sand, earth or commercial products) on site to deal with spillages and train staff in their use. ● If there is a spill take immediate action to prevent entering drains, watercourses, unmade ground or porous surfaces. Do not hose the spillage down or use any	Contractor	JMUCIDC, ESE, LIEC	Included in the implementation of the approved Soil and Water Conservation Plan

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			detergents use oil absorbents and dispose of used absorbents at a waste management facility. ● Record any spill events and actions taken in environmental monitoring logs and report to LIEC. ● Properly store petroleum products, hazardous materials and waste in clearly labeled containers on an impermeable surface in secure and covered areas, preferably with a containment tray for any leaks. ● Remove all construction waste from the site to approved waste disposal sites.			
	Air quality	Dust (TSP) during construction	• Provide dust masks to operating personnel; • Spray water regularly on hauling and access roads to borrow pits (at least once a day) to suppress dust; and erect hoarding around dusty activities; • Minimize the storage time of construction and demolition wastes on site by regularly removing them off site; • Equip concrete batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions. Additionally, concrete mixing stations at least 300 meters downwind of the nearest residential household; • Mount protective canvasses on all trucks which transport material that could generate dust; • Build access and hauling roads at sufficient distances from residential areas, particular, from local schools and hospitals; • Assign haulage routes and schedules to avoid transport occurring in the central areas, traffic intensive areas or residential areas. For the areas with high-demand on environmental quality, transport should be arranged at night. • Keep construction vehicles and	Contractor	JMUCIDC, ESE, LIEC	$20,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			machinery in good working order, regularly service and turn off engines when not in use; • Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin; • Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads; • Immediately cleanup all muddy or dusty materials on public roads outside the exits of the works areas. • In periods of high wind, dust-generating operations shall not be permitted within 100 m of residential areas. Special precautions need to be applied in the vicinity of sensitive areas such as schools and hospitals; • Equip material stockpiles and concrete mixing equipment with dust shrouds. For the earthwork management for backfill, measures will include surface press and periodical spraying and covering. The extra earth or dreg should be cleared from the project site in time to avoid long term stockpiling. The height of stockpiles should be less than 0.7m; • Plan the transport routes and time to avoid busy traffic and heavily populated areas when transporting earthy materials; • Immediately plant vegetation in all temporary landtake areas upon completion of construction to prevent dust and soil erosion; • Unauthorized burning of construction and demolition waste material and refuse shall be			

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			subject to penalties for the Contractor, and withholding of payment.			
		Fumes and particulate matter from asphalt mixing plant, concrete batching plant and other equipment and machinery	● Locate asphalt plants and mixers at least 200m downwind from residential areas and other sensitive receptors. ● Enclose these plants and equip them with bag house filter or similar air pollution control equipment. ● Regularly inspect and certify vehicle and equipment emissions and maintain to a high standard.	Contractor	JMUCIDC, ESE, LIEC	
	Noise and vibration	Noise from PME and vehicles	• During daytime construction, the contractor will ensure that: (i) noise levels from equipment and machinery conform to the PRC standard for Noise Limits for Construction Sites (GB12523-2011) and the WBG EHS Standards, and properly maintain machinery to minimize noise; (ii) equipment with high noise and high vibration are not used near village or township areas and only low noise machinery or the equipment with sound insulation is employed; (iii) sites for asphalt-mixing plants and similar activities will be located at least 300 m away from the nearest sensitive receptor; and (iii) temporary anti-noise barriers or hoardings will be installed around the equipment to shield residences when there are residences within 50 m of the noise source; • For all the urban roads, there will be no night time (between 2200 and 0600 hours) construction; • For the BRT corridor, night time construction shall be avoided. Yet, recognizing that construction (e.g. BRT stations) 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 on the BRT corridor if needed	Contractor	JMUCIDC, ESE, LIEC	$30,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			should prevent using high sound power level equipment and nearby residents should be notified of such night time activities well beforehand • Regularly monitor noise at sensitive areas (refer to the monitoring plan). If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; • Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health protection law of the PRC; • Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition; • Limit the speed of vehicles travelling on site (less than 8 km/hr), forbid the use of horns unless absolutely necessary, minimize the use of whistles; • Maintain continual communication with the villages and communities along the road alignments and Yudai River.			
	Water quality	Construction site runoff and wastewater discharge; dredging impact	• Portable toilets and small package wastewater treatment plants will be provided on construction sites 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; • Sedimentation tanks will be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide (PAM) will be used to facilitate sedimentation;	Contractor	JMUCIDC, ESE, LIEC	$20,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			• Construction of road bridge foundations will avoid the rainy season from May to October to minimize potential water quality impact. Mitigation measures such as placement of sandbags or berms around foundation works to contain muddy water runoff will be adopted. Slurry from pile drilling in the river bed will be pumped to shore and properly disposed of. This will reduce the disturbance of sediments and the impact on water quality. Pier construction in Yudai River will be planned and laid out to ensure adequate opening for water flow; • Dredging in Yudai River will be done in the dry and during the dry season from October to March to minimize potential water quality impact. Sand bags or berms placed around the dredging area will be planned and laid out to ensure adequate opening for water flow; • Construction machinery will be repaired and washed at special repairing shops. No onsite machine repair and washing shall be allowed; • Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces, and provided with bunds and cleanup kits; • The contractors' fuel suppliers must be properly licensed, follow proper protocol for transferring fuel, and must be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88); • Material stockpiles will be protected against wind and runoff waters which might transport them to surface waters; • Any spills are to be cleaned up according to PRC norms and codes within 24 hours of the			

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			occurrence, with contaminated soils and water treated according to PRC norms and codes. Records must be handed over without delay to the JPMO and JEPB; • Mitigation of water quality impact during water pumping and sediment removal at each dredging location will be based on water quality monitoring results. The water quality monitoring approach for dredging works will include, at each dredging location, one control station up current of the location and one impact station down current of the location. When the monitoring result shows that the suspended solids (SS) level at the down current impact station is 130% higher than that at the up current control station, it is indicative of bottom sediment being stirred up and discharged downstream by water pumping or during sediment excavation. The contractor shall reduce the pumping or excavation rate and/or pump the slurry to a sedimentation pond first for settling of SS, until the down current SS level is less than 130% above the upstream SS level; • Similar monitoring approach will be adopted for mitigating water quality impact during road bridge construction, where up current and down current monitoring stations will be set up and SS levels monitored. When the SS levels at the down current impact station is 130% higher than the SS levels at the up current control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the down current SS level is less than 130% above the upstream SS level.			

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
	Solid waste	Construction site refuse and spoil disposal	• Temporary storage and permanent disposal of spoil and construction and demolition waste at designated sites only. These sites shall be at least 500 m from any water body. • Transport construction waste in enclosed containers; • Establish enclosed waste collection points on site, with separation of domestic waste and construction waste; • Set up centralized domestic waste collection point and transport offsite for disposal regularly by sanitation department; • Spoil disposal site management and restoration plans will be developed, to be approved by responsible authority; a protocol will be established between the contractors and Ji'an Cityscape Management Department to clarify the spoil quantity and a permit for the clearance of excavated earthwork shall be obtained; • Site restoration will follow the completion of works in full compliance with all applicable standards and specifications, and will be required before final acceptance and payment under the terms of contracts..	Contractor	JMUCIDC, ESE, LIEC	$20,000
	Ecology	Destruction of vegetation	• Construction workers are prohibited from capturing any wildlife during construction; • Construction workers are prohibited from damaging camphor trees • Preserve existing vegetation where no construction activity is planned; • Protect existing trees and grassland during construction; where a tree has to be removed or an area of grassland disturbed, replant trees and re-vegetate the area after construction; • Remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works.	Contractor	JMUCIDC, ESE, LIEC	$10,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
	Physical cultural resources	Destruction of cultural relics in stream bed and soil	● Construction workers are prohibited from damaging the old camphor trees ● Contractor must comply with PRC's *Cultural Relics Protection Law* and *Cultural Relics Protection Law Implementation Regulations* if such relics are discovered, stop work immediately and notify the relevant authorities, adopt protection measures and notify the Security Bureau to protect the site.	Contractor	JMUCIDC, ESE, LIEC	None
	Overall disturbance to communities	Excessive disturbance to communities due to prolonged construction times	● Contractors to identify and adhere to strict schedule for completion of each pipeline section and to avoid prolonged construction, disturbance	Contractor	JMUCIDC, ESE, LIEC	Covered in above costs
Health and Safety	Occupational health and safety	Construction site sanitation	● Effectively clean and disinfect the site. During site formation, spray with phenolated water for disinfection. Disinfect toilets and refuse piles and timely remove solid waste; ● Exterminate rodents on site at least once every 3 months, and exterminate mosquitoes and flies at least twice each year; ● Minimise the risk of fly- or mosquito-borne diseases by maintaining well-drained and hygenic project sites; ● Remove standing water bodies and cover drums and other containers to avoid formation of stagnant water; ● Ensure personnel are aware of potential disease risks; ● Enforce on-site hygiene regulations to prevent litter; ● Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and appoint designated staff responsible for cleaning and disinfection. ● Work camp wastewater shall be discharged into the municipal sewer system or treated on-site with portable system.	Contractor	JMUCIDC, ESE, LIEC	$30,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
		Occupational safety	• Provide safety hats and shoes to all construction workers and enforce their use by the workers; • Provide ear plugs to workers working near noisy PME; • Clearly demarcate all open-cut pipeline trenches and erect barriers on either side of them to prevent injury to workers / the public	Contractor	JMUCIDC, ESE, LIEC	$10,000
		Food safety	• Inspect and supervise food hygiene in cafeteria on site regularly. Cafeteria workers must have valid health permits. • Once food poisoning is discovered, implement effective control measures immediately to prevent it from spreading.	Contractor	JMUCIDC, ESE, LIEC	None
		Disease prevention and safety awareness	• Construction workers must have physical examination before start working on site. If infectious disease is found, the patient must be isolated for treatment to prevent the disease from spreading. From the 2nd year onwards, conduct physical examination on 20% of the workers every year. • Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents. • Specify the persons responsible for health and epidemic prevention, education on food hygiene, and disease prevention, to raise the awareness of workers.	Contractor	JMUCIDC, ESE, LIEC	$20,000
	Community health and safety	Temporary traffic management	• A traffic control and operation plan will be prepared together with the local traffic management authority prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning	**Contractor**, local traffic police	JMUCIDC, ESE, LIEC	JMG (traffic police department)

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			in advance.			
		Information disclosure	• Residents and businesses will be informed in advance through media of the construction activities, given the dates and duration of expected disruption.	Contractor	JMUCIDC, ESE, LIEC	None
		Access to construction sites	• Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc and raising awareness on safety issues. • All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.	Contractor	JMUCIDC, ESE, LIEC	None
		Utility services interruptions	• Assess construction locations in advance for potential disruption to services and identify risks before starting construction. • If temporary disruption is unavoidable, develop a plan to minimize disruption with relevant authorities e.g. power company, water supply company, communication company, and communicate dates and duration in advance to all affected people.	**Contractor**, local service providers	JMUCIDC, ESE, LIEC	None
Grievance redress mechanism	Social & environmental	Handling and resolving complaints on contractors	• Establish a GRM, appoint a GRM coordinator within JPMO. • Brief and provide training to GRM access points (JPMO, JMUCIDC, contractors). • Disclose GRM to affected people before construction begins at the main entrance to each construction site. • Maintain and update a Complaint Register to document all complaints.	Contractor, JPMO, JMUCIDC, ESE, LIEC	JEPB	JPMO budget, Loan implementation Consulting Service
					Estimated cost for the Construction Stage: $160,000	
Operational Stage						
Urban roads and BRT	Traffic	Road and drainage condition	Regularly inspect and maintain the road surface and drainage system.	O&M units	JPMO	O&M Unit's operation budget
		Road safety and	Strictly enforce traffic law to improve	Ji'an traffic	JMG	O&M Unit's

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
corridor		traffic accidents	road safety and reduce traffic accidents.	police		operation budget
	Social, environmental health	Noise mitigation on BRT corridor	To be implemented according to Table V.8 of this EIA	JMUCIDC	JPMO	$140,000
		Noise mitigation on five urban roads	Installation of ventilated double glazed windows at the 28 existing sensitive receptors in Table V.10 of this EIA that show noise level increases of >3dB(A) compared to the existing noise levels, if these receptors are not resettled in or before year 2020.	JMUCIDC	JPMO	$140,000
Yudai River	Social, health and safety	Flood protection	Regularly inspect and maintain river embankment and clean up refuse in the river	O&M units	JPMO	O&M Unit's operation budget
	Water quality	Accident or spillage	O&M Manual to include accident and spill management measures for clean-up and to minimise the spread of pollutants in the event of an incident.	O&M units	JMG	O&M Unit's operation budget
	Water quality	Waste management and minimisation	Park staff to regularly empty waste management receptacles and ensure transfer to appropriate licensed facility. Options for composting of green waste and reuse of recycled water for irrigation to be maximised.	O&M units	JMG	O&M Unit's operation budget
	Ecology	Landscaping aftercare and ecological monitoring	Monitor establishment of rehabilitated and newly created habitats. Monitor the population of target bird species.	O&M units	JMG	O&M Unit's operation budget ***Ad hoc*** (eg. local bird group)
	Emergency response	Extreme rainfall and flood	Respond to early warning of extreme weather events and flood, as per agreed municipality plan.	O&M units	JMG	O&M Unit's operation budget
						Estimated cost for the Operational Stage: $280,000

ADB = Asian Development Bank; EIA = Environmental Impact Assessment; EIR = Environmental Impact Report; ESE = Environmental supervision engineer; JEMS = Ji'an Environmental Monitoring Station; JEPB = Ji'an Environmental Protection Bureau; JMUCIDC = Ji'an Urban Investment and Development Company, Ltd. (JIDC); JMG = Ji'an Municipal Government; JPMO = Ji'an Project Management Office; LIEC = Loan implementation environmental consultant; O&M = operation & maintenance; PME = powered mechanical equipment; SS = suspended solid; TSP = total suspended particles.

D. Monitoring and reporting

15. Three types of project monitoring will be conducted under the EMP. [1]
   (i) Project readiness monitoring. To be conducted by the LIEC.
   (ii) Project impact monitoring. To be conducted by: (a) the Ji'an Environmental Monitoring Station (JEMS) contracted by JPMO; and (b) the contractors, who will be required to conduct frequent noise and air quality monitoring around construction sites and to report monitoring results in the framework of their weekly progress reports to JPMO, JMUCIDC and ESE.
   (iii) Independent evaluation. To be conducted by the ESE (contracted by JPMO) and LIEC (from loan implementation consulting services). To verify EMP compliance during project implementation.

16. ADB will oversee project compliance on the basis of the semi-annual environmental monitoring reports provided by JPMO and site visits (generally 1-2 times/year). Monitoring and reporting arrangements defined for this project are described below.

17. **Project readiness monitoring.** Before construction, the LIEC will assess the project's readiness in terms of environmental management based on a set of indicators (Table EMP-3) and report it to ADB and JPMO. This assessment will demonstrate that environmental commitments are being carried out and environmental management systems are in place before construction starts, or suggest corrective actions to ensure that all requirements are met.

Table EMP-3: Project Readiness Assessment Indicators

Indicator	Criteria	Assessment	
EMP update	• EMP was updated after technical detailed design & approved by ADB	Yes	No
Compliance with loan covenants	• The borrower complies with loan covenants related to project design and environmental management planning	Yes	No
Public involvement effectiveness	• Meaningful consultation completed	Yes	No
	• GRM established with entry points	Yes	No
Environmental Supervision in place	• Loan implementation environmental consultant (LIEC) is in place	Yes	No
	• Staff environment specialists appointed by JPMO and JMUCIDC	Yes	No
	• Environmental supervision engineer (ESE) contracted by JPMO	Yes	No
	• Environment monitoring station contracted by JPMO	Yes	No
Bidding documents and contracts with environmental safeguards	• Bidding documents and contracts incorporating the environmental activities and safeguards listed as loan assurances	Yes	No
	• Bidding documents and contracts incorporating the impact mitigation and environmental management provisions of the EMP	Yes	No
	• Environmental requirements of EMP included in contract documents for construction contracts	Yes	No
EMP financial support	• The required funds have been set aside for EMP implementation	Yes	No

18. **Project impact monitoring.** Table EMP-4 shows the internal environmental impact monitoring program designed for this project, defining the scope, location, parameter, duration and frequency, and responsible agencies, for monitoring during the construction and operational stages. Internal environmental monitoring will include monitoring of air quality, noise, water

[1] In addition to project-specific monitoring, Ji'an EPB will conduct independent ambient and/or enforcement monitoring as per national requirements. This is separate to, and not funded by, the project.

quality and ecology. For air, noise, and water, the monitoring during construction and operation will be conducted by JEMS contracted by JPMO.

19. For monitoring of dredging and bridge construction impacts on water quality, a control station versus impact station approach will be adopted. The monitoring station upstream of the dredging section will function as the control station as it is not to be impacted by dredging activities. The monitoring station downstream of the dredging section will function as the impact station. Any increase in the level of water quality parameter (such as suspended solids; SS) at the impact station compared to the control station is indicative of potential impact due to dredging. If the level of the water quality parameter (mainly SS) at the impact station is >130% of the control station, mitigation measures such as changing the dredging method or reducing the dredging rate will need to be adopted.

20. The internal environmental impact monitoring results will be compared with relevant PRC performance standards (Table EMP-5). Non-compliance with these standards will be highlighted in the monitoring reports. Monitoring results will be (i) submitted by JEMS to JPMO, JMUCIDC and ESE on a monthly basis, and (ii) then reported by JPMO to ADB in semi-annual environmental monitoring reports (prepared with the support of the LIEC–Table EMP-6).

Table EMP-4: Internal Environmental Monitoring Program

Item	Parameter	Monitoring Location	Monitoring Frequency & Durationx	Implementing Entity	Supervising Entity	Estimated Cost
Construction Stage						
Dust and noise	TSP, L_{Aeq}	At boundaries of all construction sites	2 times/day, three times/ week during construction period	Contractor	JMUCIDC, ESE	Included in Contractor budget
Air quality	TSP	28 locations: BRT corridor 1. Jinggangshan University Affiliated Hospital井冈山大学附属医院 2. Ji'an City Center People's Hospital吉安市中心人民医院 3. Taqian Village塔前村 4. Jiangjiafang江家坊 5. Xinfeng Village新丰村 6. Nankeng Village南坑村 7. Jinggangshan National Economic Development Zone井冈山国家经济开发区 Urban roads 8. Baitang Village白塘村 9. Jinluhuayuan金鹭花园 10. Wuli Village Zoujia Village Group五里村邹家村组 11. Wuli Primary School五里小学 12. Jiangbian Village江边村 13. Luogang Village螺冈村 14. Chengshang Village城上村 15. Maobei Village毛背村 16. Baitang Primary School白塘小学	1 day (24-hr continuous sampling) per month when there is construction occurring within 200 m of the monitoring location	JEMS (contracted through JPMO)	JMUCIDC, ESE	$50,000

Item	Parameter	Monitoring Location	Monitoring Frequency & Durationx	Implementing Entity	Supervising Entity	Estimated Cost
		17. Anqian Old Village案前老村 18. Anqian New Village案前新村 19. Ji'an City Disease Prevention and Control Center吉安市疾病预防控制中心 20. Yangminghuayuan阳明花园 21. Dujiafang Village杜家坊村 22. Nan'an Village南岸村 23. Dongtou Village冻头村 24. Laoyangjia Village老杨家村 25. Jiaojialing Village焦家岭村 26. Jinggangshan University Ji'an City Health College井冈山大学吉安市卫生学校 Yudai River 27. Xiazhou Village 下洲村 28. Qiaotou Village 桥头村				
Noise	L_{Aeq}	28 locations (same as for air quality)	2 times per day (day time and night time); 1 day per month when there is construction occurring within 200 m of the monitoring location	JEMS (contracted through JPMO)	JMUCIDC, ESE	$50,000
Water quality	SS, DO, TPH	Yudai River dredging: 2 locations at each dredging section: (1) 50 m upstream of the dredging section (control station), (2) 100 m downstream of the dredging section (impact station) Road bridge construction: 2 locations on the river: (1) 50 m upstream of the bridge alignment (control station), (2) 100 m downstream of the bridge alignment (impact station)	2 times/ day: 1 day per month when there are dredging or bridge construction activities.	JEMS (contracted through JPMO)	JMUCIDC, ESE	$40,000
Operational Stage (first year)						
Air quality	NO_2	26 locations for the urban roads and BRT corridor same as in the construction stage	1 time per day; 2 days per month for 12 consecutive months	JEMS (contracted through O&M units)	JPMO	Included in O&M budget
Noise	L_{Aeq}	26 locations for the urban roads and BRT corridor same as in the construction stage	Two times per day (day time and night time); 2 days per month for 12 consecutive months. Monitoring can cease when 100% compliance is achieved 3 consecutive times at the same site	JEMS (contracted through O&M units)	JPMO	Included in O&M budget
Total estimated cost:						**$140,000**

ESE = Environmental supervision engineer; JEMS = Ji'an Environmental Monitoring Station; JMUCIDC = Ji'an Urban Investment and Development Company, Ltd. (JIDC); JPMO = Ji'an Project Management Office; O&M = operation and maintenance.

Table EMP-5: Monitoring Indicators and Applicable PRC Standards[2]

Phase	Indicator	Standard
Construction	TSP	Class II Ambient Air Quality Standard (GB 3095-1996)
	Noise limits of PME at boundary of construction site	Emission Standard of Environmental Noise for Boundary of Construction Site (GB 12523-2011)
	Water quality during dredging and embankment construction (SS, DO, TPH)	Use control station and impact station approach. If the level at the impact station is >130% of the control station, mitigation measures such as reducing the dredging rate or changing the dredging equipment will be implemented.
Operation	NO_2	Class II Ambient Air Quality Standard (GB 3095-2012)
	Noise	Emission Standard for Industrial Enterprises Noise at Boundary (GB 12348-2008)

Note: DO = dissolved oxygen, NO_2 = nitrogen dioxide, PME = powered mechanical equipment, SS = suspended solids, TPH = total petroleum hydrocarbon, TSP = total suspended particulates.

21. **Independent evaluation.** Independent evaluation of EMP implementation will be undertaken by the ESE and LIEC. The budget for the ESE is estimated at $100,000. The budget for the LIEC will be included in the Loan Implementation Consulting services ($71,000). JPMO will report the LIEC's independent evaluation to ADB on the project's adherence to the EMP, information on project implementation, environmental performance of the contractors, and environmental compliance through quarterly project progress reports and semi-annual environmental monitoring reports (Table EMP-6). The LIEC will support JPMO in developing the semi-annual environmental monitoring reports. The reports should confirm the project's compliance with the EMP and local legislation (including the PRC's EIA requirements), the results of independent evaluation (both contractor compliance with the EMP and the results of environmental monitoring by the JEMS), identify any environment related implementation issues and necessary corrective actions, and reflect these in a corrective action plan. Operation and performance of the project GRM, environmental institutional strengthening and training, and compliance with all covenants under the project will be included in the report.

22. **Monitoring by ADB.** Besides reviewing the semi-annual environment monitoring reports from JPMO and the verification reports from the LIEC, ADB missions will inspect the project progress and implementation on site at least once a year. For environmental issues, inspections will focus mainly on (i) monitoring data; (ii) the implementation status of project performance indicators specified in the loan documents for the environment, environmental compliance, implementation of the EMP, and environmental institutional strengthening and training; (iii) the environmental performance of contractors, LIEC, and JPMO; and (iv) operation and performance of the project GRM. The performance of the contractors in respect of environmental compliance will be recorded and will be considered in the next bid evaluations.

23. **Environmental acceptance monitoring and reporting.** Following the PRC Regulation on Project Completion Environmental Audit (MEP, 2001), within three months after the completion of each project component, an environmental acceptance monitoring and audit report for the component shall be prepared by a licensed environmental monitoring institute. The report will be reviewed and approved by JEPB, and then reported to ADB (Table EMP-6). The environmental acceptance reports of the component completions will indicate the timing,

[2] The project applies PRC standards. A comparison of PRC standards with internationally accepted standards (as defined in the World Bank's Environment Health and Safety Guidelines) was conducted for the EIA. The comparison confirmed that PRC standards are either internationally accepted, or have comparable standard limits with most of the international standards.

extent, effectiveness of completed mitigation and of maintenance, and the needs for additional mitigation measures and monitoring during operations.

Table EMP-6: Reporting Plan

Reports		From	To	Frequency
Construction Phase				
Internal progress reports by contractors	Internal project progress report by construction contractors, including monitoring results	Contractors	JPMO, JMUCIDC, ESE	Monthly
Internal environmental monitoring	Environmental monitoring report	JEMS	JEPB, JPMO JMUCIDC, ESE	Monthly
	Environment progress and monitoring reports	JPMO	ADB	Semi-annual
Acceptance report	Environmental acceptance monitoring and audit report	Licensed institute	JEPB	Once; within 3 months of completion of physical works
Operational Phase				
Internal environmental monitoring	Environmental monitoring report (first year of operation)	JEMS	JEPB, JPMO	Quarterly
	Environment progress and monitoring report	JPMO	ADB	Semi-annual

ADB = Asian Development Bank; ESE = Environmental supervision engineer;; JEMS = Ji'an Environment Monitoring Station; JEPB = Ji'an Environmental Protection Bureau; Ji'an Urban Investment and Development Company, Ltd. (JIDC); JPMO = Ji'an Project Management Office.

E. Institutional Capacity Building and Training

24. The capacity of JPMO, JMUCIDC, O&M units and contractors' staff responsible for EMP implementation and supervision will be strengthened. All parties involved in implementing and supervising the EMP must have an understanding of the goals, methods, and practices of project environmental management. The project will address the lack of capacities and expertise in environmental management through (i) institutional capacity building, and (ii) training.

25. **Institutional strengthening.** The capacities of the JPMO, JMUCIDC and O&M units to coordinate environmental management will be strengthened through a set of measures:

(i) The appointment of at least one qualified environment specialist within the JPMO staff to be in charge of EMP coordination, implementation and site inspections including GRM.
(ii) The commission of an independent ESE by JPMO to provide independent monitoring and verification of EMP implementation
(iii) The appointment of LIEC under the loan implementation consultancy to guide JPMO and JMUCIDC in implementing the EMP and ensure compliance with ADB's Safeguard Policy Statement (SPS 2009).

26. **Training.** JPMO, JMUCIDC, contractors and O&M units will receive training in EMP implementation, supervision, and reporting, and on the Grievance Redress Mechanism (**Table EMP-7**). Training will be facilitated by the LIEC with support of other experts under the loan implementation consultant services. The budget for training is estimated to be $15,000.

Table EMP-7: Training Program

Training	Attendees	Contents	Times	Period (days)	No. of persons	Cost ($/person /day)	Total Cost
EMP adjustment and implementation	JPMO, JMUCIDC, O&M units, contractors	Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting procedures, review of experience (after 12 months)	Twice - Once prior to, and once after the first year of project implementation	2	20	100	$8,000
Grievance Redress Mechanism	JPMO, JMUCIDC, contractors, JEPB	Roles and responsibilities, Procedures, review of experience (after 12 months)	Twice - Once prior to, and once after the first year of project implementation	1	15	100	$3,000
Environmental protection	JPMO, JMUCIDC, contractors	Pollution control on construction sites (air, noise, wastewater, solid waste)	Once (during project implementation)	2	15	100	$3,000
Environmental monitoring	JPMO, JMUCIDC, O&M units, contractors	Monitoring methods, data collection and processing, reporting systems	Once (at beginning of project construction)	1	10	100	$1,000
						Total estimated cost:	**$15,000**

JEPB = Ji'an Environmental Protection Bureau; Ji'an Urban Investment and Development Company, Ltd. (JIDC); JPMO = Ji'an Project Management Office; O&M = operation and maintenance.

27. **Capacity building.** In addition to training for EMP implementation, the project will provide consulting services and training to assist and train the staff of JPMO and JMUCIDC in project management, environmental management, land acquisition and resettlement, procurement, as well as external resettlement and environmental monitoring. The institutional components of the project will also involve training by loan implementation consultants in operation and maintenance of completed facilities. Part of this training will focus on teaching staff how to use a set of indicators to monitor performance of the completed facilities. These indicators will be designed by loan implementation consultants prior to operation start-up.

F. Consultation, Participation and Information Disclosure

28. **Consultation during Project Preparation.** Chapter VII of the EIA describes the public participation and consultation implemented during project preparation.

29. **Future Public Consultation Plan.** Plans for public involvement during construction and operation stages were developed during project preparation. These include public participation in (i) monitoring impacts and mitigation measures during the construction and operation stages; (ii) evaluating environmental and economic benefits and social impacts; and (iii) interviewing the public after the project is completed. These plans will include several types of public involvement, including site visits, workshops, investigation of specific issues, interviews, and public hearings (Table EMP-8). The budget for public consultation is estimated to be $9,000.

Table EMP-8: Public Consultation Plan

Organizer	Format	No. of Times	Subject	Attendees	Budget
Construction Stage					
JPMO	Public consultation & site visit	4 times: 1 time before construction commences and 1 time each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents adjacent to components, representatives of social sectors	$4,000
JPMO	Expert workshop / press conference	As needed based on public consultation	Comments / suggestions on mitigation measures, public opinions	Experts of various sectors, media	$2,000
JPMO	Resettlement survey	As required by relevant resettlement plan	Comments on resettlement, improvement of living conditions, livelihood, and poverty reduction; comments and suggestions	Persons affected by resettlement and relocation	Included in the resettlement plan update survey budget
Operational Stage					
JPMO, O&M Units	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to component sites, social sectors	$1,500
JPMO, O&M Units	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on operational impacts, public opinions	Experts of various sectors, media	$1,500
				Total budget:	**$9,000**

Notes: JPMO = Ji'an Project Management Office; O&M = operation and maintenance.

G. Grievance Redress Mechanism

30. A Grievance Redress Mechanism (GRM) will be established as part of this EMP to receive and manage any public concerns or issues which may arise due to the project. The GRM comprises: (i) a set of clear procedures developed by the JPMO to receive, record, and address any concerns which are lodged; (ii) specific contact individuals at the JPMO and JMUCIDC, and (iii) the Ji'an Environmental Protection Bureau (JEPB).

31. All contractors and work staff will be briefed by the JPMO on the GRM. Contractors and workers will be instructed to be courteous to local residents and, in the event they are approached by the general public with an issue, to immediately halt their work and report the issue to the foreman. The foreman will immediately report the issue to JMUCIDC or JPMO for action.

32. Multiple means of using this mechanism, including face-to-face meetings, written complaints, hotline number and telephone conversations, anonymous drop-boxes for written comments, and/or e-mail, will be available. All concerns received will be treated confidentially and professionally. The identity of individuals will not be circulated among project agencies or staff and will only be shared with senior staff, and then only when there is clear justification. In the construction period and the initial operational period covered by loan covenants, the JPMO will report progress to the ADB, and this will include reporting complaints and their resolution.

33. Basic steps for resolving complaints are as follows and illustrated in Figure EMP-1.

Step 1: For environmental problems during the construction stage, the affected person (AP) can register his/her complaint directly with the contractors, or through GRM access points

(JPMO complaint center hotline, JMUCIDC, JEPB hotline). Contractors are required to set up a complaint hotline and designate a person in charge of handling complaints, and advertise the hotline number at the main entrance to each construction site, together with the hotline number of the JPMO complaint center. The contractors are required to maintain and update a Complaint Register to document all complaints. The contractors are also required to respond to the complainant in writing within 7 calendar days on their proposed solution and how it will be implemented. If the problem is resolved and the complainant is satisfied with the solution, the grievance handling ends here. The contractors are required to report complaints received, handled, resolved and unresolved to the JPMO complaint center immediately, and to JMUCIDC and JPMO monthly (through progress reporting).

Step 2: If no appropriate solution can be found during step 1, the contractor has the obligation to forward the complaint to the JPMO complaint center. The AP may also decide to submit a written or oral complaint to the JPMO complaint center directly, by-passing step 1. A joint hotline for resettlement and environment issues will be established within the JPMO. For an oral complaint, proper written records will be made. Once a complaint is registered and put on file, the JPMO complaints center will immediately notify ADB. The JPMO complaint center will assess the eligibility of the complaint, identify the solution and provide a clear reply for the complainant within five (5) working days. Complaints related to land acquisition and resettlement issues will be directed to the relevant agencies in accordance with the resettlement GRM. The LIEC will assist the JPMO complaint center in addressing the complaint, and replying to the affected person. The JPMO complaint center will also inform the ADB project team and submit all relevant documents. Meanwhile, the JPMO complaint center will timely convey the complaint/grievance and suggested solution to the contractors, JMCIC and/or facility operator. The contractors during construction and the facility operator during operation will implement the agreed upon redress solution and report the outcome to the JPMO complaint center within fifteen (15) working days.

Step 3: In case no solution can be identified by the JPMO complaint center, or the complainant is not satisfied with the proposed solution, the JPMO complaint center will organize, within two (2) weeks, a multi-stakeholder hearing (meeting) involving all relevant stakeholders (including the complainant, JMCIC, contractors, facility operator, JEPB, JPMO). The hearing shall identify a solution acceptable to all, and formulate an action plan.

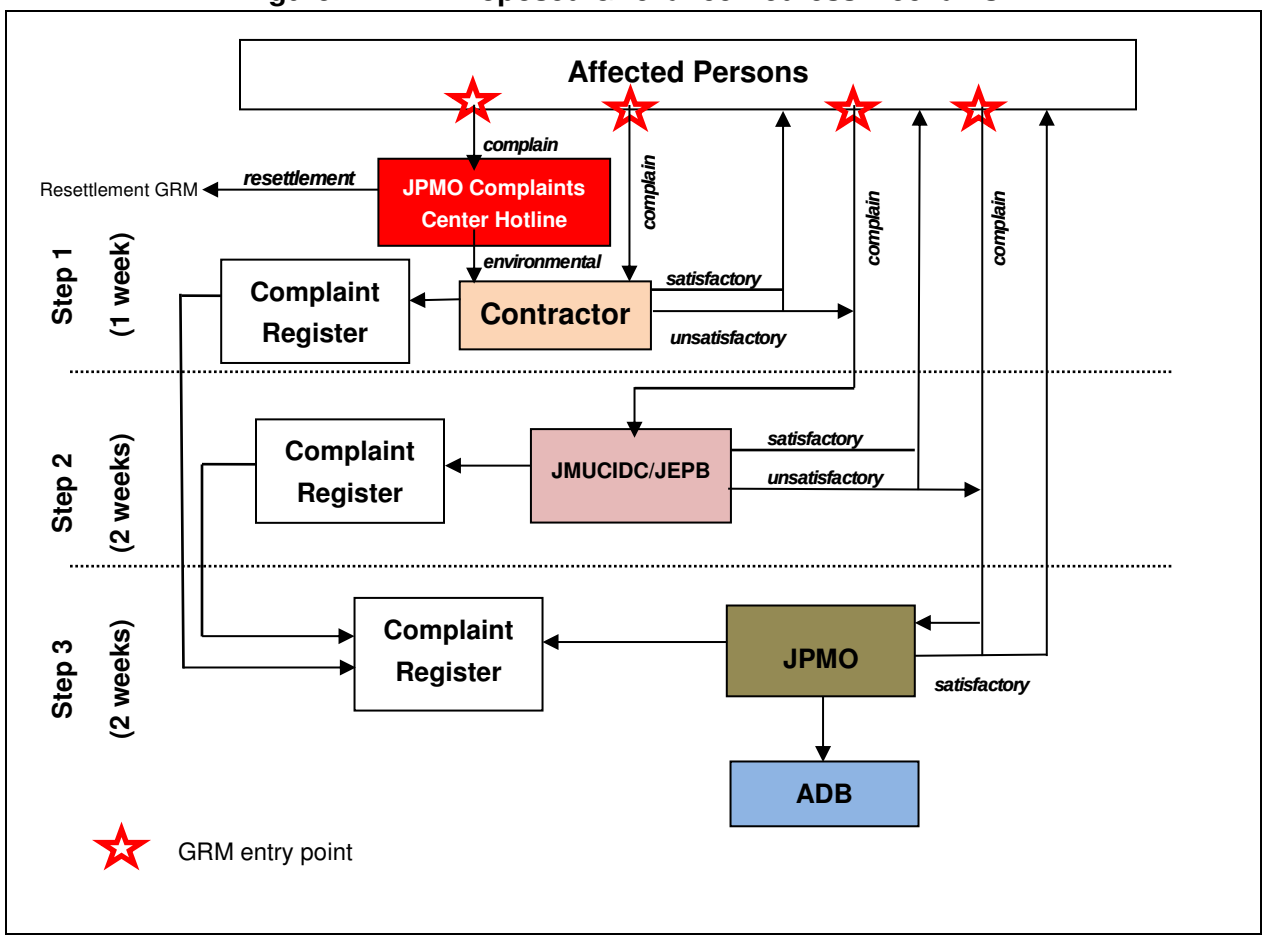
34. The tracking and documenting of grievance resolutions by JPMO will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) regular updating of the GRM database by the JPMO Environment and/or Social Specialist; (iii) processes for informing stakeholders about the status of a case; and (iv) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

35. At any time, an affected person may contact ADB (East Asia Department) directly, including the ADB Resident Mission in the PRC.

36. If the above steps are unsuccessful, persons who are, or may in the future be, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make a good faith effort to solve their problems by working with the concerned ADB operations department.

Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.[3]

Figure EMP-1: Proposed Grievance Redress Mechanism



H. Cost Estimates

37. The total cost for EMP implementation comprises six items: (i) mitigation measures (Table EMP-2), (ii) internal environmental impact monitoring by JEMS (Table EMP-4), (iii) external independent EMP compliance monitoring by ESE, (iv) public consultation (Table EMP-7), (v) training (Table EMP-8), and (vi) the LIEC. The total cost is summarized in Table EMP-9 and is $775,000. The mitigation cost of $440,000 includes a future cost of $280,000 for implementation of traffic noise mitigation measures on the BRT corridor and the five urban roads. The LIEC cost of $71,000 will be funded by the Loan Implementation Consulting services under the ADB loan, while the EA will bear the remaining cost of $704,000.

[3] See: http://compliance.adb.org/.

Table EMP-9: Estimated Budget for Implementation of the Environmental Management Plan

310. EMP Item	Estimated Cost	
	EA Funded	ADB Funded
Mitigation measures	$440,000	---
Internal environmental impact monitoring by JEMS	$140,000	---
External EMP compliance monitoring by ESE	$100,000	---
External monitoring by LIEC	---	$71,000
Training	$15,000	---
Public consultation	$9,000	---
Sub-total	**$704,000**	**$71,000**
Total	**$775,000**	

38. Excluded from the budget are (i) infrastructure costs which relate to environment and public health but which are already included in the project direct costs and (ii) remuneration for the JPMO environment specialist, consulting packages for the non-structural sub-components, and technical experts on equipment operation and maintenance (covered elsewhere in the project budget).

39. JPMO will bear all internal environmental impact monitoring costs during the construction stage and contracting of ESE for independent monitoring and verification of EMP implementation. The O&M units will bear all internal monitoring costs during the operational stage. Contractors will bear the costs for all mitigation measures during construction, including those specified in the tender and contract documents as well as those to mitigate unforeseen impacts due to their construction activities. The O&M units will bear the costs related to mitigation measures during operation.

I. Mechanisms for Feedback and Adjustment

40. The EMP is a living document. The need to update and adjust the EMP will be reviewed when there are design changes, changes in construction methods and program, unfavorable environmental monitoring results or inappropriate monitoring locations, and ineffective or inadequate mitigation measures. Based on environmental monitoring and reporting systems in place, JPMO (with the support of the LIEC) shall assess whether further mitigation measures are required as corrective action, or improvement in environmental management practices are required. JPMO will inform ADB promptly on any changes to the project and needed adjustments to the EMP. The updated EMP will be submitted to ADB for review and approval, and will be disclosed on the ADB and JMG project website.

TA-7965 PRC: Jiangxi Ji'an Sustainable Urban Transport Project - N2 Ecologist/Wetland Specialist (45022-001)

DRAFT TECHNICAL REPORT

Prepared by: Jiang Hongxing

National Ecology/Wetland Specialist (Contract no. 114410-S82581 Var. 1)

2014/10/14

The objective of this assignment is to work with the Design Institutes for the Yudai river rehabilitation and riverside park development during the detailed design to support the integration of ecological design principles to minimize and compensate biodiversity loss.

Acknowledgements

I would like to take this opportunity to sincerely thank all the staff in Jiangxi Ji'an Sustainable Urban Transport Project Management Office, for their full logistical arrangements including the office room, field visits, workshops, interviews with related stakeholders, and opening discussion. In particular, many thanks to Director Mr. Li Zhigui, Ms. Zhang Zhihong (Alice), Mr. Chen Kai, and the driver Mr. Zeng in the Ji'an PMO.

I thank all representatives from Ji'an Environment Protection Bureau, Ji'an Construction Bureau, Ji'an Water Resources Bureau, Ji'an Landscape Management Bureau and Ji'an Municipal Urban Construction Investment and Development Co., Ltd. (JMUCIDC), who attended and contributed to the discussion workshop. Many thanks for your time, active involvement and fruitful discussion.

I am grateful to Director Huang Chun from the Ji'an Forestry Bureau, for the detailed introduction of the Luohuwan Wetland Park. I also appreciate two working staff from the Ji'an Hydrology Bureau for their detailed introduction of water systems in Ji'an City including the Luohu water system.

Finally, I sincerely express my appreciation to the staff of Shanghai Urban Construction and Design Research Institute, and Jiangxi Zhong-Chang Engineering Consultation and Supervision Co. Ltd for their support and collaboration, especially to Mr. Gao Weihua, Hu Jun, and Zhu Pinghua.

Without all of your help and support, it is hard for me to accomplish my tasks in an effective and smooth way.

Contents

Summary

Ji'an City is located in the mid-western region of Jiangxi Province, eastern China. The project area of Jiangxi Ji'an Sustainable Urban Transportation Project is situated in the planned new western city development area. The proposed Chang-Ji-Gan High-speed railway is the major stimulator to develop a new western district in Ji'an City. Meanwhile, the project area is adjacent to the Daguang (Daqing-Guangzhou) expressway in the west, and the Chengbei connecting line in the north. The development of a new western city development district has been given high priority for construction under 11th five-year plan.

This project will have a significant accelerator for promoting the economic and social development of the region in a sustainable manner, and closing the gap between Ji'an and more developed areas in China. The project includes five components: public transportation, river rehabilitation, urban roads, traffic management and capacity development.

The project area of Yudai River Rehabilitation Sub-Project is located in the front of the planned high-speed railway station, and in the middle of the new western city development area. The Yudai River is the first class tributary of Gan River, which is one of five major rivers feeding water into the largest fresh lake: Poyang Lake in China. The project includes works to alleviate flood risk, and landscaping to create a new riverside park and recreational resources for the city.

The length of river rehabilitation is 8.02 km, including 5.3 km of south and main channels, and 2.73 km of north channel of Yudai River. The project area is 1622.002 mu (c. 108.133 hectares). The improved river is expected to create a more attractive environment for the city, improving the life quality of local citizen, and maintain natural ecological systems and functions as well.

The objective of this consultancy assignment is to work with Design Institutes for the Yudai River rehabilitation and riverside park development to support the integration of ecological design principles to minimize and compensate biodiversity loss. This has been achieved through data review, site visit, consultation with local stakeholders, interviews with relevant representatives, and experts' knowledge.

In the period of my inputs, one discussion workshop was organized to achieve the agreement on the design recommendations among the relevant stakeholders. Four interviews with key staff from different governmental organizations were conducted to acquire the basic information of similar works in project area, and discuss the project impacts and their expectations. Meanwhile, extensive discussions were conducted with the local PMO, Design Institutes for the Yudai River Rehabilitation Sub-Project and the whole JI'an Sustainable Urban Transportation Project.

The major adjustments for the project design include optimizing the project functional zoning, e.g. consolidating the landscape configuration with river rehabilitation works for each functional zone in a systematic way and taking into account of the needs of water quality for the lower wetland park; creating the diverse landscapes to match with the ecological requirements of each functional zone and maximum the local biodiversity, e.g. woodland

dominated in urban countryside park, shrub dominated in shallow marshes, and aquatic plants dominated in water treatment unit; and improving the infrastructures structure for flood protection works, e.g. constructing the sluice gate on either the left or right side of each cofferdams and introducing the rubber dams to ensure flood water passing smoothly as required.

The improvements to benefit to the ecology include: (1) Creating a landscape complex including the woodland, shrub, grassland, wet meadow, deep and shallow marshes to maintain the endemic communities of wild fauna and flora, and to match with the functional demands of three components; (2) Applying ecological rehabilitation technique to maintain the nature of the river bed and river bank, except in the areas with water income, water outcome, high water speed and drainage nodes, where the solid treatment is designed to reduce the erosion of soil and bank. (3) Dividing the embankment improvements into two levels to keep the native grass and aquatic plant along the upper slope, and prevent the erosion along the lower slope.

This report consists of five sections. The section one introduces the backgrounds of Jiangxi Ji'an Sustainable Transportation Project and proposed Yudai River Rehabilitation Sub-Project. The section two outlines the hydrological and ecological status of Yudai River, which also underlies the ecological considerations in the project design. The section three presents the original design and proposed functional zonation of landscape works, and improvements to benefit to the ecology. The section four delineates the original design and integrative recommendations on flood protection works, and improvements to benefit to the ecology. The section five outlines the other technical matters including rationale for adjustment of project functional zonation, issues and solutions in the period of my inputs, and important information requirements during construction and operation.

1 Introduction

1.1 Background of Jiangxi Ji'an Sustainable Urban Transportation Project

Ji'an City is located in the mid-western region of Jiangxi Province, eastern China. The project area of Jiangxi Ji'an Sustainable Urban Transportation Project is situated in the planned new development area of western Ji'an City as showed in **Figure 1.1**.

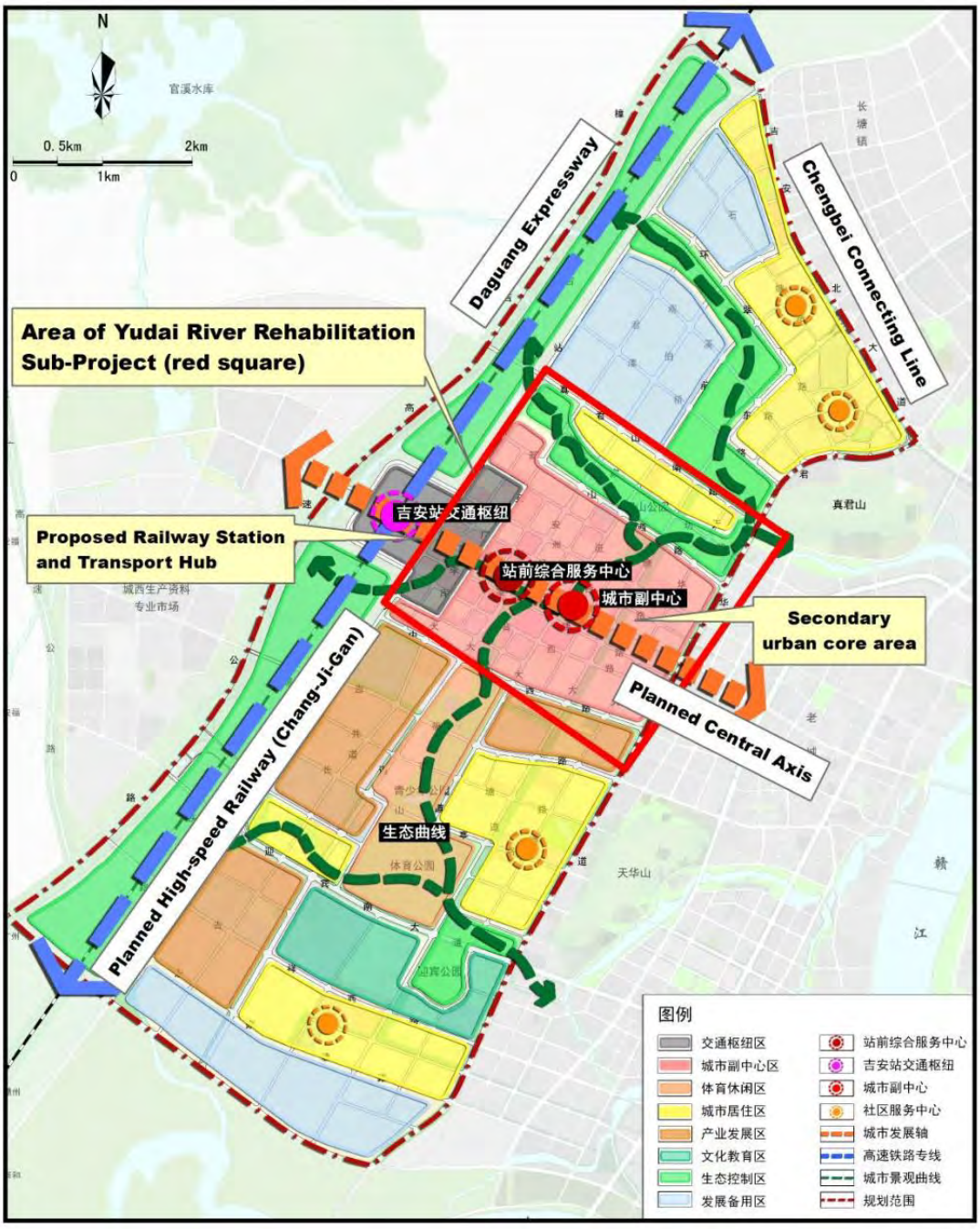


Figure 1.1 Location of planned new western city development area by 2020. The green dashed arrow lines represent the planned river system, which is mainly created on the existing Yudai River and its tributaries. (sourced from detailed plan for western city new development area)

The proposed Chang-Ji-Gan High-speed railway is the major stimulator to develop a new western district in Ji'an City. The proposed intercity railway will facilitate the flow of people, goods and services between the big cities in Jiangxi Province. Meanwhile, the project area is adjacent to the Daguang (Daqing-Guangzhou) expressway in the west, and the Chengbei connecting line in the north (**Figure 1.1**). This indicates the area holds geographical significance to the wider transport network.

The development of a new western city development district has been given high priority for construction under 11th five-year plan. As a part of the Ji'an urban development strategy, the new western development area has been designated as a preferred location for future population expansion and land development. The area of planned new western district is approximately 50 square kilometers, and a planned population is approximately 300 thousand by 2030. It will consolidate commercial, residential, logistical, business services, and recreational development into an integrated, high-quality, efficient, and multi-functional new urban area. The area will be developed along a central axis connecting the new railway station (not part of this project) and the old urban area, and also along the Yudai River ecological belt.

This project will have a significant accelerator for promoting the economic and social development of the region in a sustainable manner, and closing the gap between Ji'an and more developed areas in China. The project includes five components: the development of a new Bus Rapid Transit (BRT) system and an intermodal hub, rehabilitation of the Yudai River to improve flood capacity and creation of a new riverside park construction of five new urban roads, traffic management and institutional capacity building.

1.2 Background of Yudai River Rehabilitation Sub-Project

Yudai River is an inland river running through the main part of the western new development area as showed in **Figure 1.2**. The Yudai River Rehabilitation Sub-Project is one of five components of Jiangxi Ji'an Sustainable Urban Transportation Project. The river is the first class tributary of Gan River, which is one of five rivers (the other four rivers include Fu River, Xin River, Rao River, and Xiu River) feeding into the largest fresh lake in China – Poyang Lake. The Yudai River is also named as Luohu water system. The water was mainly used for the irrigation along both sides of river. The river is winding and the drainage is poor. There are many small branches and ponds distributed along the river, which can mitigate the flood to some extent. In flooding seasons, the farmland on both sides would be flooded frequently. The occurrence of flood is mainly attributed to the big rainfall in this catchment area and high water level of lower reaches caused by the flood in Gan River.

The new western city development area is planning to be developed along both sides of the Yudai River. For this reason, the river needs to be improved to ensure the new town will not be flooded, and also provide the recreational services for the local residents. The proposed river rehabilitation project will improve not only the flood protection capacity of the inner urban area at the river reaches, but also the ecological environment of Ji'an City.

The proposed project area is located in the lower reaches of Yudai River, which is surrounded by four roads as Zhanqian Avenue in the north, Zhenjun Avenue in the south, Shaoshan West Road in the east, and Zhongshan West Road in the west **(Figure 1.3)**. The length of the river

within the project area is 8.02km, including 5.3 km of south branch and main river, and 2.72km of north branch. The current land use and land cover is shown in **Figure 1.2**, which include forest, farmland, residential area, river course and pond. The planned land use is shown in **Figure 1.3**, which include business area, residential area, culture land, reserved land, and landscape land.

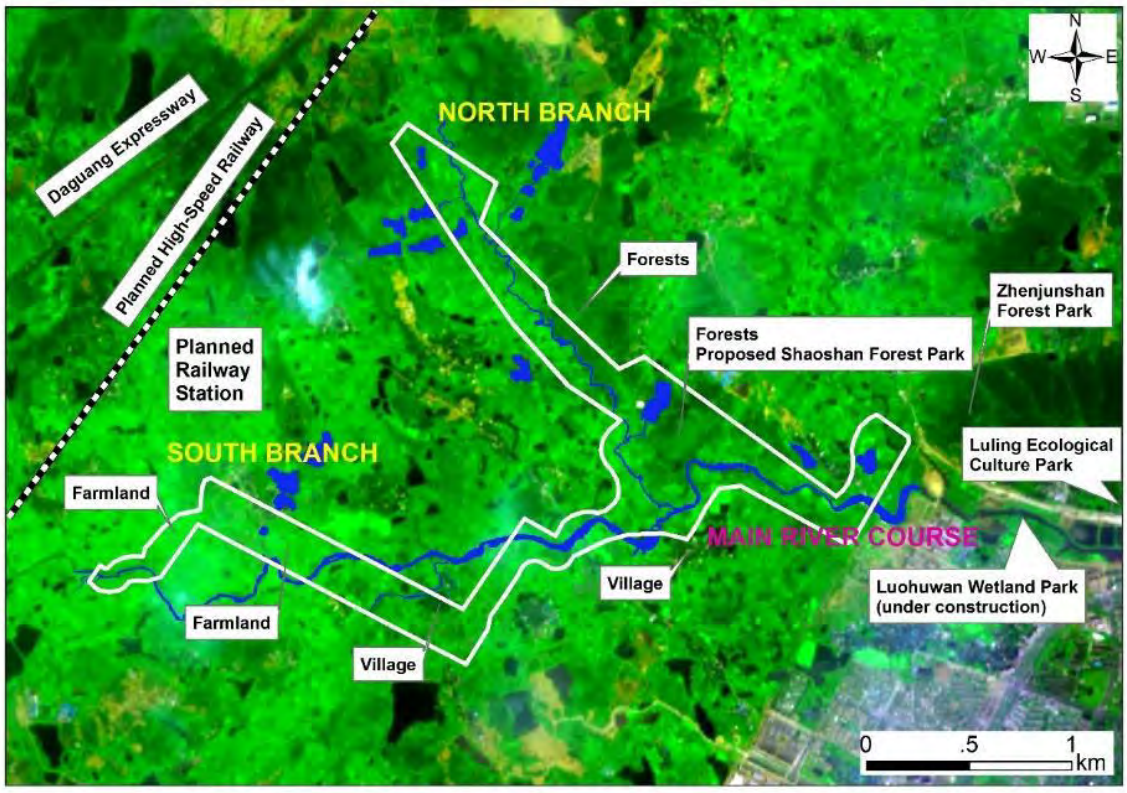


Figure 1.2 The current Land use and cover of Yudai River Rehabilitation Project Area (China ZY3 image acquired on June 13 2014, spatial resolution 5.8 × 5.8 m). The white polygon shows the proposed project area.

The Yudai River rehabilitation will involve works to alleviate flood risk, and landscaping to create a new riverside park and recreational resource for the city. The general design for the project was drafted by October 2013, and reviewed in one discussion workshop after then. The updated landscape improvement report was developed by February 2014, which is in the PPT format. The updated flood protection report was updated by June 2014.

The improved river is expected to create a more attractive environment for the city, improving quality of life while maintaining natural ecological systems and functions. The design concept is developed around the theme of a people-centered, low-carbon-sustainable development. This component would benefit the promotion of the image of the city as well as the land value. As this proposed area is strategically located in front of the planned high speed railway station, a synergy of benefits of the new urban roads, Yudai River rehabilitation, and the social and economic development of the city is also expected.

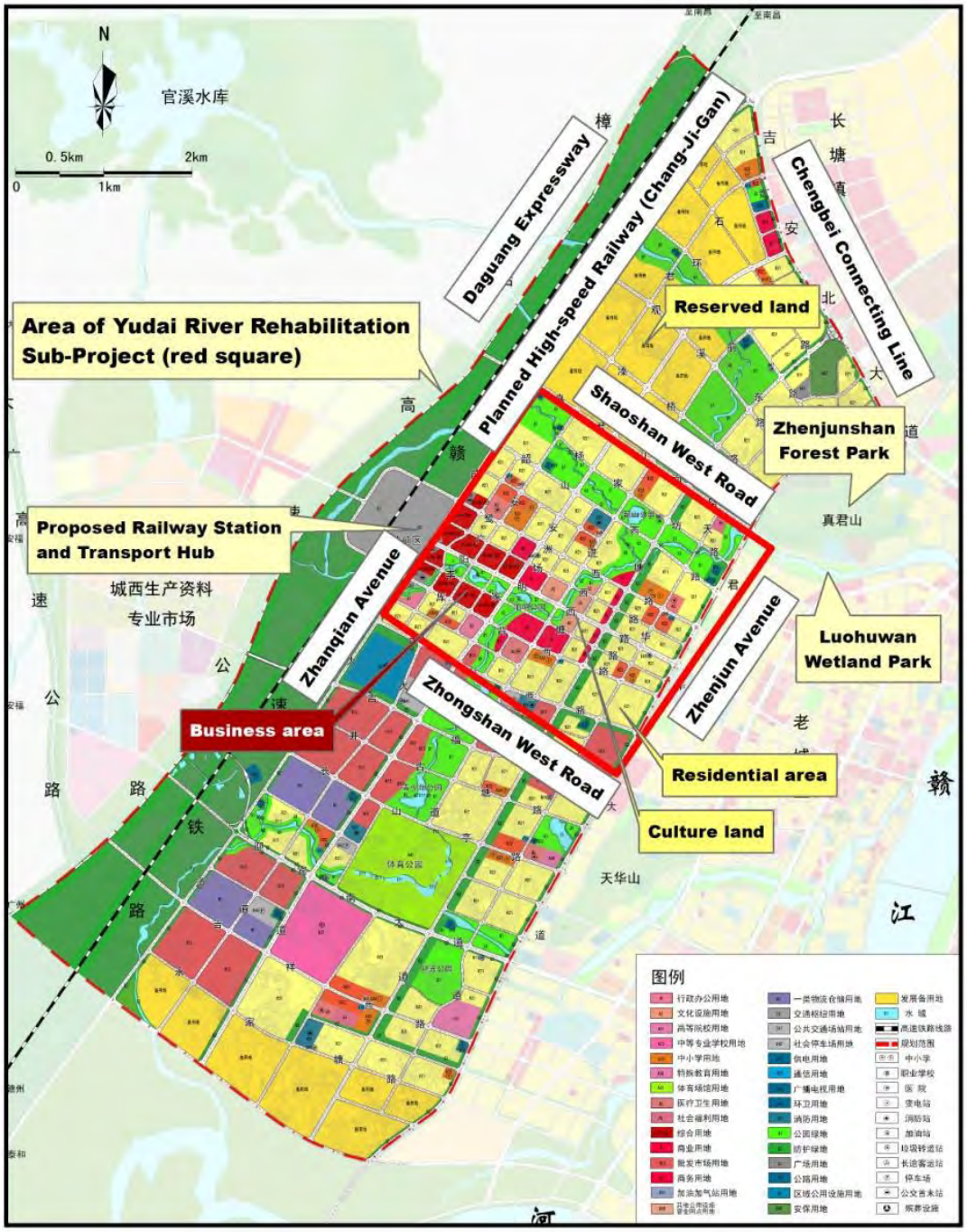


Figure 1.3 The planned land use and land cover of Yudai river rehabilitation project area

1.3 Objectives of this consulting assignment

The objectives of this consultant is to work with the Design Institutes for the Yudai river rehabilitation and riverside park development during the detailed design to support the integration of ecological design principles to minimize and compensate biodiversity loss: (a) maximize opportunities to retain existing riverine habitats, species and features of value; and (b) incorporate new habitats and features of value for local biodiversity.

The specific tasks include the data review, site visit, ecological design recommendations, and

integration of design recommendations.

1.4 Main Activities and Deliverables

I had the field works in Ji'an City from July 7 to July 23 2014. The key tasks have carried out as the below:

(1) Collection of all available project materials and documents as summarized in **appendix I**.

(2) Extensive discussions and meetings with the local PMO and Design Institutes for Planning Scheme (general design) for the Yudai River Rehabilitation Sub-Project, and the Feasibility Study Report for the whole project.

(3) Interviews with key staff in Ji'an Forestry Bureau, Ji'an Water Resources Bureau, Luohuwan Wetland Park and Luling Culture Ecology Park, to collect additional information to address the project impacts and improve the proposed design.

(4) One workshop organized in the PMO meeting room to discuss the proposed project design and reach agreement between the stakeholders. The minutes of workshop is shown in **appendix II** in Chinese.

(5) Site visit to the proposed area for Yudai River Rehabilitation Sub-Project conducted, which also include the surrounding similar works such as Luohuwan Wetland Park and Luling Ecological Culture Park.

Main deliverables are the follows:

(1) PowerPoint presentation in the discussion workshop (**appendix III**), which was developed with the staff of Design Institute based on the preliminary agreement on my recommendations between the PMO, Design Institute.

(2) Minutes of the workshop, which have been reached agreement among stakeholders.

(3) Technical recommendations including the project functional zonation, landscape works, flood protection works, and other technical matters related to general project design.

2 Current Status of Yudai River

2.1 Hydrological status of Yudai River

Yudai River is the first class tributary of Gan River, which is originated at Lijiatian of Xingqiao Town of Jizhuo District and feeds into Gan River at Luohu Bridge of former diesel engine factory. The length of main river course is 22.2 km and the catchment area is 89.2 km^2 with average slope of 1.64 ‰. The average annual rainfall is 1450 mm, annual evaporation is 1060 mm, and annual water flow is 74 million m^3. The water of Yudai River is mainly used for irrigation along both sides of river course.

The area belongs to subtropical monsoon climate zone. The monthly rainfall mainly occurred from April to June, which accounts for 40% of annual rainfall. The evaporation in these three months occupies 20% of that in one year. The flood would occur in summer season if the continuous high water level of Gan River in the same period. With the construction of reservoirs and ponds, and agriculture development, the flood occurrence was reduced in the upper reaches since 1970s. The current flood mainly occurs in the middle and lower reaches of Yudai River.

The rainfall from July to September accounts for less than 30% and the evaporation occupies 44%. However, these three months also are the growth seasons for crops. Accordingly, the drought would frequently occur in fall season. In addition, the water flow would break at some locations in winter season of some years due to the poor rainfall.

Actually, the Yudai River is the small tributary of Gan River. There are five main tributaries feed the water to Gan River, including Helu River, Wu River, Suichuan River, Gu River and Shu River. Only Maobei hydrologic station at Liangyuan Village was established along Yudai River in 1975 and ended in 2004.

In the project design document, the Design Institute did not calculate the water supply and demand of the whole catchment, and estimate water use and consumption of the project area.

2.2 Ecological status of Yudai River

The baseline data of ecological status was mainly referred to the Environmental Impact Report, which was develped by the specialists from the Jiangxi Environmental Protection and Scientific Research Institute in 2013. The bird list herewith is sourced from the bird banding station of Suichuan County, which is about 100 km away from the northwest of Ji'an City.

2.2.1 Vegetation

The vegetation in the project area include natural vegetation such as warm climate coniferous woodland, broad leaf deciduous woodland, evergreen broad leaf woodland, bamboo woodland, shrub, and shrub-grass land; and planted vegetation such as timber woodland, orchards, food crops and economic crops.

These vegetation types were dominated by common plant species, with only the Camphor Tree (*Cinnamomum camphora*) being a protected species (national Class II protection).

Camphor Trees are widely distributed in southern and southwestern PRC, which are widely planted for urban landscaping and greening in PRC cities. Camphor Tree colonies were found to be among the dominant species in the evergreen broad leaf woodlands in the project area. There is no old and/or wild camphor trees distributed in the proposed river rehabilitation project area.

2.2.2 Amphibians, reptiles and mammals

For amphibians, three families, six species of toads and frogs were recorded in the project area. Two species, the Zhoushan Toad and the Black-spotted Pond Frog are on the provincial protection list. None of the species are under national or IUCN protection status.

For reptiles, two orders, ten species were recorded. Of them, four species of snakes are under provincial protection. None of the species are under national or IUCN protection status.

For mammals, four orders, eight species were recorded. Only Siberian Weasel is under provincial protection. None of the species are under national or IUCN protection status.

2.2.3 Birds

For birds, 34 species were recorded in the Environmental Impact Report. 16 species are in the provincial protection list but none are in the national protection list. Only the Yellow-breasted Bunting was recently upgraded from 'vulnerable' to 'endangered' by the IUCN. The main concern is the species has undergone a very rapid population decline due to the abundant trapping in the stopover sites and wintering grounds.

The banded bird list in Suichuan Bird Banding Station includes 13 orders, 46 families, 193 species (**Appendix V**). The station is about 100 km away from the northwest of project area. We assume the majority of these birds would also distribute in this area.

According to the banded list, three species including Fairy Pitta, Black-throated Robin and Brown-chested Jungle Flycatcher are recognized as the vulnerable, and one species as Yellow-breasted Bunting as the endangered by the IUCN. In addition, seven species are categorized as the class II of national protection animals, such as Spotted Scops Owl, Collared Scops Owl, Oriental Scops Owl, Collared Pygmy Owl, Cuckoo Owl, Brown Hawk Owl, and Fariy Pitta.

2.2.4 Aquatic biota

The project environmental impact report describes the aquatic vascular plants in the project area were dominated by Lotus (*Nelumbo nucifera*), Common Reed (*Phragmites australis*), Bullrush (*Typha orientalis*), Water Caltrop (*Trapa natans*), Alligator Weed (*Alternanthera philoxeroides*), Tape Grass (*Vallisneria natans*)，Three-leaf Arrowhead (*Sagittaria trifolia*)，Common Duckweed (*Lemna minor*) and Greater Duckweed (*Spirodela polyrhiza*). The wild Lotus is under national Class II protection. However, the lotus in this area is only wild, but the artificial plantation.

For the others including the phytoplankton, zooplankton, benthic organisms and fishes, all of them are commonly and widely distributed in eastern China.

2.2.5 Protected area

The project area is mainly composed of artificial landscapes including farmland, woodland, and residential area. Human distances are very frequent in these land covers. The patch of natural landscape such as river channels/water bodies and flood land cover is not extensive, and water inflow velocity is 2.0-2.5 m/s. There are no protected areas, fish spawning ground, concentrated bird breeding, stop-over and wintering grounds, wetlands of importance and nature reserves within the project area. If buried artifacts will be discovered during construction, they will be dealt with in accordance with PRC's Cultural Relics Protection Law.

Generally, there are approximately three bird species as globally vulnerable, one bird species as globally endangered, five bird species of national protection Class II (including one vulnerable species), and the wild Camphor Tree of national protection Class II in the project area. In the project landscape design, more attention should be not only given to the above species, but also to creating diverse habitats for birds, and other animals.

3 Project Functional Zonation and Landscape Works

3.1 Original Landscape Design and Zonation

The landscaping works will provide a riverside park for recreation and leisure activities. The proposed area was divided into three zones, which were included in the first draft of general design document in October of 2013, and in the Feasibility Study Report in July of 2014. However, the updated landscape improvement report in February of 2014 presented four zones for the landscape works as showed in **Figure 3.1**. The only difference is that former zone one was divided into two zones as zone one and zone two. The main purpose is to emphasize the recreational function in the current zone two. The locations and functions of three zones are the follows:

Zone I (the below zone I and zone II): Located around the main corridor, planned high speed rail station, and planned Yangming West Road. Landscaping is styled as grand and open space. The zone will provide ecological scenic woodland, public education and outdoor recreation.

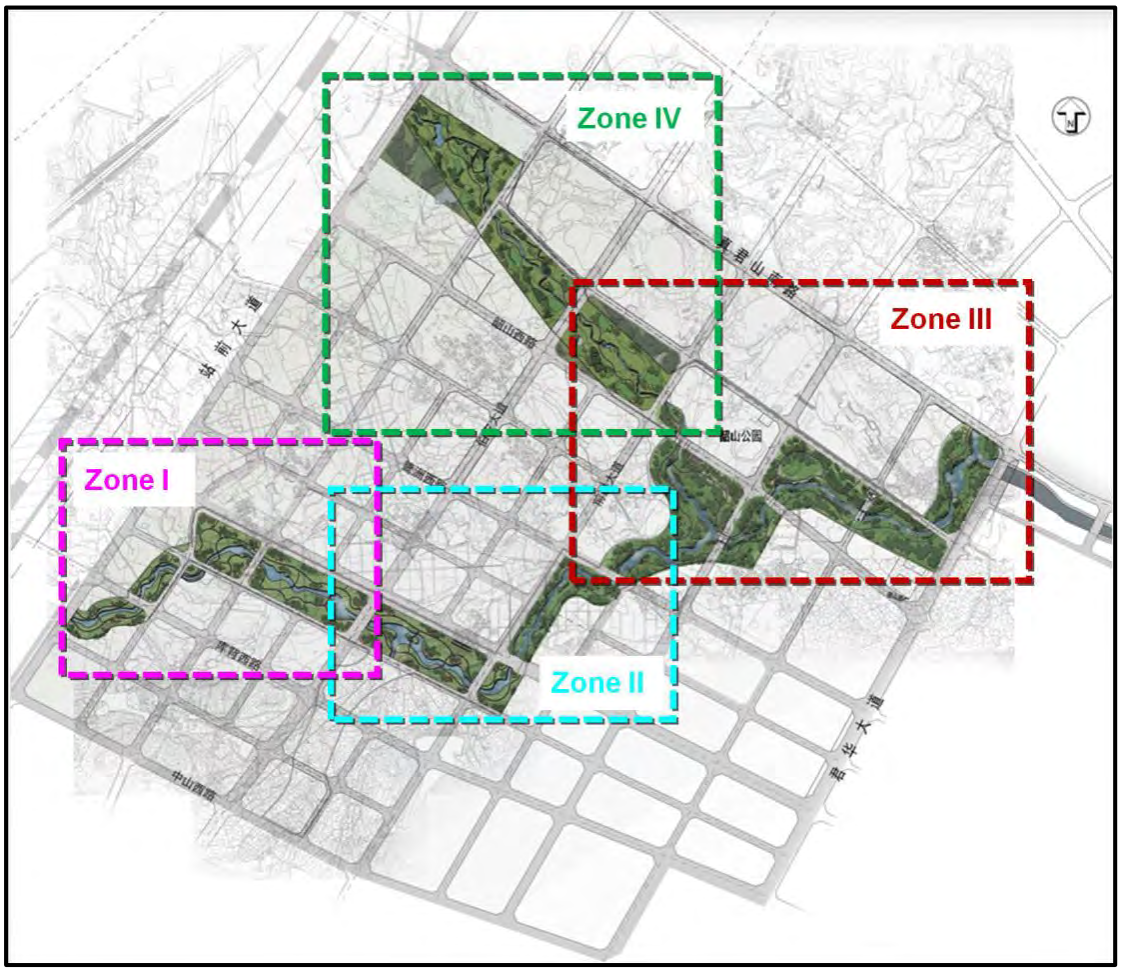


Figure 3.1 Proposed landscape zones of Yudai river rehabilitation project area

Zone II (the above zone III): Located near planned Shaoshan Forest Park. The section of river is wide and pedestrian flows would be high. There will be some commercial development

around the river bank. In conjunction with Shaoshan Park, a riverfront park will be developed, and recreational facilities will be provided.

Zone III (the above zone IV): Located at residential area where the water course is narrow. Ecological design principles will be adopted to minimize disruption to the natural environment. The creation of wetlands is proposed to follow the natural landform.

The landscaping works will create a riverside park and promenade, the design proposes soft engineered approaches and incorporation of ecological features to create a new amenity resource that is in keeping with the natural environment. The park will include woodland, and lawn areas, pedestrian paths, bicycle trails, a car park and associated facilities including lighting, service areas for leisure activities and street furniture.

Generally, the original landscape zonation is consistent with the current landform and proposed land use plan in the Detailed Plan for Western City New Development Area. It was not fully taken into account of the current land cover types, the ecological requirements of local wildlife with special interests, and the needs of Luohuwan Wetland Park and Luling Ecological Culture Park in the lower reaches.

Secondly, the original landscape zoning is separated from the Yudai River flood protection works. The landform construction did not present in details, which was attributed to the unavailability of fine resolution topography map. The landscape configuration should match with the landform construction, and the general landscape view.

3.2 Recommendations on Functional Zonation and Landscape Works

Based on the above considerations and agreement among the stakeholders, the proposed project zonation consists of three components: urban recreational zone, wetland functional zone, and ecological agriculture zone (**Figure 3.2**). The main functions and detailed management units (**Figure 3.3**) for each zone are as the follows:

3.2.1 Urban recreational zone

The urban recreational zone is located in the south branch of Yudai River. The average width of river course is 15 m, ranging from 10 to 20 m. The current land cover types consist of residential area, farmland and river course and ponds (**Figure 1.2**). The planned land use includes business area and culture area (**Figure 1.3**).

The zone is proposed to be divided into water retention zone, urban countryside park and shallow marshes (mixed with shrub, wet meadow and shallow wetlands). The main purpose is to provide the near-wild recreational place for the city citizen, clean the large and solid trash and supply the clear water for the lower reaches.

The landscape works in the water retention unit had better to be the local flowering lawn. This design can reduce the solid wastes in the water body such as leaf and branch, and help to remove the solid trash from the upper reaches.

The landscape works in the urban countryside park should be dominated by the sparse forest and grassland. The landscape would be flat with the slight slope along the both sides of river course. The newly developed river course should be close to the Yangming West Road to

increase the viewing opportunity.

The landscape works in the shallow marshes should include the shrub, grass, and wetland plants, which can provide nesting, sheltering and feeding habitats for amphibians, reptiles, and birds, especially for the globally endangered Yellow-breasted Bunting.

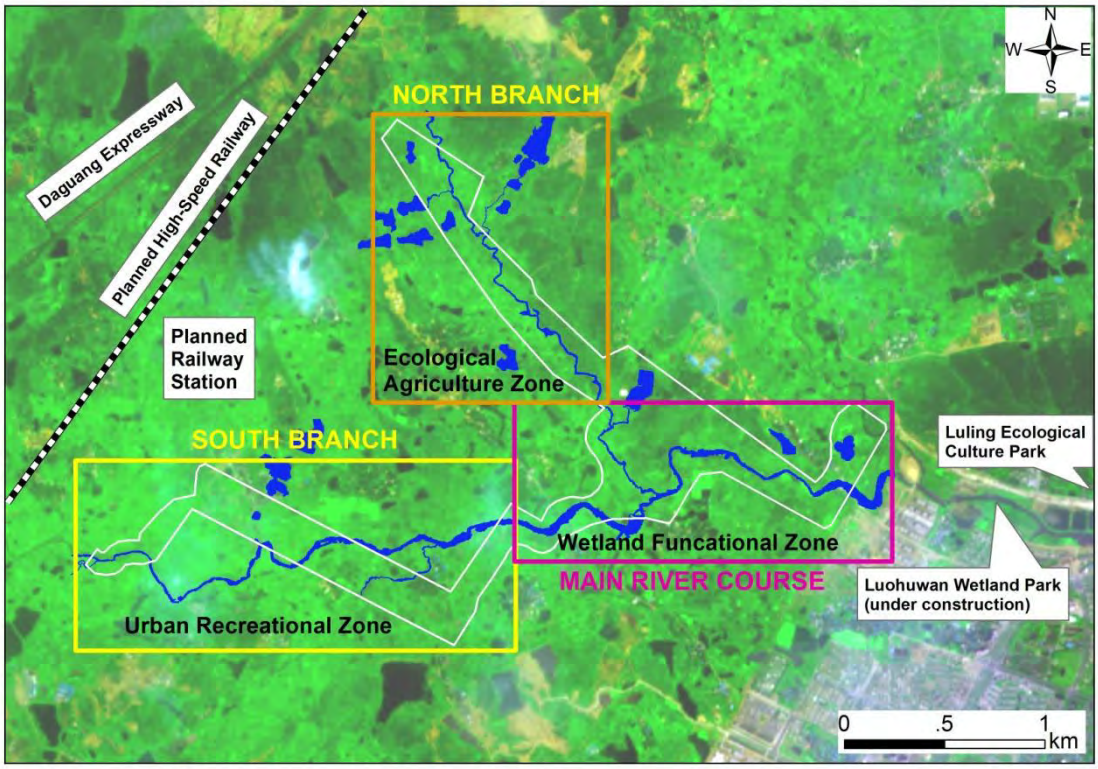


Figure 3.2 The proposed functional zones of Yudai River Rehabilitation Project Area

3.2.2 Wetland functional zone

The wetland functional zone is located in the main branch of Yudai River. The average width of river course is similar with that of south branch. The current land cover types are the similar with the urban recreational zone **(Figure 1.2)**. The planned land use mainly is the residential land (**Figure 1.3**).

The zone will be divided into water treatment unit and deep marshes (reed belt along both sides of river course). The main purpose is to create the new wetland to purify the water. The zone can also provide the healthy water for the lower Luohuwan Wetland Park and Luling Ecological Culture Park, and opportunities for public interaction with the environment, such as interpretation information.

Landscape works include to plant aquatic plants such as reed and cattail in the water body to purify the water quality, and sparse arbor such as willow and metasequoia, and local flowering lawn in the surrounding land to create the public recreation and interaction. The general landscape view should be open and flat.

3.2.3 Ecological agriculture zone

The ecological agriculture zone is located in the north branch of Yudai River. The average

width of river course is 2 m, ranging from 2 to 4 m. There are two mountains in the east part of north branch. It is not recommended to flatten the mountains (**Figure 1.2**). On the contrary, the organic orchards are proposed to match with the existing landform. Meanwhile, the woodland also provides habitats for nationally protected owls and the other forest birds.

In addition, this area is not given the high priority to be developed in the current detailed plan for the new western city development area (**Figure 1.3**). The design will respect the local plants and trees within the site, taking the weak principle of intervention and pursuing natural, rustic charm.

The zone will be divided into the natural conservation zone and organic orchards. The main purpose is to provide the outdoor expanded training to raise the teamwork spirit and innovation ability, increase employment opportunity and economic incomes for local people, and also create the agriculture expedition for city citizen.

Taking into account of the cost-effectiveness, landscape works in the natural conservation unit mainly plant the local plants and trees to foster the local vegetation communities. The organic agriculture unit can be divided into two parts. One side near the mountains can be the organic orchards, and the other side would be the organic vegetables and melons.

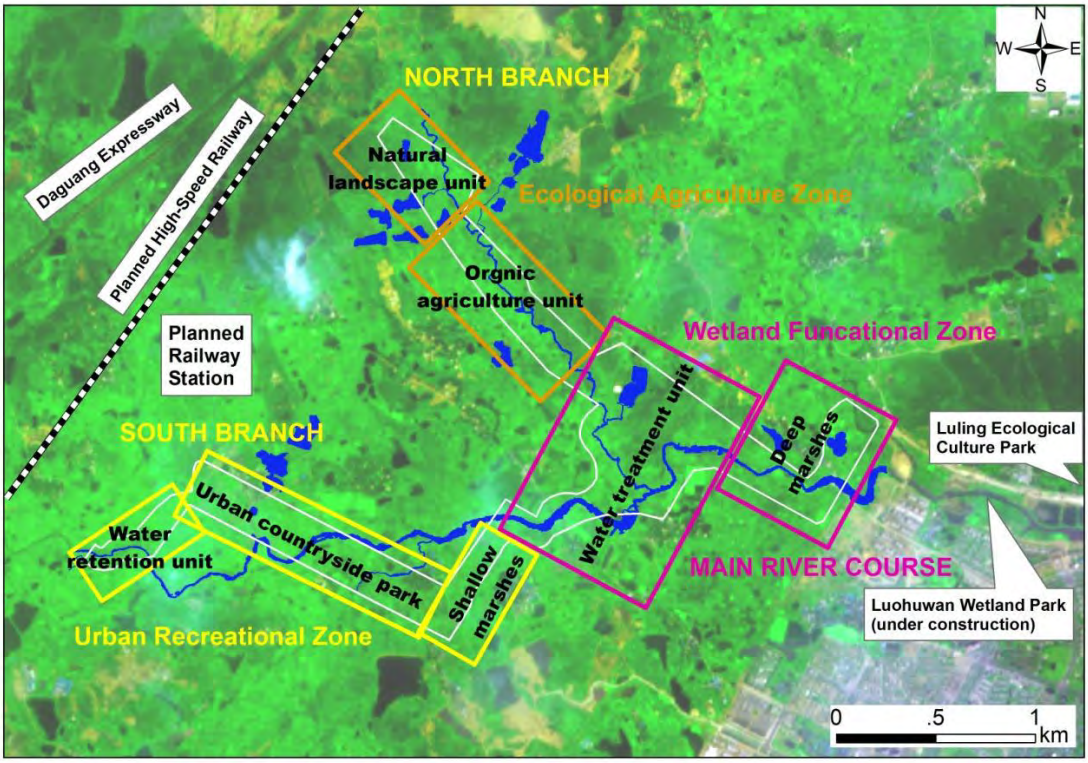


Figure 3.3 The proposed management units for each functional zone of Yudai River Rehabilitation Project Area

3.3 Improvements of Landscape Works to Benefit to the Ecology

Regarding the general landscape design and vegetation configuration, we agree to create a complex including the woodland, shrub, grassland, wet meadow, deep and shallow marshes to maintain the endemic communities of wild fauna and flora, and to match with the functional demands of three components. The landscape design presents the gradient layout

from the forests, shrubs to the flat wetlands along the south channel to the main stream. This design can also provide the visitors different experiences and interactions.

In the project area, a few Passeriforms are listed as the endangered (Yellow-breasted Bunting) and vulnerable (Fairy Pitta, Black-throated Robin) species in the IUCN RedList. We also take into account of the ecological requirements for these species in the landscape works, especially to create the shrubs for the bunting. The mountains in the east part of project area are recommended to be preserved, which can provide the habitats for birds and animals, especially for the nationally protected raptors.

In addition, the natural conservation unit is proposed in the ecological agriculture zone. The local plants and trees will be planted to foster the local vegetation communities, which can also provide the refugee for the local animal communities.

Generally, the proposed project functional zoning has established the close connection between the two components of river rehabilitation and landscape configurations. This zonation is not only in consistent with the water needs for the lower wetland park and ecological culture park, but also in accordance with the ecological demands for maintaining local biodiversity and ecological values.

The planned landscape works need to be improved according to the agreed functional zoning. The terrain should be constructed to meet with the needs of different management units. The structure of roads, pedestrian paths and scenic bridges would be in consistent with the surrounding landscape. The locations of toilets, trash cans, and information boards etc would be easy for visitors. The technical parameters for all construction would be specific to calculate the project budget.

4 Project Flood Protection Works

4.1 Original Flood Protection Works

The existing river course is winding with varying widths. The width of south and main river channels is wider than that of north branch. The soil slopes on both banks are left natural and unprotected, which result in the bank collapses very often, water drainage very poor and sediment very seriously. The current river bed has been lifted, river channel become narrow, and flood carriage capacity is poor. In order to protect the surroundings from floods, promote economic development and improve urban living environment, it is critical and urgent to improve the water system of Yudai River (Luohu water system).

The flood protection report was updated in June 2014, which was mainly based on the recommendations in one evaluation workshop in October 2013. The major change is that the design flood return period of once in 20 years changed to be in 50 years. This is consistent with the Urban Master Plan for Ji'an City (2007-2020).

The updated report defines the rationale and scope of the works; elaborates on the current landforms, geological conditions, geological survey results and existing conditions of river banks; and describes major proposed intervention works. The report structure is generally in line with the requirements and in accordance with relevant codes and standards. According to 'Flood Protection Standard (GB50201-94)', the flood protection work is defined as category IV. The objective is adjusted to protect the flood in the period of 50 years. The main structure is designed as Grade 4, and minor structure is designed as Grade 5.

The updated report presents the results of the data collection and analysis from the Data of Maobei Hydrologic Monitoring Station (1975-2000). This is the only station to monitor the hydrologic data along Yudai River. Unfortunately, the station stopped monitoring works after 2004. The designed flood is calculated in the report via the 'Calculation Manual of Storm and Flood of Jiangxi Province'. This method is reasonable and acceptable due to the limit of data availability.

The updated report also presents the conditions of geology and earthquake in the project area. The area is located in the north of Jitai depressed basin. The substrate rock stratum is the occurrence of a slightly undulating monocline. The rock joints are not well developed. According to the 'Zoning Map of Seismic Motion Parameters (GB18306-2001)', the peak accelerated speed is less than 0.05 g and the basic seismic intensity is less than VI. The evaluation of engineering geology and hydrological geology in the project area is also reasonable and acceptable.

An integrated treatment is proposed for the 5.3 km south branch and main river course, and 2.72 km north branch, including embankment treatment, main channel dredging, slope protection, cross-dike structures improvement, water-lifting weirs, and associated structures etc. The construction will enhance the flood protection capacity of the river by raising and strengthening embankments, ensuring safety of people's lives and property. Socio-economic benefits will be significant for the new urban area.

Generally, the updated Yudai River Flood Protection Report is appropriately organized and satisfactory. The report was developed based on the topographic map at the scale of 1:4000. The detailed design should be more specific in accordance with the updated topographic map at the scale of 1:1000. The major improvements would include infrastructures and water level adjustments.

4.2 Recommendations on the Flood Protection Works

The planned flood protection works include embankment treatment, main channel dredging, slope protection, cross-dike structures improvement, water-lifting weirs, and associated structures. The below recommendations for improvements are mainly based on the functional structures.

4.2.1 Determining different water level elevations

The current hydrologic situation of Yudai River indicates the water flow is unstable in four seasons. In the summer, the catchment area would be flooded due to the plentiful rainfall. In the autumn, the catchment area would be drought due to the plentiful water demands by the agriculture practices. In the winter, the water flow would be broken due to the poor rainfall.

It is recommended to set up different water level elevations for each management units to be adapted to the existing hydrologic situation and proposed management objectives. The maximum, standard and minimum elevations of water levels should be determined in the project design documents. These elevations are critical to defining the height of cofferdam in each management unit.

It is also recommended to set up higher water level elevation in the water treatment unit, which can maintain the water for a longer time and reduce the water velocity for complete purification. Accordingly, the bottom terrain would be deeper than the other management units.

4.2.2 Structures of cofferdams

The purpose of cofferdam construction is to retain water in the river channel across the whole year, and also meet with the functional needs of each management units in the project area.

The updated report and the Feasibility Study Report also presented the river elevations at inflow and outflow will be the same as existing. Water depths under normal flow condition range from 0.6 – 1.2 m. River bed width ranges from 15 m in the upstream section to 20 m in the downstream section. Revetment will be 1.4 m in height constructed with stone mortar. Five cofferdams will be constructed across Yudai River at sections 1+000, 2+000, 3+500, 4+500 and at Yudai confluence with Luohu River. The Jiangbian Stream (the name will be changed to North Yudai River) will have five cofferdams at sections 0+2200, 0+720, 1+220, 1+720, 2+220.

The two reports present the cofferdams will be constructed by the C25 concrete. The stilling basin was planned to be constructed along the lower reaches of each cofferdam with the

width of 3.0 m and depth of 0.5 m. The main purpose is to mitigate the scouring of sediments by the water flow from the top of cofferdams. The original sluice gates on either the left of right side of each cofferdam were cancelled in the updated report.

A few options are recommended to improve the structure of cofferdams:

(1) It is recommended to maintain the sluice gate on either the left or right side of each cofferdam to allow sediment flushing and for flood water to pass smoothly. The height of each cofferdam would be in line with the minimum water level elevation.

(2) In the wet season, it is recommended to use the rubber dams to heighten the water level, which is also easy for lower down in the flood period.

Alternatively, two or three cofferdams in the small elevation difference between the upper and lower reaches of cofferdams can be constructed as the rubber dams.

4.2.3 Pumping stations

According to the agreed project zoning as presented in the section 3.2 of this report, five cofferdams will be constructed along the south channel and main river course, and two water sluices and water dumping stations will be constructed to supply water for organic orchards along the north channel.

The proposed purpose of pumping station is to supply the water for organic orchards, vegetables and melons. At this moment, it is hard to confirm how many sluices and pumping stations will be constructed. The locations, numbers and structures would depend on the results of detailed terrain survey.

The fact is that the water flow is not big, width of river bottom is 5 meters, and water velocity is quite slow. Should cofferdam be reasonable structure in the location with narrow channel and relative small elevation difference.

4.2.4 Cross-dike structures

The both reports present improvements for the outer drainage system connected with the current river channels. The measures include strengthening the drainage ditches using M7.5 masonry stone linings with the length of over 20 m and C15 ditch bottom with 20 cm depth. The structure of culverts cross the dikes will be in accordance with the urban planning standard, and manufactured on the construction site. The major improvements are recommended as the follows:

(1) Structure of culvers should be described in the design document, especially for either the inlet and outlet culverts.

(2) For the inlet culverts, the design should consider how to prevent the solid trashes and how to maintain the water level elevation of project area. For the outlet culverts, the design should consider how to secure the water flow for the lower reaches, especially for the agriculture irrigation before the land development.

(3) The sluice gates are recommended to be constructed for each cross-dike culverts to match with the water control of project area.

4.3 Improvements of Flood Protection Works to Benefit to the Ecology

Regarding the river channel renovation, we agree to employ the ecological rehabilitation technique to maintain the nature of the river bed and river bank, except in the areas with water income, water outcome, high water speed and drainage nodes, where the solid treatment is designed to reduce the erosion of soil and bank. Accordingly, the river bank slope is planning to divide into two levels. The upper slope is more tilt to keep the native grass and aquatic plant growing up to protect the bank, and the lower solid slope is more narrow to prevent the erosion. This approach would also benefit to the benthos in the river bed and surrounding wetlands, especially for the reptiles and amphibians.

Regarding the terrain construction of water drainage system, we agree to construct the infrastructures such as the water log and water leeves to keep the water level in an acceptable and normal level automatically, and adjust the sand sediments to be removable. Furthermore, we also agree to create some deep water areas in some functional zones to retain the sediments, purify the water, and provide healthy water for the urban wetland park in the lower reaches. This design can demonstrate the wetland function and values to the local people, and bridge the connection with other urban development projects.

5 Other Technical Matters

5.1 Rationale for Adjustment of Project Functional Zonation

The water pollution sources of Yudai River (Luohu Water System) mainly consist of aquaculture (fishes) using feces of domestic livestock (pigs) and poultry (ducks), chemical fertilizer, and mixed feed; and agriculture practices using chemical fertilizer and pesticides. There are 5 large reservoirs, 41 medium reservoirs, 1800 small reservoirs, and approximately 20 thousand hilly ponds within the whole administrative region of Ji'an City.

To improve the water quality, the Government of Ji'an City issued one regulation to carry out the ecological and healthy aquaculture patterns, cancel the aquaculture contacts in the reservoirs, stop the aquaculture using the fertilizing water, and implement the ecological protection project for water body. The project will last two years to restore the water quality to the class III standard.

In addition, the construction of Luohuwan Wetland Park was initiated in June of 2012 (**Figure 3.2 and Figure 3.3**). The objectives are: (1) to supply cleaning water for Zhenjunshan Forest Park and Luling Ecological Culture Park at the lower reaches of Yudai River/Luohu Water System, where are the most important recreational parks for the local citizens; (2) to form a 'two parks and one river' city leisure greenbelt; (3) to improve the life quality for local citizens; (4) to extend the tourism with the topics of historical culture and ecological entertainment.

The project components include: (1) construction of urban roads in the project area; (2) treatment of urban wastewater; (3) purification of water quality; (4) embankment improvement and landscape configuration.

The project also realized the shortage of water supply in fall season. One bumping station is planning to be constructed in the intersection of Yudai River and Gan River. At present, the east part of Luhuwan Wetland Park was almost completed, and the west part is undergoing construction.

Therefore, it is imperative to consider the water treatment function in the proposed Yudai River Rehabilitation Sub-Project. That is why the wetland functional zone is designated to be located in the upper of Luhuwan Wetland Park. Meanwhile, some measures also proposed to be taken in the water inlet to clean solid trashes and settle down the sediments of water body in the project area, in order to provide clean water for the lower reaches.

5.2 General Issues and Solutions

The below issues were put forward during the period of my field works in Ji'an. Some resolutions were taken when I was there, and the others were completed afterwards. All of these solutions are benefit to pushing the project progress in an effective way.

5.2.1 Scope of project area

The scope of project area is not consistent in different project reports. On July 18, one informal meeting was held to confirm the project area, including the representatives from

Design Institutes for the Feasibility Study Report and Yudai River Rehabilitation Sub-Project, and staff from the Ji'an PMO (Ji'an Municipal Urban Construction Investment and Development Co., Ltd.).

The updated scope of project area is in line with the Resettlement Plan for Jiangxi Ji'an Sustainable Urban Transport Project. **The length of river rehabilitation is 8.02km,** including 5.3 km length of south and main channels, and 2.72 km length of north channel of Yudai River. **The total area is 1622.002 mu (approximately 108.133 hectares),** including 1108.938 mu paddy field, 76.078 mu dryland, 3.285 mu courtyard, 157.241 mu woodland, 67.822 mu ponds, 56.753 mu channels/canals, 2.963 mu cemetery, 18.856 mu residential area, 26.811 mu roads, and 103.255 state-owned land.

5.2.2 Fine resolution topographic map

The design documents related to landscape works and flood protection works were based on the topographic map at the scale of 1:4000. In the discussion workshop on July 15, it was recommended to initiate the topographic survey at the scale of 1:500 or 1: 1000 immediately.

The Ji'an PMO has authorized the local mapping and surveying organization to complete the topographic survey by September 10 2014.

5.2.3 Detailed project design

During the period of my inputs, only the general reports related to the landscape and flood protection works can be available. Anyway, these documents are important for our discussion and improvements. Meanwhile, we pushed the local PMO to contract with the Design Institute for developing the detailed design report as soon as possible.

The Ji'an PMO contacted with the former Design Institute for developing the detailed design in the late August. The Design Institute promised to draft the detailed design on the landscape and flood control works by middle October, 2014.

5.3 Other Information Gaps

5.3.1 Lack of water resources assessment of Yudai River

The Yudai River/Luohu water system is a small tributary of Gan River. Only one hydrologic monitoring station named as Maobei Station was established along the whole river. The hydrologic data of this station from 1975 to 2000 is the only reference to conduct the analysis of flood intensity and water level in the design report. It is recommended to conduct the water resources assessment of Yudai River, in order to determine water supply and water needs in this catchment area.

5.3.2 Lack of safeguard measures to meet with the water needs in project area

In the Feasibility Study Report, no safeguard measures were proposed to ensure the water needs in different seasons for the project area. It is recommended to include this content in the design document. Please make the judgments according to the below information, to secure potential water sources in the dry seasons.

There are two reservoirs established along the Yudai River/Luohu Water System. One is the Zhongqishan Reservoir, which is located in the west of Liangyuan Village, at the beginning of the proposed project area. Furthermore, there is channel connected with the reservoir and Yudai River channel. The water capacity is 2.3 million cubic meters. The water needs of project area is approximately 0.6 million cubic meters. The other one is Xingqiao Reservoir, which is located in the head of Yudai River/Luohu Water System. It is about 8 km away from the head of project area. However, one National Demonstration Park of Agriculture Sciences was established over there. It is hard to coordinate water allocation to the lower reaches.

5.3.3 Lack of project implementation arrangement

At present, the project area mainly consists of the agriculture fields, woodland, ponds and river channels. It is impossible to implement the project construction without the transportation roads. It is recommended to start the road construction first.

Secondly, the river rehabilitation works should be conducted in the dry seasons to avoid the plentiful rainfall and big water flow in the current river channels. Thirdly, the design should also consider how to ensure the agriculture practices before the other land developed.

Main Cited Project Documents

1. Project data sheet for Jiangxi Ji'an Sustainable Urban Transport Project, People's Republic of China. Updated on April 25, 2014. Project number: 45022-001. Downloaded from the ADB website. (in English)
2. Environmental Impact Assessment (Draft) for the Jiangxi Ji'an Sustainable Urban Transport Project. Prepared by the Ji'an Municipal Government. May 2014. Downloaded from the ADB website. (in English)
3. Urban Master Plan for Ji'an City (2007-2020). Prepared by Urban Planning and Design Institute of Huazhong University of Science and Technology. September 2009. (in Chinese)
4. Conceptual Plan and Controlling Plan of Ji'an Western City Development (2013-2020). Prepared by Urban Planning and Design Institute of Huazhong University of Science and Technology. December 2010. (in Chinese)
5. Jiangxi Ji'an Luohu Bay Wetland Park Implementation Design. Prepared by Shanghai Pudong Architecture and Design Institute, and Xuanquan Urban Design Institute. February 2012 and May 2012. (in Chinese)
6. Project Proposal for Jiangxi Ji'an Sustainable Urban Transportation Project (Asian loan: 45022). Prepared by Ji'an Municipal Urban Construction Investment and Development Co., Ltd. (JMUCIDC). March 2013. (in Chinese)
7. Project Administration Manual for Jiangxi Ji'an Sustainable Urban Transportation Project (45022-013). March 2014. The front cover mentioned that the PAM needs to be revised and updated with the adjustment of project costs, scope and implementation arrangement. (in Chinese)
8. Environmental Impact Assessment Report for Jiangxi Ji'an Sustainable Urban Transportation Project. Prepared by Jiangxi Academy of Environmental Sciences. March 2014. (in Chinese)
9. Yudai River Flood Protection Report under Ji'an Urban Sustainable Transport Project. Updated by Shanghai Urban Construction and Design Research Institute in June 2014. (in Chinese)
10. Yudai River Landscape Improvement Report. Updated by Shanghai Urban Construction and Design Research Institute in February 2014. (in Chinese)
11. Feasibility Study Report on the Jiangxi Ji'an Sustainable Urban Transport Project (PRC 45022). Prepared by Jiangxi Zhong-Chang Engineering Consultation and Supervision Co. Ltd. June 2014. (in Chinese)
12. Resettlement plan for Jiangxi Ji'an Sustainable Urban Transport Project. Prepared by the Ji'an PMO. December 2013. (in Chinese)

Technical Assistance Consultant's Report

Contract No. 115574-S82959

TA-7965 PRC: Jiangxi Ji'an Sustainable Urban Transport Project

Climate Change Impact Assessment on Jiangxi Ji'an Sustainable Urban Transport Project in People's Republic of China

October 2014

Prepared by Wei Ye

Asian Development Bank

List of Tables and Figures

Contents

Abbreviations

ADB	Asian Development Bank
AR5	The Fifth Assessment Report (Intergovernmental Panel on Climate Change)
DMC	developing member country (ADB)
GCM	general circulation model
GEV	general extreme value function
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
JSTDP	Ji'an Sustainable Transport Development Project
PMO	Project Management Office
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China
RCP	Representative Concentration Pathway
SUCDRI	Shanghai Urban Construction Development and Research Institute
V&A	Vulnerability and Adaptation

Executive Summary

The objective of this study is to assess the vulnerability of the Ji'an Sustainable Transport Development Project (JSTDP) to the impact of projected climate change and to identify adaptive measures to reduce the vulnerability. The JSTDP is to be implemented in the Jizhou District, which is the urban centre of Ji'an city. It includes a 6.94 Km bus rapid transit (BRT) corridor; five urban roads totalling 19.33 Km in length; and the rehabilitation of an 8.02 km section of the Yudai River.

Geographically, Jizhou is characterised by low and flat plains on the west side of the Gan River. It has been under consistent flood thread from the Gan River and the rivers across its urban area. The flood of Jianxi is mainly triggered by torrential rain during the rainy season; hence the heavy rainfall event is the highest risk to the climate sensitive component of the JSTDP. Based on the IPCC AR5 General Circulation Model (GCM) outputs and historical observation from the area; quantitative climate projections for the key climate variables were generated. A statistical relationship between heavy rainfall and flood was developed to support the vulnerability and adaptation (V&A) assessment.

The climate scenario analysis has revealed that average rainfall is likely to increase gradually in the future, which may become noticeable by 2050 particularly for the rainy season. The climate change impact is even more manifested as a result of changes in the intensity and frequency of heavy rainfall events. The median projections from the GCM ensemble indicated that, for the 1:50 year annual maximum 10 day rainfall event, its intensity is likely to increase by 8% and 16% in 2050 and 2100 respectively. The increase in both average rainfall and, in particular, the heavy rainfall intensity and frequency implies a more severe flood risk for the project area. Taking these adverse impacts into project design consideration may prevent costly infrastructure maintenance and repairs and minimise the disruption of transportation due to climate disaster in the future.

1. Introduction

Climate change will pose various threats to a transport system. In order to achieve a sustainable development, it is important to make climate adaptation adjustments to engineering specifications, alignments, and master planning; incorporate associated environmental measures; and adjust maintenance and contract scheduling for transport projects (ADB 2010). An effective climate-proofing of a transport system requires project specific climate change impact vulnerability assessment and identifying, evaluating and implementing feasible adaptation measures to strengthen project resilience to future climate change impact. This report presents the climate change impact V&A assessment for the Ji'an Sustainable Transport Development Project (JSTDP) in Jiangxi Province, the People's Republic of China (PRC).

1.1 Background of the project area

Jiangxi Province is located in the middle of the PRC with an area of 166900 km^2, and Ji'an is its second largest city in terms of area. Topographically, most areas of Jiangxi are mountains and high hills, which constitute 54% of its total area. Mountains surround the province from the east, south and west forming a water basin with a shape almost coinciding with the province administration boundary. The Poyang Lake in the northern border of Jiangxi is the bottom of the basin and also the outlet of the five major rivers of the province. The Gan River is the longest river of Jiangxi, and is one of the major tributaries of the Yangtze River. It is 823 Km long and its network covers almost from the southern border of the province to the Poyang Lake in the north. The upper reach of the Gan River is characterised by high mountains, whereas the middle and low reaches are relatively low in altitude with small hills and plains.

Jiangxi has subtropical humid climate and is characterised by mild temperature. The average annual temperature is between 16-20°C and the average annual rainfall is 1650 mm. The rainfall has distinctive seasonality with the 3 month rainfall of rainy season from April to June accounting for almost half of the annual total. Due to its unique geography and abundant rainfall; the province, particularly the area along the Gan River, has been under consistent threat of flood during the rainy season. Since 1950, Jiangxi had more than 2000 floods, with a death toll of 2023 and total direct economic damage of over US$ 1 billon (Fan et al., 2012).

Ji'an City is located in the middle reach of the Gan River between latitude 25°58′32''N to 27°57'50''N and longitude 113°46′E to 115°56′E.The city extends 218 Km from north to south and 208 Km from east to west, with an area of 25300 Km^2, the second largest prefectural city of Jiangxi. The city population is approximately 5 million. The Luoxiao Mountains in the west of the city is one of the torrential rainfall centres of Jiangxi. Jizhou district is the urban centre of Ji'an located on the relative low-lying Ji-Tai plain in the middle of Ji'an (Figure 1). Jizhou is bisected by the Gan River. The section length of the Gan River in Jizhou is 20 Km. The river width varies from 600-800 metres during the dry season to 1500-2500 metres during flooding. The catchment area of the Gan River above Ji'an is 56223 Km^2.

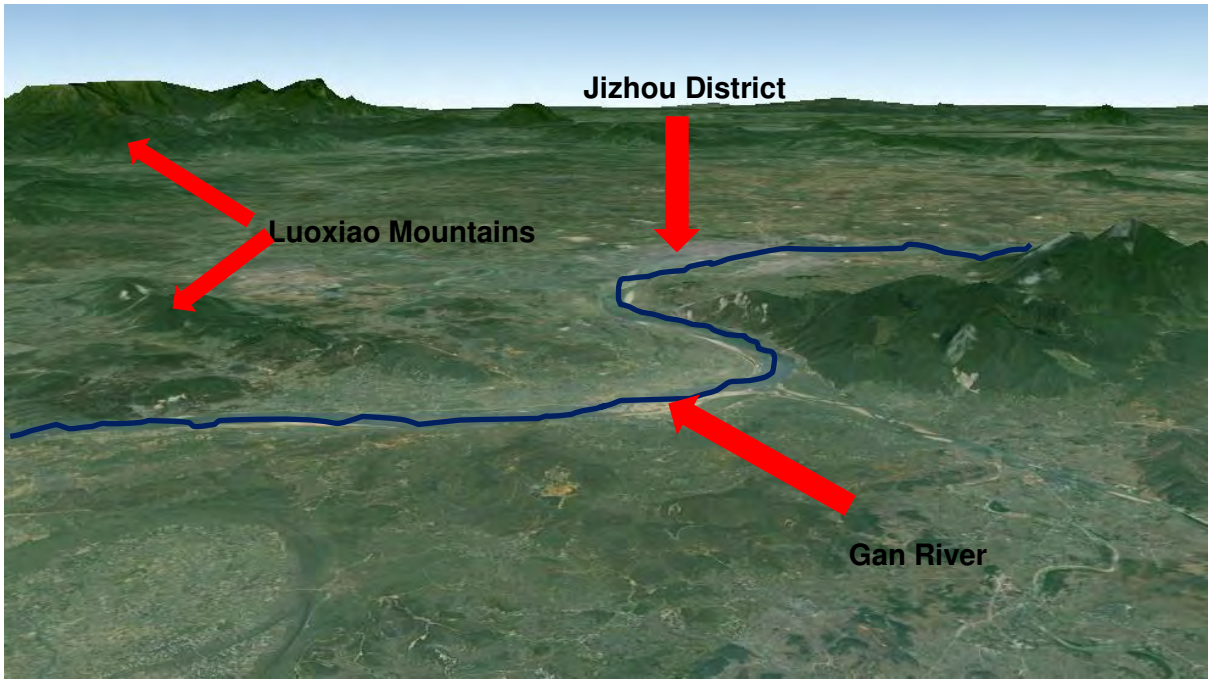


Figure 1: Topography of Ji'an and location of Jizhou, the project area.

Ji'an is the most important city in the middle of Jiangxi. Due to the fast economic development; its urban area needs to expand with new road networks, improved and safer public transport services, improved non-motorized transport and more efficient multimodal interchange of transport to alleviate existing problems caused by overcrowded urban population. Hence, the Ji'an Municipal Government has proposed the new Western City Development of Jizhou District, with a planned new city area of 52 Km^2 and a projected population of 276000 by 2020 and an ultimate population of 300000. Currently the Jizhou District has a land area of 425 Km^2 and a population of 343200. The JSTDP is located in the new city development area and includes the following four components (Figure 2):

- The development of a 6.94 Km bus rapid transit (BRT) corridor along Jinggangshan Road with 15 stations, as well as the improvement of the station square at the existing Ji'an Railway Station;
- Rehabilitation of 8.02 Km of Yudai River (5.3 Km) and its tributary (2.72 Km);
- Construction of five urban roads totalling 19.33 Km in the Western City Development Area and traffic management improvement through the provision of coordinated signal system, central control system and traffic information collection system; and
- Capacity building and institutional strengthening.

With the exception of the capacity building and institutional strengthening, the other three components require designing and planning before construction. Transport system design requires careful consideration of local climate conditions to prevent any disastrous damage to the system from climate hazard. Climate change has the potential to alter the climate condition; hence this study is focused on the climate change impact on the sensitive project components to the climate and the implication for the design process for the Yudai River rehabilitation and five new road development components.

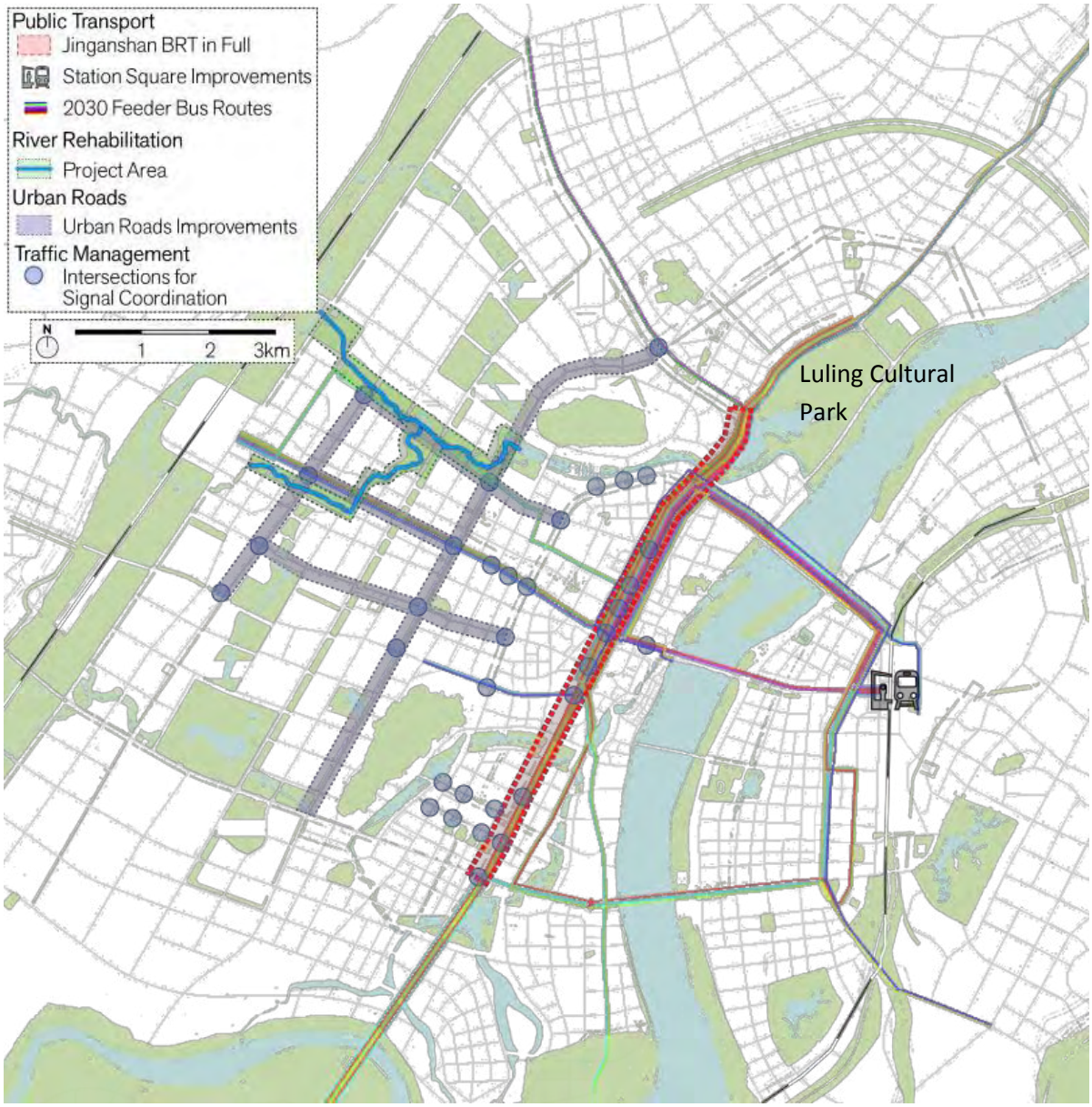


Figure 2: Location of the project components *(source: ADB)*

1.2 Potential risks of climate change to the project

Transport is vulnerable to climate variability and change. Although most climate factors can influence a transport system, for systems located at inland regions the major road damages are sourced from temperature and precipitation. The influence of these two factors on a transport system is to a large degree manifested by their extremes and aftermath. In terms of temperature, the high temperature caused extreme heat places stress on road infrastructure; softens the asphalt causing traffic rutting and potentially resulting in cracking. Extreme heat can also stress the steel in bridges through thermal expansion and movement of bridge joints. Extremely low temperature can cause fatigue and thermal cracking of the pavement. A wide range of temperatures (the difference between the maximum and the minimum temperature) will make asphalt binders difficult to span accordingly. In terms of precipitation, a torrential rain can lead to urban waterlogging if the drainage system has inadequate capacity. Flood resulted from torrential or heavy rainfall can cause severe water damage to roads, including collapse of the slope bed; damage to the subgrade, road surface, and key infrastructure components such as bridges; and damage due to landslide and debris flow etc.

The latest climate science points to an increasingly rapid pace of climate change over the forthcoming decades. Such change will likely alter the long term climatic averages and, in particular, the frequency and severity of extreme weather events. Hence the heat extremes and extreme rainfall, as well as floods are likely to become more intense and more frequent during this century.

The Ji-Tai plain has relative low altitude, and is historically threatened by river flooding from the Gan River. In addition, the JSTDP is built on low-lying farmland along the Yudai River in the western side of Jizhou, hence is under the risk of waterlogging from torrential rain. As most urban flooding in Ji'an is caused by rainfall; within the context of this study, potential changes in rainfall, including changes in its variability, is of critical importance to the long term sustainability of the JSTDP. As indicated in the EIA report (ADB, 2014) detailed design of project components sensitive to the flood, and the flood control capacity of the Yudai River, will need to take account of potential changes to accommodate the climate change impact consequences. The temperature of Ji'an is characterised as mild sub-tropical climatology. The change in temperature is not expected to have major impact on the project. Nevertheless, the climate change impact on temperature related factors is also analysed in this study.

1.3 Purpose and scope of this study

This study aims to provide an assessment of potential risks posed by climate change to the design of the climate sensitive components of the JSTDP, and identify options to manage such risks by proposing and analysing a range of adaptive measures.
Climate risk assessment will consider changes in temperature and rainfall based on outputs from the latest climate modelling experiments. Consideration of climate risk management options will include both "hard" measures entailing possible adjustment in design specifications, as well as "soft" options of ecological, governance or an institutional learning nature.

The overall objective of the climate change V&A assessment is to minimize the road damage and disruption in road use due to climate change impact. A scoping exercise was carried out to identify the vulnerability of the project to climate change impact. For the JSTDP, the temperature and rainfall sensitive project components includes road subgrade, pavement, bridge structures, slope protection and drainage system. The current design criteria are based on historical data and do not take account of changes in key hydro-met parameters under a changing climate.

Because the focus of this study is on the project vulnerability to changes in temperature and rainfall and its extremes, the required information to support this climate change impact assessment is historical observed temperature and rainfall at appropriate spatial and temporal scale, as well as the future climate change projections based on the latest scientific findings. Section 2 below will describe the methodology underlying the climate risk assessments. Details on the baseline and scenario datasets used for climate impacts assessment are provided in Section 3. Section 4 presents the impacts of climate change for the various components of the proposed project and their implications for the design, construction and operation of the project. Two future timeslice, i.e., 2050 and 2100, were used to illustrate the impact consequences. Possible adaptation options to manage climate risks within the context of the project, as well as a preliminary assessment of them, are discussed in Section 5. The report concludes with a set of recommendations on the design, construction and operation of the proposed project.

2. Methodology

A risk is the product of the interaction between hazards, exposure and vulnerability. In this study, hazard is used to denote the threat from climate factors of temperature and rainfall, their extremes and aftermath. Exposure is refer to the presence of infrastructure and other assets related to a transport system that could be adversely affected when hazard happens and which, thereby, are subject to potential future harm, loss, or damage. For this project, the exposure is also related to the closeness of a low lying flood prone area to a major river (the Gan River). Vulnerability is defined generally as the susceptibility to be adversely affected. The vulnerability can be either physical or socio-economic. For example for this project, the vulnerability may come from the inadequate capacity of the project for future flood protection, or the possible economic constraints of building a comprehensive flood protection mechanism for the changing climate. This section discusses the method of analysis the climate factors that may pose threat to the JSTDP based on their historical observation and future projections under climate change.

2.1 Overall approach

The first step in climate change impact assessment is the construction of the future climate change scenarios. The construction of a climate change scenario involves the development of the baseline climate condition and the future climate change projections. Depending on the assessment need, spatial and/or site-specific climate change scenarios are required for impact studies. In this study, the baseline spatial climatology for the project areas was derived from the WorldCLIM database (http://www.worldclim.org). The baseline site-specific climate condition was obtained from station based observed data.

The future climate change is subject to considerable uncertainty. One important aspect in climate change V&A assessment is to comprehend such an uncertainty range in decision making and policy planning process. Within this context, any climate change scenario constructed on single Greenhouse Gas (GHG) emission rate and/or individual GCM outputs is generally considered inappropriate for V&A assessment purposes, because it cannot provide information of the uncertainty range associated with its projection. In this study, to reflect the uncertainties in future GHG emission rates and in the climate sensitivity, a combination of different GHG Representative Concentration Pathways (RCPs) and climate sensitivities is used to characterise the future climate change scenario with associated uncertainty range. RCP6.0 with mid-climate sensitivity represents a middle range future global change scenario, which was used as an indicator of the median scenario projection of the future global change, while RCP4.5 with low-climate sensitivity and RCP8.5 with high-climate sensitivity was used as an indicator of the corresponding low and high bound of the uncertainty range (Table 1). Another important uncertainty in climate change scenario generation is the difference in different GCM simulations. To account for such an uncertainty in V&A assessment, a pattern scaling method was adopted and applied to wide range of GCMs to build a model ensemble. The average of models' simulation of changes for a climate variable is normally used to capture the middle conditions, as that the average often agrees better with observed climate than any individual model estimates (Reichler and Kim 2008). In this study however, the 50 percentile of the GCM model ensemble was used in order to prevent the influence of huge outliers in some GCM simulation on the final change projection values.

The method was thus termed as 'ensemble based pattern scaling'. Details of the method as well as the steps of constructing the future climate change scenario can be found in Appendix 1, while Appendix 2 lists the 40 IPCC AR5 GCMs used for model ensemble.

Table 1: Three climate projections and their input conditions represent the uncertainty ranges

Climate projection	Representative Concentration Pathways	Climate sensitivity
Median scenario	RCP6.0	Mid
Low scenario	RCP4.5	Low
High scenario	RCP8.5	High

2.2 Spatial climate change scenario

Monthly and seasonal climate change impact was assessed spatially over the project areas. The baseline climatology for the project areas was obtained from the WorldCLIM database with a spatial resolution of about 1 Km (http://www.worldclim.org). In generating the climate change scenario for the project areas, the simulation results from 40 GCMs that are assessed in the IPCC AR5 were used (Appendix 2). All 40 models have their monthly simulation results available.

2.3 Site specific climate change scenario

Besides the spatial monthly change projections, site specific climate change scenarios with finer temporal scale are usually required for impact assessment. The site specific temperature change scenario was constructed by perturbing the station observed daily data using the normalised GCM pattern value from the GCM grid where the climate station is located. In this study, all observation data from a station was used to represent the baseline climate condition for the site.

For site specific extreme value analysis, we first chose an intensity value (such as 1:20 year maximum daily precipitation) and then selected its normalised pattern value from the GCM gird where the site is located. The value is then applied to the same precipitation intensity that derived from the observed historical data to generate the future change scenarios.

In the following two sections, the method described above is adopted to generate the change projections for climate variables that may become hazardous to the proposed project. Rainfall and temperature data were collected for 4 stations around the project area. Table 2 lists the information for the four stations. The location of the stations can be found in

Table 2: Location information of the meteorological stations

Station Name	Longitude (°)	Latitude (°)	Altitude (m)	Observation Period
Ji'an	114.92	27.05	71.2	1951-2013
Ganzhou	115.00	25.87	137.5	1951-2013
Jingangshan	114.17	26.58	843.0	1999-2013
Lianhua	113.95	27.13	181.4	2006-2013

Appendix 4 (Figure A4-1). The temperature related climate variables were analysed for Ji'an only, as its impact is only site-specific. With regard to rainfall, of the 4 stations, Ji'an is the local station; Jinggangshan and Lianhua are located in the west of the city at the centre of the torrential rain along the Luoxiao Mountains, hence represent the upper stream hill and mountainous conditions of the Ji'an city catchment. Ganzhou represents the upper-reach condition of the Gan River. Unfortunately, both Jingganshan and Lianhua have relative short periods of observation, making them unsuitable for baseline and climate change analysis. In this study, only Ji'an and Ganzhou data were used for rainfall related climate variable analysis.

3. Climate observation and change projections

3.1 Observational temperature data and their future projections

The temperature related climate variables that have impacts on transport systems include the mean, minimum and maximum temperature; the extreme maximum temperature and related heat waves; and the temperature change range (the difference between minimum and maximum temperature). Appendix 3 lists the temperature related climate variables and their projected future changes in 2050 and 2100 for Ji'an. The baseline annual average mean, minimum and maximum temperatures of Ji'an are 18.5, 15.1 and 23.1°C respectively. By 2050, the median projection was 19.8°C, indicating an increase of 1.3°C, with an uncertainty range of change increase between 0.9 to 2.6°C. By 2100, the median temperature projection is 21.0°C, an increase of 2.5°C, with an uncertainty range of 1.3 to 6°C.

It is likely that the extreme maximum temperature will become more intense. The current 1:50 year observed annual maximum daily temperature is 40.8°C, whilst the event of the same intensity will likely become 41.9°C (1.1°C increase) by 2050 and 43.0°C (2.2°C increase) by 2100, and the corresponding uncertainty ranges are 0.8 to 2.4°C and 1.1 to 5.4°C for 2050 and 2100 respectively. Heat wave thus will likely become more intensified and frequent, as indicated by the 7 day average maximum temperature for Ji'an, but is still under 45°C for the high scenario by the end of this century.

The minimum temperature, both average and extreme low, will likely to increase, which indicates a reduced frost period and snow falls in the area. Given the likelihood of increase of both the daily maximum and minimum temperature, the difference between them may not change or may be slightly reduced: the current difference of the 1:50 year annual daily maximum and minimum temperature is 48.3°C i.e., the difference between 40.8°C and -7.5°C; the changes of median projection for 2050 and 2100 are 48.2°C and 48.0°C respectively.

3.2 Observational rainfall data and their future projections

The rainfall related climate variables and their aftermath that could become hazardous for the project including torrential rain and flood. No major landslide or debris flow has been observed in Jizhou. Details of the observed rainfall data and their future change projections are demonstrated in Appendix 4. The key findings are discussed below:

Baseline

1) Jizhou district has relatively lower rainfall than its surrounding areas. However, due to its low-lying location, the heavy rainfall from the upper reach of the Gan River leads to a higher flood risk in Jizhou than its surrounding area. The large rainfall in the north and northeast of the province contributes significant runoff to the Gan River, as well as the Luoxiao Mountains in the west which is the centre of torrential rain during the rainy season.
2) The normal rainfall of the rainy season is relatively evenly distributed inside Ji'an city at around 700 mm (Figure A4-4), except for the areas of Jiangganshan in the southwest and the high hilly areas in the east side of the Gan River, which all have relative larger rainfall than the rest area of Ji'an.
3) Derived from the observation of 1951 to 2013, the annual average precipitation at Ji'an is 1488 mm with a coefficient of variation (C_v) of 0.19. Year 2010 recorded the maximum annual rainfall of 2209 mm, while the minimum was only 963 mm in 1963, which is less than half of the maximum. At the upper reach of the Gan River, Ganzhou has an annual average of 1437 mm and C_v of 0.20.

4) For Ji'an, the total average rainfall during the rainy season is 677 mm, which accounts for 45% of annual total. In general, May is the wettest month in a year but most of the severe floods occur in June.

Future projection

1) Applying the ensemble based pattern scaling method to the project area, the median climate change projection indicates that the normal rainfall change during the rainy season is likely to be noticeable. For Jiangxi, the median projection of the annual average precipitation is likely an increase of 1.5 to 4.5% by 2050 and 3 to 9% by 2100 (Figure A4-3). Ji'an has a slightly higher increase rate than the province average, which is 3-4.5% and 6-9% by 2050 and 2100 respectively (Figure A4-4).
2) For both Ji'an and Ganzhou stations, monthly rainfall is projected to increase for all months, though this is not significant for dry seasons (Figure A4-6). The rainy season has more obvious rainfall increase but accompanied with larger uncertainties. The uncertainty range skews quite heavily to the upper bound of the projection, which implies more likelihood of higher risk of climate change.

Extreme rainfall and its projection

According to the extreme value theorem, for normalized maxima (minima) of a sequence of independent and identically distributed random variables such as annual daily maximum rainfall, the generalized extreme value (GEV) distribution is the only possible limit distribution, and it is often used as an approximation to model the maxima (minima) of long (finite) sequences of random variables. In this study, the GEV distribution was applied to the daily observation to investigate extreme rainfall and their future changes. A detailed method description and analysis process can be found from Ye and Li (2011).

Table 3 lists for both stations the baseline intensity and frequency and the future changes of annual maximum rainfall in 2050 and 2100. As shown in Table 3, the current 1:50 year event of the annual maximum 10 day rainfall is 395.34 mm for Ji'an. The median change projection of such an event is 427.58 mm by 2050 and 458.53 mm by 2100, which represent 8% and 16% increase in rain intensity. The uncertainty range of the projection is 6% to 17% for 2050 and 8% to 39% for 2100. Another findings is that the climate change impact is likely to be larger when the extreme rainfall event become more intense: for 2050 at Ji'an, the annual maximum daily rainfall change from median scenario for 1:5 year event is only 5%, i.e., (127.55-121.54)/121.54; but it becomes 8.2%, i.e., (232.28-214.73)/214.73 for 1:50 year event. This is also evident from the enlarged gap between the baseline GEV distribution and its future projections (Figure A4-4 to A4-7).

Similarly, for Ganzhou its current 1:50 year event of the annual maximum 30 day rainfall is 569.65 mm. The median scenario projection of such an event increases to 615.39 and 659.45 mm by2050 and 2100 respectively, which are also 8% and 16% increases in rain intensity, accompanied with a similar uncertainty range of 6% to 17% for 2050 and 8% to 39% for 2100.

In summary, average rainfall is projected to increase gradually for the project area. The average increase is likely to be noticeable by 2050 and beyond, particularly for the rainy season. In contrast to the relatively small increase in average rainfall, the extreme rainfall intensity and/or frequency increase is significant. Such impacts will very likely result in an increased flood risk for the project area in the future.

Table 3: The GEV results of annual maximum rainfall and its future projections

Return period (years)	Annual maximum rainfall (mm)						
	Baseline	2050 scenario			2100 scenario		
		Low	Median	High	Low	Median	High
Ji'an: 1 day rainfall event							
2	88.92	91.47	92.40	95.95	92.37	95.61	104.73
5	121.54	125.93	127.55	133.89	127.49	133.26	149.60
10	146.77	153.02	155.32	164.40	155.25	163.50	186.95
20	174.12	182.75	185.94	198.50	185.83	197.26	229.86
50	214.73	227.55	232.28	250.94	232.13	249.10	297.94
100	249.55	266.51	272.78	297.47	272.57	295.03	360.18
Ji'an: 10 day rainfall event							
50	395.34	418.88	427.58	461.92	427.30	458.53	550.08
100	431.76	461.10	471.93	514.77	471.58	510.53	626.61
Ganzhou: 30 day rainfall event							
50	569.65	603.05	615.39	664.29	614.99	659.45	791.61
100	607.90	648.60	663.63	723.30	663.14	717.38	882.81

3.3 Climate change impact on the JSTDP and the implication to the project design

The climate change information needs to be related to the project components that are sensitive to the climate, in order to support the vulnerability assessment and adaptation options identified. In the context of this project, the target sensitive project components include:

- Change in maximum temperature of the pavement;
- Change in minimum temperature of the pavement;
- Change in the range of temperature of the pavement;
- The change of 1:2 year rainfall events, which is used in design for the storm water drainage for the road networks;
- The change of 1:20, 1:50 year 24 hour heavy rainfall, which is used for urban flood water drain system design; and
- The change of 1:50 year flood water level; which is used for rehabilitation of Yudai River flood protection design.

The pavement temperature has a linear relationship with the air temperature, so the increase of air temperature will lead to increase of pavement temperature. The baseline annual average air temperature of Ji'an is relatively mild. An increase of 1.3°C by 2050 or 2.5°C by 2100 will not cause significant impact to the transport system. The upper bound change from the high scenario projection of the annual maximum daily temperature may require some attention. Under such change scenario, the 1:20 maximum daily temperature is 42.8°C and 45.9°C in 2050 and 2100 respectively, which implies more intense and longer lasting heat waves, but the change temperature is generally under 50°C. The increase in minimum temperature and the reduction of the temperature range will be beneficial to the transport system.

Compared to the potential impact from temperature, the heavy rainfall and it triggered flood pose a much greater risk to road systems, therefore are the major climate induced hazards for the JSTDP. To support criteria adjustment in project design, Table 3 lists the relevant heavy rainfall current observation and their future change projections. As shown in Table 3, the baseline 1:2 year annual maximum rainfall event intensity is 88.92 mm. The median projection of such event in 2050 is 92.40 mm, with an uncertainty range of 91.47 mm

to 95.95 mm. The storm water drain system design should take such changes into consideration. If the current drain design criteria become inadequate for 2050 median projection, it is recommended to expend the capacity to accommodate the additional storm and flood water. For drain system components that will become difficult to repair or replace, it would be even more appropriate to use the high scenario change projections as the base for drainage design.

Due to its great damage potential, flood has always been the major consideration in transport system design in Jiangxi. For the purpose of assessing climate change impact on flood, it is necessary to develop a hydrologic model to reveal the relationship between rainfall and flood. The composition of flood water of the Gan River in Ji'an is complicated by its tributaries in its middle reach. The major tributaries inside Ji'an section include the Huolushui River, Gu River, Shushui River, Suichuan River. The combined catchment area from these tributaries is as large as 19323 Km^2. In addition, the human activities in the area have significantly altered the natural river flows. Inside the Ji'an City, there are 5 large reservoirs and 36 middle sized ones, and more than 1000 small dam and man-made water storage ponds (Liu, 2004). Though the small and middle size reservoirs may not have much influence on the natural river flow, the large reservoirs have significantly affected the river flow at its downstream. Wan'an reservoir is the largest hydraulic engineering project in the Gan River upper Ji'an. The height of its dam is 58 metres with a water catchment area of 36900 Km^2. The reservoir has completely altered the downstream river flow from its natural. Thus it is very difficult to determine the flood water level at Ji'an just based on rainfall from its catchments (Mao and Wang, 2002). It appears inappropriate to apply any physical based and/or sophisticated conceptual hydrologic model to the Ji'an catchment, given its complex hydrologic condition. A statistical approach is thus adopted based on available hydro-met observations. In addition to the daily observed rainfall data of Ji'an and Ganzhou, an observed 30 years annual maximum flood height data from 1983 to 2012 was collected from the Hydrology Institute for Ji'an Station.

A regression model was developed as follows:

$$Y = 44.1627 + 0.01018X_1 + 0.00924X_2 \quad (1)$$

where: $\boldsymbol{Y}$ is the annual peak flow height (masl); $\boldsymbol{X_1}$ is the 10 day total rainfall of Ji'an correspond in time to the peak flow height, i.e., the 10 day rainfall immediately preceding to the peak flow date, and $\boldsymbol{X_2}$ is the corresponding 30 day total rainfall in Ganzhou. Appendix 5 gives the details of the statistical model development. The model has a reasonable performance in simulating the annual peak flow height as illustrated in Figure 3. The correlation coefficiency (R^2) is 0.58 with the standard error of 1.1 m. Thus for a given annual peak flow height prediction, a confidence interval of ±0.34 metre is expected based on the 95% confidence level. The model slightly over-predicts smaller floods and under-predicts larger floods.

With the developed rainfall—flow height model, a climate change impact assessment on river flood height at Ji'an can then be carried out. The detailed steps of calculating the flow height and their future projected changes are demonstrated in Appendix 6,

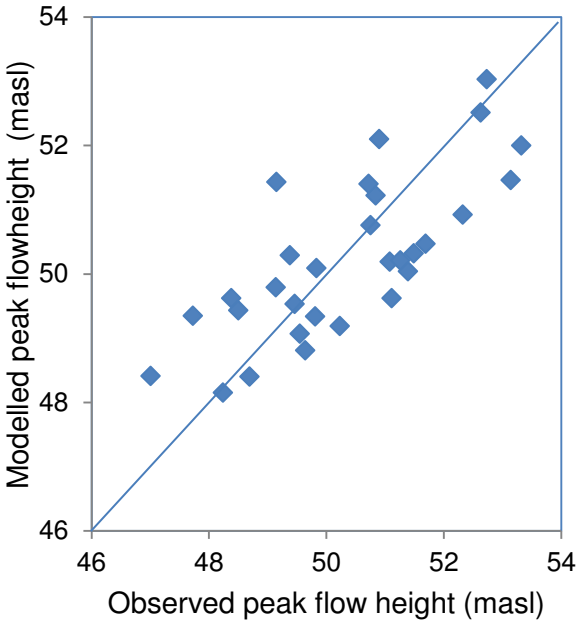


Figure 3: Performance of the statistical model in simulating the observed annual peak flow height.

Because of the linear relationship of extreme flow height to extreme rainfall (Equation 1), to what extent that climate change will impact on a flood depends on the magnitude of the flood event; the larger the flood event (or the higher the maximum flow height), the more impact the climate change may bring in. For the 30 year record, the largest flow height happens in 2010 with a flood water height being 53.14 masl. This particular event was linked to the 1:15 year heavy 10 day rainfall event of Ji'an (331.9 mm) and a normal 30 day rainfall event in Ganzhou (213.1 mm). By 2050 based on the extreme rainfall changes for Ji'an and Ganzhou and derived from Equation 1, an increase of 0.45 metre to 53.59 masl is projected by the median climate change scenario, with an uncertainty range of increase between 0.33 and 0.91 metre. The low and median scenario change is similar to the model's confidence interval of ±0.34 m at 95% confidence level, but the high scenario projection is clearly beyond the interval range. Towards the end of this century, an increase of 0.85 metre is projected by the median scenario, but with an even higher uncertainty range of 0.45 to 2.02 metre. Even with high uncertainty, by 2100 the climate change impact projections are significant larger than the model's confidence interval at 95% confidence level.

From a conservative viewpoint, a potential additional 0.45 metre flood height is still a significant risk increase to a transport system. Careful review of current flood protection design is necessary to analyse any capacity insufficiency and identify any adaptation options to alleviate such negative impact. The urban flood in Ji'an can be distinguished into two basic types:

- The flood from the Gan River;
- The urban waterlogging due to localized torrential rainfall.

In the following part, the climate change impact on the types of flood is analysed individually.

Climate change impact on the Gan River flood and its implication to project design

The JSTDP area is located in low-lying farmland and is fundamentally depends on the levee and dyke along the banks of the Gan River for protection during flood periods. The JSTDP flood protection design is based on 1:50 year flood event. The Ji'an Government has a mid-term objective to strengthen the dykes to protect the urban area from 1:50 year flood and a long term objective of completion of a plan to protect the urban area from 1:100 year flood. The enhancement of the Gan River dykes for flood protection is one of the top priorities in Ji'an government Flood Protection Plan (Ji'an Government, 2014 (1)). The current 1:50 year flood height at Ji'an is 54.41 masl (Tang and Deng, 2008). A 0.9 metre increase as projected by high climate change scenario by 2050 will make the intensity to 55.31 metre.

According to the information provided by SUCDRI, the new road network design criteria is 1:50 year flood level, but the actual height is 59 masl for most parts of the road surface due to other top-geographic requirements. The actual design standard is sufficiently higher than the climate change induced 1:50 year flood height increase. It may become inadequate only by the end of this century for high scenario, when the intensity change may be 2 metres higher. Additional adaptation measures, discussed in the next section, will be needed to further strengthen the resilience of the project against even more severe climate change impact in future.

Climate change impact on waterlogging and its implication for project design

Urban flood of waterlogging is caused by heavy rainfall in the urban catchment. In this project, all storm–water is designed to drain naturally to the Gan River by its own gravity. According to the Ji'an Government Flood Protection Plan, the drainage system must meet the requirement of completely draining the storm water from 1:10 year 24h rainfall event in one day (Ji'an Government, 2014(1)).

A drainage system capacity is commonly calculated by the waterlogging drainage module, as described as:

$$M = \frac{R_t}{3.6Tt}$$

where: M is the waterlogging drainage module ($m^3/s/km^2$);
R_t is the effective rainfall (mm)
T is designed drain duration (days)
t is the total drain time per day (hour).

From the "Jianxi Torrential Rainfall and Flood Manual", the point-to-area rainfall coefficient of Ji'an is 0.995, and the effective rainfall coefficient for urban area is 0.85. Take T as 1 day and t as 24 hours, the water logging drainage modules for the 1:10 year daily maximum rainfall event was calculated as in Table 4. According to Table 4, the waterlogging drainage module may be required to increase by 6% in 2050 and 11% by 2100, in order to meet the Ji'an government flood protection plan.

Climate change impact on urban flood due to high flood water level and waterlogging

As discussed previously, the drainage system is designed to drain storm water to the Gan River outfalls or outlets driven by water gravity. Such flow condition cannot be satisfied when the water level in the Gan River becomes higher than the outfalls or outlets. This may not be an issue if torrential rain does not occur at the same time in the urban area. The most severe flood occurs when the flood of the Gan River coincides with torrential rain in the

urban area. Out of the 10 major floods since 1950 to early 2000s (i.e., 1959, 1961, 1962, 1964, 1968, 1982, 1994, 1998, 2002, 2010), three (1962, 1998 and 2010) can be classified as this type of flood. Under such hydrologic conditions, the storm water cannot be drained to the Gan River due to the backwater effects. The urban area may undergo a period of waterlogging, and may potentially affect the sensitive components of the proposed project.

Because the actual height is 59 masl for most parts of the road surface due to other top-geographic requirements (per comm. SUCDRI), the occurrence of flood water overtopping the new road network is unlikely even under high scenario climate change conditions (the current 1:200 year flood water level is 55.42 masl). The main function of the Yudai River area is for recreation. Hence the main design objective will be to protect river bed from flood and prevent soil erosion, which have all been incorporated in the Yudai River Rehabilitation design. Given climate change impact caused increase of both Gan River flood and torrential rain in Ji'an; it is likely that waterlogging may still occur for the Yudai River Rehabilitation area if the two weather events coincide together, but huge cost of damage is unlikely from the inundation of the green field of the recreation area.

Table 4: Ji'an water logging drainage modulus for 1:10 year daily rainfall

Waterlogging drainage modulus ($m^3/s/km^2$)						
Baseline	2050 scenario			2100 scenario		
	Low	Median	High	Low	Median	High
1.43	1.49	1.51	1.60	1.51	1.59	1.82

4. The adaptation options

As discussed previously, flood damage is the major climate risk to the JSTDP. To avoid costly repairing and/or replacement in the future, the sensitive exposure components to flood in the JSTDP should take the climate change impact induced additional flood risk into project design and construction consideration. In the following part, the adaptation options are discussed in three general categories.

4.1 "Hard" options: adjustments to design of relevant project component(s)

Given the safety factor adopted in the project design, together with the Ji'an Government plan of raising the Gan River dykes to protect the urban centre from 1:100 year flood, the current road and bridge design standards are likely to be adequate by the middle of this century. After 2050, further rising of the Gan River dykes may be required. However even the flood water overtopping the dyke, the damage to the new road network and the Yudai River area will be limited due to the relatively higher ground of the road system. On the other hand, the drainage system may need to be adjusted to a higher design standard. A conservative 6% increment of the waterlogging drainage module is recommended, and an 8-10% increment for the critical components would be more appropriate, given the difficulty of repair and replacement of urban drainage system in the future. The induced waterlogging may become even severer under climate change, but the risk of flood damage to the project components will be limited, due to the height of road network and relative low lying area surrounding them. The BRT system is built on existing roads, so its flood protection design needs to be considered carefully with the existing road system. The green space of the Luling Cultural Park downstream of the JSTDP could also help reduce the waterlogging in the project area. Therefore another adaptation could be built on the green space development, based on detailed digital elevation model. However, waterlogging for a substantially long time may still have the potential of damaging the infrastructure of the project components, additional water drainage system--such as flood water pump station--may be considered in the future as an alternative adaptation options. Clearly, at what stage the additional adaptation options may be implemented depends on the financial

consideration and future climate change trends. The Ji'an Government has a long term plan to enhance the dykes of the Gan River along the Ji'an to protect the urban area against 1:200 year flood event. The implementation of such plan will no doubt substantially benefit the proposed project against the climate change impact.

4.2 "Soft" measures: ecological solutions, institutional and technical capacity building to enhance risk awareness and ability for ongoing risk assessment & management, knowledge management to improve risk assessment as new information emerges

Human activity has considerably interfered with both the Gan River flow and other river flows in Ji'an (including Luohushui, the upper stream of Yudai River). It makes the flood prediction a complex task on the one hand, but provides good opportunity as an effective adaptation to alleviate the damage from flood on the other. As mentioned previously, in general, flood from either Gan River or rivers inside Ji'an only cause minor damage. The most severe urban flood is caused by the coincidence of flood of the Gan River and torrential rain in the urban area, i.e., all river systems has high flood levels. In such a case, the hydraulic facilities inside both river systems could provide effective adaptive capacity against flooding in the Ji'an city.

For example, the Wan'an Reservoir has strong flood water storage capacity and can reduce peak flood height by 0.5-0.7metre for Ji'an (Li et al. 2007). The Wan'an Reservoir has not yet operated at its full capacity, so it is expected more peak flood water adjustment can be achieved by Wan'an Reservoir in the future. The numerous small and middle sized dams in Ji'an also have the potential to adjust the intensity and duration of flood. These existing hydraulic facilities are; however, heavily depend on accurate and real-time hydro-met information in order to operate in synergy to optimise their capacity against flood. The Ji'an Government has prioritised the task of the development of a comprehensive hydro-met prediction system in its 12th five year development plan (Ji'an Government, 2014 (2)).

4.3 Assessment of climate risk management options

Risk assessment encounters difficulties in estimating the likelihood and magnitude of extreme events and their impacts. Management of the risk associated with climate extremes, extreme impacts and disasters benefits from an integrated systems approach; as opposed to separately managing individual types of risk, or risk in particular locations. The above adaptations are discussed against their targeted vulnerable components.

Table 5: Summary of adaptation options

Adaptation options	Cost	Benefit	Comments
Operation of Wan'an reservoir at full capacity for flood control	Depends on the re-settlement	Current operation already can reduce the peak flood height by 0.5 m. More flood height reduction can be achieved when the reservoir on full operation	The reservoir is not operated at its full capacity due to a historical re-settlement issue.
Increase drainage capacity under the new road netwok	~CNY10million	Reduce the risk of waterlogging in the project area	Cost is approximation. More accurate value will be available when detailed design starts.
Addition of auxiliary pumps for water removal	unknown	Reduce the risk of waterlogging in the project area	This adaptation is not in the scope of this project, so no plan yet.
Cost of raising levees	Will be implemented by Ji'an Government	Reduce the flood risk from the Gan RIver	This option is already in Ji'an government hydraulic plan, and will add no cost to the project

However, one adaptation will not only strengthen the resilience of the target component, but will also benefit all components across the project.

Of the adaptations discussed above, the “Hard” options will likely incur more financial investment. Careful review of the current design, if this has not already done, is required to examine whether the future climate change impact can be covered. If not, a cost-benefit analysis may be required to determine the best adaptation options. The BRT system is built on existing road and any “Hard” options will be constrained by the existing road conditions. The new road system and the Yudai River rehabilitation have a range of adaptation options to consider but the most important one is the review of the adequacy of the drainage system design for the new roads. The Yudai River rehabilitation design provides a good opportunity to re-design the river channels to satisfy the future flood conditions. The “Hard” adaptation review should be as comprehensive as possible. Some adaptation measures may be beyond a project scope, but may bring in substantial benefit to the project such as the Ji’an Government Flood Protection Plan for the JSTDP.

It should also be recognised that the “Soft” options could be much cost effective and equally efficient. The hydraulic facilities in Ji’an have great potential to alleviate the flood risk. The Wan’an Reservoir alone has the potential to reduce the flood height in Ji’an by a half metre if it is operated under on-time hydro-met information during flooding. The ecosystem restoration in the Ji’an will have good potential to prevent river bank collapse, debris flow and other hazards to road systems, hence reduce damage. It has been found that great resilience can also be reached by management options through capacity building and raising awareness; so a comprehensive review of the current institutional capacity and management structure may be a good start to achieve both effective and efficient adaption for climate change impact. Table 5 lists a summary of the adaptations with estimated cost/benefit analysis.

5. Conclusion

The objective of the Jiangxi Ji’an Urban Transport Development Project is to facilitate the socio-economic development in the Western City Development Area of Ji’an City and benefit a future population of 300,000 in the area. Climate change may have significant impact on the future use and maintenance of the project. Immediate actions should be taken to include effective and efficient adaptations as an integral part of project design and construction to alleviate any negative climate change impact consequences. Incorporating effective adaptation measures in project design and construction will prevent costly infrastructure remedy and/or re-construction and warrant the long term economic benefit for which the project is designed.

This report produces quantitative climate change information relevant to the project by making use of the pattern scaling based GCM ensemble method. The advantage of the method is that it not only takes the key uncertainties in climate change science into future projection consideration, but also treats these key uncertainties independently. Therefore climate change projections and their associated uncertainty range can be produced consistently through combination of the different scenarios. A quantitative impact assessment can then be conducted by building the risk profile for the key vulnerable components, and targeted adaptation options can subsequently be identified and evaluated. As revealed by the study, the biggest climate related risk to the project is river flood and urban flood caused by heavy rainfall. The climate change scenario analysis indicated an enhanced risk profile for both river and urban floods. Several adaptation options were identified and discussed.

This study was constrained by a number of limitations:

- The river flow of the Gan River up Ji'an comes mainly comes three areas:
    1. Western Luoxiao Mountain Area;
    2. Area surrounding Wan'an Reservoir; and
    3. Area in the southeast beyond Wan'an Reservoir.

  Statistically, Mao and Wang (2002) found that the flood in Ji'an is correlated well with the previous 24h rainfall in Area 1; previous 24-48h rainfall in Area 2; and previous 48-72h rainfall in Area 3. In this report, long term rainfall data was not found for Areas 1 and 3, so that the rainfall - flood height is built only on the daily rainfall of Ji'an and Ganzhou (Area 2). The statistical relationship could be improved if Areas 1 and 3 data becomes available.
-
- Given the size of the project area, it would be appropriate to use climate projections that have finer spatial and/or temporal resolutions, such as outputs of Regional Climate Models (RCMs). However, these data are either not accessible, or not available in sufficient numbers for model ensemble. Nevertheless, the V&A work presented based on the latest GCM outputs is still valid and may even be a better choice because of two reasons. Firstly, for V&A assessment work, the issue of most concern is the uncertainty range in association with the future climate projection. Whether the RCM could reduce the uncertainty range projected by GCM is still an open question. As concluded by Feng et al. (2011) in simulation of extreme climate events over China with different RCMs, even though several important extreme climate events of the 1990s were reproduced, the signals were weak. Secondly, the RCM is useful on local spatially scale climate change assessment with introduction of fine scale bio-physical dynamic processes, which are generally precluded in GCM models. The V&A assessment of JSTDP is focused predominately on site specific climate change impact consequence. Although the fine scale bio-physical dynamic processes may have some role to play at this site scale, the uncertainty is still dominated by the difference in climate model assumptions. Within this context, including more climate modelling outputs in climate change projection is more important than ensuring that fine scale dynamic processes are correctly represented in the modelling process.
-
- The rainfall - flood height relationship is built on daily rainfall observation of 08:00 to 08:00. For urban flood modelling and assessment normally requires sub-daily hydro-met observations, i.e., hourly time series data. Further study can be carried out when this information becomes available.
-
- The impact assessment was conducted based on available data. Though considered as adequate for this study, a properly developed impact model will better reveal the detailed relationship between heavy rainfall and the river flood and urban flood. For example, a time series river flow data would help in developing proper hydrologic and hydraulic models so that the impact on flood due to changes in rainfall could be explored; a detailed digital elevation model (DEM) would help to develop flood area mapping to identify the most vulnerable area for effective adaptation action implementation.
-
- The adaptation options discussed were presented as initial recommendations. Although the median scenario may be used in supporting design adjustment or adaptation planning, some critical transport infrastructure may be required to sustain high climate risk; hence a projection developed on a higher change scenario may be needed.

- No economic data was available to investigate the cost-benefit of implementing such adaptation options. However, we recommend selection of appropriate adaptations and/or their combination to be considered in project design wherever it is feasible.

6. References

ADB 2010. Sustainable Transport Initiative: Operational Plan. (http://www.adb.org/documents/sustainable-transport-initiative-operational-plan; website accessed at June 2013)
ADB 2012. Proceedings of ADB Sustainable Inland Waterway Transport International Workshop, 11-12 Sept. 2012, Chongqing, PR China.
ADB 2013. Sustainable Transport for All. (http://www.adb.org/sectors/transport/overview. Website accessed at June 2013)
Andrewartha, H. G. and L. C. Birch. 1973. The History of Insect Ecology. In History of Entomology, ed. R. F. Smith, T. E. Mittler and C. N. Smith, 229-266. Annual Reviews Inc., Palo Alto, CA
Fan J., Shan J., Guan M. and Xu X. 2012. Calculation of the critical area rainfall causing flood in Jianxi small watersheds. Meteorological Monthly. 2012 Vol.38 No.9. (In Chinese)
Feng J, Wang Y. and Fu C. 2011. Simulation of extreme climate events over China with different regional climate models. Atmospheric and Oceanic Science Letters, Vol. 4, No.1.
Ji'an Government. 2014 (1). Ji'an Urban Development Planning Revision (2007-2020). http://www.jxjatv.com/...ge=5/content-22-657 (website accessed August 2014, in Chinese)
Ji'an Government. 2014(2) The 12th Five Year Plan of Ji'an Economic and social Development. http://www.jian.gov.cn/pubinfo/fzgh/fzgh/201309/t20130924_1661901.html (website accessed at August, 2014, in Chinese).
Li K. Tan Z. Zhou J and Jiang W. 2007 On the influence of Human activities on the river environment of Gan River catchment. Water Resource Environment. Vol 28 No. 3 (in Chinese)
Liu J. 2004 Discussion of the flood control condition of the channel on the mid-stream of Gan River. Hydraulic Science and Technology, 2004.2.
Mao W. and Wang H. 2002. Forecast method on surface rainfall of river basin in middle stream of of Gan River and flood meteorological index in Ji'an. Jiangxi Meteorological science and technology. Vol. 25 No. 2
Murphy, J.M., D.M. Sexton, D.N. Barnett, G.S. Jones, M.J. Webb, M. Collins, D.A. Stainforth, 2004. Quantification of modelling uncertainties in a large ensemble of climate change simulations. Nat., 430 (7001): 768-772. DOI: 10.1038/nature02771.
Murphy, J.M., A. Noda, S.C.B. Raper, I.G. Watterson, A.J. Weaver, and Z. Zhao, 2007. Global climate projections. In Climate Change 2007: The physical science basis. Contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change (eds S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor & H. L. Miller). Cambridge, UK and New York, NY: Cambridge University Press.
Räisänen, J. 2007. How reliable are climate models? Tellus**,** 59, A(1), S.2-29. DOI: 10.1111/j.1600-0870.2006. 00211.x.
Santer, B.D., T.M.L. Wigley, M.E. Schlesinger, J.F.B. Mitchell, 1990. Developing climate scenarios from equilibrium GCM results, MPI Report Number 47, Hamburg
Shan J. Yin J. Zhang Y. Chen J. and Liu X. 2007. The study on of torrential rainfall characteristics and the prediction of the induced flood in Jiangxi. Torrential Rainfall and Disaster. Vol. 26 No.4. 2007 (In Chinese)
Solomon, S., D. Qin, M. Manning, Z. Chen., M. Marquis, K.B. Averyt, M. Tignor, H.L. Miller, (eds.) 2007. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Task Group on Data and Scenario Support
Sorteberg, A. and N.G. Kvamsto, 2006. The effect of internal variability on anthropogenic climate projections. Tellus, 58A, 565–574. DOI: 10.1111/j.1600-0870.2006.00202.x.
Sterl, A., C. Severijns, G.J. Van Oldenborgh, H. Dijkstra, W. Hazeleger, M. Van den Broeke, G. Burgers, B. Van den Hurk, P.J. Van Leeuwen, P. Van Velthoven, 2007. The ESSENCE project - signal to noise ratio in climate projections. http://www.knmi.nl /~sterl/ Essence/essence_1_v2.2.pdf

Tang J, and L. Deng, 2008. Hydrological analysis of flood contro and drainage in Ji'an City. J. Nanchang Institute of Technology. Vol. 27, No. 1.
Wigley, T.M.L., 2003. MAGICC/SCENGEN 4.1: Technical Manual. National Center forAtmospheric Research, Boulder, Colorado.
Wilby R.L., J. Troni, Y. Biot, L. Tedd, B.C. Hewitson, D.M. Smith and R.T. Sutton, 2009. A review of climate risk information for adaptation and development planning, Int. J. Climatol. 29: 1193–1215
Ye W. and Y. Li, 2011. A method of applying daily GCM outputs in assessing climate change impact on multiple day extreme precipitation for Brisbane River Catchment, MODSIM11. In Chan, F., Marinova, D. and Anderssen, R.S. (eds) MODSIM2011, 19th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2011, pp. 3678-3683. ISBN: 978-0-9872143-1-7

Annex 1: Climate change scenario generation

The uncertainties in climate change scenario generation

The future climate change projection includes uncertainties, particularly at the regional and local level. The major sources of uncertainties come from: 1) the difference of spatial change projections modelled by different GCMs; 2) the future Greenhouse Gas (GHG) emission rates; and 3) different GCM model parameterisation due to the unknown or not fully understood mechanism and feedbacks in the climate systems. A thoroughly studied uncertainty by scientific community is the difference in GCM model parameterisation, or the climate sensitivity. The climate sensitivity is conventionally defined as the equilibrium change in global mean surface temperature following a doubling of the atmospheric (equivalent) CO_2 concentration simulated by a GCM. It has been found that the uncertainty range is between 2.0°C to 4.5°C (Solomon et al., 2007).

To reflect the uncertainty of future GHG emission rates, a new process has been used for future global climate change projection since IPCC AR5. In this process, GHG emissions and socioeconomic scenarios are developed in parallel, building on different trajectories of radiative forcing over time to construct ***pathways*** (trajectories over time) of radiative forcing levels (or CO_2-equivalent concentrations) that are both ***representative*** of the emissions scenario literature and span a wide space of resulting GHG ***concentrations*** that lead to clearly distinguishable climate futures. These radiative forcing trajectories were thus termed "Representative Concentration Pathways" (RCPs). A RCP was simulated in an Integrated Assessment model to provide one internally consistent plausible pathway of GHG emissions and land use change that leads to the specific radiative forcing target. The full set of RCPs spans the complete range of integrated assessment literature on emissions pathways and the radiative forcing targets are distinct enough to result in clearly different climate signals.

In this study, three RCPs: RCP4.5, RCP6.0 and RCP8.5, is used to characterise the possible climate change scenario for the project area and uncertainty range. RCP6.0 with mid-climate sensitivity represents a GHG concentration reaching 850 ppm and stabilized after 2100, it is a middle range future change scenario. Similarly, RCP4.5 (650 ppm GHG and stabilized at 2100) with low-climate sensitivity and RCP8.5 (concentration larger than 1370 ppm at 2100 and still rising) with high-climate sensitivity represents the low and high bound of the uncertainty range of future global change scenarios as shown in Table 1. The three RCPs represent rising radiative forcing to 4.5, 6 and 8.5 W/m^2 by 2100 respectively.

The General Circulation Model (GCM) is the most reliable tool in generating the future climate change scenarios at large to global scale. However, given the current state of scientific understanding and limitations of GCMs in simulating the complex climate system, for any given region in the world, it is still not possible to single out a GCM that outperforms all other GCMs in future climate change projection. Future climate change projection based on the analysis of a large ensemble of GCM outputs is more appropriate than using any individual GCM outputs (Wilby et al. 2009). This is particularly important if such a projection is used for impact assessments; a large ensemble of GCM simulations can provide a reliable specification of the spread of possible regional changes by including samples covering the widest possible range modelling uncertainties (Murphy et al. 2004, Sortberg and Kvamsto 2006, Murphy et al. 2007, Räisänen 2007). A single GCM projection of future climate made with even the most sophisticated GCM can be of limited use for impact assessment as it lacks the ability to provide information on the range of uncertainties. Within an ensemble approach, provided the members of the ensemble are independent, a larger ensemble size could lead to a more reliable statistical result (Sterl et al. 2007). In this study, the 50

percentile value from the model ensemble sample was used in generating future climate change projections.

The pattern scaling method

The pattern-scaling method (Santer ***et al***., 1990) is based on the theory that, firstly, a simple climate model can accurately represent the global responses of a GCM, even when the response is non-linear (Raper et al. 2001), and secondly, a wide range of climatic variables represented by a GCM are a linear function of the global annual mean temperature change represented by the same GCM at different spatial and/or temporal scales (Mitchell, 2003, Whetton et al. 2005). Constructing climate change scenarios using the pattern-scaling method requires the following information:

a) regional patterns of changes in climate (e.g. for precipitation) by specified timeframe (e.g. month) from GCM results, which are normalized to give a spatial pattern of change per degree of global-mean temperature change;
b) time-dependent projections of global-mean temperature change projected by a selected RCP under a selected "climate sensitivities"
c) baseline climate variables derived from observational records.

In generating a "time-slice" scenario for a future year, the normalised pattern (a) is scaled by a time dependent projection of global-mean temperature change (b). The resultant scenario of climate change is then used to perturb the underlying observed spatial climatology (c) to give a "new" climate for the year in question. In this way, the three key uncertainties – the GCM spatial patterns of change, the future GHG emission rates and the climate sensitivity – can be treated independently and combined flexibly and quickly to produce future climate scenarios (as per Wigley, 2003).

The pattern scaling method is also extended to analyse the climate change impact on climate variability, such as the extreme precipitation event. A general extreme value (GEV) function was applied to the daily precipitation data from historical observations and GCM outputs to derive precipitation intensity values. Similar to a normalised pattern for monthly precipitation, normalised patterns of a series of precipitation intensities, such as 1:20 year maximum daily precipitation, is calculated for a GCM following the steps discussed previously. In generating the normalised patterns, the GCM simulated period of 1975 to 2005 was used as GCM baseline.

Out of the 40 GCMs 22 have their daily simulation outputs publically available (see Appendix 2). For the GCM with available daily data, a linear regression method was used to process them in order to derive the normalised pattern for the precipitation intensity series. A more detail discussion of the extreme precipitation change scenario generation can be found from Ye and Li (2011).

Annex 2: IPCC AR5 GCMs used in this scenario generation and their horizontal and vertical resolutions. Models with daily data available are used for extreme rainfall event scenario generation

Model label	Resolution (longitude°× latitude°)	Daily	Institution
ACCESS1.0	1.875×1.25	No	Commonwealth Scientific and Industrial Research Organisation/Bureau of Meteorology (CSIRO-BOM) Australia
ACCESS1.3	1.875×1.25	Yes	Commonwealth Scientific and Industrial Research Organisation/Bureau of Meteorology (CSIRO-BOM) Australia
BCC-CSM1.1	2.8125×2.8125	No	Beijing Climate Center (BCC) China

Model label	Resolution (longitude°× latitude°)	Daily	Institution
BCC-CSM1.1(m)	2.8125×2.8125	No	Beijing Climate Center (BCC) China
BNU-ESM	2.8125×2.8125	No	Beijing Normal University (BNU) China
CanESM2	2.8125×2.8125	Yes	Canadian Centre for Climate Modelling and Analysis (CCCma) Canada
CCSM4	1.25×0.9375	Yes	National Center for Atmospheric Research (NCAR) USA
CESM1(BGC)	1.25×0.9375	Yes	National Center for Atmospheric Research (NCAR) USA
CESM1(CAM5)	1.25×0.9375	No	National Center for Atmospheric Research (NCAR) USA
CMCC-CM	0.75×0.75	Yes	Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) Italy
CMCC-CMS	1.875×1.875	Yes	Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) Italy
CNRM-CM5	1.4×1.4	Yes	Centre National de Recherches Météorologiques (CNRM-CERFACS) France
CSIRO-Mk3.6.0	1.875×1.875	Yes	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia
EC-EARTH	1.125×1.125	No	EC-EARTH consortium published at Irish Centre for High-End Computing (ICHEC) Netherlands/Ireland
FGOALS-g2	2.81x1.66	No	Institute of Atmospheric Physics, Chinese Academy of Sciences(LSAG-CESS) China
FGOALS-s2	2.81x1.66	No	Institute of Atmospheric Physics, Chinese Academy of Sciences(LSAG-IAP) China
GFDL-CM3	2.5 × 2.0	No	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GFDL-ESM2G	2.5x2.0	Yes	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GFDL-ESM2M	2.5x2.0	Yes	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GISS-E2-H	2.5×2×L40	No	NASA Goddard Institute for Space Studies (NASA-GISS) USA
GISS-E2-H-CC	2.5×2×L40	No	NASA Goddard Institute for Space Studies (NASA-GISS) USA
GISS-E2-R	2.5×2×L40	No	NASA Goddard Institute for Space Studies (NASA-GISS) USA
GISS-E2-R-CC	2.5x2×L40	No	NASA Goddard Institute for Space Studies (NASA-GISS) USA
HadCM3	3.75x2.5	No	Met Office Hadley Centre (MOHC) UK
HadGEM2-AO	1.875 × 1.2413	No	National Institute of Meteorological Research, Korea Meteorological Administration (NIMR-KMA) South Korea
HadGEM2-CC	1.875 × 1.2413	No	Met Office Hadley Centre (MOHC) UK
HadGEM2-AO	1.875 × 1.2413	No	National Institute of Meteorological Research, Korea Meteorological Administration (NIMR-KMA) South Korea
HadGEM2-CC	1.875 × 1.2413	No	Met Office Hadley Centre (MOHC) UK
HadGEM2-ES	1.875 × 1.2413	Yes	Met Office Hadley Centre (MOHC) UK
INM-CM4	2x1.5	Yes	Russian Academy of Sciences, Institute of Numerical Mathematics (INM) Russia
IPSL-CM5A-LR	3.75x1.875	Yes	Institut Pierre Simon Laplace (IPSL) France
IPSL-CM5A-MR	2.5x1.25874	Yes	Institut Pierre Simon Laplace (IPSL) France
IPSL-CM5B-LR	3.75x1.875	Yes	Institut Pierre Simon Laplace (IPSL) France
MIROC-ESM	2.8125x2.8125	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC)

Model label	Resolution (longitude°× latitude°)	Daily	Institution
			Japan
MIROC-ESM-CHEM	2.8125x2.8125	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MIROC4h	0.5625x0.5625	No	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MIROC5	1.40625 × 1.40625	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MPI-ESM-LR	1.875x1.875	Yes	Max Planck Institute for Meteorology (MPI-M) Germany
MPI-ESM-MR	1.875 × 1.875	Yes	Max Planck Institute for Meteorology (MPI-M) Germany
MRI-CGCM3	1.125x1.125	Yes	Meteorological Research Institute (MRI) Japan
NorESM1-M	2.5x1.875	Yes	Bjerknes Centre for Climate Research, Norwegian Meteorological Institute (NCC) Norway
NorESM1-ME	2x2	No	Bjerknes Centre for Climate Research, Norwegian Meteorological Institute (NCC) Norway

Annex 3: Ji'an temperature related observed climate variables and their future projections

Table A3-1: Annual average temperature and future change projections (°C)

	Baseline	2050 scenario			2100 scenario		
		Low	Median	High	Low	Median	High
Mean	18.5	19.4	19.8	21.1	19.8	21.0	24.5
Minimum	15,1	16.0	16.4	17.7	16.3	17.5	20.9
Maximum	23.1	24.0	24.4	25.8	24.4	25.7	29.3

Table A3-2: Annual extreme daily temperature and future change projections (°C)

	Return period (year)	Baseline (°C)	2050 scenario			2100 scenario		
			Low	Median	High	Low	Median	High
Maximum	10	40.1	41.0	41.3	42.5	41.3	42.4	45.6
	20	40.5	41.3	41.6	42.8	41.6	42.7	45.9
	50	40.8	41.6	41.9	43.2	41.9	43.0	46.2
Minimum	10	-5.3	-4.4	-4.0	-2.6	-4.0	-2.8	0.5
	20	-6.3	-5.3	-5.0	-3.6	-5.0	-3.7	-0.5
	50	-7.5	-6.6	-6.3	-4.9	-6.3	-5.0	-1.8

Table A3-3: Annual 7 day maximum temperature and future change projections (°C)

Return period (year)	Baseline	2050 scenario			2100 scenario		
		Low	Median	High	Low	Median	High
20	39.2	40.0	40.4	41.6	40.3	41.5	44.7
50	39.6	40.4	40.8	42.0	40.8	41.9	45.1
100	39.8	40.7	41.0	42.2	41.0	42.1	45.3

Annex 4: Precipitation related observed climate variables and their future projections

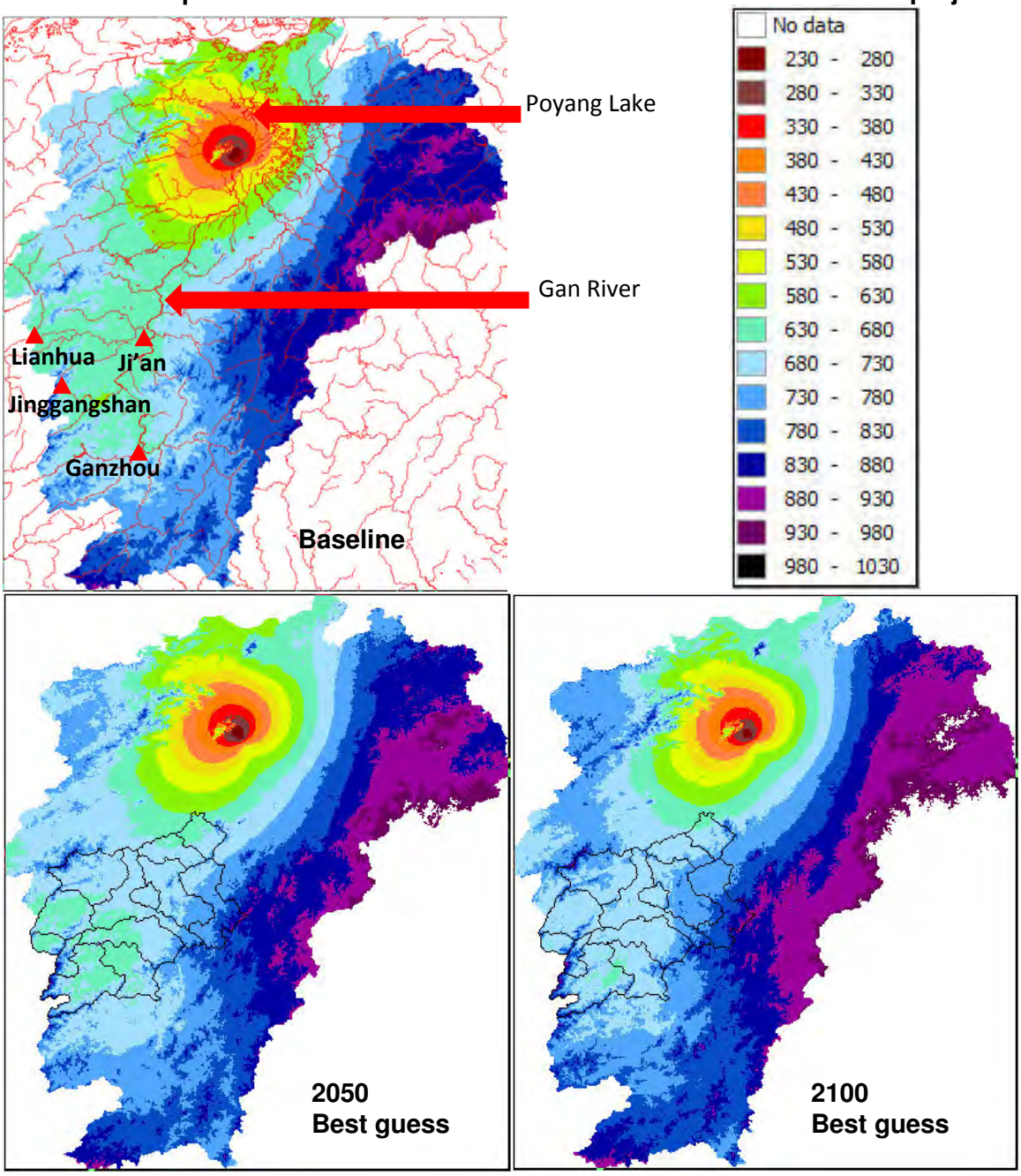


Figure A4-1: Jiangxi rainy season (Apr-Jun) rainfall distribution (mm): baseline and 2050, 2100 best guess projections. Ji'an is in the mid-west of the province shown by the black lines. The red lines are the river network and the red triangles indicates the meteorological stations.

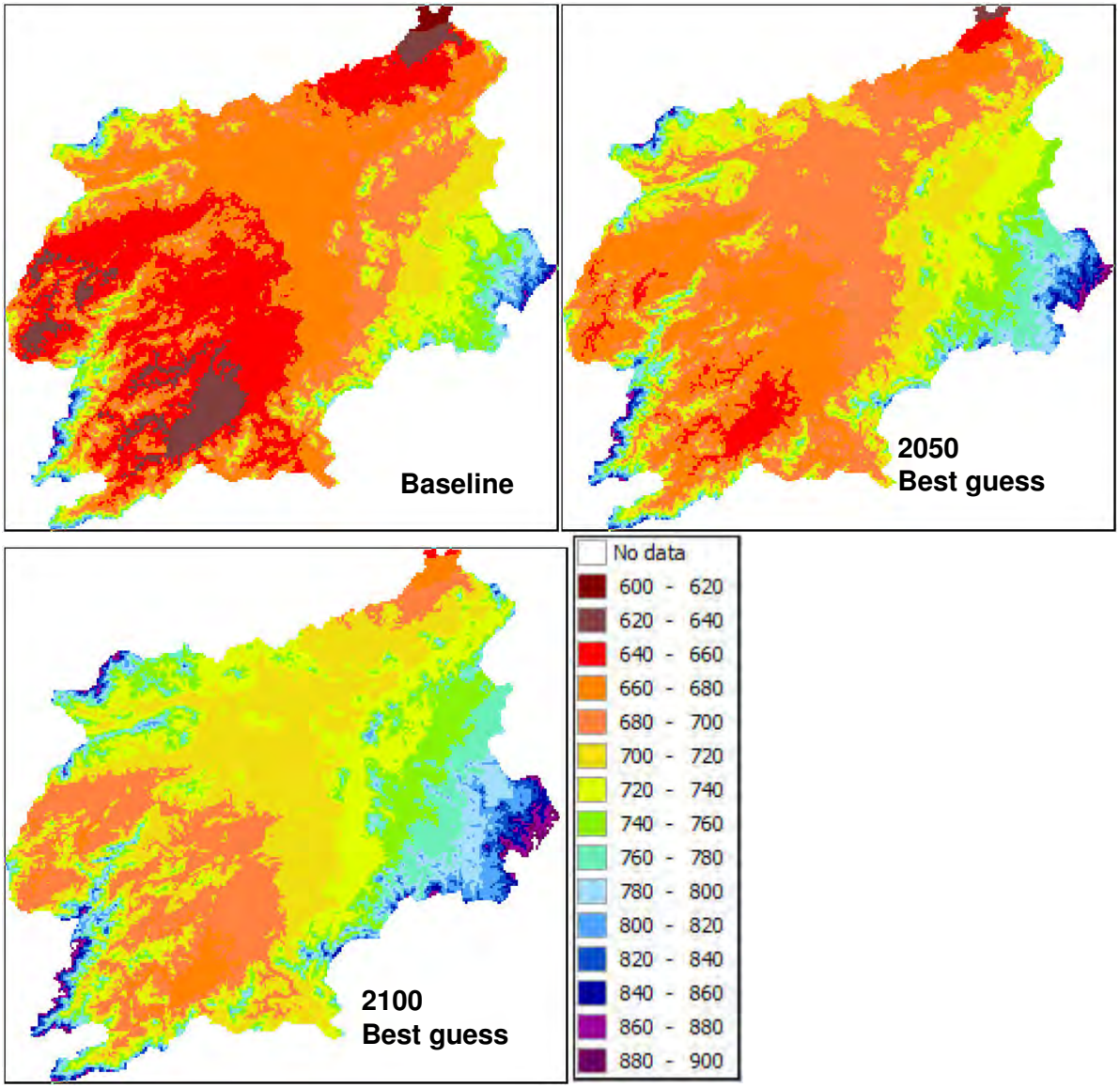


Figure A4-2: Ji'an rainy season (Apr-Jun) rainfall distribution (mm): baseline and 2050, 2100 best guess projections

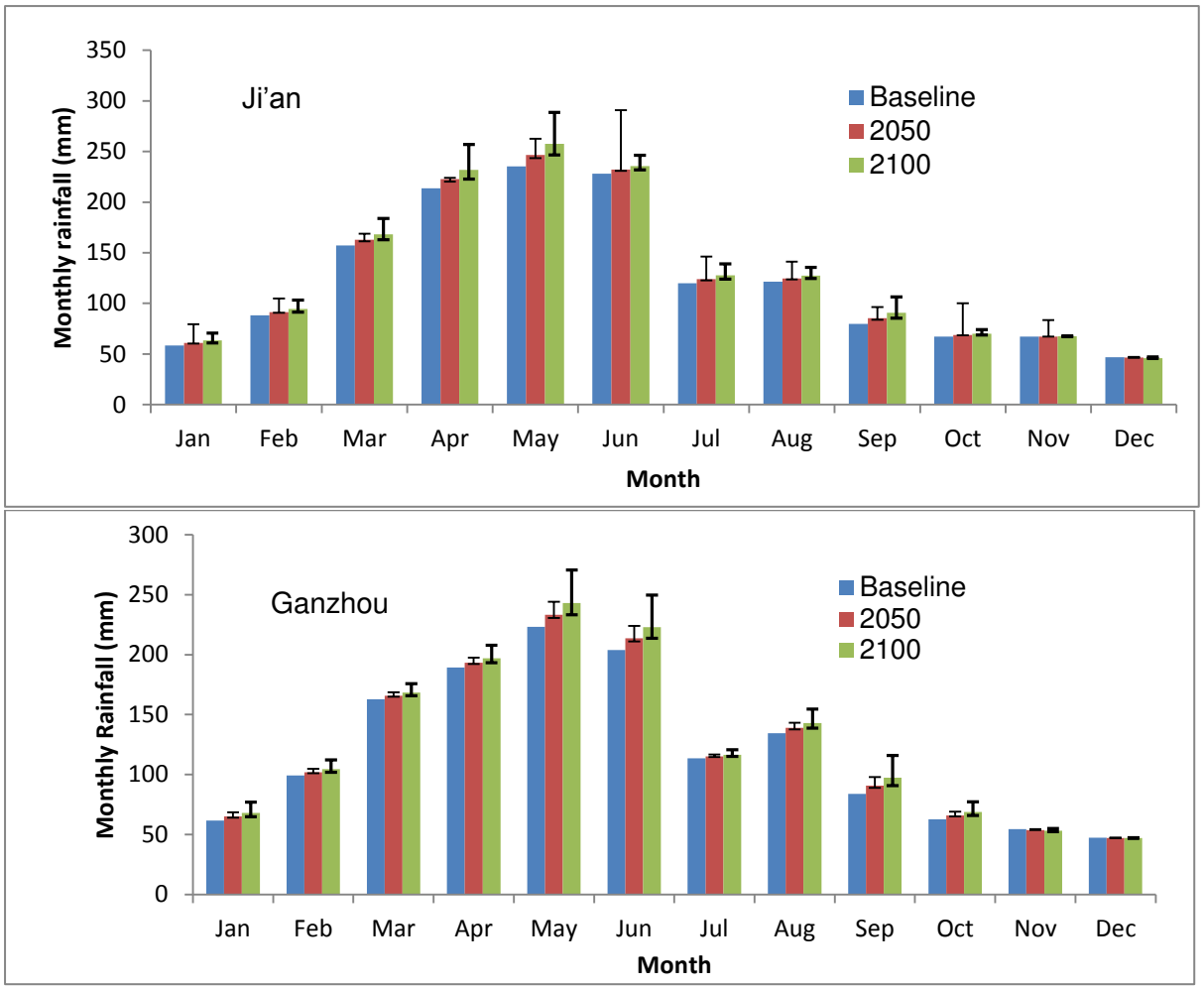


Figure A4-3: Ji'an and Ganzhou site specific monthly normal rainfall and future projection. The bar indicates the uncertainty range of the climate change projection as defined in Table 2

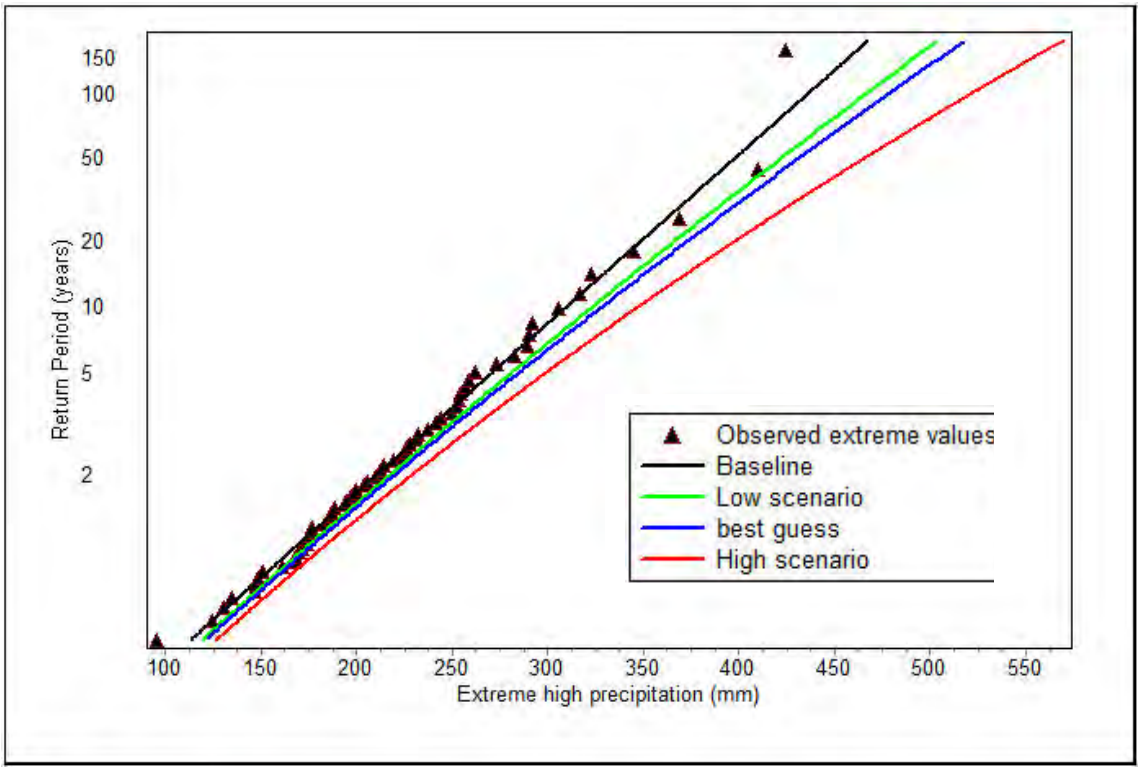


Figure A4-4: Ji'an annual maximum 10 day rainfall GEV distribution and 2050 projection. Black line is the baseline from historical data; blue and red lines represent the uncertainty range as defined in Table 2; green line is low projection; red line is high projection. The horizontal difference between green and red lines indicates the uncertain range of rainfall intensity for a given rainfall frequency; the vertical difference between green and red lines indicates the uncertain range of rainfall frequency for a given rainfall intensity

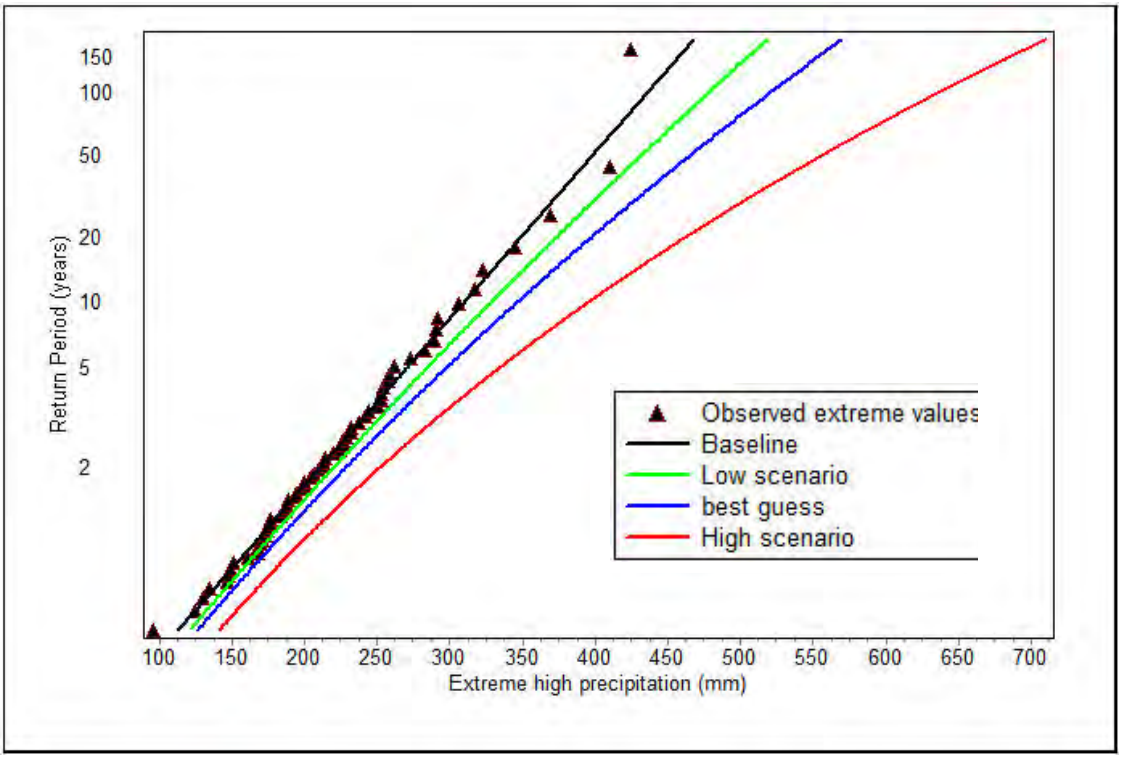


Figure A4-5: Same as Figure A4-4 but for Ji'an 2100 projection

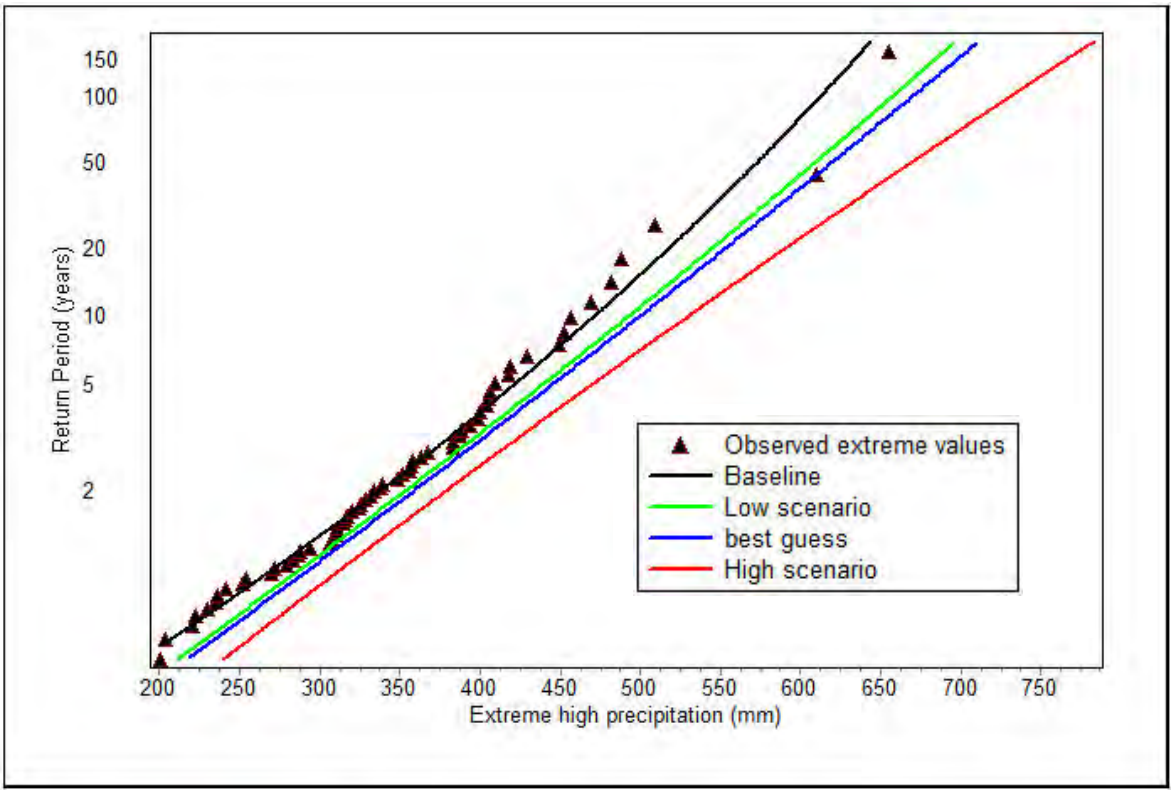


Figure A4-6: Same as Figure A4-4 but for Ganzhou 30 day 2050 projection

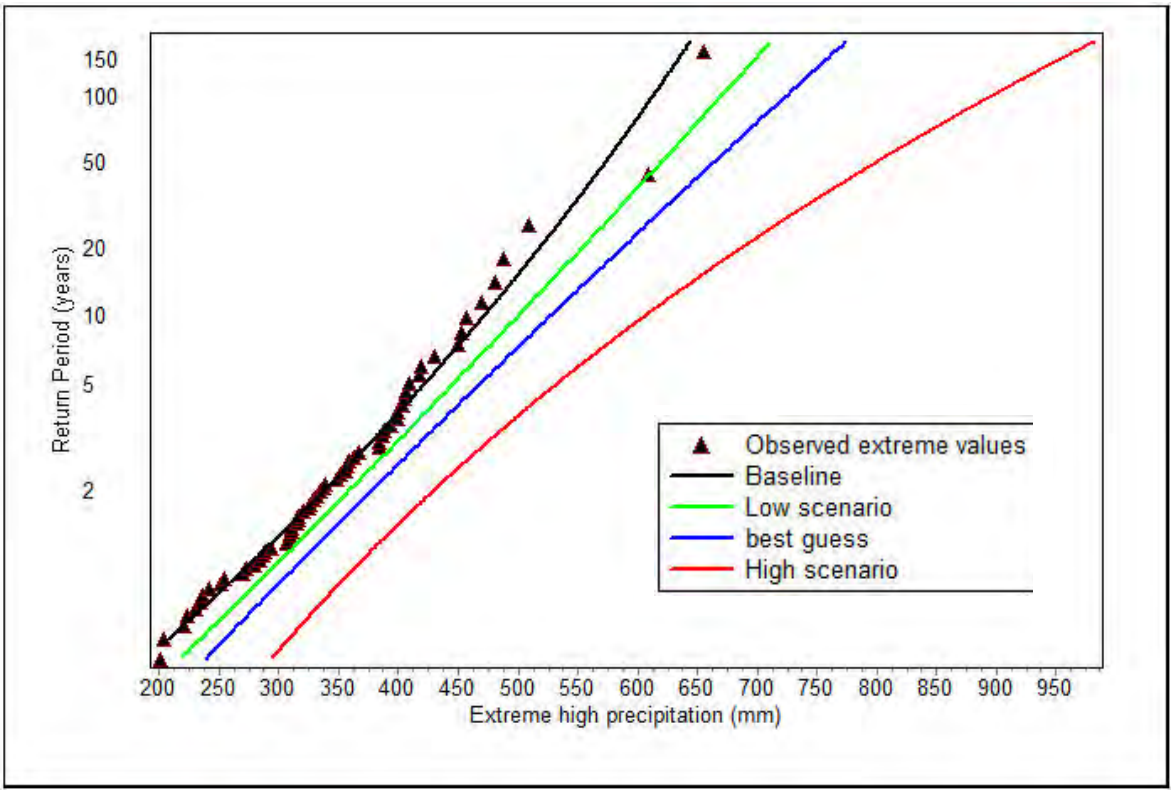


Figure A4-7: Same as Figure A4-4 but for Ganzhou 30 day 2100 projection

Annex 5: The development of the rainfall-flood model for Ji'an

A statistical modelling method was adopted to find the relationship between rainfall and the flood. An 30 years of observed annual maximum river flow height data was collected from the Hydrology Institute for Ji'an station. Corresponding to these flow events, their previous 1,3,10 and 30 days total rainfall was selected from the daily time-series observations for Ji'an and Ganzhou (Table A5-1). A statistical analysis was carried out to examine the relationship between the annual maximum flow heights and all the rainfall events of different durations, and it was found that that the flow height has most significant relationship with 30 day rainfall of Ganzhou and 10 day rainfall of Ji'an. These two rainfall events were examined in detail with results presented in Appendix 4. A regression model was developed as below:

$$Y = 44.1627 + 0.01018X_1 + 0.00924X_2 \quad (1)$$

where: $\boldsymbol{Y}$ is the annual maximum flow height (masl); $\boldsymbol{X_1}$ is the previous 10 day total rainfall of Ji'an, and $\boldsymbol{X_2}$ is the previous 30 day total rainfall in Ganzhou. The developed model has a reasonable performance in simulating the annual peak flow height with a correlation coefficiency (R^2) of 0.58 with standard error of 1.1 m (Figure 3).

Table A5-1: Observed annual maximum flow height at Ji'an hydrology station and its corresponding observed rainfall of different durations from Ji'an and Ganzhou.

Date	Flow height (masl)	Rainfall (mm)				
		Station	30 day	10 day	3 day	1 day
30/31983	51.08	Ji'an	195.6	61.7	41.2	37.0
		Ganzhou	373.0	133.3	117.8	80.3
2/9/1984	50.90	Ji'an	380.5	295.0	196.6	152.5
		Ganzhou	322.8	202.9	151.4	118.4
6/6/1985	49.14	Ji'an	262.8	214.3	153.4	75.6
		Ganzhou	162.4	58.6	27.4	14.7
1/41986	48.24	Ji'an	164.1	24.7	24.7	21.8
		Ganzhou	193.4	128.6	78.9	76.5
25/3/1987	47.73	Ji'an	127.8	87.2	20.7	10.4
		Ganzhou	254.8	77.1	102.1	68.0
14/5/1988	49.55	Ji'an	190.0	129.3	83.3	57.0
		Ganzhou	177.7	116.9	58.9	31.3
24/5/1989	49.83	Ji'an	244.3	151.5	56.3	23.3
		Ganzhou	263.6	152.8	107.5	65.4
13/9/1990	48.69	Ji'an	75.1	50.0	39.4	16.7
		Ganzhou	192.7	138.7	79.5	33.2
1/4/1991	49.38	Ji'an	297.4	201.5	97.9	25.8
		Ganzhou	230.1	144.9	108.6	44.4
29/3/1992	52.73	Ji'an	437.5	298.8	119.1	50.5
		Ganzhou	419.9	260.7	144.3	47.1
2/7/1993	49.15	Ji'an	451.9	288.8	214.7	107.4
		Ganzhou	257.4	100.6	10.4	3.8
18/6/1994	53.32	Ji'an	303.9	238.0	124.1	67.6
		Ganzhou	375.3	242.7	142.0	69.9
20/6/1995	51.11	Ji'an	271.4	79.6	68.7	0.3
		Ganzhou	291.7	198.9	160.5	93.7
4/8/1996	51.49	Ji'an	267.7	146.7	146.7	87.5
		Ganzhou	294.3	200.9	133.5	110.5

Date	Flow height (masl)	Rainfall (mm)				
		Station	30 day	10 day	3 day	1 day
12/7/1997	51.69	Ji'an	263.0	168.3	128.1	15.2
		Ganzhou	286.2	136.8	79.2	38.5
10/3/1998	52.63	Ji'an	343.8	226.5	141.5	47.0
		Ganzhou	443.0	219.4	150.3	68.4
27/5/1999	50.84	Ji'an	325.2	214.1	123.9	53.6
		Ganzhou	316.8	250.5	215.3	60.5
12/6/2000	48.38	Ji'an	245.5	187.1	163.3	78.8
		Ganzhou	173.5	78.9	70.7	44.9
14/6/2001	50.23	Ji'an	289.7	107.4	63.6	30.2
		Ganzhou	214.9	157.4	89.0	72.8
17/6/2002	52.32	Ji'an	236.5	194.1	186.8	116.5
		Ganzhou	306.2	165.1	117.9	44.5
17/5/2003	51.39	Ji'an	268.3	224.9	179.6	178.0
		Ganzhou	177.0	107.5	65.3	44.7
9/7/2004	48.50	Ji'an	192.7	56.0	55.6	18.8
		Ganzhou	297.0	159.6	159.3	141.1
25/5/2005	50.75	Ji'an	466.5	208.4	60.2	16.5
		Ganzhou	273.5	125.0	80.3	56.3
8/6/2006	50.72	Ji'an	283.6	187.5	149.5	93.9
		Ganzhou	366.0	169.7	35.0	21.1
12/6/2007	49.81	Ji'an	189.5	141.2	44.2	5.1
		Ganzhou	193.4	181.9	52.5	16.4
15/6/2008	49.46	Ji'an	153.8	83.7	47.2	45.0
		Ganzhou	277.2	163.8	121.1	115.2
5/7/2009	49.64	Ji'an	179.5	113.3	127.5	6.2
		Ganzhou	167.3	141.0	127.3	118.1
21/6/2010	53.14	Ji'an	442.2	331.9	303.0	113.1
		Ganzhou	213.1	131.8	46.4	33.1
18/5/2011	47.01	Ji'an	96.3	42.3	6.5	4.7
		Ganzhou	202.1	138.5	75.7	42.1
25/6/2012	51.26	Ji'an	281.4	123.9	95.1	4.3
		Ganzhou	307.0	212.5	93.8	52.5

Annex 6: Ji'an Hydrologic Station observed maximum flow height and projections (masl)
The calculation process for the future flow height:

- Firstly, the return period for the 10 day rainfall of Ji'an and 30 day rainfall of Ganzhou corresponding to each year peak flow height was calculated from their baseline GEV distribution;
- Secondly the future values of these rainfall events were calculated based on their future GEV distributions (refer to previous section on the detail of GEV calculation);
- Thirdly the future model calculated flood height was calculated from the future rainfall based on Equation 1, and a change ratio of model calculated future and baseline flood height was calculated for every year;

Finally, the future projected flood height was calculated by adding the change ratio to its corresponding observed value for each year.

Table A6-1: Values included in the maximum flow height projection calculation:

Observed	Modelled	2050 scenario								
		Low	Change (%)	Projection	Median	Change (%)	Projection	High	Change (%)	Projection
51.08	50.19	50.35	0.32	51.24	50.38	0.39	51.28	50.60	0.82	51.50
50.90	52.10	52.37	0.53	51.17	52.45	0.67	51.24	52.83	1.41	51.62
49.14	49.79	49.86	0.14	49.21	49.89	0.19	49.23	49.98	0.38	49.33
48.24	48.15	48.30	0.31	48.39	48.36	0.44	48.45	48.59	0.91	48.68
47.73	49.35	49.52	0.33	47.89	49.56	0.42	47.93	49.77	0.84	48.13
49.55	49.07	49.44	0.75	49.92	49.52	0.92	50.00	49.81	1.50	50.29
49.83	50.09	50.32	0.45	50.05	50.35	0.51	50.09	50.65	1.11	50.38
48.69	48.40	48.56	0.32	48.85	48.62	0.45	48.91	48.84	0.92	49.14
49.38	50.29	50.52	0.45	49.60	50.59	0.59	49.67	50.89	1.19	49.97
52.73	53.03	53.33	0.56	53.02	53.42	0.73	53.12	53.84	1.53	53.54
49.15	51.43	51.73	0.58	49.43	51.81	0.74	49.51	52.18	1.47	49.87
53.32	52.00	52.25	0.47	53.57	52.31	0.59	53.64	52.65	1.24	53.98
51.11	49.62	49.78	0.32	51.28	49.81	0.39	51.31	50.02	0.80	51.52
51.49	50.32	50.55	0.45	51.72	50.60	0.55	51.78	50.87	1.09	52.05
51.69	50.47	50.70	0.45	51.92	50.75	0.56	51.98	51.03	1.11	52.26
52.63	52.51	52.77	0.49	52.89	52.85	0.64	52.97	53.21	1.34	53.34
50.84	51.22	51.45	0.45	51.07	51.51	0.57	51.13	51.81	1.15	51.43
48.38	49.62	49.68	0.13	48.44	49.71	0.17	48.46	49.79	0.33	48.54
50.23	49.19	49.52	0.66	50.56	49.59	0.81	50.63	49.86	1.36	50.91
52.32	50.92	51.14	0.44	52.55	51.20	0.55	52.61	51.49	1.12	52.90

Observed	Modelled	2050 scenario								
		Low	Change (%)	Projection	Median	Change (%)	Projection	High	Change (%)	Projection
51.39	50.04	50.41	0.75	51.78	50.50	0.93	51.87	50.83	1.59	52.21
48.50	49.43	49.59	0.33	48.66	49.62	0.40	48.69	49.83	0.81	48.89
50.75	50.76	51.00	0.47	50.99	51.06	0.59	51.05	51.36	1.17	51.35
50.72	51.40	51.62	0.43	50.94	51.68	0.54	50.99	51.98	1.11	51.29
49.81	49.34	49.53	0.40	50.01	49.61	0.56	50.09	49.90	1.14	50.38
49.46	49.53	49.69	0.33	49.62	49.72	0.40	49.66	49.93	0.81	49.86
49.64	48.81	48.87	0.11	49.70	48.89	0.15	49.71	48.94	0.27	49.78
53.14	51.46	51.78	0.63	53.47	51.90	0.85	53.59	52.34	1.71	54.05
47.01	48.41	48.60	0.39	47.19	48.66	0.51	47.25	48.88	0.96	47.46
51.26	50.21	50.40	0.38	51.45	50.45	0.48	51.51	50.72	1.01	51.78

Observed	Modelled	2100 scenario								
		Low	Change (%)	Projection	Median	Change (%)	Projection	High	Change (%)	Projection
51.08	50.19	50.40	0.42	51.29	50.56	0.75	51.46	51.10	1.82	52.01
50.90	52.10	52.46	0.70	51.26	52.77	1.30	51.56	53.73	3.14	52.50
49.14	49.79	49.89	0.19	49.23	49.97	0.36	49.32	50.22	0.86	49.56
48.24	48.15	48.37	0.45	48.45	48.56	0.84	48.65	49.10	1.98	49.20
47.73	49.35	49.57	0.44	47.94	49.73	0.76	48.09	50.24	1.79	48.58
49.55	49.07	49.52	0.92	50.01	49.77	1.42	50.25	50.48	2.87	50.97
49.83	50.09	50.39	0.59	50.12	50.60	1.02	50.34	51.28	2.37	51.01
48.69	48.40	48.62	0.46	48.91	48.81	0.85	49.10	49.36	1.98	49.66
49.38	50.29	50.60	0.61	49.68	48.33	1.02	49.88	51.59	2.59	50.66
52.73	53.03	53.43	0.75	53.13	53.79	1.43	53.48	54.86	3.45	54.55
49.15	51.43	51.82	0.76	49.52	49.36	1.32	49.80	53.07	3.19	50.72
53.32	52.00	52.33	0.62	53.65	52.60	1.14	53.93	53.43	2.75	54.79
51.11	49.62	49.83	0.42	51.33	46.92	0.73	51.48	50.48	1.73	52.00
51.49	50.32	50.62	0.58	51.79	50.83	1.00	52.01	51.50	2.33	52.69
51.69	50.47	50.77	0.59	51.99	50.98	1.02	52.22	51.67	2.38	52.92
52.63	52.51	52.86	0.66	52.98	53.17	1.25	53.29	54.10	3.02	54.22
50.84	51.22	51.52	0.59	51.14	51.76	1.06	51.38	52.51	2.52	52.12
48.38	49.62	49.71	0.17	48.46	49.78	0.32	48.53	49.99	0.74	48.74
50.23	49.19	49.59	0.82	50.64	49.82	1.28	50.87	50.50	2.67	51.57
52.32	50.92	51.21	0.58	52.62	51.44	1.03	52.86	52.16	2.43	53.59

Observed	Modelled	2100 scenario								
		Low	Change (%)	Projection	Median	Change (%)	Projection	High	Change (%)	Projection
51.39	50.04	50.50	0.93	51.87	50.79	1.50	52.16	51.61	3.14	53.00
48.50	49.43	49.64	0.43	48.71	49.79	0.73	48.86	50.29	1.74	49.34
50.75	50.76	51.07	0.61	51.06	51.31	1.08	51.30	52.05	2.54	52.04
50.72	51.40	51.69	0.57	51.01	51.93	1.02	51.24	52.67	2.46	51.97
49.81	49.34	49.62	0.56	50.09	49.86	1.07	50.34	50.58	2.51	51.06
49.46	49.53	49.74	0.43	49.67	49.89	0.74	49.83	50.39	1.75	50.32
49.64	48.81	48.88	0.15	49.71	48.94	0.26	49.77	49.09	0.58	49.93
53.14	51.46	51.90	0.86	53.59	52.29	1.61	53.99	53.41	3.80	55.16
47.01	48.41	48.66	0.52	47.25	48.84	0.90	47.43	49.38	2.00	47.95
51.26	50.21	50.47	0.51	51.52	50.67	0.92	51.73	51.33	2.23	52.40