

Initial Environmental Examination

Project Number: 52230-001

April 2020

PRC: Xiangtan Low-Carbon Transformation Sector Development Program

Prepared by the Xiangtan Municipal Government for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS

(as of 6 April 2020)

Currency unit	–	yuan (CNY)
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ABBREVIATIONS

ADB	–	Asian Development Bank
AQG	–	Air Quality Guideline
AVAS	–	Acoustic Vehicle Alerting Systems
BEB	–	Battery Electric Bus
BEMS	–	Building and Utility Energy Management System
BOD ₅	–	5-Day Biochemical Oxygen Demand
C&D	–	Construction and Demolition
CCHP	–	Combined Cooling, Heating and Power Generation
CEMS	–	Community Energy Management System
CNY	–	Chinese Yuan
CO	–	Carbon Monoxide
COD	–	Chemical Oxygen Demand
COP	–	Conference of the Parties
CPS	–	Country Partnership Strategy
CRVA	–	Climate Risk and Vulnerability Assessment
EA	–	Executing Agency
EbA	–	Ecosystem-based Adaptation
EHS	–	Environment, Health and Safety
EIA	–	Environmental Impact Assessment
EIR	–	Environmental Impact Report
EIRF	–	Environmental Impact Registration Form
EIT	–	Environmental Impact Table
EMAS	–	Environment Monitoring and Assessment System
EMoP	–	Environmental Monitoring Plan
EMP	–	Environmental Management Plan
EMS	–	Environmental Monitoring Station
EPL	–	Environmental Protection Law
EV	–	Electric Vehicle
FSR	–	Feasibility Study Report
GDP	–	Gross Domestic Product
GHG	–	Greenhouse Gas
GRM	–	Grievance Redress Mechanism
HC	–	Hydrocarbon
HPG	–	Hunan Provincial Government
IA	–	Implementing Agency
ICT	–	Information and Communications Technology
IEE	–	Initial Environmental Examination
IFC	–	International Finance Corporation
I _{Mn}	–	Permanganate Index
IPCC	–	International Panel On Climate Change
iRAP	–	International Road Assessment Programme

ITS	–	Intelligent Transport System
LCC	–	Low Carbon Community
LCT	–	Low-Carbon Transformation
LIEC	–	Loan Implementation Environmental Consultant
MEE	–	Ministry of Ecology and Environment
MoC	–	Ministry of Construction
NDC	–	Nationally Determined Contribution
NH ₃ -N	–	Ammonia Nitrogen
NO ₂	–	Nitrogen Dioxide
NO _x	–	Nitrogen Oxides
O&G	–	Oil and Grease
OSPF	–	Office of the Special Project Facilitator
PAH	–	Poly-Aromatic Hydrocarbon
PAM	–	Project Administration Manual
PCU	–	Passenger Car Equivalent
PM	–	Particulate Matter
PM ₁₀	–	Particulate Matter with diameter ≤ 10 micrometers
PM _{2.5}	–	Particulate Matter with diameter ≤ 2.5 micrometers
PME	–	Powered Mechanical Equipment
PMO	–	Project Management Office
PMO EHSO	–	Project Management Office Environment, Health and Safety Officer
PPTA	–	Project Preparatory Technical Assistance
PRC	–	People's Republic of China
RP	–	Resettlement Plan
SDP	–	Sector Development Program
SNCR	–	Selective Non-Catalytic Reduction
SO ₂	–	Sulfur Dioxide
SOC	–	State-of-Charge
SPS	–	Safeguard Policy Statement
SS	–	Suspended Solids
STI	–	Sustainable Transport Initiative
TN	–	Total Nitrogen
TP	–	Total Phosphorus
TSP	–	Total Suspended Particulates
UNFCCC	–	United Nations Framework Convention on Climate Change
VCR	–	Volume Capturing Ratio
VOC	–	Volatile Organic Compound
WHO	–	World Health Organization
XEEB	–	Xiangtan Ecology and Environment Bureau
XCRC Toolbox	–	Xiangtan Climate Resilient City Toolbox
XMG	–	Xiangtan Municipal Government

WEIGHTS AND MEASURES

°C	–	degree centigrade
μ	–	micron
cm	–	centimeter
h	–	hour
ha	–	hectare
km	–	kilometer
km/h	–	kilometer per hour
km ²	–	square kilometer
m	–	meter
m ²	–	square meter
m ³	–	cubic meter
m/s	–	meter per second
m ³ /d	–	cubic meter per day
m ³ /s	–	cubic meter per second
mg/l	–	milligram per liter
mg/m ³	–	milligram per cubic meter
mm	–	millimeter
s	–	second
t	–	metric ton
y	–	year

NOTE

In this report, “\$” refers to US dollars.

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To: MsNa Won Kim
Senior Environment Specialist and the ADB Mission Leader
Sustainable Infrastructure Division, East Asia Department
Asian Development Bank

From: Xiangtan Municipal Government (XMG)

Subject: PRC 52230-001: People's Republic of China: Xiangtan Low-Carbon Transformation Sector Development Program

Dear MsKim,

The Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) for the captioned project are prepared and reviewed by the Xiangtan Municipal Government.

This is to formally advise you that there is no objection to these being posted on the ADB website in accordance with the ADB disclosure procedure. We will implement all actions following what are required in EIA and EMP and accept the ADB's supervision and inspection for the EMP implementation.

We appreciate your support and help for our project processing.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Chen Wei Wen'.

Mr Chen, Wei Wen
Secretary General
Xiangtan Municipal Government

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for the proposed Xiangtan Low-Carbon Transformation Sector Development Program (Xiangtan LCT SDP) in Xiangtan City, Hunan Province, in the People's Republic of China (PRC).

2. ADB's environmental safeguard requirements are specified in the Safeguard Policy Statement (SPS, 2009). The program has been screened and classified by ADB as Environment Category B, requiring the preparation of an IEE (this report) including an environmental management plan (EMP). The EMP is presented in Appendix A.

3. This report has been prepared based on domestic Feasibility Study Reports (FSRs); technical due diligence reviews of the FSRs undertaken by ADB PPTA technical specialists; additional baseline data collection and analyses undertaken by ADB PPTA technical specialists; site visits and analyses conducted by the ADB PPTA team; ADB review missions discussions and agreements with relevant government agencies; and consultations with affected persons and stakeholders.

B. Program Description

4. The Xiangtan LCT SDP is the first holistic and integrated multi-sectoral approach in promoting low-carbon transformation of a municipality in the PRC. The program is comprised of (i) a project loan to invest in priority infrastructure, and (ii) a policy-based loan to support necessary policy reforms of the municipal government to enable a successful low-carbon transformation.¹ The program will have four outputs: (i) low-carbon and resilient infrastructure transformation demonstrated; (ii) information and knowledge platforms established for informed decision making and behavioral changes; (iii) low-carbon transformation policy reforms adopted; and, (iv) capacity building and program management enhanced. Outputs (i), (ii), and (iv) will be under the project loan, while output (iii) will be supported by the policy-based loan.

(i) **Output 1: Low-Carbon and Resilient Infrastructure Transformation Demonstrated.** Physical infrastructure transformation with integrated design of cross-sectoral interventions will be demonstrated. Output (i) includes:

- (i) Establishing a **priority bus system** through (a) lane modification to 31.3 km of main trunk roads in the Yuetang and Yuhu urban districts to establish priority median bus lanes; (b) lane modification to 31.5 km of other trunk roads to establish peak hour priority curbside bus lanes; and (c) traffic light reprogramming to improve bus traffic flows.
- (ii) Establishing 104 pairs of bi-directional **smart accessible bus stops**, including 56 new bi-directional smart bus stops every 500 m along the median bus priority lanes (Figure 5), and upgrading of 48 existing bi-directional road side bus stops.

¹ Low-Carbon Development is defined as 'sustainable development' that is grounded in systems-thinking, encourages integrated city planning, collaborative and coherent sector development, resilience improvement by taking preventive approach, and active governance through engaging and activating all stakeholders by providing the right incentives. Low-carbon development progress can be measured by quantifiable indicators including GHG emissions reduction.

- (iii) **Clean-energy vehicle promotion** through (a) procurement of 100 battery electric busses (BEBs); and (b) installing 778 e-chargers in 30 charging stations in Yuetang and Yuhu districts.
 - (iv) **Fuxing Middle Road Improvement Demonstration Project**, including an iRAP road safety assessment; road layout improvements for safety, bus stops, bike lanes and pedestrian walkways; ecosystem-based adaptation (EbA) measures to treat stormwater, alleviate drainage and runoff pollution, improve flood resilience and enhance the amenity value of the street; and drainage improvements.
 - (v) **Upgrading of non-motorized transport systems** by (a) improving 63.4 km of bike paths; (b) upgrading of 69 km of pedestrian walkways; (c) installing 48 safe crossing islands at major intersections for safe use and inclusive access; and (d) providing accessible and safer pedestrian crossing by adding screens with countdown red timers and synchronized sound buzzers at 3,000 pedestrian crossings across Xiangtan.
 - (vi) A **school road safety assessment** utilizing the iRAP Star Ratings for Schools (SR4S) methodology will be undertaken for five elementary schools.
 - (vii) The construction of the first **EDGE-certified hospital building** in the PRC will demonstrate the integration of passive building design, clean energy technologies, and ecosystem-based adaptation (EbA) measures.
 - (viii) **Retrofit of a run-down public building** to be equipped with high energy and water saving features and appliances;
 - (ix) **Improvement of public facilities and other urban infrastructure** at 20 urban low-income communities showing practical ways to build a low-carbon, resilient, and livable Xiangtan.
 - (x) **Demonstrating user-friendly multimodal station design** at the Xiangtan Railway Station and Bantang Inter-city Railway Station, by modifying layouts to give priority access and use-space for public busses over taxis and private cars.
- (ii) **Output 2: Information and Knowledge Platforms Established for Informed Decision Making and Behavior Changes.** Physical transformations in output (i) will be complemented by information and communications technology (ICT) and knowledge platforms to support Xiangtan's LCT. A number of sectoral ICT platforms will be installed or upgraded, and then consolidated into a city-wide ICT platform. These will include: (i) reprogramming the existing intelligent transport system (ITS) to prioritize people and public mobility systems; (ii) developing a smart bus information platform which combines various subsystems to enable more control over the operation of busses while sharing real time location data to passengers; (iii) a building energy management system to monitor and improve energy efficiency of 200 public buildings; (iv) a community-scale energy and utility management system to optimize operational efficiency of over 1,300 companies; (v) integrated urban catchment management plans for key flood prone areas in Xiangtan; (vi) an early flood warning system to monitor and analyze potential risks caused by fluvial and pluvial floods; and (vii) an environmental monitoring and assessment system. These platforms will enable better decision making and foster behavior changes towards LCT.
- (iii) **Output 3: Low-carbon Transformation Policy Reforms Adopted.** The infrastructure and system transformations in outputs (i) and (ii) will be sustained and scaled up by policy, institutional, and operational reforms, and outreach activities. Reform areas include: (i) introduction of parking policy and institution setup; (ii) market and demand-driven operation of public buses; (iii) people-oriented ITS operation; (iv) school-zone reform for road safety; (v) clean district energy system and waste heat

recovery; (vi) industrial energy and utility management and operation; (vi) low-carbon building sector reforms through green building certification, energy performance contract, and green financing, building energy management system, and energy statistics; (vii) capacity building on EbA and climate adaptation planning tool; and (viii) data security and standardization. Reform measures will be carried out in two equal tranches of \$25 million each. Pursuing the XMG's clear and long-term commitment to carbon peaking target, the LCT policy reforms will create norms of a low-carbon, resilient, and livable city by regulating, incentivizing, guiding, and supporting all relevant actors of the society.

- (iv) **Output 4: Capacity Building and Program Management Enhanced.** Project Management Consultant (PMC) services will be provided to support the PMO in project management, technical support, and safeguards policy compliance and monitoring. The PMC will also provide training and workshops in operating the systems as well as identifying comprehensive plans and programs for sustaining LCT. Training will also be provided on the ADB SPS (2009); PRC safeguard requirements; development and implementation of environment, health and safety (EHS) plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and typical good construction EHS plans and practices.

The PMC will include a Loan Implementation Environmental Consultant (LIEC), an environmental, health and safety specialist who will support the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances.

5. Total cost for the program will be \$395.88 million. The PRC Government has requested a regular loan of \$200.0 million from ADB's ordinary capital resources comprising of a \$50.0 million policy-based loan and a \$150.0 million project loan. The balance of \$195.88 million will be PRC's counterpart financing.

C. Program Benefits

6. The program will benefit 1.8 million residents of the Xiangtan urban area, including both public transport users and residents in general.

D. Program Impacts and Mitigation Measures

7. The program zone of influence is defined as:
- (i) 500 m zones around the boundary of the program work sites, including multi-modal stations, buildings, the hospital, e-charging stations, and other sites, with respect to noise and air pollution impacts;
 - (ii) 500 m zones perpendicular to either side of the roads or lines (including bus stops, cycle ways, pedestrian walk ways, and safe islands) with respect to noise and air pollution impacts.

8. **Siting and Land Acquisition.** The program will not entail permanent or temporary physical displacement or economic displacement and is classified as ADB resettlement category C. There are a total of 17 subprojects in the four outputs. Of these, six are information system development or concept designs which will not have civil works, and two subprojects will need permanent land occupation for the construction of Xiangtan First Traditional Chinese Medicine

Hospital and the 110 kV Liwei Substation, all of which has already been acquired by the local government. The other eight subprojects, will demonstrate low-carbon and resilient infrastructure transformation on existing municipal roads, public buildings and residential communities, or install charging piles on public parking lots. No land occupation or acquisition will be required.

9. **Construction Phase.** Potential negative construction phase impacts include dust from construction sites, noise from power mechanical equipment, wastewater and solid wastes generated on construction sites, worker health and safety risks, and traffic disruptions. These impacts will be short-term and localized. Good construction practice management measures will be implemented to reduce impacts to acceptable levels. Construction will not affect any parks, protected areas or rare or threatened flora or fauna species.

10. **Operation Phase.** Potential negative operation phase impacts include runoff from roads and stations which may pollute surface waters; wastewater produced in the buildings; emissions from buildings and vehicles in stations; noise from stations, buses and cars, and buildings; hazardous materials from stations and buildings; end-of-life buses and batteries that require replacement; and safety risks on the program roads, stations and buildings. These impacts can be effectively mitigated through good design and management, including, for example, road-side bio-retention facilities to treat storm water runoff; noise control measures incorporated into station and building design; good waste and health and safety management practices including effective recycling of busses and bus batteries; and good safety plans on charging stations, multi-modal stations and buildings. All facility designs will be in accordance with PRC requirements and health and safety requirements of the EHS Guidelines.

11. Operation of the program is not expected to impact any rare or endangered flora or fauna, species with international, national or provincial protection status, areas of natural or critical habitat, parks, nature reserves, or areas with special national, regional or local ecological significance within or adjacent to any of the sites. Program operation is not expected to impact any physical cultural resources.

12. **Climate Change.** A Climate Risk and Vulnerability Assessment (CRVA) was undertaken for the program. The impact of climate change on extreme rainfall has been factored into the program design, and is included in the civil work contract costs.

E. Environmental Management Plan

13. A comprehensive EMP was developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) program compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting.

14. The EMP includes a program-level grievance redress mechanism (GRM), established to receive and facilitate resolution of complaints about the program during the preconstruction, construction and operation phases. The GRM includes procedures for receiving grievances, documenting key information, and evaluating and responding to the complainants in a reasonable time period.

F. Information Disclosure, Consultation and Participation

15. Program related information, including program description, potential environmental impacts and relevant mitigation measures, was disclosed on the XMG website, (http://www.xiangtan.gov.cn/109/181/content_820895.html). The EIT, which is under preparation, will also be disclosed when it is available.

16. Public consultation activities took place during an unprecedented and ongoing outbreak of coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus. As a result of government restrictions to fight the spread of COVID-19, public meetings and face-to-face surveys have been strictly prohibited. To address this challenge, public consultations were conducted through on-line questionnaires. The questionnaires were distributed and responses received utilizing WeChat, a popular messaging and social media app in China.

17. Three questionnaire were designed and distributed out by Xiangtan PMO and local community staff, to collect feedbacks and concerns from relevant stakeholders and affected people in three main program areas of influence: i) communities near program roads; ii) communities near the Xiangtan First Traditional Chinese Medicine Hospital site; and iii) the low-carbon communities (LCCs). In total 348 valid questionnaires were distributed and collected through the on-line survey system. The results showed strong support for the program implementation.

18. Meaningful consultation will continue throughout detailed design, construction and operation phases, including information disclosure by the program proponent, and posting of program information on community notice boards.

G. Key EMP Implementation Responsibilities

19. The Xiangtan Municipal Government (XMG) will be the program executing agency (EA) and implementing agency (IA). The Hunan Provincial Government (HPG) will provide guidance and supervision to the municipal government in program processing and implementation. A project management office (PMO) has been established under the EA to manage the program implementation on a daily basis. The PMO will be led by the Secretary General of the XMG. It will be suitably staffed, including a full-time qualified Environment and Safety Officer (PMO ESO), who will take overall responsibility for supervising the implementation of environment mitigation measures, coordinating the program level GRM and preparing monitoring reports for submission by the IA to ADB. The PMO will include relevant XMG bureaus and commissions.

20. Support for the PMO will be provided through a Project Management Consultant (PMC) including a Loan Implementation Environmental Consultant (LIEC), and a Construction Supervision Company. In addition, a qualified 3rd party Environmental Monitoring Company will be engaged to undertake construction and operation phase ambient environmental monitoring. Construction contractors will be responsible for implementing the mitigation measures during construction under supervision of the PMO.

H. Risks and Assurances

21. The program has few unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted. From an environment safeguards perspective, the main risk relates to the failure of the PMO to monitor environmental impacts and implement the EMP during the construction and operation phases. These risks will be mitigated by (i)

providing training in environmental management and safety; (ii) appointing qualified project implementation consultants; (iii) following appropriate program implementation monitoring and mitigation arrangements; (iv) ADB conducting regular program reviews; and (v) program assurances covenanted in the loan agreement with ADB.

I. Conclusion

22. The program IEE has: (i) identified potential negative environment impacts and established mitigation measures; (ii) assessed public support from the program beneficiaries and affected people; (iii) established a program GRM; and (iv) prepared a program EMP, including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

23. It is concluded that the program will not result in adverse environmental impacts that are irreversible, diverse, or unprecedented. Any minimal adverse environmental impacts associated with the program will be prevented, reduced, or minimized through the implementation of the program EMP.

I. INTRODUCTION

1. This is the Initial Environmental Examination (IEE) report for the proposed Xiangtan Low-Carbon Transformation Sector Development Program (Xiangtan LCT SDP) in Xiangtan City, Hunan Province, in the People's Republic of China (PRC) (Figure 1).

2. The Xiangtan LCT SDP will complement the Xiangtan municipal government's efforts to transform Xiangtan from a carbon-intensive, heavily polluting city to a low-carbon, climate resilient and livable one. The program is comprised of (i) a project loan to invest in priority infrastructure, and (ii) a policy-based loan to support necessary policy reforms of the municipal government to enable Xiangtan's successful low-carbon transformation (LCT).² The program will have four outputs: (i) low-carbon and resilient infrastructure transformation demonstrated; (ii) information and knowledge platforms established for informed decision making and behavioral changes; (iii) low-carbon transformation policy reforms adopted; and, (iv) capacity building and program management enhanced. Outputs (i), (ii), and (iv) will be under the project loan, while output (iii) will be supported by the policy-based loan.

3. The expected program impact will be carbon emissions peak achieved in Xiangtan by 2028. The expected outcome will be the use of low-carbon enabling systems in Xiangtan is increased.

4. The Xiangtan LCT SDP will benefit the 1.8 million residents of the Xiangtan City urban core. Residents will benefit from improved public transport; greener and safer road, cycle and pedestrian corridors; improved air quality through the provision of electric buses and electric vehicle charging stations; green, resilient, hospital and low carbon training center; safer schools; improved communities through green retrofits; enhanced flood management and response capacity; and improved urban management through enhanced ICT, and building, utility and community energy management systems.

5. The Xiangtan LCT SDP is estimated to cost \$393.19 million. The program implementation period will be from October 2020 to July 2022 for the policy based loan, and from October 2020 to September 2025 for the project loan. The Xiangtan Municipal Government (XMG) will be the program executing agency (EA) and implementing agency (IA). A project management office (PMO) has been established to manage the program implementation on a daily basis.

6. ADB's environmental safeguard requirements are specified in the Safeguard Policy Statement (SPS, 2009). The program has been screened and classified by ADB as Environment Category B, requiring the preparation of an IEE (this report) including an environmental management plan (EMP). The EMP is presented in Appendix A.

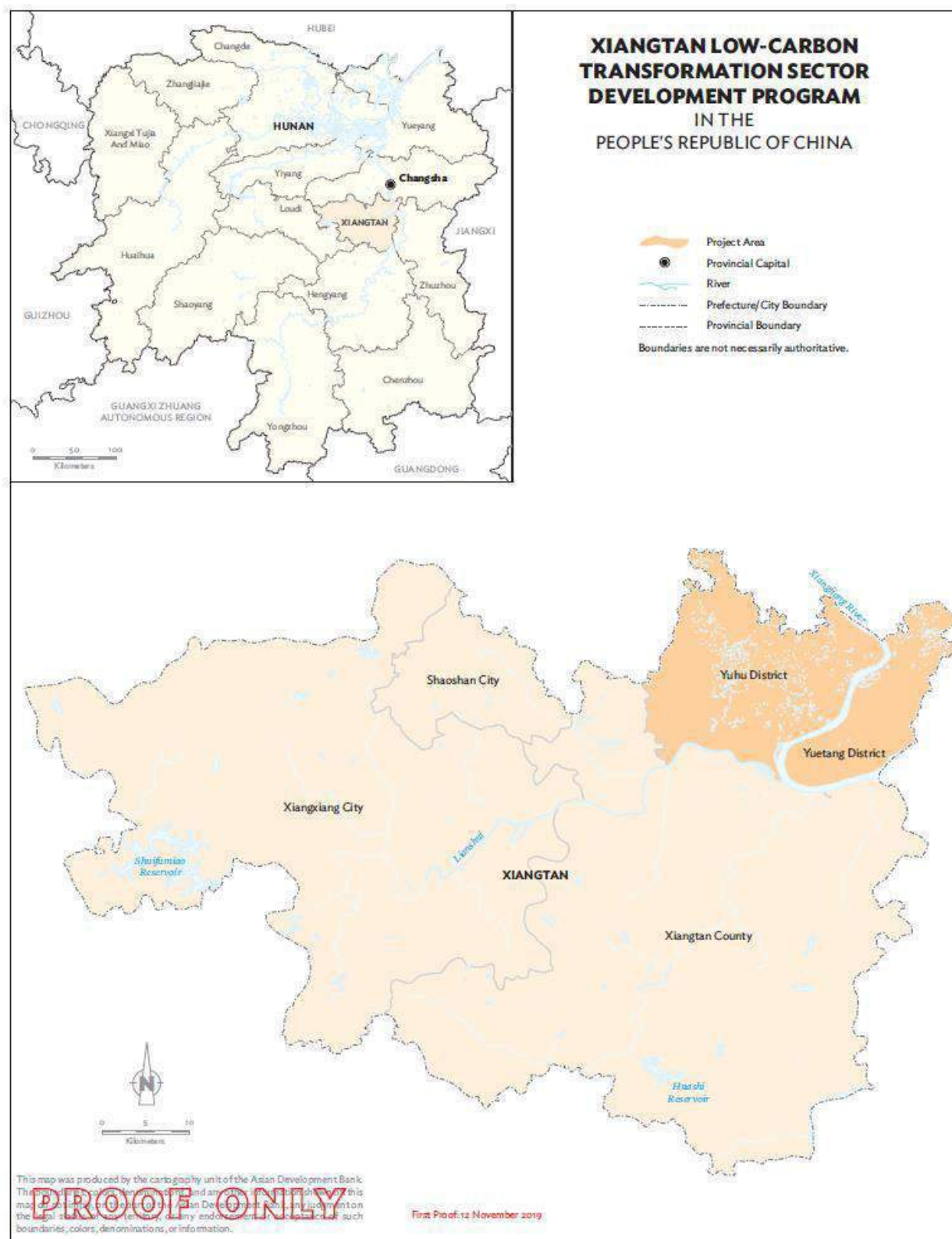
7. This report has been prepared based on domestic Feasibility Study Reports (FSRs); technical due diligence reviews of the FSRs undertaken by ADB PPTA technical specialists;³ additional baseline data collection and analyses undertaken by ADB PPTA technical specialists;

² Low-Carbon Development is defined as 'sustainable development' that is grounded in systems-thinking, encourages integrated city planning, collaborative and coherent sector development, resilience improvement by taking preventive approach, and active governance through engaging and activating all stakeholders by providing the right incentives. Low-carbon development progress can be measured by quantifiable indicators including GHG emissions reduction.

³ TA-9437 PRC: Supporting Project Preparation - Xiangtan Low-Carbon Transformation Sector Development Program.

site visits and analyses conducted by the ADB PPTA team; ADB review missions discussions and agreements with relevant government agencies; and consultations with affected persons and stakeholders.

Figure 1: Xiangtan Low-Carbon Transformation Sector Development Program



Source: Asian Development Bank.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Applicable ADB Policies, Regulations and Requirements

8. The major applicable ADB policies, regulations, requirements and procedures for environmental management and environmental impact assessment (EIA) are the *Safeguard Policy Statement* (SPS, 2009) and the *Environmental Safeguards – A Good Practice Sourcebook* (2012), which jointly provide the basis for this IEE. The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010).

9. The SPS establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

10. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. Program screening and categorization are undertaken to:

- (i) reflect the significance of the project's potential environmental impacts;
- (ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and,
- (iii) determine consultation and disclosure requirements.

11. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. ADB assigns a proposed project to one of the following categories:

- (i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA including an environmental management plan (EMP) is required.
- (ii) **Category B.** Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.
- (iii) **Category C.** Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
- (iv) **Category FI.** Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

12. The program has been classified by ADB as environment category B, requiring the preparation of an IEE (this report).

13. The SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress

mechanism; (iii) definition of the 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 (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIT, have been considered, and all applicable environmental requirements in the SPS 2009 are covered in this IEE.

14. During the design, construction, and operation of a project the SPS also requires the borrower to follow environmental standards consistent with good international practice, as reflected in internationally recognized standards such as the World Bank Group's *Environment, Health and Safety Guidelines* (hereafter referred to as the *EHS Guidelines*).⁴ The *EHS Guidelines* includes both general *EHS guidelines* and industry sector guidelines. The general *EHS Guidelines* contains (i) environmental guidelines on discharge effluent, air emissions, and other numerical guidelines; (ii) occupational health and safety guidance; (iii) community health and safety guidance; and (iv) construction and decommissioning guidelines.

15. The *EHS guidelines* also include performance indicators and prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/client is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client is required to provide justification for any proposed alternatives.

B. ADB Assistance to PRC

16. The program is aligned with the key thrusts of ADB's assistance to the PRC under the PRC Country Partnership Strategy (CPS)⁵ in the areas of: (i) managing climate change and the environment, such as transportation modes with lower emissions and energy consumption, sustainable urban public transport systems; and (ii) supporting inclusive economic growth (reducing poverty and inequality), so as to promote integrated, green, inclusive and competitive urban development, focusing on small and medium-sized cities in less-developed regions that can be used as a model for other cities in Asia and support city cluster development, including urban infrastructure development and institutional coordination.⁶ The focus on public transport and multi-modal integration also fits well with ADB's Sustainable Transport Initiative (STI).⁷

⁴ World Bank Group, *Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. <http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines>

⁵ Asian Development Bank. 2016. Transforming partnership: People's Republic of China and Asian Development Bank, 2016-2020. Manila.

⁶ 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.

⁷ 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 DMCs in line with ADB's *Strategy 2020*.

C. PRC Public Transport Policies

17. A number of high level policy decisions have emphasized that public transport is a PRC national priority:

- The PRC *Thirteenth Five-Year Plan (2016–2020)* prioritizes implementing public transport policy, speeding up development of large-capacity public transport, and encouraging green travel operations.
- The Ministry of Construction (MoC) issued *Opinions on Prioritizing the Development of Urban Public Transport (No. 38 urban construction[2004])* in March 2004, emphasizing the role of urban transport planning, speeding up the construction of public transport infrastructure such as multi-modal hubs and depots, optimizing the operation structure of public transport, and ensuring public transport priority.
- In September 2015, the General Office of the State Council issued *Guidance for Accelerating the Construction of Charging Infrastructure for Electric Vehicles (No. 73 State Council [2015])*, in order to speed up the implementation of charging facilities for electric transportation.
- In May 2016, the General Office of Hunan Provincial People's Government issued *Specific Plan for Electric Vehicle Charging Infrastructure in Hunan Province (2016-2020)*, in which the e-charging stations were planned in the entire province for electric public buses, utility vehicles, taxis and private vehicles. The overall objective is to accelerate the electric transportation in accordance with the national strategy.
- In December 2016, the *Specific Plan for Electric Vehicle Charging Infrastructure in Xiangtan City (2016-2020)* was approved by Xiangtan Government (No. 7, Xiangtan municipality [2016]). This plan has defined the development for e-charging facilities in the main urban area of Xiangtan city, including Yuhu district, Yuetang district, high-tech zone, Xiangtan economic zone and Shaoshan demonstration zone, covering 657 km² city area in total.

18. Overall, the proposed program is fully consistent with and supportive of the PRC public transport policy framework, and the urban planning framework for Xiangtan City.

D. PRC Healthcare Legal Framework

19. The key legislation that establishes China's regulatory framework governing the delivery of healthcare are the *Administrative Regulations on Medical Institutions* (revised in 2016) promulgated by the State Council, and the *Implementing Rules for Administrative Regulations on Medical Institutions* (revised in 2017) promulgated by the former National Health and Family Planning Commission.

20. The former China Food and Drug Administration (CFDA) and its provincial branches were principally responsible for the regulation of pharmaceutical products and medical devices. Following the State Council's restructuring in March 2018, the CFDA was replaced by the newly formed National Medical Products Administration (NMPA). The CFDA received, and the NMPA will receive, funding from the government's budget, but not from their enforcement activities.

21. Following the State Council's restructuring in March 2018, the National Health Commission (NHC) was established to replace the NHFPC and take over its responsibilities and those of some other former governmental agencies.⁸

⁸ Healthcare enforcement and litigation in China. Zhong Lun Law Firm, October 2019.

E. PRC Environmental Legal Framework

22. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative and technical institutions. At the top level the People's Congress of the PRC has the authority to pass and revise national environmental laws; the Ministry of Ecology and Environment (MEE)⁹ under the State Council promulgates national environmental regulations; and the MEE either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards and guidelines. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

23. Key PRC environmental laws are listed in Table 1, including associated regulations and decrees that support their implementation. Guidelines for EIA implementation are listed in Table 2.

24. The most far-reaching legislation on pollution prevention and control is the *Environmental Protection Law* (EPL) (1989, amended 2014, effective 2015 and item 2 in Table 2), which sets out key principles for the nation's pollution control system, including the "Three Simultaneities policy,"¹⁰ the application of pollution levy's, and EIA requirements. The implementation of the "Three Simultaneities" was further strengthened by implementation decrees (items 26 and 28 Table 1) and the *Construction Project Environmental Protection Management Regulation* (item 17 Table 1).

Table 1: Applicable PRC environmental laws, regulations and decrees

No.	Laws	Issued/ Updated
1	<i>Environmental Impact Assessment Law</i>	2016
2	<i>Environmental Protection Law</i>	2015
3	<i>Atmospheric Pollution Prevention and Control Law</i>	2015
4	<i>Occupational Disease Prevention and Control Law</i>	2011
5	<i>Water and Soil Conservation Law</i>	2011
6	<i>Water Pollution Prevention and Control Law</i>	2010
7	<i>Urban and Rural Planning Law</i>	2008
8	<i>Solid Waste Pollution Prevention and Control Law</i>	2005
9	<i>Water Law</i>	2002
10	<i>Cultural Relics Protection Law</i>	2002
11	<i>Noise Pollution Prevention and Control Law</i>	1999
12	<i>Labor Law</i>	1995
Regulations		
13	Atmospheric Pollution Prevention and Control Action Plan (State Council Announcement No. 37)	2013
14	Policy on Integrated Techniques for Air Pollution Prevention and Control of Small Particulates (MEE Announcement No. 59)	2013
15	Planning Environmental Impact Assessment Regulation	2009
16	Cultural Relics Protection Law Implementation Regulation	2003
17	Construction Project Environmental Protection Management Regulation	1998

⁹ The Ministry of Ecology and Environment was formerly known as the Ministry of Environmental Protection (MEP), and prior to 2008 was known as the State Environmental Protection Administration (SEPA). It is a department of the State Council of the People's Republic of China, and superseded the MEP in 2018.

¹⁰ The "Three Simultaneities Policy" requires the design, construction, and operation of pollution control and treatment facilities to occur simultaneously with the project design, construction, and operation.

18	Wild Plant Protection Regulation	1996
Decrees and Announcements		
19	Directory for the Management of Construction Project EIA Categorization (MEE Decree 2015-33)	2015
20	Measures for Public Participation in Environmental Protection (MEE Decree 2015-35)	2015
21	Management Measures for Environmental Impact Post Assessment of Construction Projects (on trial) (MEE Decree 2015-37)	2015
22	Government Information Disclosure of Construction Project EIA (on trial) (MEE Announcement No. 103)	2013
23	Measures for Environmental Supervision (MEE Decree 2012-21)	2012
24	Requirement for Preparation of EIA Report Summary (MEE Announcement 2012-51)	2012
25	Strengthening of EIA Management for Prevention of Environmental Risk (MEE Announcement 2012-77)	2012
26	Opinion from the State Council on Important Tasks for Strengthening Environmental Protection (State Council Announcement 2011-35)	2011
27	Management Measures for Operation of the Environmental Complaint Hotline (MEE Decree 2010-15)	2010
28	Management Procedures for the Supervision, Inspection and Environmental Acceptance of Construction Projects under the “Three Simultaneities” (on trial) (MEE Announcement 2009-150)	2009
29	Specifications on the Management of Urban Construction and Demolition Waste (Ministry of Construction Decree 2005-139)	2005
30	Management Measures for Inspection and Acceptance of Environmental Protection at Construction Project Completion (MEE Decree 2001-13)	2001

Source: ADB PPTA consultants.

25. The amended EPL further defines enforcement and supervision responsibilities for all levels of environmental protection authorities, imposes stricter obligations and more severe penalties on enterprises and construction units regarding pollution prevention and control, and allows for environmental public interest litigation including through nongovernment organizations. The procedures and requirements for the technical review of EIA reports by authorities have been specified (Table 2, item 4), and environmental inspection and enforcement on design, installation, and operation of project-specific environmental protection and control measures are regulated under the “Three Simultaneities” (Table 1, items 5, 15, 25, 26, and 28).

Table 2: PRC EIA Guidelines

	Guidelines	Date
1	HJ 192-2015 Technical Criterion for Ecosystem Status Evaluation	2015
2	HJ 130-2014 Technical Guidelines for Planning EIA - General Principles	2014
3	HJ 663-2013 Technical Regulation for Ambient Air Quality Assessment (on trial)	2013
4	HJ 2.1-2011 Technical Guidelines for EIA – General Program	2011
5	HJ 19-2011 Technical Guidelines for EIA – Ecological Impact	2011
6	HJ 616-2011 Guidelines for Technical Review of EIA on Construction Projects	2011
7	HJ 623-2011 Standard for the Assessment of Regional Biodiversity	2011
8	HJ 630-2011 Technical Guideline on Environmental Monitoring Quality Management	2011
9	Technical Guidelines for EIA - Public Participation (public comment version), (Jan. 2011)	2011
10	HJ 610-2011 Technical Guidelines for EIA – Groundwater Environment	2011
11	HJ 2.4-2009 Technical Guidelines for EIA – Acoustic Environment	2009
12	HJ 2.2-2008 Technical Guidelines for EIA – Atmospheric Environment	2008
13	HJ/T 393-2007 Technical Specifications for Urban Fugitive Dust Pollution	2007
14	JG/J 146-2004 Environmental and Hygiene Standards for Construction Sites	2004
15	HJ/T 2.3-1993 Technical Guidelines for EIA – Surface Water Environment	1993

Source: ADB PPTA consultants.

26. Public participation and environmental information disclosure provisions are among the most significant changes introduced in the amended EPL, further supported by the decrees on the preparation of EIA summaries for the purpose of public disclosure (Table 1, item 24), information disclosure on construction project EIAs by government (Table 1, item 22), method for public participation in environmental protection (Table 1, item 20), and technical guidelines for public participation in EIAs.

27. For grievance redress, a hotline number (12369) was established in March 2011 at each level of environmental protection authority throughout the nation for receiving and resolving environmental complaints, in accordance with the *Management Measures for Operation of the Environmental Complaint Hotline* (MEE Decree [2010] No. 15) (Table 1, item 27).

28. The PRC also provides protection for community health and occupational health and safety through the *Labor Law* (1994) (Table 1, item 12), the *Occupational Disease Prevention and Control Law* (2001) (Table 1, item 4), and environmental and hygiene standards for construction sites.

29. With respect to electric vehicle (EV) batteries, *Interim Measures for the Administration of Recycling and Utilization of New Energy Vehicles' Power Battery* was jointly issued by the Ministry of Industry and Information Technology, the Ministry of Science and Technology, the Ministry of Environmental Protection, the Ministry of Transport, the Ministry of Commerce, the General Administration of Quality Supervision, Inspection and Quarantine, and became effective on August 1, 2018. EV manufacturers are responsible for the recovery of EV batteries. They are required to set up recycling channels and service outlets where old batteries can be collected, stored, and transferred to specialty recyclers. In 2018 the Ministry of Information and Technology also issued *Interim Provisions on the Management of Traceability of Recycling and Utilization of New Energy Vehicles*. Together with battery makers and their sales units, EV manufacturers must set up a “traceability” system that enables the identification of owners of discarded batteries. Battery makers are also encouraged to adopt standardized and easily dismantled product designs to help automate the recycling process. They must also provide technical training for vehicle makers to store and dismantle old batteries.

F. PRC Environmental Impact Assessment Framework and Procedures

30. **EIA Administrative Framework.** The PRC administrative framework consists of national, provincial, and local (city and county) environmental protection authorities. The national authority is the MEE, which promulgates laws, regulations, administrative decrees, technical guidelines, and environmental quality and emission standards on EIA and pollution prevention and control. At the provincial level there are Environmental Protection Departments (EPDs), which act as gatekeepers for EIA and pollution prevention and control in the provinces. They are often delegated authority by the MEE to approve EIA reports for development planning and construction projects, except for those projects with national interest or which cross provincial boundaries. Local (city or county level) Environmental Protection Bureaus (EPB) enforce environmental laws and conduct environmental monitoring within city or county limits. EPBs can also be delegated the authority to approve EIA reports by the provincial EPDs. EPDs and EPBs are supported by Environmental Monitoring Stations (EMS), which are subsidiaries of EPDs or EPBs and are qualified entities to carry out environmental monitoring.¹¹

¹¹ In this report, “environmental monitoring” refers to the activity of collecting environmental data either through *in-situ* measurements or through sampling followed by laboratory testing of samples.

31. The PRC has an EIA qualification and registration system, and only qualified and registered institutes and individuals are allowed to prepare EIAs. Under MEE Decree 2015-36, as of 1 November 2015 qualified institutes for conducting EIAs for construction projects in the PRC can no longer be a subsidiary of an environmental authority responsible for approving EIAs.

32. **EIA Legal Framework.** EIA in the PRC is governed by the *Environmental Impact Assessment Law* (2002) (Table 1, item 1), covering EIAs for (i) plans (such as new development areas and new industrial parks) and strategic environmental assessments (SEA); and (ii) construction projects. This was followed by the promulgation of two regulations: the *Construction Project Environmental Protection Management Ordinance* (1998) (Table 1, item 17) and the *Planning Environmental Impact Assessment Regulation* (2009) (Table 1, item 15), both of which require early screening and environmental categorization.

33. **EIA Procedures.** Under MEE decree *Directory for the Management of Construction Project Environmental Impact Assessment Categorization* (MEE Decree 2015-33) (1, item 19), classifies EIAs for construction projects into three categories with different reporting requirements, based on the significance of potential environmental impacts and the environmental sensitivity¹² of the project site:

- (i) Projects with significant adverse environmental impacts, for which a full environmental impact report (EIR) is required;
- (ii) Projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a tabular environmental impact report (EIT) is required; and
- (iii) Projects unlikely to have adverse environmental impacts, for which an environmental impact registration form (EIRF) is required.

34. EIR and EITs report are generally equivalent to ADB's Category A EIA and Category B IEE reports, respectively. The EIRF is similar to an ADB Category C.

35. **EIA Follow-Up Actions.** In 2015 the MEE issued decree *Management Measures for Environmental Impact Post Assessment of Construction Projects* (MEE Decree 2015-37, item 21). Under this decree a trial program was implemented on 1 January 2016 requiring follow-up actions 3 to 5 years after commencement of project operation for large infrastructure and industrial projects or projects located in environmentally sensitive areas. These actions include environmental monitoring and impact assessment to verify the effectiveness of environmental protection measures and to undertake any corrective actions that might be needed. The decree also specifies that the institute that did the original impact assessment for the project cannot undertake environmental impact post assessment for the same project.

36. **EIA Guidelines.** The MEE has issued a series of technical guidelines for preparing EIAs (Table 2). These include impact assessment guidelines on general EIA implementation and principles, atmospheric environment and ambient air quality, noise, surface water, groundwater, ecology and regional biodiversity, biodiversity monitoring, quality management on environmental monitoring, and public participation.

¹² Environmentally sensitive areas are defined in the Decree, and include: (i) nature reserves and protected areas, scenic areas, world cultural and natural heritage sites, drinking water source protection zones; (ii) basic farmland and grassland, forest parks, geological parks, important wetland, natural woodland, critical habitats for endangered plant and animal species, important aquatic spawning/nursery/ wintering/migration grounds, regions suffering from water resource shortage, serious soil erosion areas, desertification protection areas, eutrophic water bodies; and (iii) inhabited areas with major residential, health care, scientific research, and administration functions, cultural heritage protection sites, and protection areas with historical, cultural, scientific, and ethnic values.

G. Program Domestic Environmental Assessment

37. Under MEE Decree *Management Measures for Environmental Impact Post Assessment of Construction Projects* (MEE Decree 2015-37) the program was classified as requiring the preparation of an EIT report. As of the time of writing preparation of the EIT report is underway. The approval of the EIT report, once obtained from the Xiangtan Ecology and Environment Bureau (XEEB), will be presented in Appendix B.

H. Environmental Standards

38. **PRC Environmental Standards.** Standards issued by the MEE generally consist of environmental quality (ambient) standards applicable to the receiving environment, and emission standards applicable to the pollution source. The former includes standards for ambient air quality, noise and vibration, surface water, groundwater, etc. The latter includes standards for integrated wastewater discharge, construction and community noise, odor and air pollutants, etc. (Table 3).

39. As noted above, ADB's SPS requires borrowers to follow environmental standards consistent with good international practice, as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. When host country regulations differ from these levels and measures, the borrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower is required to provide justification for any proposed alternatives.

Table 3: Applicable PRC environmental standards

No.	Standards
1	GB3095-2012 Ambient Air Quality Standards
2	GB16297-1996 Air Pollutant Integrated Emission Standards
3	GB3096-2008 Environmental Quality Standard for Noise
4	GB3838-2002 Environmental Quality Standards for Surface Water
5	GB8978-1996 Integrated Wastewater Discharge Standard
6	GB22337-2008 Emission Standard for Community Noise
7	GB10070-88 Standard of Environmental Vibration in Urban Area
8	GB12523-2011 Emission Standard of Environmental Noise for Boundary of Construction Site
9	GB/T 15190-2014 Technical Specifications for Regionalizing Environmental Noise Function
10	GB12348-2008 Noise Standards for Industrial Enterprises at Site Boundary
11	GB50118-2010 Design Specifications for Noise Insulation of Buildings for Civil Use
12	GB14554-93 Emission Standards for Odor Pollutants
13	GB/T 14848-93 Quality Standard for Ground Water
14	GB50210-94 Standard for Flood Control
15	GB11340-2005 Limits and Measurement Methods for Crankcase Pollutants from Heavy-duty Vehicles Equipped with Pressure Ignition Engines
16	GB17691-2005 Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Compression-Ignition and Gas Fueled Ignition Engines
17	GB18285-2005 Limits and Measurement Methods for Exhaust Pollutants from Vehicles Equipped with Ignition Engines
18	GB18352-2005 Limits and Measurement Methods for Emissions from Light Duty Vehicles

Source: ADB PPTA Consultants

Air Quality

40. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average,

and/or annual average. The longer averaging period such as one year is more applicable to assessing impacts from multiple or regional sources, while shorter averaging periods such as 24 hours 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. The PRC's updated *Ambient Air Quality Standards* (GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as nature reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial sites. The PRC standards for Class 2 areas are applicable for the project.¹³

41. The World Health Organization (WHO) Air Quality Guidelines (AQGs) are international standards and are adopted in the *EHS Guidelines*. In addition to guideline values, interim targets (IT) are given for each pollutant as incremental targets in a progressive reduction of air pollution.

42. The WHO AQGs and corresponding PRC standards are presented in Table 4. From a review of the table it can be observed that:

- (i) For TSP, there are PRC standards but no corresponding WHO AQGs.
- (ii) For PM₁₀ PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for PRC or WHO) but not the WHO AQG.
- (iii) For PM_{2.5} PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO) but not the WHO AQG.
- (iv) For NO₂ the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO AQG.
- (v) For SO₂ WHO only has a 24-hour average guideline (0.125 mg/m³), which is slightly lower than the PRC standard (0.150 mg/m³).

43. Overall the PRC standards show a high degree of equivalency to the WHO AQG or IT-1 values. The PRC Class 2 standards are adopted for use in this report for general ambient air quality assessment, but WHO AQGs will be used for effects monitoring at sensitive receptors.

Table 4: Comparison of PRC ambient Air Quality Standards (GB3095-2012) and WHO ambient air quality guidelines

Air Quality Parameter	Averaging Period	PRC GB3095-2012 (µg/m ³)		WHO/EHS Guidelines (µg/m ³)	
		Class I	Class II	Interim Targets	AQG
TSP	1-year	80	200	n/a	n/a
	24-hour	120	300	n/a	n/a
PM ₁₀	1-year	40	70	30 - 70	20
	24-hour	50	150	75 - 150	50
PM _{2.5}	1-year	15	35	15 - 35	10
	24-hr	35	75	37.5 - 75	25
SO ₂	1-year	20	60	n/a	n/a
	24-hour	50	150	50 - 125	20

¹³ On 29 February 2012, the China State Council approved the roadmap for ambient air quality standards to improve the environment and human health. The Ambient Air Quality Standards (GB3095-2012) prescribes the first-ever limits for PM_{2.5}. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Air Quality Parameter	Averaging Period	PRC GB3095-2012 ($\mu\text{g}/\text{m}^3$)		WHO/EHS Guidelines ($\mu\text{g}/\text{m}^3$)	
		Class I	Class II	Interim Targets	AQG
NO ₂	1-hour	150	500	n/a	n/a
	1-year	40	40	n/a	40
	24-hour	80	80	n/a	n/a
O ₃	1-hour	200	200	n/a	200
	8-hour	n/a	n/a	160	100
	1-hour	n/a	n/a	n/a	n/a
CO	24-hour	4,000	4,000	n/a	n/a
	8-hour	n/a	n/a	n/a	30
	1-hour	10,000	10,000	n/a	n/a

Note: n/a = not applicable.

Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB3095-2012.

Fugitive Particulate Matter

44. Fugitive emission of particulate matter such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standard* (GB16297-1996), which sets 120 mg/m³ as the maximum allowable emission concentration and ≤ 1.0 mg/m³ as the concentration limit at the boundary of construction sites (with no specification on particle diameter). There is no equivalent standard recommended in the *EHS Guidelines*, and the PRC standard is adopted for use in this report.

45. With respect to the emission of asphalt fumes, GB16297-1996 sets the limit at 75 mg/m³.

Exhaust Gasses

46. Exhaust gasses discharged from bus stations are regulated under PRC *Emission Standard of Air Pollutant for Gasoline Filling Stations* (GB20952-2007). Cooking fumes are regulated under the "small" class, *Emission Standard of Cooking Fumes (Trial)* (GB18483-2001) (Table 5). The *Emission Standards for Odor Pollutants* (GB14554-93) also applies (Table 6).

Table 5: Emission Standards of Cooking Fumes (GB18483-2001)

Parameter	Facility Size		
	Small	Medium	Large
Maximum allowable emission concentration (mg/m ³)		2.0	
Minimum removal efficiency of cleaning facilities (%)	60	75	85

Source: Domestic EIT, 2018.

Table 6: Level II Limits, Table 1, Emission Standards for Odor Pollutants (GB14554-93)

Pollutant	Unit	Standard Limit
Odor concentration	Dimensionless	20
Ammonia	mg/m ³	1.5
Hydrogen sulfide	mg/m ³	0.06

Source: Domestic EIT, 2018.

Noise

47. Table 7 presents the relevant PRC *Environmental Quality Noise Standards (GB3096-2008)* compared with relevant international guidelines from the WHO (as presented in the EHS Guidelines). The classes within the standards are not directly comparable as the PRC noise standards are set in different zones and WHO standards concern noise at specific receptors. Traffic noise and noise at sensitive receptors need different standards to be applied: the PRC *Environmental Quality Noise Standards (GB3096-2008)* Class I to IV will be used for noise while the EHS Guidelines will be applied for noise based on types of receptors.

Table 7: PRC *Environmental Quality Standards for Noise (GB3096-2008)*

Class	PRC Standards Leq dB(A)		International Standards One Hour Leq dB(A)		Comparison
	Day 06-22h	Night 22-06h	Day 07-22h	Night 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40			Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards will be used for traffic noise while the EHS Guidelines will be applied for noise based on types of receptors.
I: Mainly residential; and cultural and educational institutions	55	45	WHO Class I: Residential, institutional, educational: 55	WHO Class I: Residential, institutional, educational: 45	
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55	WHO Class II: industrial, commercial: 70	WHO Class II: Industrial, Commercial: 70	
IVa: Area within 35 m on both sides of urban trunk roads (Class II and above)	70	55			
IVb: Both sides of railway lines	70	60			

Source: WHO Noise Quality Guidelines (1999) in IFC *EHS Guidelines* (2007), and PRC GB3096-2008.

48. Table 8 presents the relevant PRC and international standards (US EPA, IFC *EHS Guideline: Occupational Health and Safety Standards*) for on-site construction noise. The PRC's *Emission Standard of Environmental Noise for Boundary of Construction Site (GB12523-2011)* regulates construction noise, limiting construction noise levels at the construction site boundary to 70 dB(A) in the day time (0600–2200 hours) and 55 dB(A) at night (2200–0600 hours).

Table 8: PRC *Noise Emission Standard for Construction Site Boundary (GB12523-2011)* and relevant international guidelines

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(A)	
70	55	US EPA: 85 (day, 8 hour exposure)	IFC EHS Guideline, Occupational Health and Safety: 85 (Equivalent level LAeq, 8h); 110 (Maximum L _{Amax} , fast)

Source: US EPA, IFC Occupational Health and Safety Standard, and PRC GB12523-2011.

Surface Water

49. PRC's *Surface Water Ambient Quality Standard (GB3838-2002)* defines five water quality classes for different environmental functions (Table 9). Class I is the highest quality, suitable for head waters and national nature reserves. Class 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. Class 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. Class IV is suitable for general industrial use and non-contact recreational activities. Class V is the worst quality, suitable only for agricultural and scenic water uses. For rivers within the project area the Class III standard is applicable. For Hongfeng Lake and Songbaishan Reservoir, the Class II standard applies.

Table 9: PRC Surface Water Ambient Quality Standard (GB3838-2002)

Parameter	Water Quality Category				
	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 (=LAS) [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

Source: IFC EHS Guidelines (2007) and PRC GB3838-2002.

Groundwater

50. The PRC's *Groundwater Water Ambient Quality Standard* (GB/T14848-93) is presented in Table 10. The Class III standard is applicable to the project. There is no equivalent standard recommended in the *EHS Guidelines*, and the PRC standard is adopted for use in this report.

Table 10: Groundwater standard (Class III, GB/T14848-93 Quality Standard for Ground Water).

No	Parameter	Unit	Class III Standard
1	pH	-	6.5-8.5
2	COD _{Mn}	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness (CaCO ₃)	mg/l	450
7	Nitrate NO ₃ -	mg/l	20
8	Nitrite NO ₂ -	mg/l	0.02
9	Ammonia Nitrogen NH ₃ -N	mg/l	0.2
10	Molybdenum	mg/l	0.1
1	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

Source: ADB PPTA Consultants and GB/T14848-93.

Wastewater

51. Discharge of wastewater from construction sites is regulated under the PRC's *Integrated Wastewater Discharge Standard* (GB8978–1996) (Table 11). The Class 1 standard applies to discharge into Class III water bodies under GB3838–2002; the Class 2 standard applies to discharge into class IV and V water bodies; and the Class 3 standard applies to discharge into municipal sewers going to municipal wastewater treatment plants (WWTPs) with secondary treatment. No new discharge of wastewater into Class I and II water bodies is allowed. The *EHS Guidelines* does not have ambient water quality standards, and recognizes the use of national and local ambient water quality criteria, and the PRC standards are adopted for use in this report.

Table 11: PRC Standards for discharging wastewater from construction sites (GB8978–1996)

Parameter		Class 1	Class 2	Class 3
		(Discharge into Class III water bodies)	(Discharge into Class IV and V water bodies)	(Discharge into municipal sewers)
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
Ammonia Nitrogen NH ₃ -N	mg/L	15	25	---
PO ₄ ²⁻ (as P)	mg/L	0.5	1.0	---
Anionic Surfactants	mg/L	5.0	10	20

Source: PRC GB8978-1996.

Solid Waste

52. For waste oil generated from maintenance and oil sludge produced from oil/water separator tanks, the *Standard for Pollution Control on Hazardous Waste Storage* (GB18597-2001) and its revision in 2013 apply.

53. For general solid waste, the *Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes* (GB18599-2001) and its revision in 2013 apply.

Summary of Environmental Standards applicable to the Project

54. Table 12 presents the environmental standards and guidelines applicable to the Project, which reflects the PRC requirements and the ADB SPS (2009) guidance on the use of international standards.

Table 12: Environmental standards and guidelines applicable to the project

Parameter / Area of Concern	Applicable Standards and Guidelines	Remarks
Ambient air quality	<i>Ambient Air Quality Standard</i> (GB3095-2012), Class II	<u>Yearly average:</u>
		PM ₁₀ : 0.070 mg/m ³
		PM _{2.5} : 0.035 mg/m ³
		SO ₂ : 0.06 mg/m ³
		NO ₂ : 0.04 mg/m ³
		CO: 4.0 mg/m ³
		<u>Daily average:</u>
		TSP: 0.30 mg/m ³
		PM ₁₀ : 0.15 mg/m ³
		PM _{2.5} : 0.075 mg/m ³
		SO ₂ : 0.15 mg/m ³
		NO ₂ : 0.08 mg/m ³
		CO: 4.0 mg/m ³
		<u>Hourly average:</u>
		SO ₂ : 0.50 mg/m ³
		NO ₂ : 0.20 mg/m ³
		CO: 10.0 mg/m ³

Parameter / Area of Concern	Applicable Standards and Guidelines	Remarks
Construction air pollutant emission	<i>Air Pollutant Integrated Emission Standard (GB16297-1996)</i>	<p>Maximum allowable emission concentration: Particulate matter (PM): 120 mg/m³ Fumes from asphalt plant: 40 mg/m³ during production and 75 mg/m³ during mixing</p> <p>Limits for fugitive emission: PM: ≤1.0 mg/m³ at construction site boundary Fumes from asphalt plant: no obvious emission at asphalt production plant</p>
Environmental noise	<p><i>Environmental Quality Standard for Noise (GB3096-2008):</i></p> <ul style="list-style-type: none"> Class IVa for areas within 35 m from the boundary line of roads Class II for areas 35 to 200 m from the boundary line of roads <p><i>WHO Noise Level Guideline</i></p>	<p><u>Class IVa areas:</u> Day time: 70 dB(A) Night time: 55 dB(A)</p> <p><u>Class II areas:</u> Day time: 60 dB(A) Night time: 50 dB(A)</p> <p><u>Residential, institutional, and educational receptor</u> Day time: 55 dB(A) Night time: 45 dB(A)</p> <p><u>Industrial and commercial receptor</u> Day time: 70 dB(A) Night time: 70 dB(A)</p>
Construction noise	<i>Emission Standard of Environmental Noise for Boundary of Construction Site (GB12523-2011)</i>	<p><u>Noise level at construction site boundary:</u> Day time: 70 dB(A) Night time: 55 dB(A)</p> <p><u>Noise level within construction site:</u> Day time: 60 dB(A) Night time: 50 dB(A)</p>
Surface water quality	<i>Environmental Quality Standards for Surface Water (GB3838-2002), see Table 9.</i>	<ul style="list-style-type: none"> Class II standard for Hongfeng Lake and Songbaishan Reservoir (drinking water source) Class III for rivers within the project area.
Wastewater discharge	<i>Integrated Wastewater Discharge Standard (GB8978-1996)</i>	<p><u>Discharge into Class III water body:</u> COD: ≤100 mg/l BOD₅: ≤20 mg/l SS: ≤70 mg/l TPH: ≤5 mg/l NH₃-N: ≤15 mg/l</p> <p><u>Discharge into sewers:</u> COD: ≤500 mg/l BOD₅: ≤300 mg/l SS: ≤400 mg/l TPH: ≤30 mg/l</p>
Environmental adverse impacts	<i>WB EHS Guidelines: Environment</i>	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Occupational health and safety	<i>WB EHS Occupational Health and Safety Guidelines</i>	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Community health and safety	<i>WB EHS Community Health and Safety Guidelines</i>	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Construction and Decommissioning	<i>WB EHS Construction and Decommission Guidelines</i>	Approaches and measures appropriate to mitigate adverse impacts from the project activities

Source: PPTA consultant.

I. International Agreements

55. **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 dates of signing by the PRC, are listed in Table 13.

Table 13: Applicable international agreements with the PRC as a signatory

No.	Name of Agreement	PRC Signing Date	Agreement Objective
1	Convention Concerning the Protection of the World Cultural and Natural Heritage	1985.12.12	Conserving cultural and natural heritage sites.
2	Montreal Protocol on Substances That Deplete the Ozone Layer	1989.01.01	To protect the ozone layer by controlling emissions of substances that deplete it
3	United Nations Framework Convention on Climate Change	1994.03.21	To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system
4	Kyoto Protocol to the United Nations Framework Convention on Climate Change	2005.02.23	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

Source: ADB PPTA consultants.

III. DESCRIPTION OF THE PROGRAM

A. The Program

56. The proposed Xiangtan Low-Carbon Transformation Sector Development Program (Xiangtan LCT SDP) is the first holistic and integrated multi-sectoral approach in promoting low-carbon transformation of a municipality in the PRC. The Xiangtan LCT SDP is comprised of (i) a project loan to invest in priority infrastructure, and (ii) a policy-based loan to support necessary policy reforms of the municipal government to enable a successful low-carbon transformation.¹⁴ The Xiangtan LCT SDP will provide (i) required infrastructure for reducing carbon emissions; (ii) information and knowledge platforms to promote better decisions and behavioral changes; (iii) policy and institutional reforms to enable transformations; and (iv) capacity building to sustain the program interventions.

57. The Xiangtan LCT SDP will complement the XMG's existing efforts to transform Xiangtan from a carbon-intensive, heavily polluting city to a low-carbon, climate resilient and livable one. This report primarily focusses on physical works to be implemented under the investment loan portion of the program.

¹⁴ Low-Carbon Development is defined as 'sustainable development' that is grounded in systems-thinking, encourages integrated city planning, collaborative and coherent sector development, resilience improvement by taking preventive approach, and active governance through engaging and activating all stakeholders by providing the right incentives. Low-carbon development progress can be measured by quantifiable indicators including GHG emissions reduction.

B. Rational

58. **PRC Carbon Peaking: Performance and Commitment.** The PRC is a signatory to the 21st Paris Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). The PRC Government (the Government) is committed to its nationally determined contributions (NDCs) of carbon emissions peak by 2030, with best efforts to achieve an earlier peak. Since 2010, the Government has been implementing the Low-Carbon Cities Initiatives (LCCI), and there are currently 87 cities and provinces, including Xiangtan municipality in Hunan province,¹⁵ registered and committed to contribute to NDC targets. Cities at different stage of development are required to create their own low-carbon path suitable to their local conditions.

59. **Challenges in Low-Carbon Transformation.** Xiangtan is an old industrial town experiencing recent rapid urbanization and industrial transformation. It has an administrative area of 5,006 square kilometers (km²), a population of approximately 2.9 million, and an urbanization rate of 60%–65% in 2016.¹⁶ Located within the Changsha–Zhuzhou–Xiangtan urban cluster, Xiangtan has been a key economic driver of Hunan Province. Its growth has also led to a substantial increase in greenhouse gas (GHG) emissions, from 24.36 megatons of carbon dioxide equivalent (Mt CO₂e) in 2005 to 41.40 Mt CO₂e in 2015. During this period emissions from energy and industrial activities doubled, while those from transport activities increased five times.

60. As noted above, Xiangtan is a designated pilot city under the LCCI, and the XMG is committed to carbon peaking by 2028. Though the XMG has begun initial works,¹⁷ more significant and orchestrated actions are needed to achieve the target, and Xiangtan's GHG intensity is still much higher than the average in Hunan Province or the PRC.

61. **Proposed Sector Development Program.** LCT is a long-term process, but consolidated efforts from key societal stakeholders can expedite it. Holistic and integrated approaches rather than development in silos, can significantly reinforce LCT, and well-designed infrastructure can make low-carbon actions easier to adopt. However, LCT also needs to be complemented by appropriate incentives and mechanisms to involve and activate different stakeholders. Applying systems-thinking to technical, policy, and institutional reforms can help create such an enabling system.

62. The Xiangtan LCT SDP is comprised (i) a project loan that will demonstrate how low-carbon and resilient infrastructure transformation, coupled with information and knowledge systems using information and communications technology (ICT) can foster continuous LCT; and (ii) a policy-based loan that will support reforms to update existing policies and introduce innovative measures to unlock the potentials for carbon reduction.

63. The Xiangtan LCT SDP is aligned with key operational priorities of the *ADB Strategy 2030* of tackling climate change, building resilience, enhancing environmental sustainability, and making cities inclusive and more livable. The program is included in ADB's *2017 Country Operations Business Plan for the People's Republic of China, 2018–2020*.

¹⁵ Xiangtan Low-Carbon City Pilot Implementation Plan, 2017–2030.

¹⁶ Xiangtan Municipal Government. 2016. Xiangtan City Housing, Urban and Rural Construction Network. Xiangtan.

¹⁷ The Xiangtan municipal government established a low-carbon leadership group, retrofitted existing buildings for energy efficiency, replaced a number of busses to fuel efficient ones, and commenced ecological rehabilitation works.

C. Impact, Outcome and Outputs

64. The expected program impact will be carbon emissions peak achieved in Xiangtan by 2028. The expected outcome will be the use of low-carbon enabling systems in Xiangtan increased.

65. The program will have four outputs: (i) low-carbon and resilient infrastructure transformation demonstrated; (ii) information and knowledge platforms established for informed decision making and behavioral changes; (iii) low-carbon transformation policy reforms adopted; and, (iv) capacity building and program management enhanced. Outputs (i), (ii), and (iv) will be under the project loan, while output (iii) will be supported by the policy-based loan. The program's physical works are primarily in output (i) and to a lesser extent output (ii), and are the primary focus of this IEE report.

D. Detailed Output Description

66. The four program outputs are described below.

i) **Output 1: Low-Carbon and Resilient Infrastructure Transformation Demonstrated**

67. Physical infrastructure transformation with integrated design of cross-sectoral interventions will be demonstrated. Road infrastructure will be transformed to ensure seamless access to public mobility systems that are safe and inclusive to all, including children, elderly people, and persons with disabilities. Incorporating safety will support the shift to low-carbon modes of transport.

68. The output includes the development of a priority bus system including the deployment of 100 battery electric buses (BEBs) and the installation of 778 e-charging units at 30 locations, integrated with improved bicycle network and pedestrian facilities; school zone transformation for children's road safety at five primary schools; and street transformation for climate resilient and multi-purposed street for users.

69. The building sector contributes over 35% of GHG emissions. Output (i) will also promote low-carbon buildings through energy and resource efficiency measures and certifications, and ecosystem-based adaptation (EbA) measures at two demonstration sites – the construction of the first "EDGE-certified" hospital building in the PRC, and the retro-fit of a semi-abandoned government building.¹⁸ Other infrastructure transformation includes improvement of public facilities and other urban infrastructure at 20 urban communities showing practical ways to build a low-carbon, resilient, and livable Xiangtan.

70. Specifically, output (i) includes:

- (i) Establishing a **priority bus system** through (a) lane modification to 31.3 km of main trunk roads in the Yuetang and Yuhu urban districts to establish priority median bus lanes; (b) lane modification to 31.5 km of other trunk roads to establish peak hour

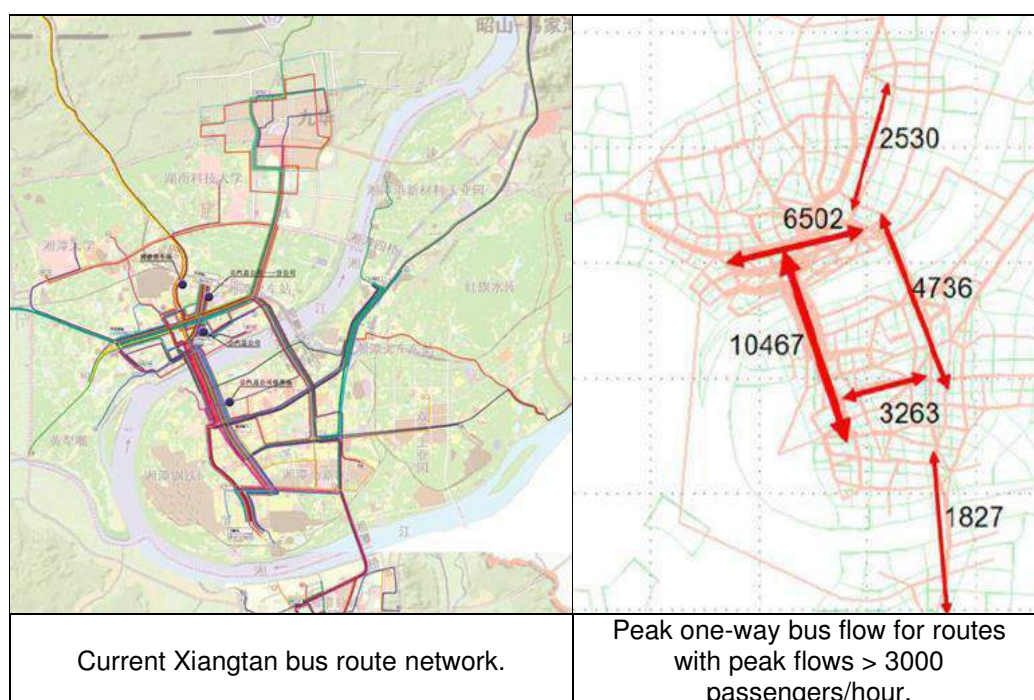
¹⁸ Ecosystem-based adaptation measures using urban water (blue) infrastructure with green assets and ecosystem services are effective measures for flood control, drought mitigation, heat stress reduction, and carbon sink, and also provide co-benefits like aesthetic quality, recreational and restorative capacity, improved local air quality, and health benefits. .

- priority curbside bus lanes; and (c) traffic light reprogramming to improve bus traffic flows.
- (ii) Establishing 104 pairs of bi-directional **smart accessible bus stops**, including 56 new bi-directional smart bus stops every 500 m along the median bus priority lanes (Figure 5), and upgrading of 48 existing bi-directional road side bus stops.
 - (iii) **Clean-energy vehicle promotion** through (a) procurement of 100 battery electric busses (BEBs); and (b) installing 778 e-chargers in 30 charging stations in Yuetang and Yuhu districts.
 - (iv) **Fuxing Middle Road Improvement Demonstration Project**, including an iRAP road safety assessment; road layout improvements for safety, bus stops, bike lanes and pedestrian walkways; ecosystem-based adaptation (EbA) measures to treat stormwater, alleviate drainage and runoff pollution, improve flood resilience and enhance the amenity value of the street; and drainage improvements.
 - (v) **Upgrading of non-motorized transport systems** by (a) improving 63.4 km of bike paths; (b) upgrading of 69 km of pedestrian walkways; (c) installing 48 safe crossing islands at major intersections for safe use and inclusive access; and (d) providing accessible and safer pedestrian crossing by adding screens with countdown red timers and synchronized sound buzzers at 3,000 pedestrian crossings across Xiangtan.
 - (vi) A **school road safety assessment** utilizing the iRAP Star Ratings for Schools (SR4S) methodology will be undertaken for five elementary schools.
 - (vii) The construction of the first **EDGE-certified hospital building** in the PRC will demonstrate the integration of passive building design, clean energy technologies, and ecosystem-based adaptation (EbA) measures.
 - (viii) **Retrofit of a run-down public building** to be equipped with high energy and water saving features and appliances;
 - (ix) **Improvement of public facilities and other urban infrastructure** at 20 urban low-income communities showing practical ways to build a low-carbon, resilient, and livable Xiangtan; and,
 - (x) **Demonstrating user-friendly multimodal station design** at the Xiangtan Railway Station and Bantang Inter-city Railway Station, by modifying layouts to give priority access and use-space for public busses over taxis and private cars.

a. Priority Bus System

71. **Priority Median Bus Lanes.** Xiangtan currently has only 207 km of bus routes (Figure 2). The network is inefficient and slow, and suffers from limited routes, poor bus stop locations, a lack of car-free bus lanes, and a lack of prioritization of bus traffic. Stakeholder meetings and surveys have identified slow bus speeds as the main reason urban Xiangtan residents prefer private cars over public busses.

Figure 2: Current Xiangtan bus routes and one-way bus flows



Source: Xiangtan City Public Transport Special Planning Unit.

72. The program will establish priority median bus lanes¹⁹ on 31.3 km of main trunk roads and peak-hour (07:00-10:00; and 17:00-19:00) curb-side bus priority lane in 31.5 km of the remaining bus routes in Yuetang and Yuhu districts, to form an integrated network connecting main transport hubs which promotes faster bus flows (Figure 3 and Figure 4). The priority median bus lanes were selected based on the Xiangtan urban layout, road type (two way, six lanes or more), current bus routes, and current and predicted passenger flows (Figure 2). Hard separations will be adopted to isolate the two-way bus lanes, with green belts used where road width allows. Lane design will be in accordance with *DG/TJ 08-2172-2015 J 13115-2015 Bus Lane System Design Specification*, and lanes will be painted a bright, distinct color and equipped with appropriate signage.

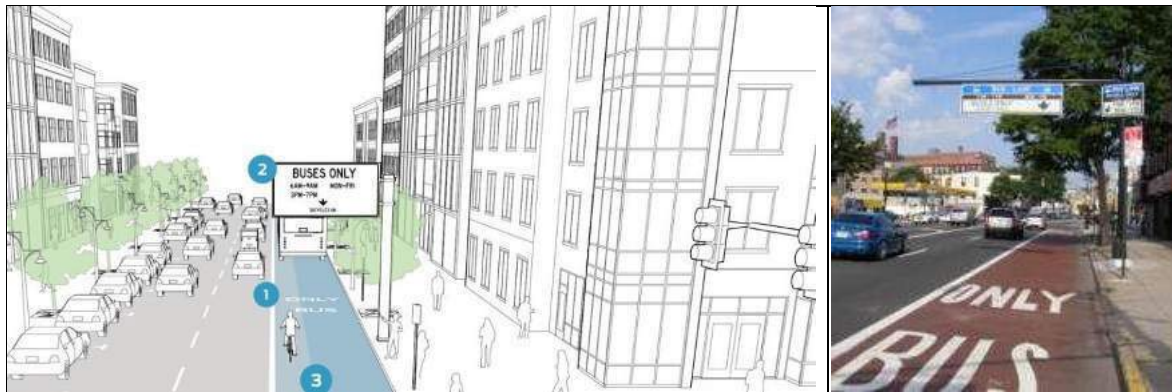
¹⁹ There are four basic types of bus lanes: curbside, median, sub-curbside and reverse. A curbside bus lane is located in the outmost lane. A median bus lane is located in the innermost lane. A sub-curbside bus lane can be set on the lane next to the outmost lane when the road is one-way three or more lanes. A reverse bus lane is set on one-way road to allow busses to pass in the opposite direction.

Figure 3: Examples of priority median bus lanes, Republic of Korea



Source: ADB PPTA consultant, 2019.

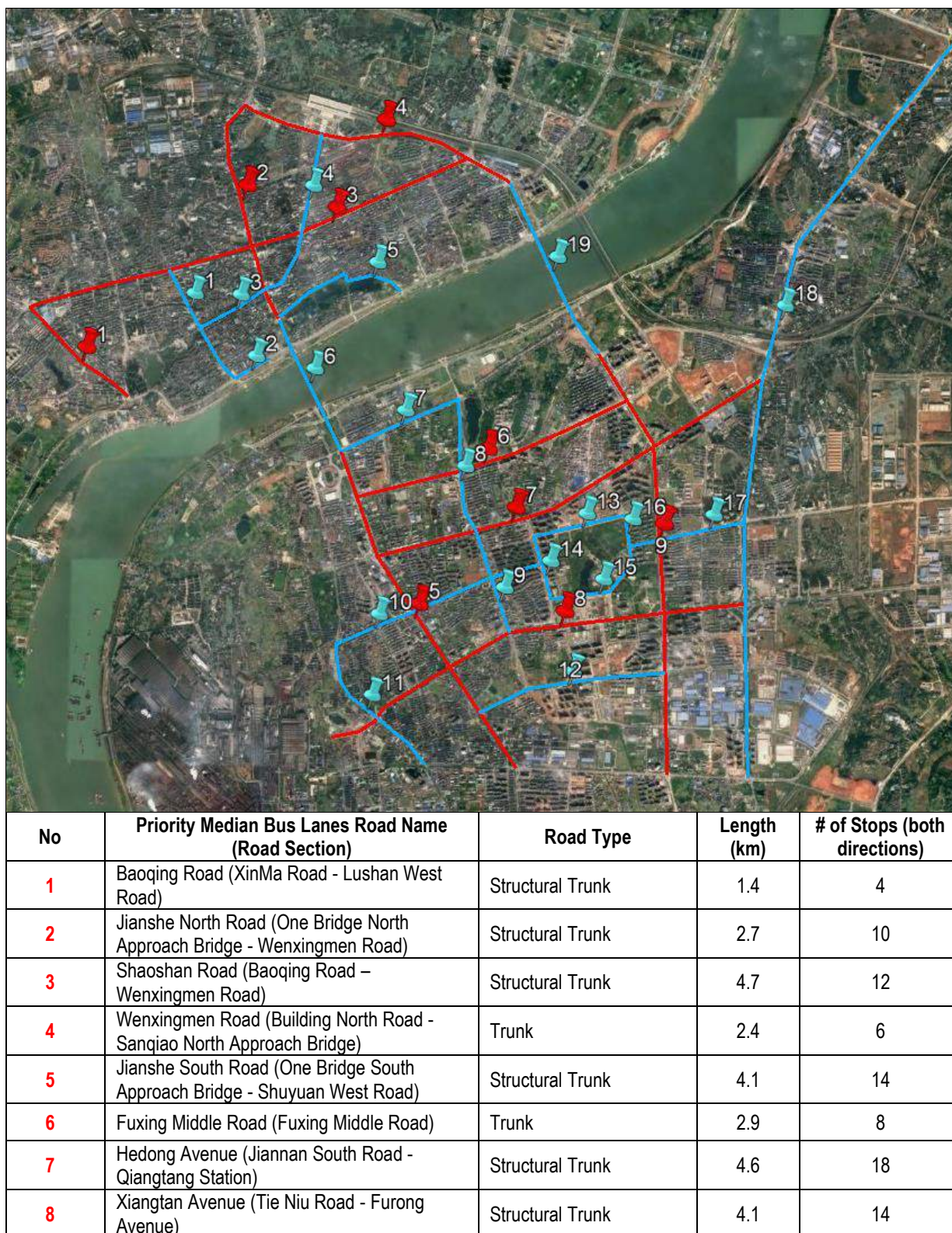
Figure 4: Examples of curb-side bus priority lane design



Source: NACTO design guidelines.

73. **Traffic Light Reprogramming.** Currently trunk roads in Xiangtan urban areas, including those to receive priority bus lanes, are equipped with three traffic lights. The far right-side traffic lights are used to signal right-turns, which is not actually required as right turns are permitted on both green and red lights. Priority median bus lanes will be supported by exclusive traffic light management to give priority signals to busses over other vehicles. Far left-side traffic lights will be reprogrammed to be used for bus flow management, and the two remaining traffic lights will be reprogrammed for other traffic flow management. Figure 6 presents current traffic light use and the bus-designated traffic light reprogramming that will be implemented to support the bus priority system.

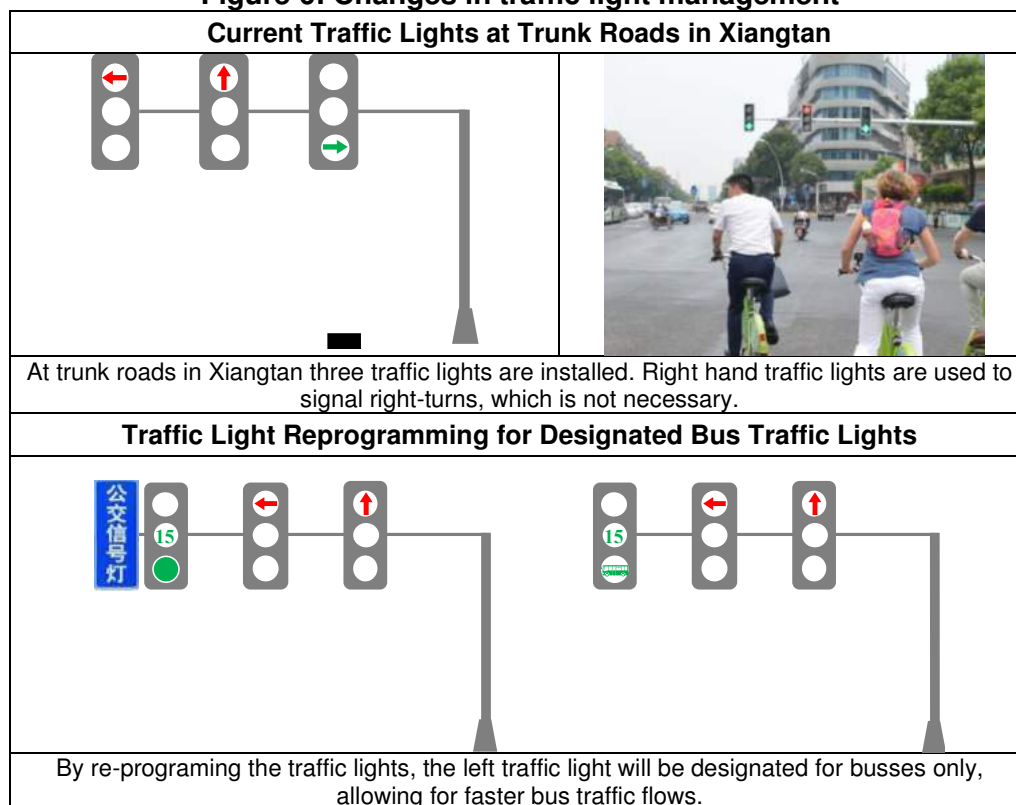
Figure 5: Xiangtan urban trunk roads to receive lane modifications to establish priority median bus lanes (red) and peak hour priority curbside bus lanes (blue)



9	Shuangyong Road (Sanqiao South Approach Bridge - Shuyuan Middle Road)	Structural Trunk	4.4	16
Total			31.3	102
No.	Priority Curbside Bus Lanes Road Name (Road Section)	Road Type	Length (km)	# of Stops (both directions)
1	Bai Ma Hu Road	Structural Trunk Road	1.2	
2	Zhong Shan Road	Structural Trunk Road	0.4	
3	Min Zhu Road	Trunk Road	0.9	
4	Che Zhan Road	Trunk Road	1.6	
5	Yu Hu Road	Structural Trunk Road	1.5	
6	Jian She Middle Road	Trunk Road	1.4	
7	Dong Hu East Road	Structural Trunk Road	1.3	
8	Bao Ta North Road	Trunk Road	1	
9	Bao Ta Middle Road	Trunk Road	1.4	
10	Xia Guang Road	Trunk Road	2.2	
11	Yue Tang Road	Trunk Road	3.7	
12	Xiao Tang Middle Road	Trunk Road	1.9	
13	Hu Xiang North Road	Structural Trunk Road	0.9	
14	Hu Xiang West Road	Structural Trunk Road	0.6	
15	Hu Xiang South Road	Structural Trunk Road	1	
16	Hu Xiang East Road	Structural Trunk Road	0.5	
17	Gao Xin Road	Structural Trunk Road	1.2	
18	Fu Rong Avenue	Structural Trunk Road	6.9	
19	Xiang Tan 3rd Bridge	Trunk Road	1.9	
Total			31.5	

Source: ADB PPTA consultant, 2019.

Figure 6: Changes in traffic light management



Source: ADB PPTA consultant, 2019.

b. Smart Accessible Bus Stops

74. Bus stops in Xiangtan are typically narrow, and do not have sufficient space for bus users to sit or stand comfortably. They also are not easily accessible and do not provide safe spaces for the disabled. While the stops are often equipped with digital screens, the content is dominated by advertisements and the screens are not very helpful to users (Figure 7).

75. A total of 104 pairs of bi-directional smart accessible bus stops will be established, including 56 new bi-directional smart bus stops every 500 m along the median bus priority lanes, and upgrading of 48 existing bi-directional road side bus stops. The stops will be equipped with bus information systems to provide real-time bus arrival, departure and route information. In addition, the bus stops will incorporate user-friendly designs including wider roofs to protect against sun and rain, room for comfortable benches, and improved access for elderly, children, and the disabled. All stops will have demarcated safety lines to protect passengers from bus traffic, and high passenger volume stops will be equipped with safety barriers (Figure 8). Bus stop design will be in accordance with *DG/TJ 08-2172-2015 J 13115-2015 Bus Lane System Design Specification*.

Figure 7: Typical bus stops in Xiangtan



Source: ADB PPTA consultant, 2019.

Figure 8: Conceptual design for improved smart bus stops



Source: ADB PPTA consultant, 2019.

c. Clean Energy Vehicle Promotion

76. **Electric Bus Procurement.** Modern battery electric busses (BEBs) can have a range of up to 250 km with just one charge, and are particularly well suited to urban routes. Urban driving involves extensive accelerating and braking, and BEBs can recharge much of the kinetic energy back into the batteries in braking situations, reducing brake wear and extending range.

77. The program will procure a fleet of 100 BEBs. The 10.5 m long busses will be powered through on-board 145 to 205 kW lithium-ion (Li-ion) batteries, charged at existing bus depots and electric charging stations or at those to be established by the program. Batteries will have a guarantee of 8 years minimum lifespan at 100% state-of-charge (SOC). This type of battery set has proven able to meet the daily demands of a majority of typical bus routes with one fast-charge during the day and slow-charging during the night. Buses will be equipped with a thermal management system to control heat and ensure safe operation.

78. Busses will be equipped with onboard systems to communicate with the traffic management control and data centers. For pedestrian safety busses will also be equipped with Acoustic Vehicle Alerting Systems (AVAS), which will emit warning sounds at speeds less than 30 km/h.

79. The average program bus route length will be 16.49 km 1-way and take 40 minutes. Due diligence has confirmed that the routes (gradients, length) and the climatic conditions in Xiangtan pose no problem for the proposed BEBs.

Table 14: Battery bus fleet technical data

Parameter	Battery Electric Bus
Size	10.5 m
Number of busses	100
Passenger Capacity	70
Daily distance driven	160
Annual distance driven (km)	30,900
Electricity usage average (kWh)	82.8 kWh/100 km
Battery pack required (for summer with 10% reserve and 90% SOC) in kWh	145 to 205 kW
Type of Battery	Lithium iron phosphate (LiFePO ₄)
Station Chargers	15 to 30 kW DC slow chargers for overnight charging. 45 to 160 kW DC fast chargers.
Estimated electricity cost (RMB/kWh)	0.9
Estimated annual electricity cost per bus RMB	23,000

Source: ADB PPTA consultant, 2019.

Figure 9: Example of a BEB, produced by BYD, Hanzhou, PRC



Source: ADB PPTA consultant, 2019.

80. **E-Charging Stations.** A network of 30 electric charging stations for both private and public vehicles will be established at existing bus stations and municipal and public parking lots. The stations will have a combined total area of 58,500 m², and no land acquisition will be required. The stations will be equipped with automated 60 to 320 kW DC quick chargers, each having two

or more 7 or 9 pin plug-in nozzles, capable of meeting the quick-charge requirements of small, medium and large sized electric vehicles. In total there will be 778 chargers providing 1,445 charging spaces.

81. Charging stations will be equipped with intelligent monitoring systems, displaying reservation and operating status of the charging points in real time on a large screen, and allowing for payment via mobile applications. Power will be sourced from adjacent substations via the grid, and no new substations will be required, although substations will require upgraded transformers. Solid waste will be collected by the municipal sanitation department, but no sanitation facilities will be provided. Charging stations will be equipped with fire alarms and suppression systems, and will be landscaped with appropriate vegetation for local conditions. The stations are described in more detail in Appendix C.

Figure 10: Existing e-bus and e-bus charging station in Xiangtan, with two-nozzle charger



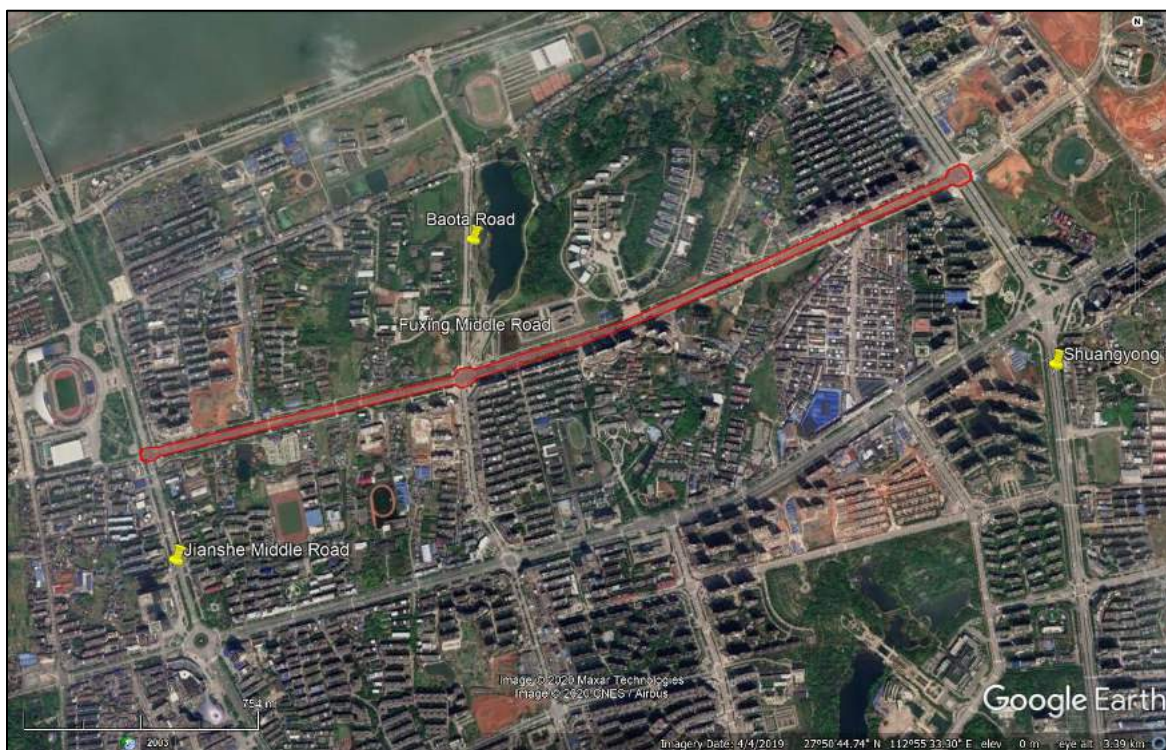
Source: ADB PPTA Consultant, 2018.

d. Fuxing Middle Road Improvement Demonstration Project

82. A Xiangtan pluvial flood assessment was carried out during the program preparation (see Section IV.B.v). The assessment shows that Fuxing Middle Road, an important feeder road into the city center in Yuetang District and one of the output (i) trunk roads, is located in a flood prone-zone. A comprehensive road improvement demonstration project will be undertaken at Fuxing Middle Road, with the goal to create a safer, convenient, accessible and user-friendly street.

83. Fuxing Middle Road runs from Jianshe Middle Road to Shuangyong North Road, and is 2.9 km long. It is a two way trunk road with 6 lanes, and has several intersections with 6 lane cross streets. It has 4 to 8 m wide sidewalks (Figure 11 and Figure 12). According to the Xiangtan Urban Master Plan, the road is targeted for education, scientific research and green space.

Figure 11: Fuxing Middle Road demonstration project area, Yuetang District



Source: ADB PPTA consultant, 2019.

Figure 12: Photos from Fuxing Middle Road



Source: Baidu map street view captured by ADB PPTA consultant, 2019.

84. **iRAP Star Rating Assessment.** The program will undertake a road infrastructure safety assessment of Fuxing Middle Road. The assessment will utilize the iRAP Star Ratings (Figure 13) and Safer Roads Investment Plan (SRIP), produced in accordance with iRAP specifications (www.irap.org/specifications/) and online iRAP software (<http://vida.irap.org>). Star Ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is 'built-in' to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians. Five-star roads are the safest while one-star roads are the least safe. The results of the assessment will identify potential safety enhancements which will be incorporated into the planned road layout improvements (below) in accordance with local design standards.

Figure 13: International Road Assessment Programme

The International Road Assessment Programme or iRAP assesses roads all over the world and aims to significantly reduce road casualties by improving the safety of road infrastructure. iRAP was formed in 2006 as an umbrella organization for EuroRAP, usRAP and AusRAP, and to facilitate work in middle and low income countries.

The iRAP Star Rating system is used to assess the safety of roads. High-risk roads where large numbers are killed or seriously injured are inspected and affordable programmes of safety engineering are identified. As the percentage road deaths of vulnerable road users like pedestrians and two-wheelers is high in developing countries, iRAP focuses on measures to improve road design for these users.

iRAP Star Ratings are based on road inspection data (road condition, signage, markings, and more) and provide a simple and objective measure of the level of safety which is 'built-in' to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians. Five-star roads are the safest while one-star roads are the least safe. Broadly speaking, every extra star rating results in a halving of crash cost in terms of the number of people who are killed and seriously injured. Importantly, Star Ratings can be completed without reference to detailed crash data, which is often unavailable in low-income and middle-income countries.

Source: iRAP, 2019.

85. **Road Layout Improvements.** The main layout problems with Fuxing Middle Road are: (i) road space is inefficient and designed for cars only; (ii) pedestrian crossings design is not user-friendly; (iii) the cycle lanes are discontinuous (some sections do not have cycle lanes), and there is conflict between cycle ways and on-street parking; and (iv) sidewalks are often occupied by parked cars.

86. To address these problems the program will undertake section-by-section road layout modifications as described in detail in Appendix D. It should be noted that some of these modifications may undergo design changes as a result of the above noted iRAP Star Rating Assessment.

87. **EbA Measures.** Flooding of Fuxing Middle Road and adjacent blocks is caused by stormwater runoff from the road and buildings. The runoff is seriously polluted due to the high traffic load on the street. Substantial retention of stormwater along Fuxing Middle Road will reduce flood risk and damage in this downstream area, and improve runoff water quality.

88. A range of ecosystem-based adaptation (EbA) measures will be installed. The measures were identified in cooperation with Xiangtan government staff in a series of ecosystem-based training and design workshops, and then further developed in a customized Chinese-language version of the Adaptation Support Tool,²⁰ called the Xiangtan Climate Resilient City Toolbox

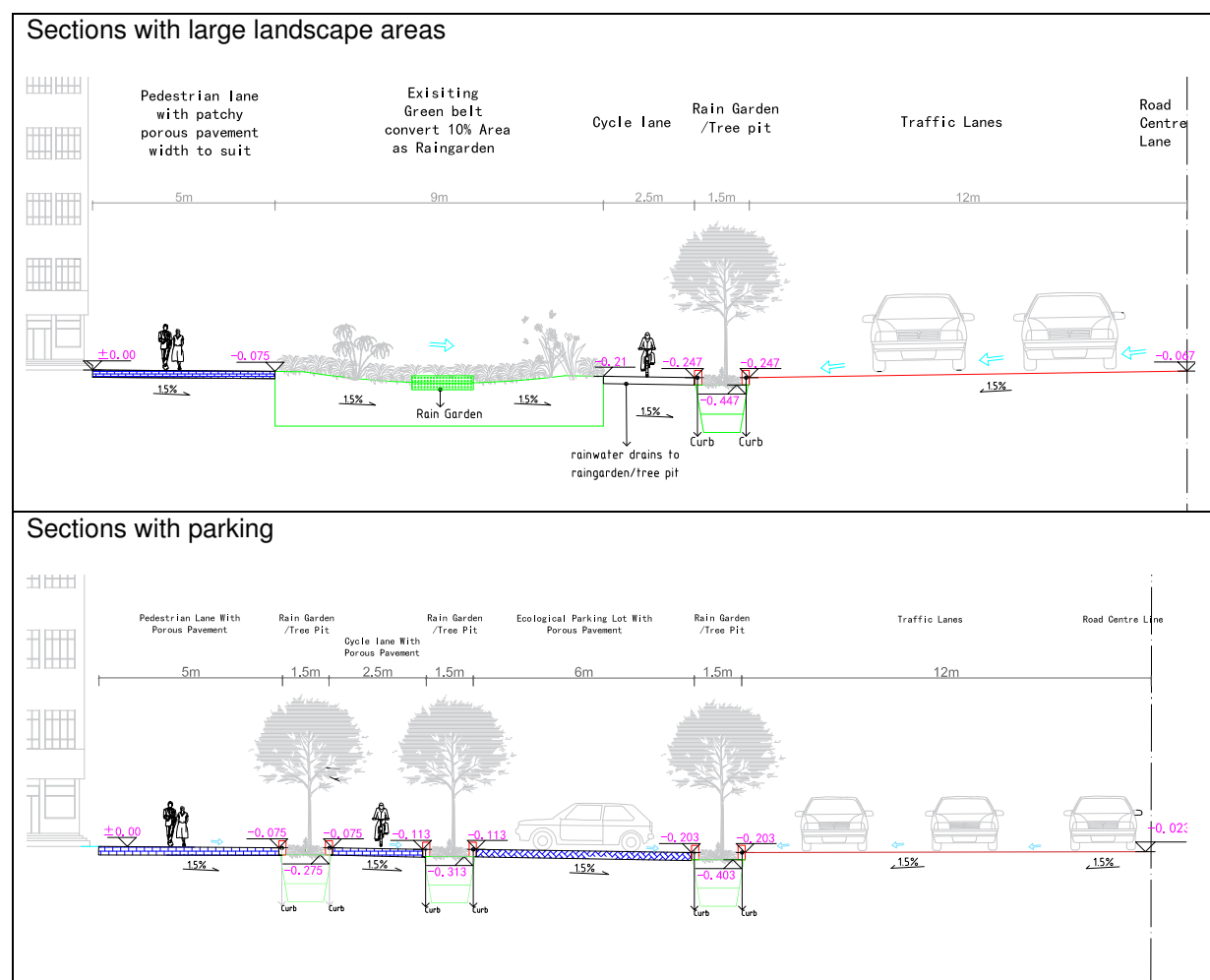
²⁰ The Adaptation Support Tool is an on-line resource developed by Deltares which can be used to explore measures that increase the water resilience of an area. See: <https://crctool.org/en/>.

(XCRC Toolbox). The XCRC Toolbox contains a set of nature-based solutions and information on their water storage effectiveness and costs. Customization of the Toolbox included fine-tuning the Chinese translations to the local professional terminology, adding pictures of local examples of measures, adding an assessment of the effectiveness of each of the adaptation measures under the local climate conditions and land use in the pilot areas, and adding an assessment of the unit cost prices for implementation and maintenance of each of the measures.

89. EbA measures to be implemented include converting existing trees to tree pits, the size and type to be dependent on the local site conditions; new raingardens or swales for treating stormwater from the side pathways, size and type to be dependent on the local site conditions such as gradient; abandon/relocate/modify existing catchpits to new raingarden areas; porous pavement for cycle lanes; patchy porous pavement for the pedestrian walkways; and subsurface infiltration/detention boxes for water storage under cycle lanes and pedestrian walkways.

90. Figure 14 presents an EbA conceptual plan, and Figure 15 illustrates the range of measures to be implemented.

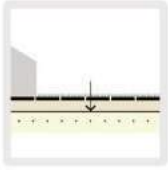

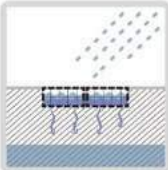



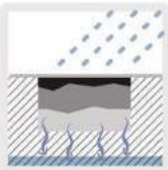

Figure 14: Conceptual design of EbA measures for Fuxing Middle Road.



Source: ADB PPTA consultant, 2020.

91. The EbA measures will support and be coordinated with the road, sidewalk and cycle lane improvements, and will increase and capture infiltration, retain part of the runoff for peak reduction, treat the stormwater, reduce drainage and runoff pollution to the downstream system, and improve the street amenity value. The EbA facilities on each side of the road will each be capable of storing two m³ of stormwater for each m of road length, and are supportive of Xiangtan's transition to a "sponge city".

Figure 15: EbA measures to be implemented, Fuxing Middle Road

<p>Permeable pavement (infiltration & storage)</p>  <p>Permeable pavements consist of porous material that absorbs rainfall. Water can be stored either in the top layer (e.g. very open asphalt concrete) or in below the top layer in the foundation. Besides reducing runoff, permeable pavements can trap suspended solids and filter pollutants from the water.</p>	
<p>Infiltration boxes</p>  <p>Infiltration boxes buffer rainwater underground and allow using a single area for two purposes. In general they offer more storage capacity than above-ground infiltration installations. More rainwater can be buffered temporarily and gradually released into the groundwater. The extra infiltration leads to less drought damage, subsidence and salinization.</p>	
<p>Bioretention cell</p>  <p>Bioretention cells are stormwater detention features that collect, detain, infiltrate, and filter stormwater runoff prior to releasing it to a storm sewer system via an overflow or discharge mechanism. These facilities typically feature both surface level (freeboard) and subsurface stormwater detention. Starting from the surface, it is commonly composed by: planting (trees & native shrubs), mulch layer, bioretention soil, aggregate bridging course, aggregate subbase, pipe underdrain, and undisturbed native soil.</p>	
<p>Rain garden</p>  <p>These are sandy soil or aggregate filled depressions that treat stormwater runoff to improve water quality. Stormwater is captured and allowed to percolate through the soil/aggregate layer, where pollutants are removed, prior to being released through an underdrain located at the bottom of the depression.</p>	

Source: ADB PPTA consultant, 2019.

92. The pollution load of a busy road like Fuxing Middle Road is substantial. In addition to suspended sediments there are substantial concentrations of heavy metals, poly-aromatic hydrocarbons and mineral oil due to traffic, and pesticides may also be present from riparian vegetation. Most of these pollutants are particle-bound, and filtering and settling are effective techniques to remove such pollutants from the runoff. The rain gardens and the catch pits will play an important role in retaining pollutants. Filtration through a layer of soil aggregate and settling in special catch basins will achieve estimated retentions of 80 to 90 % of these pollutants.

e. Non-motorized Transport System Improvement

93. **Cycle Lanes.** Typical problems with current Xiangtan cycle lanes include unsafe design such as being too narrow; lack of connectivity such as lanes not extending through intersections; cars using cycle lanes for driving or parking; and, poor or confusing signage (Figure 16). A total of 63.4 km of urban cycle lanes will be improved (Figure 17), with improvements including ensuring a minimum width of 1.5 m per lane; separating cycle lanes from vehicle roads where possible, or providing barriers to separate lanes from road traffic; demarcating lanes through brightly colored pavement and appropriate signage; and provision of bicycle parking.

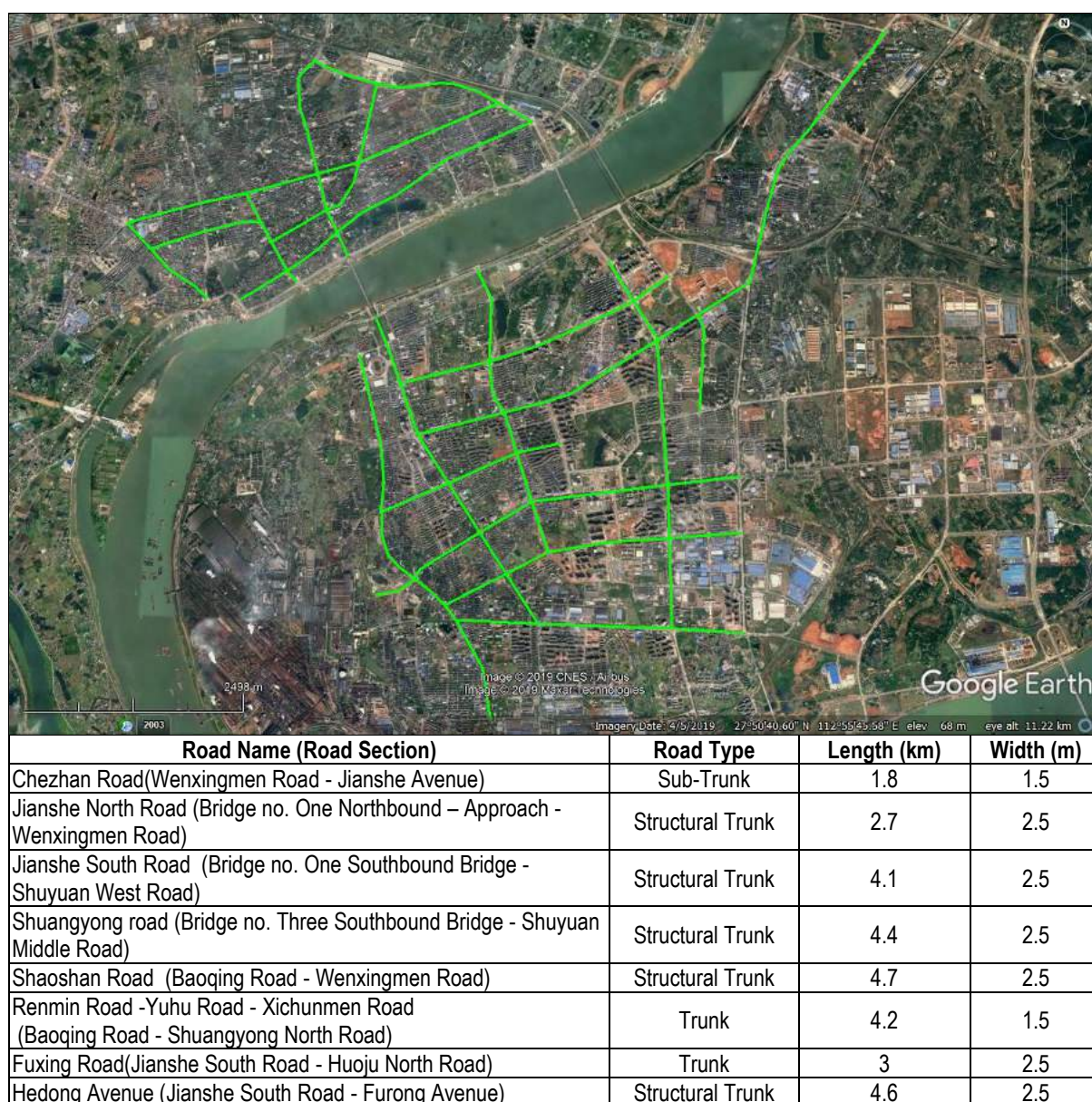
Figure 16: Problems with existing cycle lanes

	
<p>Cycle lanes do not extend through intersections, creating confusion and a safety hazard.</p>	<p>Wide cycle lane allows passenger car access.</p>
	
<p>Poor design can be unsafe, for example riders may run into doors or cars during parking.</p>	<p>Signage is confusing and difficult to understand. Landscaping creates blind-spots.</p>



Source: ADB PPTA consultant, 2019.

Figure 17: Cycle lanes to be improved



Xiangtan Avenue (Yuetang Road - Furong Avenue)	Structural Trunk	4.1	2.5
Xiaotang Road (Yuetang Road-Furong Avenue)	Trunk	3.5	1.5
Shuyuan Road (Yuetang Road-Furong Avenue)	Trunk	3.3	2.5
Wenxingmen Road (Jianshe North Road - Bridge no. Three Northbound Bridge)	Trunk	2.4	2.5
Fuxing Middle Road (Fuxing Middle Road)	Trunk	2.9	1.5
Xianguang Road (Huxiang West Road - Yuetang Road)	Trunk	2.3	1.5
Huoju road (Gaoxin Road-Hedong Avenue))	Sub-Trunk	1.2	1.5
Yuetang Road(Liyuan Road - Zhongzhou Road)	Sub-Trunk	3.6	1.5
Dongsi Road (Donghu West Road - Lanyuan Road)	Sub-Trunk	1.1	1.5
Baoqing Road (Xinma Road -Shaoshan West Road)	Structural Trunk	1.4	2.5
Baimahu Road (Shaoshan West Road – Yanjiang West Road)	Trunk	1.3	1.5
Minzhu Road(Jianshe North Road - Baimahu Road)	Sub-Trunk	0.8	1.5
Yinbin Road(Baimahu Road - Baoqing Road)	Sub-Trunk	1.4	1.5
Furong Avenue (Hedong Avenue - North Second Ring Road)	Trunk	4.6	2.5
Total		63.4	-

Source: ADB PPTA consultant, 2019.

94. **Pedestrian Walkways.** Typical problems with urban pedestrian walkways in Xiangtan include frequent access barriers at main road crossings; narrow widths; lack of pedestrian road crossing lights; blockage by parked cars and motorcycles; blockage by improperly sited public facilities such as power poles and garbage cans; uneven and unsafe surfaces that can be a tripping hazard; impervious surfaces and poor drainage which can lead to flooding; and poor accessibility for the disabled (Figure 18).

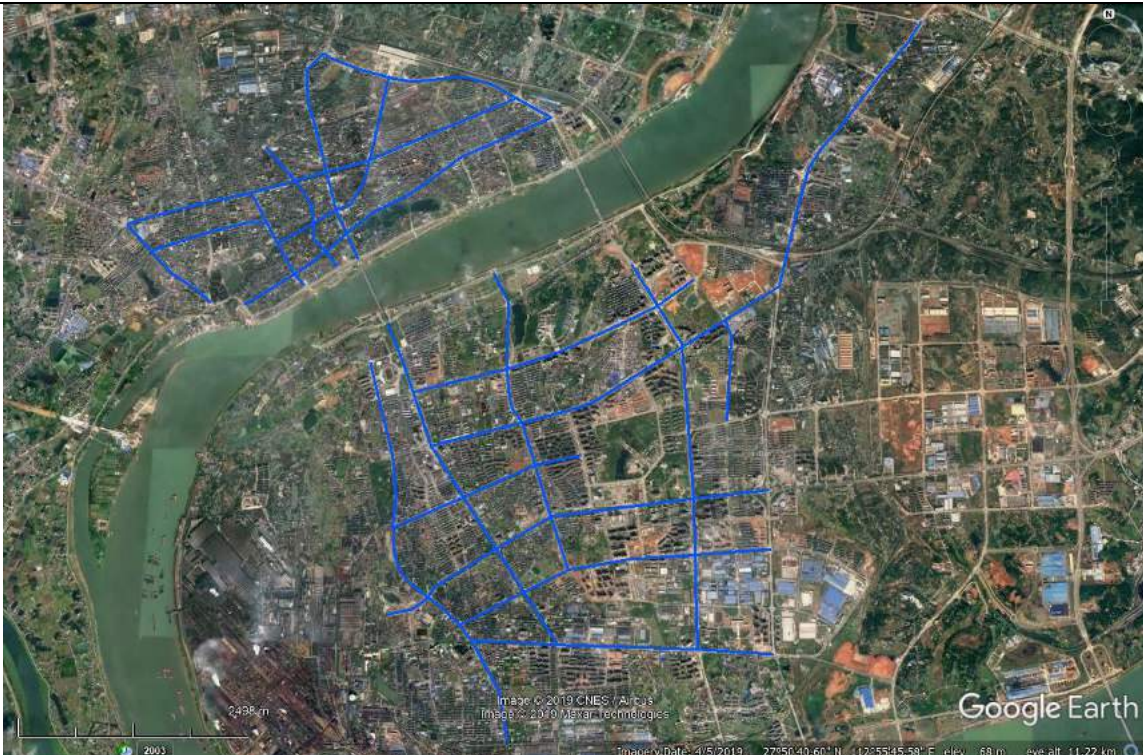
Figure 18: Problems with existing pedestrian walkways in Xiangtan

	
<p>Pedestrian road crossings frequently have barriers preventing access to strollers and wheelchairs, and may lack pedestrian crossing lights.</p>	<p>Pedestrian walkway blocked by parked cars.</p>
	
<p>Uneven and impervious walkways can flood easily and be a fall hazard.</p>	<p>Infrastructure blocking pedestrian walkway.</p>

Source: ADB PPTA consultant, 2019.

95. A total of 69 km of pedestrian walkways will be upgraded (Figure 19), including ensuring a minimum width of 2 m to allow for two-way wheel chair passage; removal of approximately 5,000 isolation barriers at sidewalk entrances; removal or re-siting of public facility obstacles such as garbage cans; and resurfacing over 250,000 m² of walkway with water pervious non-slip surfaces (Figure 20).

Figure 19: Pedestrian walkways to be improved

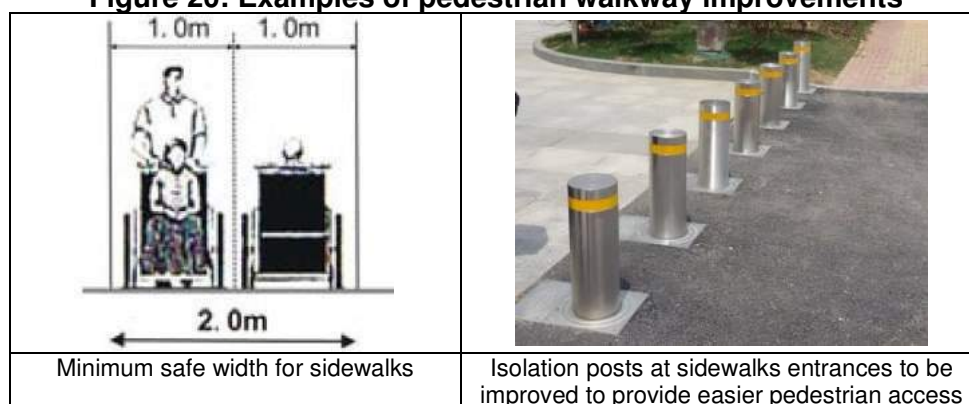


Type of Improvement	Road (Section)	Length (km)
Removing approx. 5,000 walkway access barriers	Main urban core trunk roads in the such as Jianshe Rd., Shaoshan Rd. and Xiangtan Avenue	NA
Sidewalk quality improvement, including ensuring a minimum width of 2 m to allow for two-way wheel chair passage; removal of isolation barriers at sidewalk entrances; removal or re-siting of public facility obstacles such as garbage cans; and resurfacing with water pervious non-slip surfaces.	Heping Rd. (Shaoshan East Rd. - Yuhu Rd.)	0.62
	Yuetang Rd. (Xianguang Rd. — Shuyuan West Rd.)	1.6
	Yingbin Rd. (Baimahu Rd. - Baoqing Rd.)	1.95
	Chezhan Rd. (Wenxingmen Rd. - Jianshe North Rd.)	1.9
	East Huxiang Rd. (Hedong Avenue - Xiangtan Avenue)	1.58
	Jie Fang Rd. (Guangyun Rd. - Yanjiang Middle Rd.)	1.74
	Jianshe North Road (Bridge no. One Northbound – Approach - Wenxingmen Road)	2.7
	Jianshe South Road (Bridge no. One Southbound Bridge - Shuyuan West Road)	4.1
	Shuangyong road (Bridge no. Three Southbound Bridge - Shuyuan Middle Road)	4.4
	Shaoshan Road (Baoqing Road - Wenxingmen Road)	4.7
	Renmin Road -Yuhu Road - Xichunmen Road (Baoqing Road - Shuangyong North Road)	4.2
	Fuxing Road(Jianshe South Road - Huoju North Road)	3
	Hedong Avenue (Jianshe South Road - Furong Avenue)	4.6
	Xiangtan Avenue (Yuetang Road - Furong Avenue)	4.1
	Xiaotang Road (Yuetang Road-Furong Avenue)	3.5
	Shuyuan Road (Yuetang Road-Furong Avenue)	3.3
Relevant standard is Accessibility Design Specification	Wenxingmen Road (Jianshe North Road - Bridge no. Three Northbound Bridge)	2.4

(GB50763-2012).	Fuxing Middle Road (Fuxing Middle Road)	2.9
	Xiaiguang Road(Huxiang West Road - Yuetang Road)	2.3
	Huoju road (Gaoxin Road-Hedong Avenue))	1.2
	Yuetang Road(Liyuan Road - Zhongzhou Road)	3.6
	Dongsi Road (Donghu West Road - Lanyuan Road)	1.1
	Baoqing Road(Xinma Road -Shaoshan West Road)	1.4
	Baimahu Road (Shaoshan West Road – Yanjiang West Road)	1.3
	Minzhu road(Jianshe North Road - Baimahu Road)	0.8
	Furong Avenue (Hedong Avenue - North Second Ring Rd.)	4.6
Total		69.5

Source: ADB PPTA consultant, 2019.

Figure 20: Examples of pedestrian walkway improvements



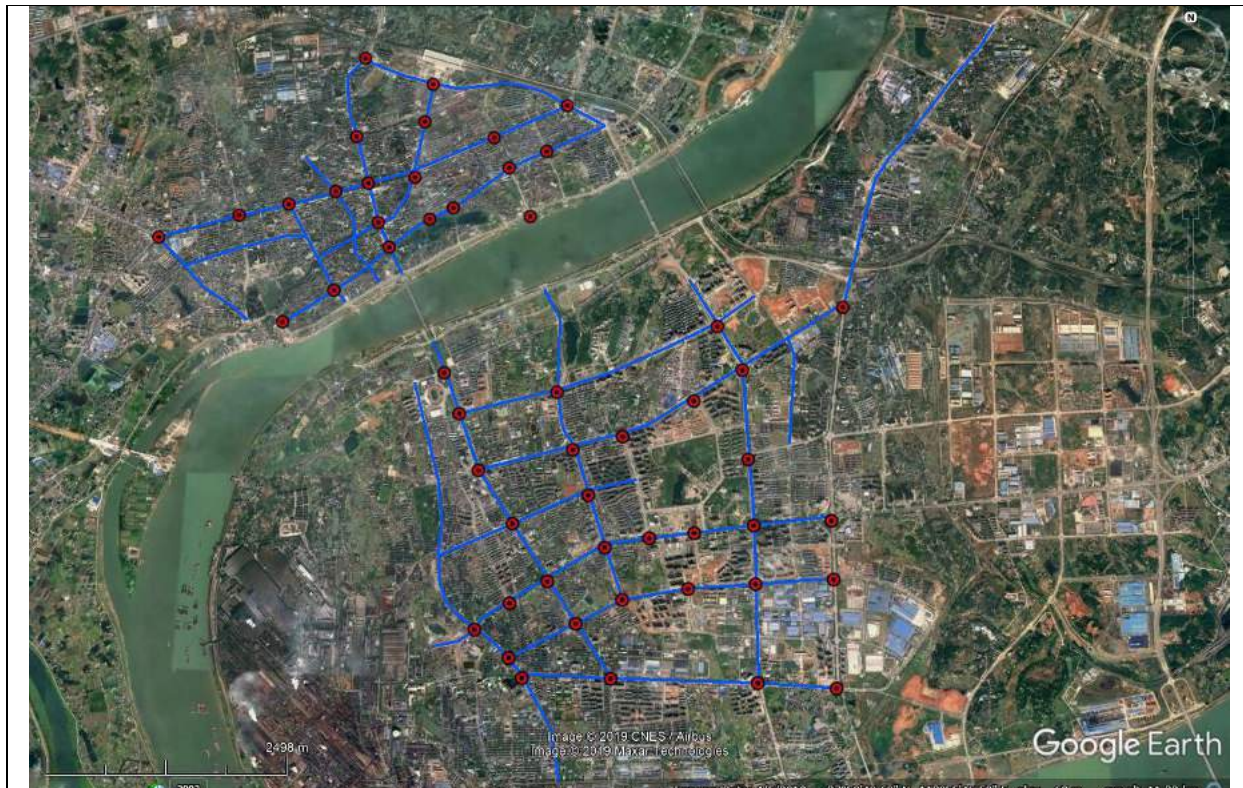
Source: ADB PPTA consultant, 2019.

96. **Safe Islands.** Trunk roads in Xiangtan are typically six lanes wide and traffic lights are timed based on traffic flows. Pedestrian, especially children, the elderly and disabled, may not have time to cross completely and risk being caught in traffic flows. A Safe Island is a small protected area where pedestrians can stop before finishing crossing a road. They are typically used on streets so wide that some individuals may not be able to cross in one traffic light cycle. A total of 48 Safe Islands will be installed at major intersection crossings to allow for safe pedestrian access and use (Figure 21 and Table 15).

Figure 21: Typical Xiangtan wide intersection, and sample conceptual drawing of wide intersection safety islands



Source: ADB PPTA consultant, 2019.

Table 15: Locations for intersection Safety Islands to be installed


No	Road	Intersection Name	Intersection Type	Road Connection Type
1	Shaoshan Road	Tanshao Rd.-West Shaoshan Rd.	Cross Intersection	Trunk-Trunk
2		West Shaoshan Rd.-Naling Rd.	Cross Intersection	Trunk-Sub Trunk
3		West Shaoshan Rd. -Baimahu Rd.	T Intersection	Trunk-Trunk
4		Middle Shaoshan Rd.-Middle Jiefang Rd.	Cross Intersection	Trunk-Sub Trunk
5		West Shaoshan Rd. -North Jianshe Rd.	Cross Intersection	Trunk-Trunk
6		Chezhan Rd.-East Shaoshan Rd.	Cross Intersection	Sub Trunk-Trunk
7		East Shaoshan Rd. -Tongjimen Rd.	T Intersection	Trunk-Trunk
8		East Shaoshan Rd. -Wenxingmen Rd.	Cross Intersection	Trunk-Trunk
9	Xichunmen Road	Xichunmen Rd.-Tongjimen Rd.	Cross Intersection	Trunk-Trunk
10		Xichunmen Rd.-Guanxiangmen Rd.	Cross Intersection	Trunk-Sub Trunk
11	Yuhu Road	Yuhu Rd.-Wenhua Street	T Intersection	Trunk-Branch
12		Yuhu Rd.-Heping Rd.	Cross Intersection	Trunk-Branch
13	Renmin Road	Renmin Rd.-Baimahu Rd.	Cross Intersection	Trunk-Trunk
14		Renmin Rd.-Xinma Rd.	T Intersection	Trunk-Trunk
15	Middle Fuxing Road	Middle Fuxing Rd.-North Baota Rd.	Cross Intersection	Trunk-Trunk
16		Middle Fuxing Rd.-North Shuangyong Rd.	Cross Intersection	Trunk-Trunk
17	Hedong Avenue	Hedong Avenue-Furong Avenue	T Intersection	Trunk-Trunk
18		Hedong Avenue-North Shuangyong Rd.	Cross Intersection	Trunk-Trunk
19		Hedong Avenue-East Huxiang Rd.	T Intersection	Trunk-Sub Trunk
20		Hedong Avenue-West Huxiang Rd.	T Intersection	Trunk-Sub Trunk
21		Hedong Avenue-Middle Baota Rd.	Cross Intersection	Trunk-Trunk
22		Hedong Avenue-South Jianshe Rd.	Cross Intersection	Trunk-Trunk
23	Xiangtan Avenue	Xiangtan Avenue-FuRong Avenue	Cross Intersection	Trunk-Trunk
24		Xiangtan Avenue-Middle Shuangyong Rd.	Cross Intersection	Trunk-Trunk
25		Xiangtan Avenue-Wangyue Rd.	T Intersection	Trunk-Sub Trunk

26		Xiangtan Avenue-West Xianghu Rd.	T Intersection	Trunk-Sub Trunk
27		Xiangtan Avenue-Middle Baota Rd.	Cross Intersection	Trunk-Trunk
28		Xiangtan Avenue-South Jianshe Rd.	Cross Intersection	Trunk-Trunk
29		Xiangtan Avenue-Lanxia Rd.	T Intersection	Trunk-Sub Trunk
30		Xiangtan Avenue-Yuetang Rd.	T Intersection	Trunk-Trunk
31	Xiaotang Road	West Xiaotang Rd.-Yuetang Rd.	T Intersection	Trunk-Trunk
32		Middle Xiaotang Rd.-South Baota Rd.	Cross Intersection	Trunk-Trunk
33		Middle Xiaotang Rd.-Yuehua Rd.	T Intersection	Trunk-Trunk
34		Middle Xiaotang Rd.-South Shuangyong Rd.	Cross Intersection	Trunk-Trunk
35		East Xiaotang Rd.-Furong Avenue	Cross Intersection	Trunk-Trunk
36	Shuyuan Road	Middle Shuyuan Rd.-Furong Avenue	Cross Intersection	Trunk-Trunk
37		Middle Shuyuan Rd.-South Shuangyong Rd.	Cross Intersection	Trunk-Trunk
38		West Shuyuan Rd.-South Jianshe Rd.	Cross Intersection	Trunk-Trunk
39		West Shuyuan Rd.-Yuetang Rd.	Cross Intersection	Trunk-Trunk
40	Jianshe Road	North Jianshe Rd.-Guangyun Rd.	Cross Intersection	Trunk-Trunk
41		North Jianshe Rd.-Wenxingmen Rd.	T Intersection	Trunk-Trunk
42		Chezhan Rd.-Guangyun Rd.	T Intersection	Branch-Trunk
43		North Jianshe Rd.-Minzhu Rd.	Cross Intersection	Trunk-Sub Trunk
44		North Jianshe Rd. -Yuhu Rd.	Cross Intersection	Trunk-Trunk
45		Middle Jianshe Rd.-Donghu Rd.	Cross Intersection	Trunk-Trunk
46		Middle Jianshe Rd.-Middle Fuxing Rd.	Cross Intersection	Trunk-Trunk
47		South Jianshe Rd.-Middle Xiaotang Rd.	Cross Intersection	Trunk-Trunk
48	Other	South Jianshe Rd.-Xiaguang Rd.	Cross Intersection	Trunk-Trunk
49		Tongjimen Rd.-Middle Yanjiang Rd.	T Intersection	Trunk-Trunk
50		Middle Baota Rd.-Xiaguang Rd.	Cross Intersection	Trunk-Trunk
51		Middle Shuangyong Rd.-Gaoxin Rd.	Cross Intersection	Trunk-Trunk
52		Chezhan Rd.-Wenxingmen Rd.	T Intersection	Trunk-Sub Trunk

Source: ADB PPTA consultant, 2019.

97. **Pedestrian Crossing Timers.** Xiangtan's pedestrian crossing times vary by intersection, and it can be difficult for pedestrians to predict the duration of crossing signals. To improve pedestrian crossing safety, countdown screens with audible warning buzzers (speaker units) will be installed at 3,000 pedestrian crossings across Xiangtan. This will provide pedestrians accurate signal information and reduce pedestrian anxiety about abrupt signal changes, making it safer to cross Xiangtan roads.

f. School Safety Road Assessment

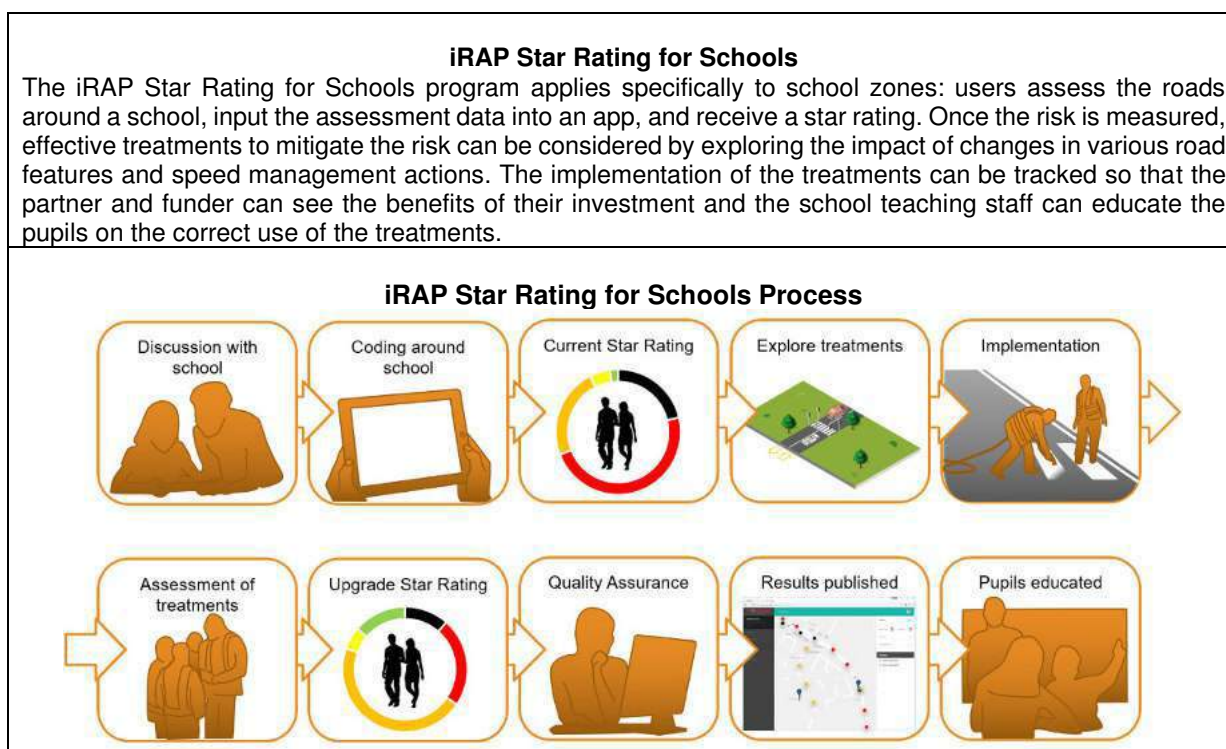
98. The program will undertake a road infrastructure safety assessment at five elementary schools utilizing the iRAP Star Ratings for Schools (SR4S) methodology at two to three select points at each school (Figure 22). The assessment will identify potential safety enhancements for the schools and provide cost estimates. The objective is to achieve at least a 3-star rating for all road users and a 5-star rating for students, other pedestrians, and cyclists.

99. The five schools have been selected by the Xiangtan DRC, and are among the largest elementary schools in Xiangtan (Table 16). As an example, Figure 23 shows Xiangji Primary School, located on Yunhe Road. The road is narrow and roadside parking causes problems during the school rush hour. A preliminary recommendation is to make Yunhe Road one way, and strengthen the management and enforcement of roadside parking.

Table 16: Elementary schools to undergo the iRAP Star Ratings for Schools assessment

No	School Name	Relevant Roads
1	Heping Primary School	Yuhu Road, Wenhua Street
2	Jinting Primary School	Baimahu Road, Jinting Street
3	Huoju Primary School	Huoju Zhong Road
4	No. 3 Primary School	Sanxiao Street
5	Xiangji Primary School	Yunhe Road

Source: ADB PPTA consultant, 2019.

Figure 22: iRAP Star Rating for Schools

Source: iRAP, 2019.

Figure 23: Yunhe Road at Xiangji Elementary School

Source: ADB PPTA consultant, 2019.

g. Xiangtan First Traditional Chinese Medicine Hospital

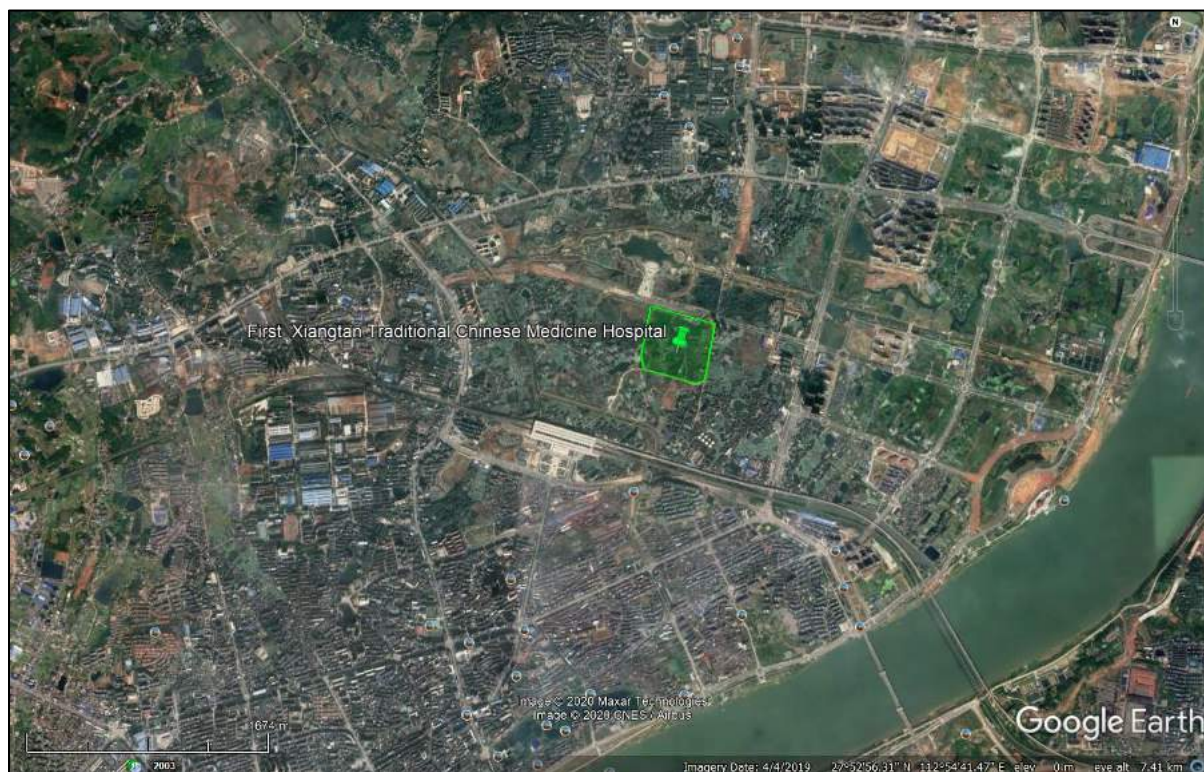
100. The Xiangtan First Traditional Chinese Medicine Hospital is a new hospital in a new development area in Yuhu District. As part of the program PPTA process, a Xiangtan flood hazard map was produced to identify flood prone zones and vulnerable areas in the urban districts of Xiangtan City (Figure 55). After the discovery of the hospital being located in a critical flood-prone zone, the premise of the hospital was redesigned to enhance EbA measures for flood resilience.

101. The program will support the construction of a green, resilient, low-carbon hospital through EDGE certification resulting from energy and other conservation design modifications, and the reduction of flood threats through the application of EbA measures. The design modifications and EbA measures will help in the creation of a pleasant environment for patients, staff and visitors, and will be supportive of Xiangtan's transition into a "sponge city".

102. The Xiangtan First Traditional Chinese Medicine Hospital will be built on a 5.53 ha site in the northern part of Wanlou new development area in Yuhu District, near the intersection of Jiangnan and Hutan Roads. The site is across the road from the newly built Biquan Lake Park (Figure 24).

103. A rendering of the hospital design is presented in Figure 25 and an initial site plan in Figure 26. The hospital will include an inpatient building (41,476 m³), an outpatient building (36,575 m³), a dormitory building (11,655 m³), and a medicine manufacturing building (3,450 m³).

Figure 24: Future location of the Xiangtan First Traditional Chinese Medicine Hospital



Source: ADB PPTA consultant 2019, and Google Earth 2019.

Figure 25: Artist rendering of the Xiangtan First Traditional Chinese Medicine Hospital



Source: ADB PPTA consultant, 2019.

Figure 26: Xiangtan First Traditional Chinese Medicine Hospital initial site plan



Source: ADB PPTA consultant, 2019.

104. **IFC Edge Certification and CCHP.** The program will support the hospital in achieving EDGE certification, the first hospital in the PRC to be so certified. Developed by the International Finance Corporation (IFC) under the World Bank Group, EDGE (*Excellence in Design for Greater*

Efficiencies) is an online platform, a green building standard, and a certification system used in over 150 countries. The EDGE application helps to determine the most cost-effective options for green design within a local climate context. EDGE can be used for buildings of all vintages, including new construction, existing buildings and major retrofits. A project that reaches the EDGE standard of 20% less energy use, 20% less water use, and 20% less embodied energy in materials compared to a base case building can be EDGE certified.

105. A review of the hospital design determined that despite a number of green building features that are incorporated into the existing design, in order to achieve EDGE certification improvements are required. The hospital will have a continuous and stable annual electricity and domestic hot water loads, a cooling load in the summer, and a heating load in the winter. In the current design cooling is provided by a water cooled centrifugal chiller and two absorption chillers, which can also provide hot water. Although this system is space saving, the efficiency of an absorption chiller in the summer is relatively low.

106. A assessment of gas tariffs, electricity tariffs, load profile, financial viability, available technology, energy efficiency improvements and emission reductions, and estimated capital expenses (CAPEX) and operation expenses (OPEX) was undertaken, and it was determined that the optimal energy system for the hospital to increase energy efficiency and reduce emissions is a natural gas Combined Cooling, Heating and Power Generation (CCHP) system, developed in accordance with best international practice.²¹

107. The program will install a CCHP system which will recover waste heat from a power generation unit to provide heating or drive an absorption machine for cooling. The system will consist of a 1 MW capacity natural gas internal combustion engine and generator unit; a 1.18 MW heating capacity absorber with 1.24 MW cooling capacity through heat recovered from jacket cooling water for the engine and flue gas exhausted from the engine; two 8.4 MW cooling capacity mechanical chillers for peak cooling load; two natural gas boilers with 6.4 MW heating capacity to cover peak heating load; and, other auxiliary components (Figure 27). The system will be intergarted with a roof-top solar system. A DeNOx system (Selective Non-Catalytic Reduction or SNCR) will be installed on the gas engine to ensure NOx emissions are less than 30 mg/Nm³, and the gas boilers will use low-NOx burners. The system will utilize urea as a reagent, which is non-toxic and more easily handled and stored than ammonia.²² With the integration of CCHP into the hospital design, and the EbA measures described below, it is anticipated that the hospital design will receive EDGE certification, and will be fully functional even at flood events and/or power blackouts.

108. The wintertime heat demand and supply balance of the system is presented in Table 17. Heat recovery from CCHP will account for 15.5% of the total heating capacity. The remaining demand will be covered by the gas-fired boilers.

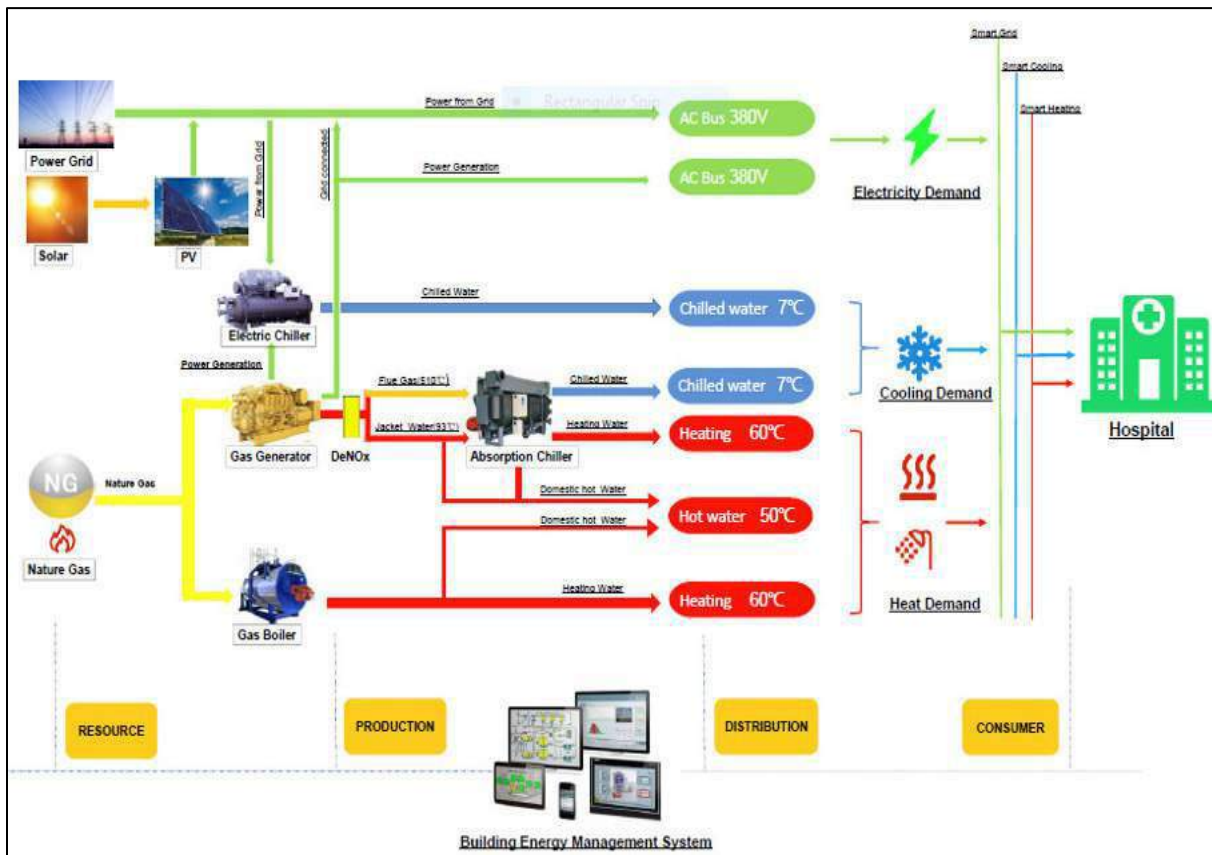
109. The summertime cooling demand and supply balance is presented in Table 18. The cooling capacity of absorption machine will account for 13% of the total cooling capacity. The remaining demand will be covered by centrifugal chillers.

110. Main CCHP component parameters are presented in Table 19.

²¹ CCHP is also commonly referred to as Tri-generation.

²² US EPA-CICA Fact Sheet, SNCR. EPA-452/F-03-031.

Figure 27: Conceptual diagram of Xiangtan First Traditional Chinese Medicine Hospital CCHP



Source: ADB PPTA consultant, 2019.

Table 17: Xiangtan First Traditional Chinese Medicine Hospital CCHP wintertime heat balance

Total Heating Supply	7.58 MW
<i>CCHP heating capacity</i>	<i>1.18 MW</i>
<i>Boiler heating capacity</i>	<i>6.4 MW</i>
Total Heating Demand	6.9 MW
<i>Space heating load</i>	<i>5.8 MW</i>
<i>Domestic hot water load</i>	<i>2.2 MW</i>
Balance	+0.68 MW

Source: ADB PPTA consultant, 2019.

Table 18: Xiangtan First Traditional Chinese Medicine Hospital CCHP summertime cooling balance

Total Cooling Supply	9.64 MW
<i>Cooling capacity of absorption machine</i>	<i>1.24 MW</i>
<i>Cooling capacity of centrifugal chiller</i>	<i>8.4 MW</i>
Total Cooling Demand	9.5 MW
Balance	+0.14 MW

Source: ADB PPTA consultant, 2019.

Table 19: Xiangtan First Traditional Chinese Medicine Hospital CCHP main components

No.	Name	Capacity	Quantity
1	Gas Generator	1.00 MW Power Generation Capacity	1
2	Denitrification	NOx Emission <30 mg/m ³	1
3	Centrifugal Chiller	4.20 MW Cooling Capacity	2
4	Gas Boiler 1	3.70 MW Heating Capacity	1
5	Gas Boiler 2	2.70 MW Cooling Capacity	1
6	Absorption Chillers	1.24 MW Cooling Capacity	1
		1.18 MW Heating Capacity	

Source: ADB PPTA consultant, 2019.

111. **EbA Measures.** The hospital site is relatively flat, with elevations ranging from 34.1 to 35.5 masl. A deep creek runs through the site, draining towards the Hutan River. The flood risk hazard assessment undertaken by PPTA consultants during program preparation identified the site as being at high risk for flooding from the stream (Figure 55, Chapter IV).

112. The program will help improve drought resistance and reduce flood risks at the hospital through the application of EbA measures.

- Drought resistance: the PRC sponge city guidelines include a Volume Capturing Ratio (VCR) of annual rainfall, which is the minimum stormwater storage volume to cover water demands in drought periods, and is set according to land use and ecological damage sensitivity of the area. An assessment of the hospital site determined that VCR target storage volume is approximately 740 m³.

- Flood protection: a site assessment determined that for protection from pluvial flooding during periods of extreme rainfall with a safety risk of 1-in-30 years, the 5.53 ha hospital site has a required retention capacity of 5,630 m³.

113. The program will support the hospital in achieving these drought resistance and flood protection targets through the implementation of a range of sub-catchment rainwater retention EbA measures, identified initially in cooperation with Xiangtan government staff in a series of ecosystem-based training and design workshops, and then further developed in the XCRC Toolbox (Figure 28 and Table 20). Figure 29 illustrates the range of EbA measures to be used, including rainwater gardens, permeable pavement, urban wetlands and green roofs. The design also includes a 70 m³ storage tank under the green space on the east side of the hospital to collect rainwater green space irrigation.

114. The XCRC Toolbox predicts that these measures will provide a total water storage capacity of approximately 7,840 m³, considerably more than the drought protection VCR target of 740 m³ and the 1-in-30 year pluvial flood protection target of 5,630 m³. In particular the rain retention ponds, the rain gardens and the swales create large peak storage volumes for both drought resistance and flood protection. Peak flows will be reduced by a factor of 35 as compared to an area without this retention capacity.

115. Substantial positive effects are also predicted for the reduction of suspended sediments and their adsorbed pollutants and pathogenic bacteria. However, the effect on nutrients is neutral. This is caused by the intensive green roofs used to grow medicinal plants and herbs which will need fertilization. Some of this fertilizer will be washed out into the runoff, giving no net effect of the EbA measures on nutrient levels in the runoff.

116. In addition to reducing flood risks and improving runoff water quality, the EbA measures will enhance green space, provide medicinal plants and herbs, and allow rainwater to be harvested so as to withstand periods of drought more effectively. In addition, EbA measures will help to strengthen biodiversity, and improve the landscape.

117. Aspects such as emergency evacuation plan and anti-nosocomial infection plans have not yet been developed, but will be developed in due course by the hospital administration, in accordance with relevant PRC regulations and requirements, including but not limited to the *Administrative Regulations on Medical Institutions* (revised in 2016) promulgated by the State Council, and the *Implementing Rules for Administrative Regulations on Medical Institutions* (revised in 2017) promulgated by the former National Health and Family Planning Commission.

Figure 28: Conceptual design of EbA measures for the Xiangtan First Traditional Chinese Medicine Hospital, as presented in the XCRC Toolbox



Source: ADB PPTA consultant, 2019.

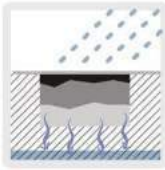
Table 20: Design parameters of EbA measures for the Xiangtan First Traditional Chinese Medicine Hospital, as presented in the XCRC Toolbox

Measure	Surface	Storage capacity (m3)	Return time factor (+1)	Groundwater recharge (mm/y)	Evapotranspira... (mm/y)	Heat reduction (C)	Cool areas
Urban wetland	383.9	288	0.29	0	0	0.02	0
Bioswale (with drainage)	475.43	166	0.23	25	0	0.03	0
Fountains, waterfalls, water facades	201.06	201	0	0	0	0.01	1
Intensive green roof	9246.64	3699	0.4	0	21	0.51	0
Urban forest	2114.39	922	0.68	4	8	0.12	1
Private green garden	6226.42	763	3.75	45	-2	0.35	0
Rain barrel	16.49	16	0.27	0	0	0	0
Rainwater detention pond (wet pond)	1302.32	1302	22.9	93	1	0.07	0
Permeable pavement (storage)	2175.8	481	6.89	17	-2	0.12	0

Source: ADB PPTA consultant, 2019

Figure 29: EbA measures to be implemented

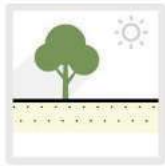
Rain garden



These are sandy soil or aggregate filled depressions that treat stormwater runoff to improve water quality. Stormwater is captured and allowed to percolate through the soil/aggregate layer, where pollutants are removed, prior to being released through an underdrain located at the bottom of the depression.



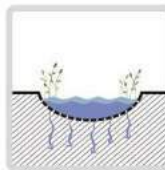
Creating shade



Creating shade is important to prevent surfaces from heating up and to cool the surroundings. This can be accomplished by using trees, pergolas, overhangs, awnings and such. Arcades and covered walkways are urban elements commonly used in warm countries to create shade.



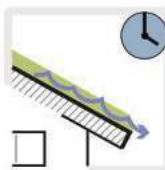
Rainwater detention pond (wet pond)



Buffer ponds temporarily capture precipitation and allow it to drain off slowly. During rainfall, the rainwater is captured in the pond and subsequently drained off to create room for the next precipitation. Buffer ponds can be designed to have a mostly stony or a mostly natural appearance.



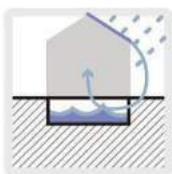
Green roof with drainage delay



Green roofs with drainage delay are also called retention roofs. It is a green roof that can store extra water in a substrate layer under the green planted layer and is drained delayed with a pinched drain. A polder roof is a retention roof where the control system is linked to the weather forecast.



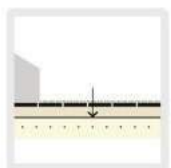
Systems for rainwater harvesting



Rainwater harvesting is the collection and storage of stormwater for reuse on site. This is most commonly achieved by capturing runoff from the roof of a building, however, it can also include the collection of runoff from throughout the site or byproducts from systems such as air conditioning condensate. The collection structures can take on multiple forms and be installed either above ground or subsurface. Depending on its source and treatment, the harvested water can be reused on site for irrigation.



Permeable pavement (infiltration & storage)



Permeable pavements consist of porous material that absorbs rainfall. Water can be stored either in the top layer (e.g. very open asphalt concrete) or in below the top layer in the foundation. Besides reducing runoff, permeable pavements can trap suspended solids and filter pollutants from the water.



Infiltration trench



An infiltration trench, also known as a French drain, is a linear feature used to reduce stormwater runoff and improve water quality. These shallow excavated trenches are filled with aggregate or crushed stone that is designed to allow for stormwater to infiltrate the ground plane and ultimately percolate through permeable soils into the groundwater. Their linear shape can also serve to convey stormwater from one area to another, or away from built structures, and typically contain a perforated pipe underdrain.

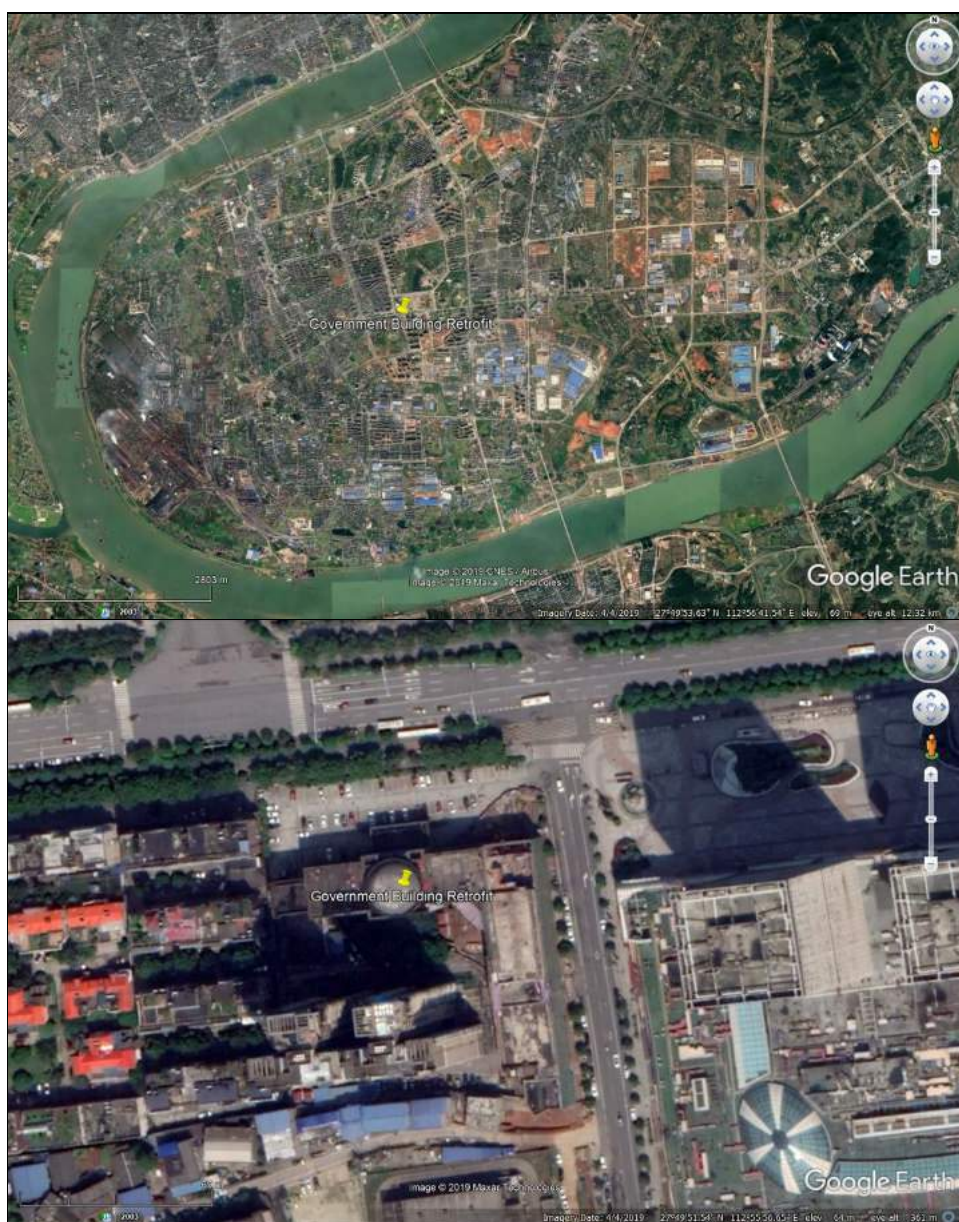


Source: ADB PPTA consultant, 2019.

h. Government Building Retrofit

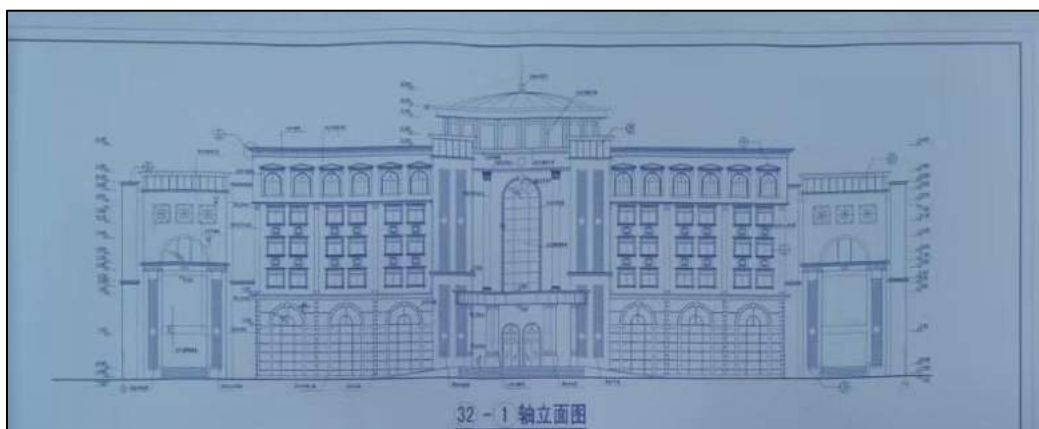
118. The program will support the retrofit a semi-abandoned government-owned office building into a training center to showcase green and low-carbon building techniques. Located in Yuetang District near the intersection of Furong Mi Road and Mudan Road (Figure 30), the building was originally built in 2003 and was used as government offices. Currently only the 4th floor is still in use as a Training Center, and the rest of the building has been abandoned (Figure 31 and Figure 32).

Figure 30: Location of the government-owned building to be retrofitted



Source: Google Earth, 2019.

Figure 31: Government building original design, 2003



Source: Xiangtan Municipal Government FSR on Government Building (2003).

Figure 32: Government building current condition, November 2019



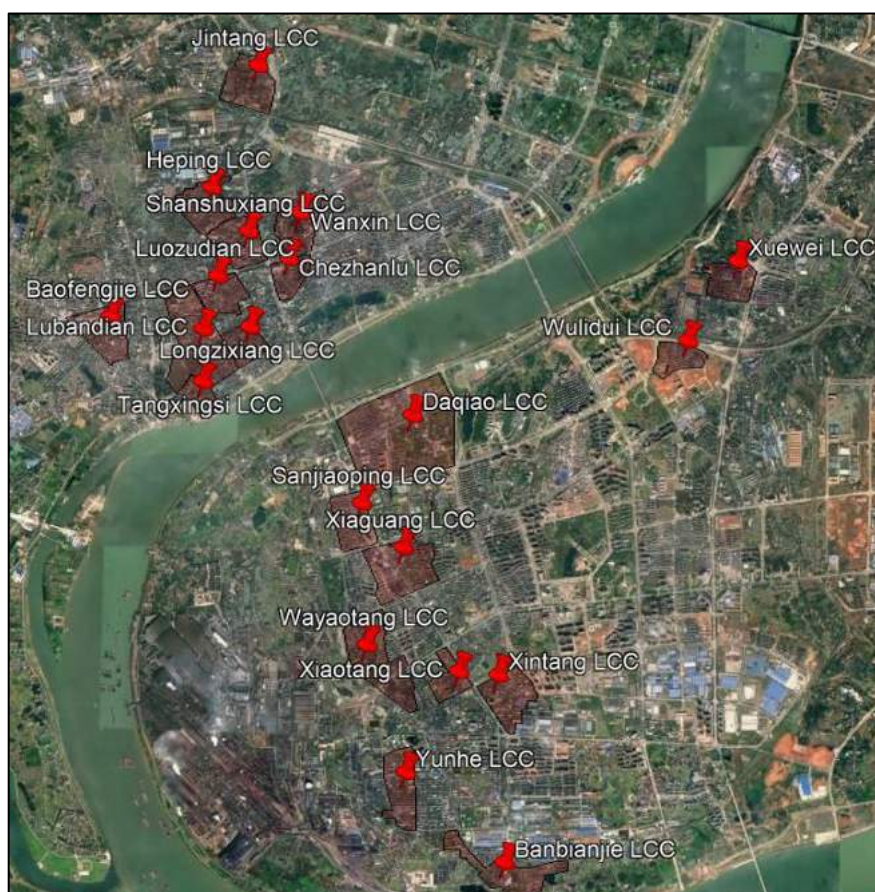
Source: ADB PPTA consultant, 2019.

119. The total floor area to be retrofitted is approximately 6,000 m², not including the basement parking area. The retrofit will include external wall and roof insulation, triple/quadruple-glazed windows, an intelligent sunshade system, central air conditioning, combined with heat pump system and/or roof top solar energy system to optimize energy consumption, an intelligent building energy monitoring system, high efficiency energy appliances, water saving faucets and toilets, and other green and low-carbon features. Once completed the building will be EDGE certified. The municipal government intends to use the building as the *Asia Pacific Low-Carbon Training Center* to showcase the EDGE-certified building retrofit and to disseminate Xiangtan's LCT experience and learning to other cities in the PRC and beyond.

i. Low Carbon Community (LCC) Improvements

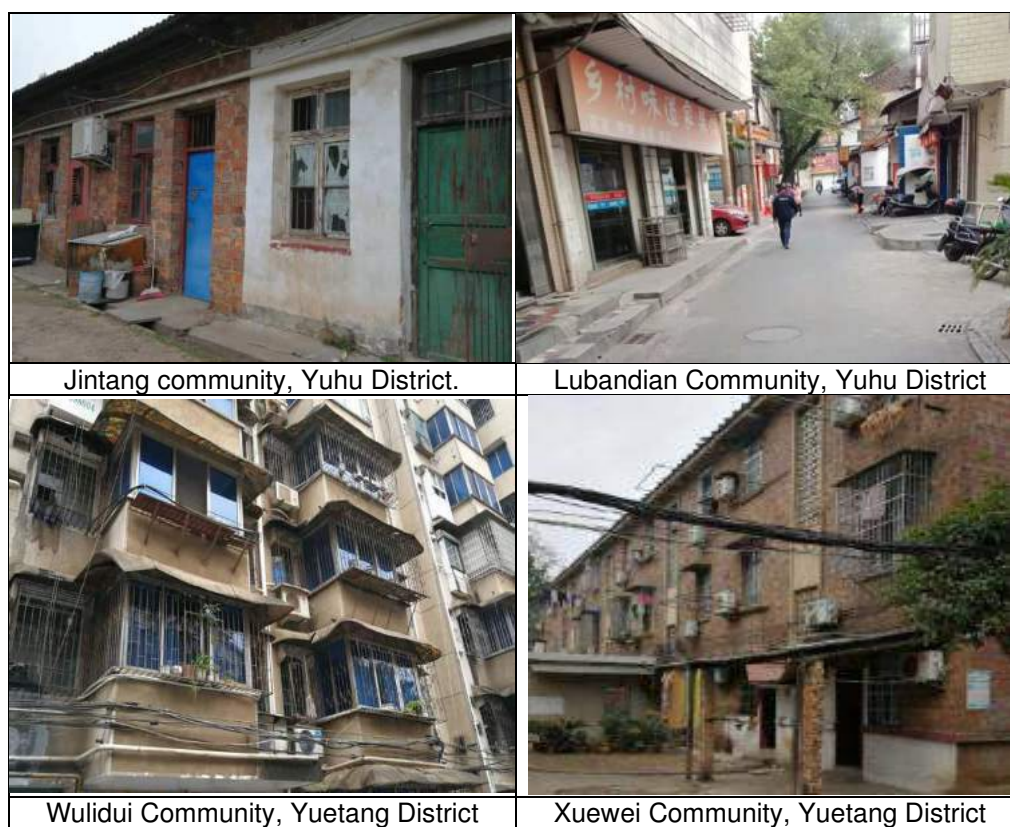
120. Small-scale low carbon renovations and retrofitting will be undertaken in 20 Xiangtan low-income communities (Figure 33). Low carbon community (LCC) works will include building insulation improvements, conversion from coal to natural gas cooking for low income households, installation of roof top solar hot water systems and solar PV panels, LED street lighting, EbA measures in community parks, and installation of electric vehicle and bike charging stations. LCC measures by community are presented in Appendix E). Works will be undertaken in existing buildings or facilities, and no building demolition will be required.

Figure 33: Locations for low-carbon community improvements



Source: ADB PPTA consultant 2019, and Google Earth 2019.

Figure 34: Typical low-income communities that will receive LCC improvements in Xiangtan



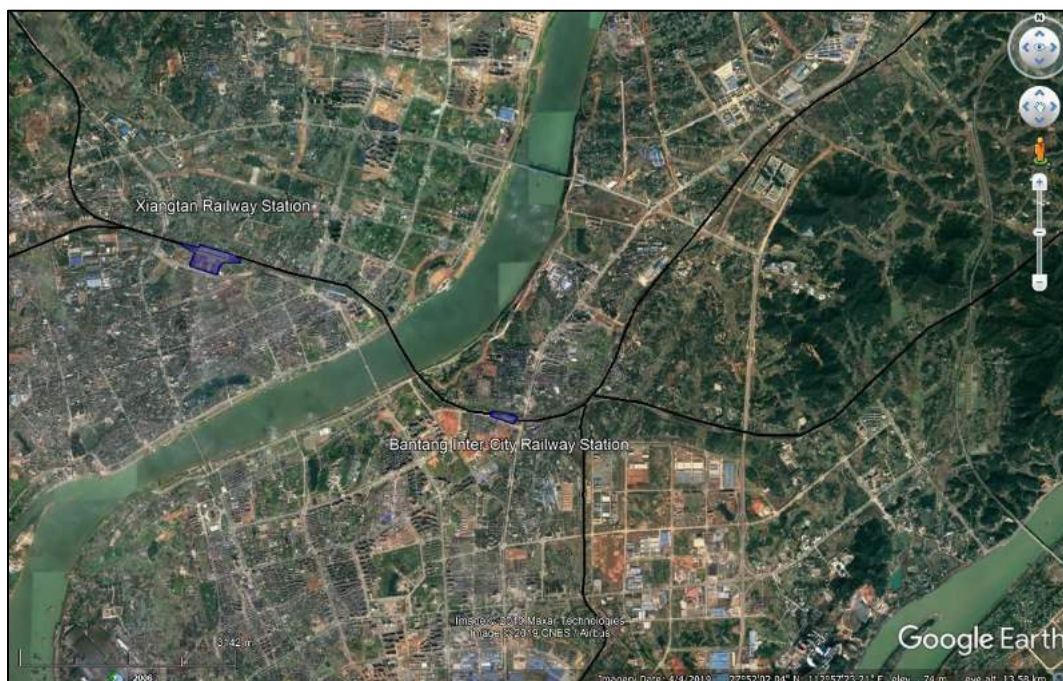
Source: ADB PPTA consultant, 2019.

j. Demonstration Multi-Modal Train Stations

121. A multi-modal passenger transport station is one that connects two or more transport modes, such as rail, bus, waterway, aviation, etc. The efficiency of the connections between the various modes will directly affect the overall operational efficiency of the station. At present the connection between bus and train modes in Xiangtan is not very efficient, which negatively affects the experience of bus and rail passengers.

122. The program will support the development of two demonstration inner-city multi-mode passenger transport stations, Xiangtan Railway Station and Bantang Intercity Railway Station (Figure 35). By modify layouts, improvements will optimize bus access to the stations over taxis and private cars, establish bus stops with shelters, and establish safe taxi and passenger pick-up and drop-off areas.

Figure 35: Locations of Xiangtan Railway Station and Bantang Intercity Railway Station



Source: Google Earth 2019, and ADB PPTA consultant, 2019.

123. **Xiangtan Railway Station.** Xiangtan Railway Station is a second-class station on the Shanghai-Kunming Railway and the starting station of the Changzhu-tan intercity railway. It is located off Chezhan Road in Yuhu District (Figure 35), and is administered by the China Railway Guangzhou Group. The Xiangtan Railway Station was built in 1958, and a reconstruction and expansion project was completed in 2012. Problems with the current station design include the taxi que blocks public bus access; passengers need to cross the road twice when exiting the station to transfer to the nearest bus stop; and there is no shelter at the bus stop (Figure 36).

Figure 36: Waiting taxis blocking bus access, Xiangtan Railway Station

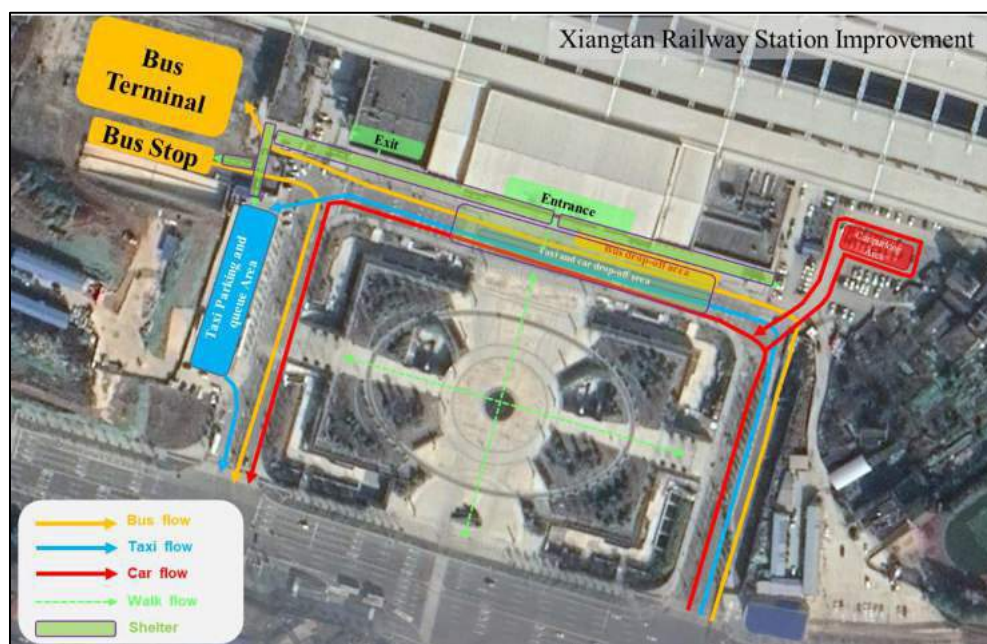


Source: ADB PPTA consultant, 2019.

124. To address these problems the program will:

- (i) optimize the bus access route - the nearest position from the entrance of the railway station will be used as the bus unloading area, and the current bus stop will be moved to the exit of the railway station to improve pedestrian safety by eliminating the need to cross the road to access the bus stop;
- (ii) establish a covered bus shelter;
- (iii) establish safe taxi and private car unloading area;
- (iv) establish a new taxi parking and queuing area (Figure 37).

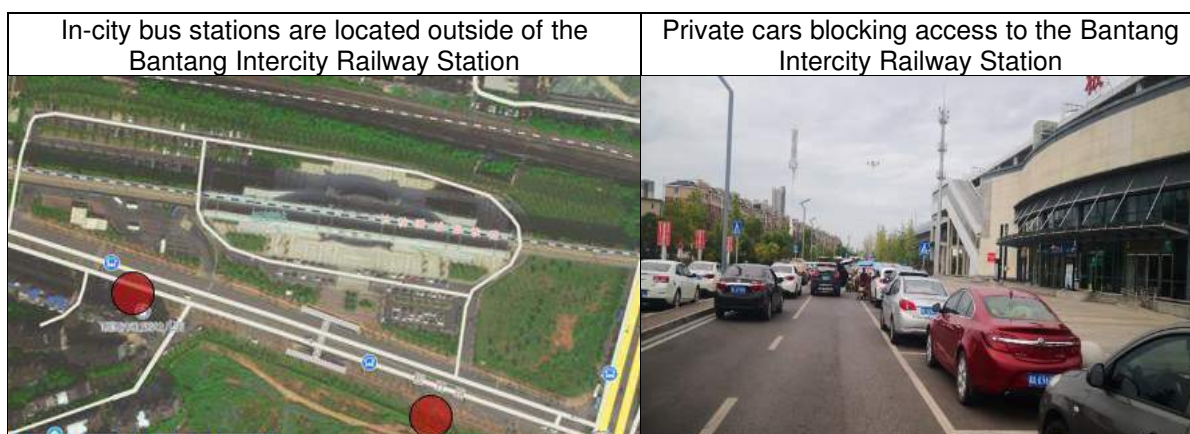
Figure 37: Transport improvements, Xiangtan Railway Station



Source: ADB PPTA consultant, 2019.

125. **Bantang Intercity Railway Station.** Bantang station is located at the intersection of Furong Avenue and Banwu Road in Yuetang District (Figure 35). There are currently two bus stops located to the south of the station (Figure 38). The station is being further developed as a transport hub in two stages by the Xiangtan City Development Group (Figure 39).

Figure 38: Bantang Intercity Railway Station in Xiangtan



Source: ADB PPTA consultant, 2019.

Figure 39: Planned transport hub development, Bantang Intercity Railway Station

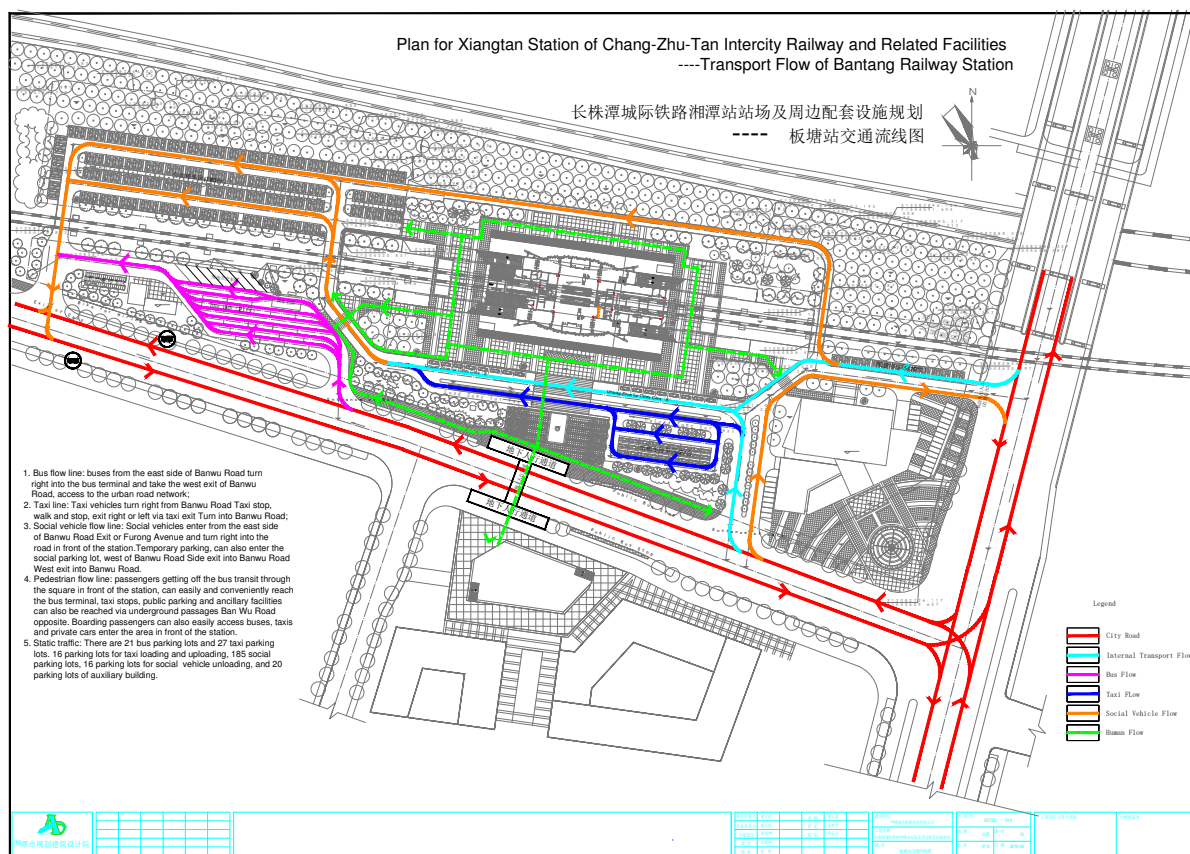


Source: ADB PPTA consultant, 2019.

126. Current problems at the station include private cars occupying the entrance to the station; existing bus stops being far from the station; and the lack of a covered shelter for bus passengers.

127. The program will support the development of the station through improvements to the transport access, including: (i) relocating the bus drop-off area to near the station entrance; (ii) moving the taxi and private cars drop-off area further to the west to avoid interference with busses and improve safety; (iii) rerouting bus travel to the bus terminal station to be established to the west of the train station; and (iv) establishing a covered shelter at the bus station (Figure 40).

Figure 40: Transport access improvements, Bantang Intercity Railway Station



Source: ADB PPTA consultant, 2019.

ii) Output 2: Information and Knowledge Platforms Established for Informed Decision Making and Behavior Changes

128. There are a number of independent or semi-independent ICT systems in Xiangtan, some of which are at the piloting or testing stage. An assessment indicates that existing systems are not obtaining full benefits due to a lack of integration and limited technical capacity.

129. Physical transformations in output (i) will be complemented by ICT and knowledge platforms to support Xiangtan's LCT. A number of sectoral ICT platforms will be installed or upgraded, and then consolidated into a city-wide ICT platform. These will include: (i) reprogramming the existing intelligent transport system (ITS) to prioritize people and public mobility systems; (ii) developing a smart bus information platform which combines various subsystems to enable more control over the operation of busses while sharing real time location data to passengers; (iii) a building energy management system to monitor and improve energy efficiency of 200 public buildings; (iv) a community-scale energy and utility management system to optimize operational efficiency of over 1,300 companies; (v) integrated urban catchment management plans for key flood prone areas in Xiangtan; (vi) an early flood warning system to monitor and analyze potential risks caused by fluvial and pluvial floods; and (vii) an environmental monitoring and assessment system. These platforms will enable better decision making and foster behavior changes towards LCT.

a. Optimization of the Xiangtan ITS

130. The existing Xiangtan Intelligent Transport System (ITS), or Smart Integrated ITS as it is referred to by the Xiangtan Traffic Police, is a newly implemented system covering all 225 intersections in the city. The system is comprised of 225 traffic lights, 1,100 traffic sensors (cameras), and a self-optimizing algorithm and platform. The system runs on various parameters to control and optimize traffic flows. However, it was designed with a focus on car traffic and does not meet the needs and demands of pedestrians and other non-car users.

131. A green wave system refers to traffic light coordination to allow continuous traffic flow over several intersections in one direction. Green wave systems can be used for certain groups of vehicles like busses and can be implemented dynamically using real-time sensors like GPS or short range proximity sensors. The sensor data is used to synchronize traffic signals to provide green lights for improved traffic flows.

132. The current Xiangtan ITS is capable of implementing a green wave for any vehicle without any additional hardware. With the right parameters as input to the smart intersections, busses can be given priority in traffic inside or outside the median bus lane.

133. The program will modify the Xiangtan ITS parameters by prioritizing public transport bus traffic, followed by pedestrians, thereby improving services for bus operators and providing better pedestrian flows. Each of the 225 intersections signals will be self-optimized in real time according to the traffic flow. With correct programming and calibration the system will be capable of providing both priority signaling to green waves for busses, without any changes or additional components.

134. The ITS improvements will include a combination of exclusive traffic signals for busses with priority signal programming optimized for increasing bus speeds in the median bus lanes as well as for the busses in mixed traffic. This will reduce travel time for bus users making travelling by busses more appealing. The system will work best if it can detect an incoming bus before it

reaches the signal. To achieve this the system will utilize highly accurate real time GPS positions of the busses provided by the bus operator, the Jiaofa Group.

135. Overall, the combination of priority bus lanes, traffic light reprogramming, smart bus platform and human-optimized traffic operation and management, will prioritize bus flows over other traffic flows and increase public transport efficiency.

b. Smart Bus Platform

136. Public transportation systems are increasingly equipped with information and communication technologies in order to improve the level of service and facilitate fleet management. Automatic Vehicle Location (AVL) was first used for improving operations and management. Later, these systems were also utilized to provide real-time information (RTI) to passengers in the context of public transport systems. More specifically, in the context of public transport busses, bus RTI refers to information on service disruptions, crowding conditions, prescriptive journey planners or the time remaining until the arrival of the next bus.

137. The program will develop a smart bus information platform which combines various AVL and RTI subsystems to enable more control over the operation of busses while sharing real time location data to passengers and service providers. The system will include upgrading of the existing bus RTI system in combination with a bus dispatch system which make use of real time GPS location of the busses; smart accessible bus stops (see above); and installation of system devices on the bus including IC Card terminals, coin machines, face recognition terminals, and GPS modules, to make the system more connected and hence easier to monitor and operate more efficiently.

138. A bus monitoring control room equipped with 24 large screens to monitor various data from the smart bus platform will be installed at the new headquarter building of Jiaofa Group, the Xiangtan bus operator. The screens will act as a display to the smart bus platform, showing amongst other things the bus RTI and position of the busses, bus routes, information on service disruptions, crowding conditions, communications with the driver, and passenger and road videos. This will give the operators a better overview of their services for all their bus routes at one place using a single platform.

c. Building and Utility Energy Management Systems

139. In cooperation with the Xiangtan Housing Bureau the program will develop and install intelligent building and utility energy management system (BEMS), to monitor electricity, water, and gas consumption, in 200 public government buildings. In total approximately 900,000 m² floor area will be covered. The main works will include minor updates of existing monitoring platform, installation of sensors and meters, and integration into the ICT platform.

140. A BEMS will also be installed in the Xiangtan First Traditional Chinese Medicine Hospital, to manage multi energy systems such as grid connection and the CCHP. The BEMS will continuously monitor operation data, forecast demand based on weather, customer behaviors and actual indoor indicators such as room temperature and lighting, and automatically control energy production and distribution to meet the demand. It will also pro-actively promote demand side energy conservation through timing schedule, detection of occupation, etc.

d. Community Energy Management System

141. A community energy management system (CEMS) is used in an unstable system based on renewable energy (photovoltaic and wind power) generation, to realize optimal operation that minimizes CO₂ emission while solving power quality problems due to supply-demand imbalance and reverse power flows. A CEMS can optimize energy savings of an entire community.

142. The program will develop a CEMS for the Xiangtan High-Tech Development Zone (Figure 41), to monitor electricity, water, and gas consumption of 170 enterprises and other relevant buildings in the zone.

Figure 41: Locations of the Xiangtan Big Data Center, Jiuhua Economic and Technological Development Zone, and the Xiangtan High-Tech Development Zone



Source: Google Earth, 2019; and ADB PPTA consultant, 2019.

e. Industrial Zone Multi-Energy and Utility Management System

143. The program will develop a multi-energy and utility management system (MEMS) at Jiuhua Economic and Technological Development Zone covering 670 industries and enterprises (Figure 41). The MEMS will include:

- (i) digital dispatch and control system for zone operation;
- (ii) administrative approval service system;
- (iii) online monitoring and control system for public facilities in the zone;
- (iv) data manufacturing public service system
- (v) comprehensive energy service system;

- (vi) spare parts and other public service systems; and,
- (vii) a schematic diagram of the zone.

144. MEMS software will be developed and installed in the Xiangtan Municipal Big Data Center, one of the XMG bureaus established under the government mandate of “Xiangtan Smart City Pilot”,²³ and all data will be collected and sent there.

145. The Jiuhua Economic and Technological Development Zone is currently underserved by electrical infrastructure. There are few substations, and the distribution network is limited. To address these shortcomings, the program will construct i) construct a 110 kV substation and associated transmission lines, and ii) a power distribution grid.

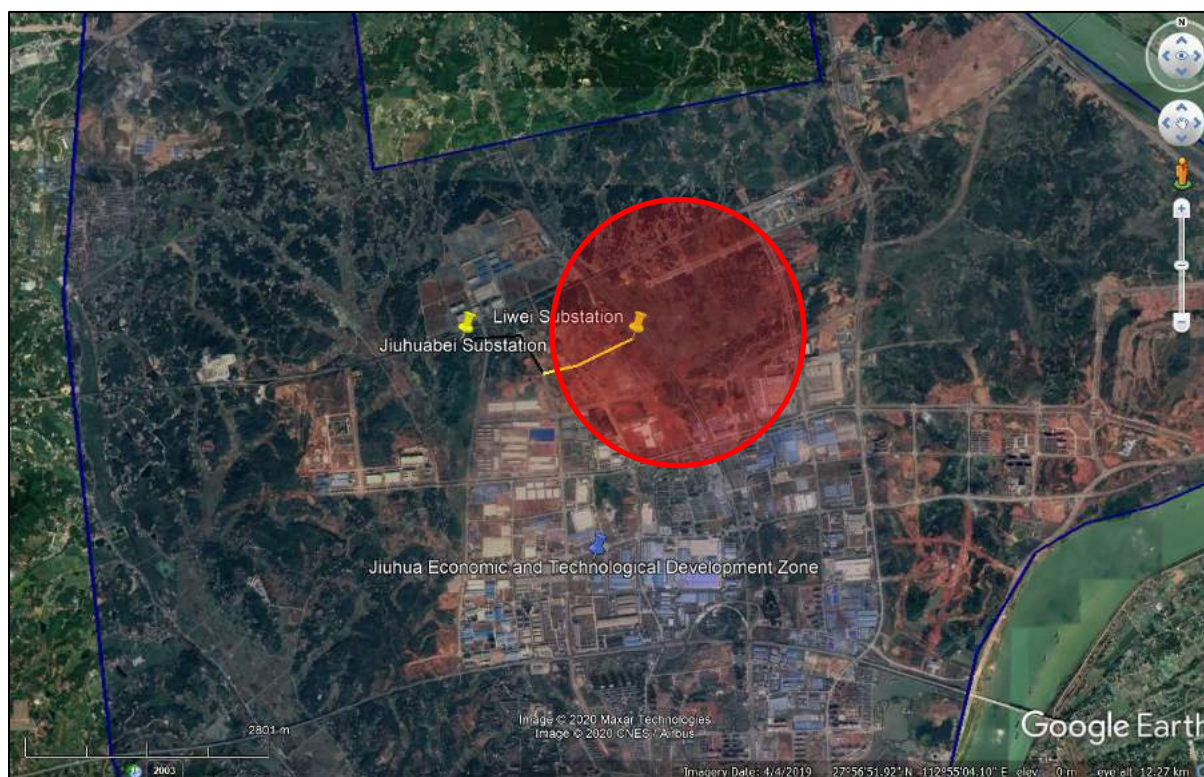
146. **Liwei Substation.** The program will construct the 110 kV Liwei Substation, consisting of one 63 MVA transformer, one 110 kV feeding bus, 14 outgoing feeder lines of 10 kV, and one 6000 kvar low voltage capacitor. One bay will be added to the existing Jiuhuabei 220 kV Substation, and it will be the 110 kV power source for the Liwei Substation. A 0.8 km JL/G1A-300/25 overhead transmission and a 1.9 km of YJLW-110-1600 underground cable will connect the Liwei Substation with the Jiuhuabei substation.

147. **Power Distribution.** The program will install 10 kV power distribution lines in a pilot area within the Jiuhua Economic and Technological Development Zone. The lines will have a maximum length of 1.8 km, and in total of 7.3 km of lines will be installed.

²³ A data center is building, dedicated space within a building, or a group of buildings used to house computer systems and associated components, such as telecommunications and storage systems. Data over the size of a petabyte is considered Big Data.

Figure 42: Locations of the Liwei Substation, transmission lines and power distribution area, Jiuhoa Economic and Technological Development Zone

The black lines denotes an underground cable, the yellow an above ground transmission line. The red zone is the approximate area for power distribution lines.



Source: Google Earth, 2019; and ADB PPTA consultant, 2019.

148. The power demand in the pilot area is predicted to be 344 MW in 2025, and 469 MW in 2030. Annual power consumption in the pilot area is predicted to be 1.769 billion kWh in 2025, and 2.234 billion kWh in 2030.

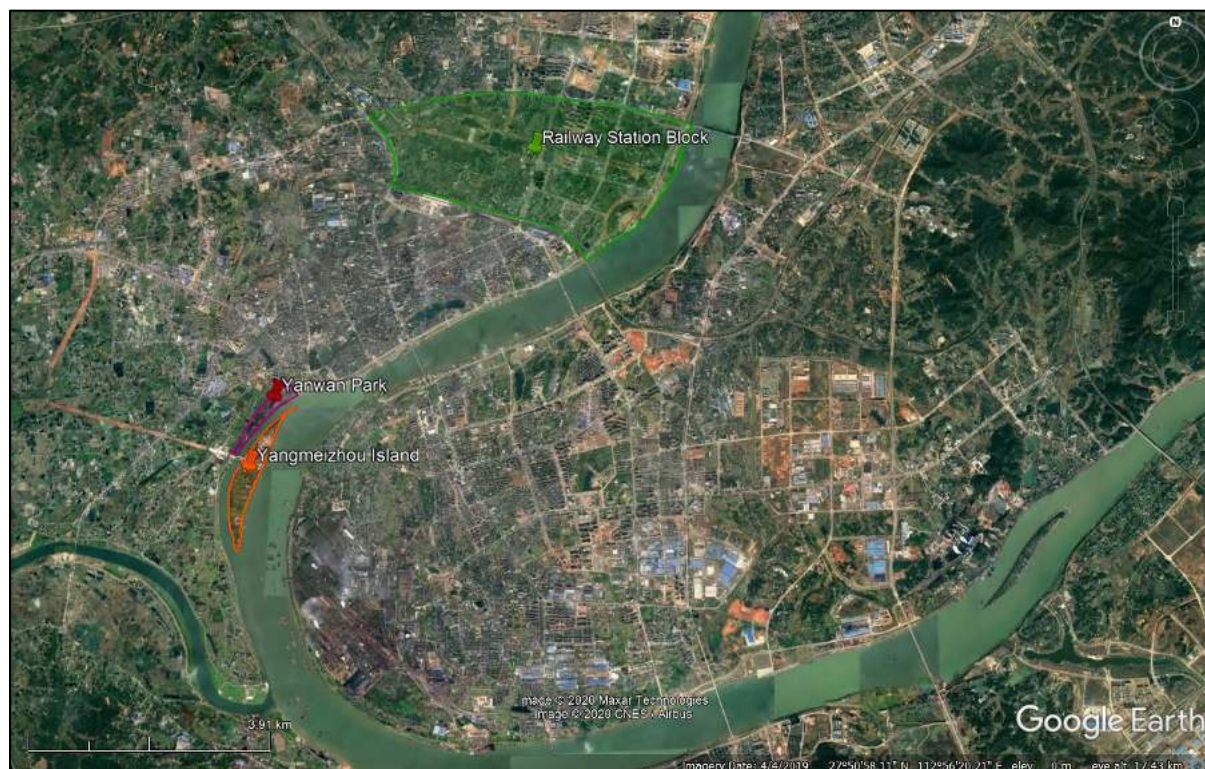
149. The Jiuhoa Economic and Technological Development Zone does not yet have its own environmental and social management systems (ESMS). Its old EHS management was integrated in the administration office of the zone. The administration office has committed to fulfill all relevant domestic regulations, and follow EMP requirements from the ADB.

f. Integrated Urban Catchment Management Plans

150. The Xiangtan pluvial flood assessment (Chapter III) determined that some planned Xiangtan urban development zones are in high flood risk areas, including the 'Railway Station Block', 'Yaowan Park' and Yangmeizhou Island (Figure 43). These areas are already suffering from frequent flood events and associated economic losses. The program will develop Integrated Urban Catchment Management Plans for each area. The plans will be developed through comprehensive flood modelling, flood hazards assessment studies, geotechnical surveys, and conceptual design. Plan development will be based on the principles of resilience improvement, and the "room for river" principle that allows flooding in upstream areas of the river to lessen flood

impacts on downstream urban areas. Plan development will help avoid economic loss induced by future flood events.

Figure 43: Integrated Urban Catchment Management Plans locations



Source: ADB PPTA consultant 2019, and Google Earth 2019.

g. Smart Early Flood Warning System

151. Xiangtan City has experienced substantial economic loss and social impacts caused by river and urban flooding. Existing flood warning systems relevant to Xiangtan are as follows:

Four-level (province, city, county and township) Early Warning Platform

- a) The platform has videos, images and monitoring data (from rainfall station, water stage gauging station, and rainfall- water stage integrated station). Every city, county, and town is responsible for monitoring by itself, including automatic monitoring and simple manual monitoring.
- b) Data is sent to counties and Hunan province, but not to the city level.
- c) There are some emergency operational plans that have been developed.

Xiangtan City Mountain Torrents Disaster Monitoring and Early Warning System

Its disadvantages are:

- a) The collection of engineering information is relatively limited, so the system is lacking in decision-making support capacity.
- b) Poor operation for pumping stations and reservoirs.

Hunan Province Cloud-based Flood Warning System

The provincial Water Conservancy Department is responsible for this system and provide a terminal for each city. Data from this system covers the data provided by the Xiangtan City Mountain Torrents Disaster Monitoring and Early Warning System.

Xiangtan City Small Watershed Flood Analysis System

Because there are a few rainfall stations and water stage gauging stations, and small slopes in this watershed, intelligent early warning for reservoirs has not been implemented.

Xiangtan City Small and Medium River Hydrological Monitoring System

This system was established by the Hydrological Bureau of Hunan Province. 20 stations can cover information of watersheds above 200 km², but there is no information for small watersheds (below 200 km²), so flood forecasting cannot be performed.

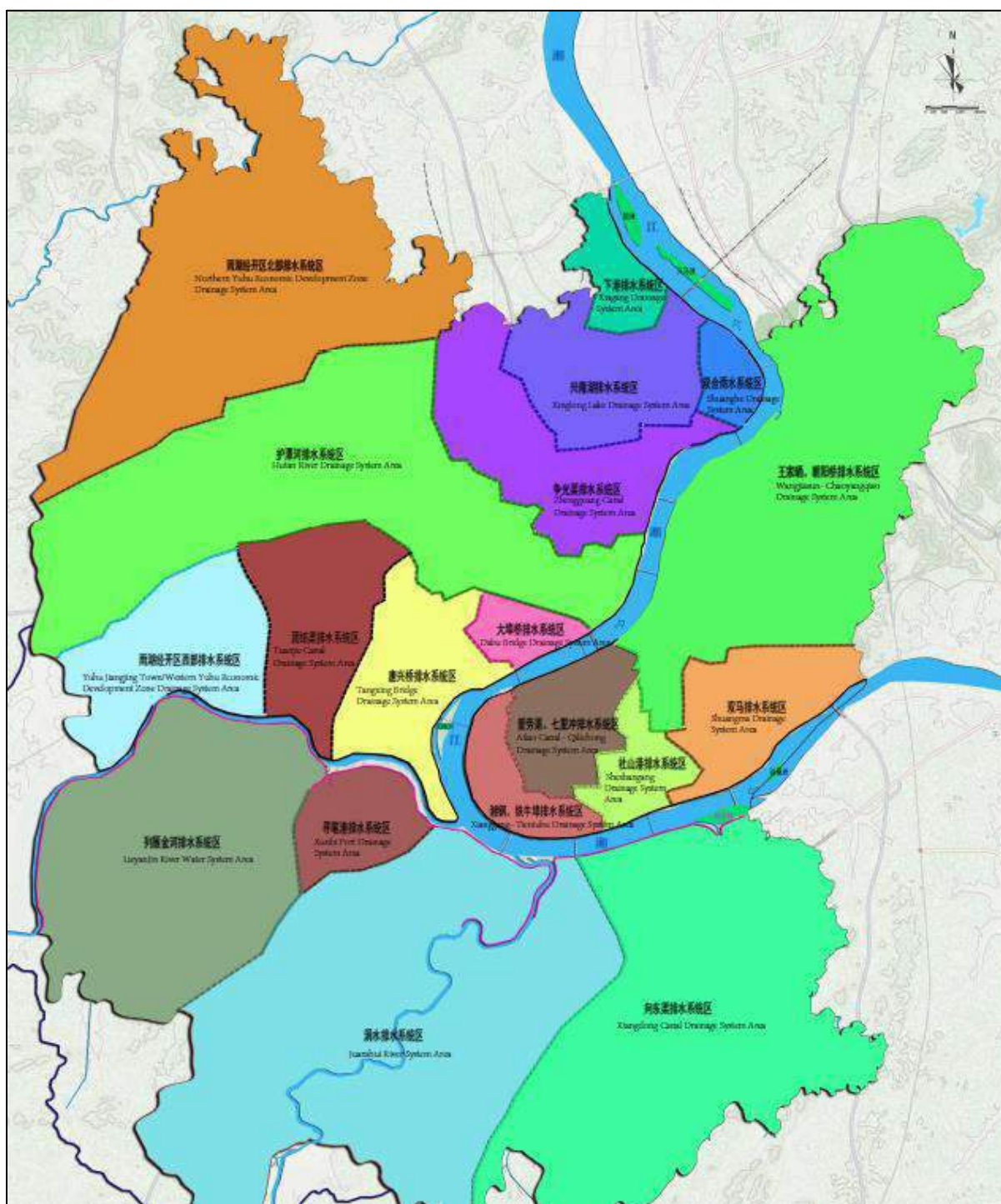
152. The above systems are described by municipal authorities and PPTA flood response experts as lacking functionality to support effective emergency management. Deficiencies include:

- low density of rainfall and stream level gauges;
- limited status monitoring of major control structures;
- limited functionalities within the existing software;
- risk information output from the existing system only covers rainfall from the flash flood warning system, and some river levels, and is insufficient to support effective emergency response and management.

153. In addition, there is currently no existing Xiangtan urban flood management system.

154. In response to these deficiencies, the program will develop a modern early flood warning system at the Xiangtan Big Data Center. The flood warning system was proposed in Section 10.3.1 of the *Urban Water Conservancy Plan of Xiangtan (2016-2030)* as one of 8 supporting systems for modern water conservancy development in Xiangtan. The early flood warning system will be consistent with the Xiangtan Urban Master Plan and the Xiangtan Urban Flood Management Plan. The system will cover 5 drainage areas and 19 sub-catchments, with a total catchment area of 1,069 km² (Figure 44).

Figure 44: Coverage of the Xiangtan Early Flood Warning System



Source: ADB PPTA consultant, 2019.

155. The system will support flood risk assessment, information dissemination and emergency response during flood events. The system will also share and exchange necessary data through secure protocols with other smart city sub-components, such as the road ITS.

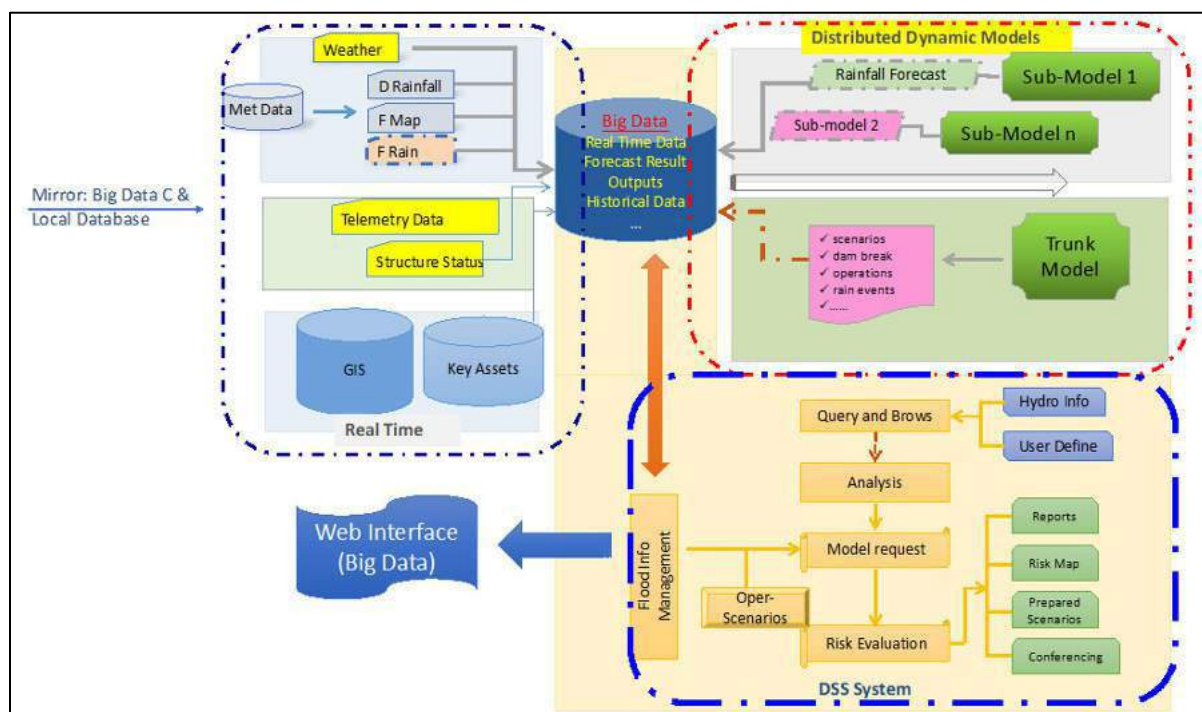
156. The system will be built by integrating large amount of real time hydrological and hydraulics monitoring data with river catchment, urban drainage, and risk assessment models. The system will be able to quickly process large amounts of data and provide rapid forecasting models to provide necessary information for decision making. The early warning system will automatically trigger workflows to facilitate daily operations. However, operators will still be able to run forecasts manually if necessary. A diagram of the system conceptual architecture is presented in Figure 45.

157. Data for the system will be sourced from:

- 62 rain gauges within Xiangtan City administrative boundary;
- 5 hydrological monitoring stations;
- major river flood gates and pump operational status;
- central city drainage pump operational status;
- rainfall, wind, atmospheric pressure, and evaporation data from the Xiangtan climate center;
- rainfall, wind, atmospheric press data from the National Climate Centre;
- rainfall, river level and flow forecast from the provincial Flood Management Department;
- urban flood incident records;
- traffic flow data;
- key infrastructure data; and
- the Xiangtan municipal GIS.

158. In addition, in order to ensure model accuracy, the municipality will provide digital elevation maps, river and pipe data, and long time series of model input data for model calibration and validation.

Figure 45: Xiangtan Early Flood Warning System conceptual architecture



Source: ADB PPTA consultant, 2019.

159. Key tasks in the system development include:

- review existing systems, quality check and process all data required for dissemination and model use;
- build city-wide river network hydrological and hydraulic models to predict flows and water levels;
- build 4 small Type I reservoir operational models;
- build urban drainage models for central city with rapid 2D, if DEM supports;
- model calibration and validation;
- develop early warning system framework which facilitates data (both observed and forecasted) processing and hydrological forecasting, as well as information dissemination. For urban flooding, the system will provide the inundation area and depth, as well as the flood propagation, to facilitate decision making;
- data communication between the Big Data Centre and the Flood Management Department;
- build data management module;
- integrate real time data and model within the system framework;
- integration with existing system, to maximize the use of existing information;
- installing, testing and troubleshooting on site; and
- provide extensive training to local forecasting teams, and 3 years support and maintenance after system completion.

h. Environment Monitoring and Assessment System

160. The program will develop a top-level environment monitoring and assessment system (EMAS), which will acquire data from sub-systems including air, surface water, and ground water monitoring networks.

161. The development of the EMAS concept is based on input from Environmental Bureau. The concept is visualized as “One Platform”, “One Center” and “Three Networks”, where:

- (i) “One Platform” is an ecological and environmental data application;
- (ii) “One Center” is an ecological and environmental data hub at the Xiangtan Municipal Big Data Center; and
- (iii) “Three Networks” is comprised of air quality, surface water quality and ground water quality monitoring networks.

162. The EMAS will include an automated environment monitoring network covering the entire Xiangtan city, and a region-wide ecological and environmental monitoring system. The EMAS will utilize an information management platform to achieve accurate environment monitoring, intelligent management, and scientific decision-making based on ecological and environmental data.

iii) Output 3: Low-carbon Transformation Policy Reforms Adopted

163. The infrastructure and system transformations in outputs (i) and (ii) will be sustained and scaled up by policy, institutional, and operational reforms, and outreach activities. Reform areas include: (i) introduction of parking policy and institution setup; (ii) market and demand-driven operation of public buses; (iii) people-oriented ITS operation; (iv) school-zone reform for road safety; (v) clean district energy system and waste heat recovery; (vi) industrial energy and utility management and operation; (vii) low-carbon building sector reforms through green building certification, energy performance contract, and green financing, building energy management system, and energy statistics; (viii) capacity building on EbA and climate adaptation planning tool; and (viii) data security and standardization. Reform measures will be carried out in two equal tranches of \$25 million each. Pursuing the XMG’s clear and long-term commitment to carbon peaking target, the LCT policy reforms will create norms of a low-carbon, resilient, and livable city by regulating, incentivizing, guiding, and supporting all relevant actors of the society.

164. Output (iii) will be financed by the policy-based loan.

iv) Output 4: Capacity Building and Program Management Enhanced.

165. Project Management Consultant (PMC) services will be provided to support the PMO in project management, technical support, and safeguards policy compliance and monitoring. The PMC will also provide training and workshops in operating the systems as well as identifying comprehensive plans and programs for sustaining LCT. Training will also be provided on the ADB SPS (2009); PRC safeguard requirements; development and implementation of environment, health and safety (EHS) plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and typical good construction EHS plans and practices. In addition, the PMC will help the XMG to be fully equipped to run the Asia Pacific Low-Carbon Training Center on its own.

166. The PMC will include a Loan Implementation Environmental Consultant (LIEC), an environmental, health and safety specialist who will support the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances.

E. Associated Facilities

167. Associated facilities are 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 program.

168. The only associated facility that has been identified for the program is the Jiuhuabei substation to which the 110 kV Liwei substation and transmission line will connect. A due diligence review of the Jiuhuabei substation is presented in Appendix G.

F. Budget and Time Schedule

169. Total cost for the program will be \$393.19 million. The Government has requested a regular loan of \$200.0 million from ADB's ordinary capital resources comprising of a \$50.0 million policy-based loan and a \$150.0 million project loan. The balance of \$193.19 million will be PRC's counterpart financing. Costs for the project loan are presented in Table 21.

170. The program implementation period will be from October 2020 to July 2022 for the policy based loan, and from October 2020 to September 2025 for the project loan.

Table 21: Estimated cost, loan project

Subprojects	ADB Finance Million USD	Total Cost Million USD	ADB Finance Million CNY	Total Cost Million CNY
1. Urban Street Transformation for Bus Priority Lanes, Sidewalks and Cycling Ways	27.52	49.33	192.00	344.19
2. Road Safety Features at 5 Elementary Schools	0.72	1.44	5.03	10.06
3. Enhancement of Multi-Modal Station	1.57	2.78	10.95	19.37
4. Clean Energy Transportation	11.02	22.04	76.88	153.76
5. Human-Optimized Intelligent Transport System Enhancement	3.57	5.74	24.90	40.03
6. Low-Carbon and Resilient, Multi-Functional Fuxing Middle Road	5.85	6.76	40.83	47.18
7. Modernization of Early Flood Warning System	3.23	4.55	22.55	31.72
8. Integrated Urban Catchment Management Plan and Design Development for the Railway Station Block and Yangmaizhou Island	2.10	2.10	14.65	14.65
9. Low-Carbon and Resilient 'Xiangtan First Traditional Chinese Medicine Hospital'	41.77	98.20	291.42	685.13
10. Public Building Retrofitting for Low-Carbon Demonstration	5.83	12.33	40.71	86.03
11. Low-Carbon Communities Improvement	22.92	47.74	159.90	333.12
12. Smart Xiangtan ICT Platform	9.00	15.95	62.79	111.32

13. Building Energy Management System Expansion and Integration	3.44	5.73	24.00	40.00
14. Multi-Energy System at Jiuhua Industrial Zone	7.07	16.01	49.35	111.69
15. Environmental Monitoring and Assessment System	2.89	10.99	20.15	76.69
16. Program Management Enhancement	1.50	1.50	10.47	10.47
TOTAL	150.00	303.19	1046.57	2115.41
	49.47%	100%	49.47%	100.00%

Note: 1 USD= 6.977 CNY (ADB Forex on 14 February 2020)

Source: ADB Estimate, 2020.

G. Implementation Arrangements

171. The Xiangtan Municipal Government (XMG) will be the program executing agency (EA) and implementing agency (IA). All program procurement will be carried out by XMG and all assets procured and acquired will remain as XMG's properties. The Hunan Provincial Government (HPG) will provide guidance and supervision to the municipal government in program processing and implementation.

172. A project management office (PMO) has been established under the EA to manage the program implementation on a daily basis. The primary responsibilities of the PMO at the preparation stage include (i) coordination with central/provincial governments, ADB, and related government agencies; (ii) preparing required reports and obtaining approvals from upper level governments/authorities; (iii) organizing program preparation activities, like consultant recruitment and report preparation (program proposal, feasibility studies, environment and social assessments, etc.); and, (iv) arranging program implementation.

173. During implementation, the PMO will be responsible for (i) coordination among central/provincial governments, ADB, the EA, and related government agencies and entities; (ii) implementation planning, arrangement, and quality control; (iii) loan disbursement and financial management; (iv) compliance of environment and social safeguards; and, (v) procurement and contract management including supervision of contractors and construction supervision company (CSC).

174. The PMO will be led by the Secretary General of the XMG. It will be suitably staffed, including a full-time qualified Environment and Safety Officer (PMO ESO), who will take overall responsibility for supervising the implementation of environment mitigation measures, coordinating the program level GRM and preparing monitoring reports for submission by the IA to ADB. The PMO will include representatives from relevant XMG bureaus including the development and reforms commission, finance bureau, transport bureau, housing and urban-rural construction bureau, water conservation bureau, ecology and environment bureau, health commission, Xiangtan big data center and commissions, as well as from the Xiangtan Jiuhua Industrial Zone.

175. Support for the PMO will be provided through a Project Management Consultant (PMC) including a Loan Implementation Environmental Consultant (LIEC), and a Construction Supervision Company. In addition, a qualified 3rd party Environmental Monitoring Company will be engaged to undertake construction and operation phase ambient environmental monitoring.

176. Construction contractors will be responsible for implementing the mitigation measures during construction under supervision of the PMO.

177. Environment related implementation arrangements are discussed in more detail in the EMP (Appendix A).

IV. DESCRIPTION OF THE ENVIRONMENT

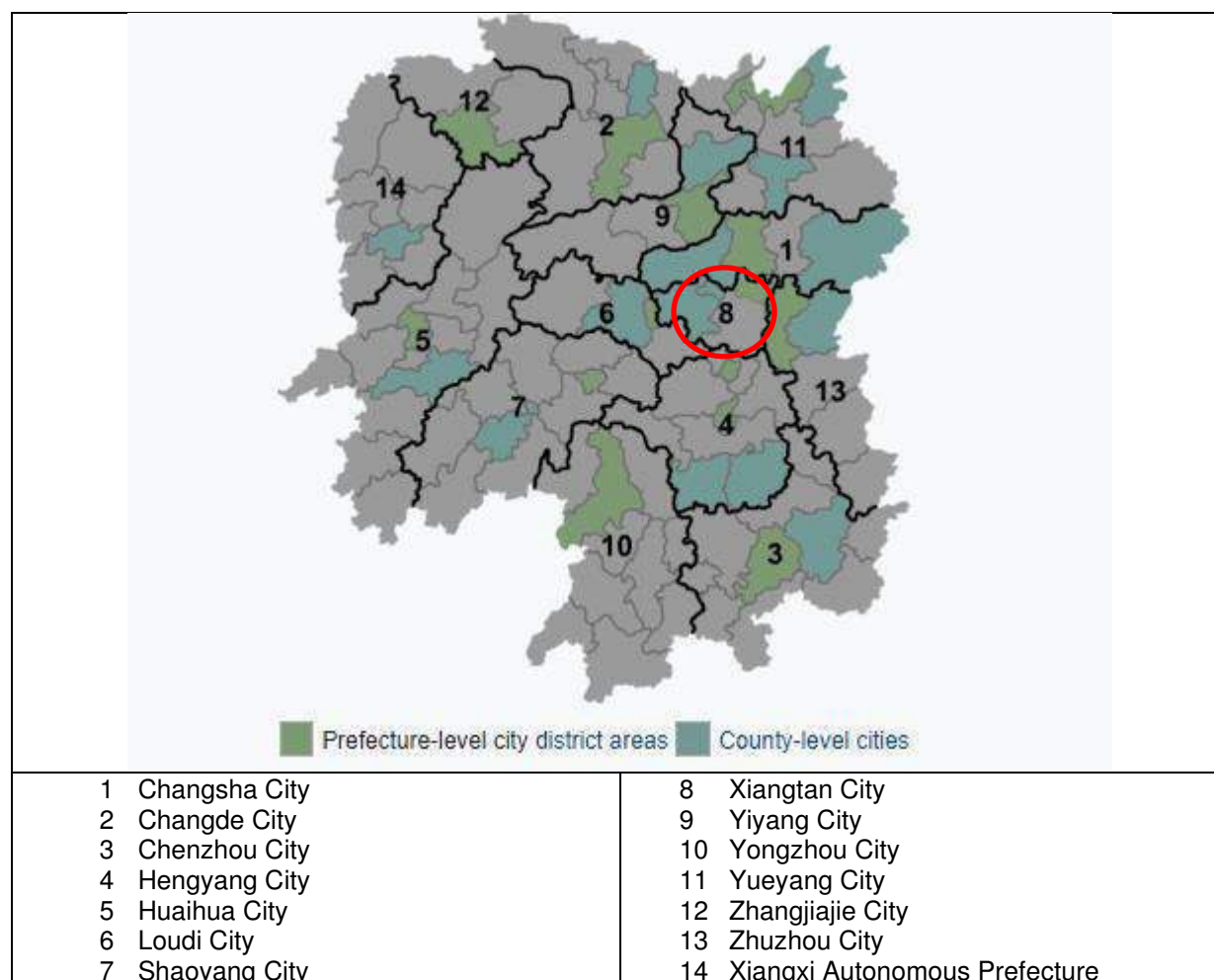
A. Location

178. The program will be implemented in Xiangtan City, Hunan Province, PRC.

i) Hunan Province

179. Hunan Province is located in south-central China. It is bounded to the north by Hubei Province, to the east by Jiangxi Province, to the south by Guangdong Province and the Zhuang Autonomous Region of Guangxi, and to the west by Chongqing Municipality and Guizhou Province. The province is comprised of thirteen prefecture-level cities and an autonomous prefecture, which are further subdivided into 122 counties (Figure 46). Its capital and largest city is Changsha.

Figure 46: Hunan Province administrative map showing Xiangtan City

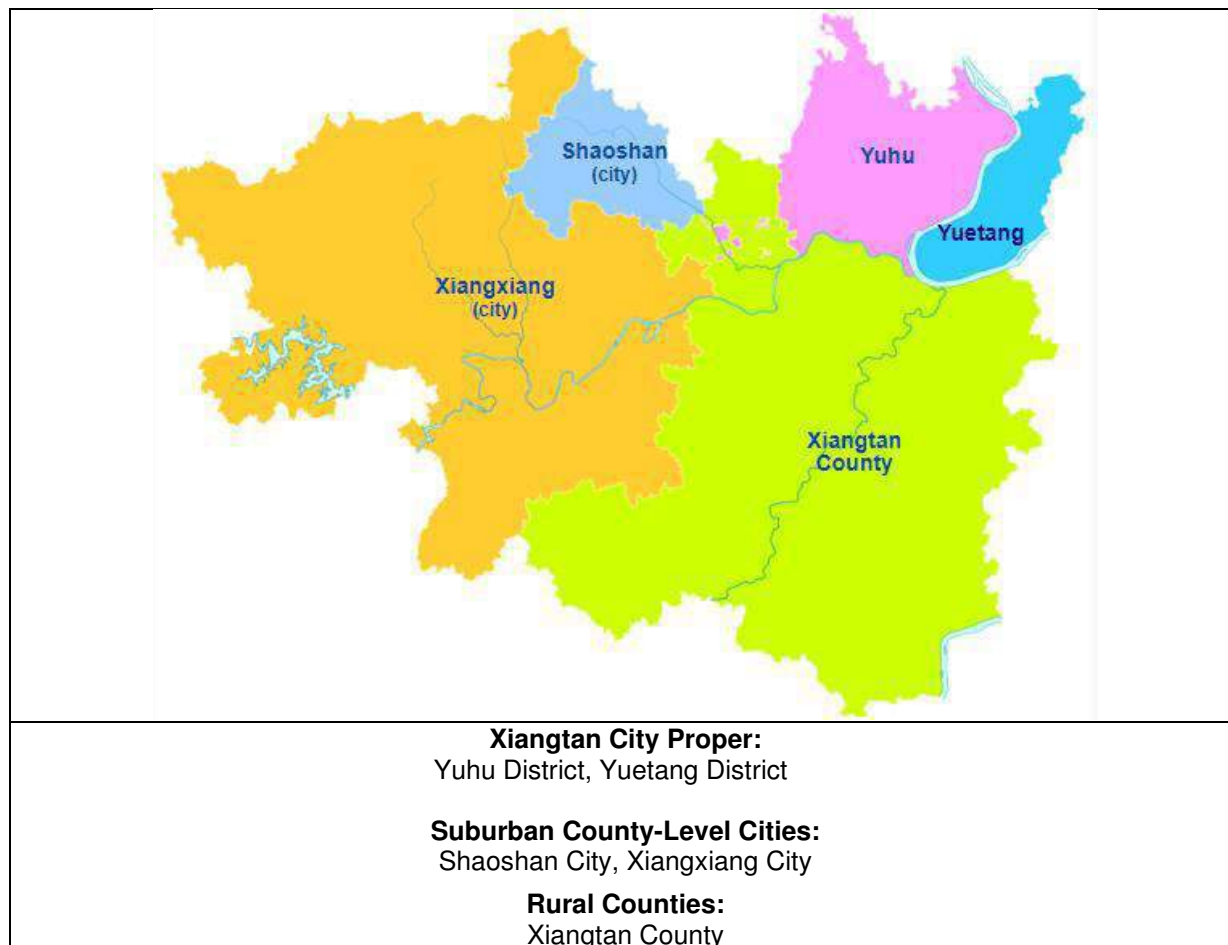


Source: https://en.wikipedia.org/wiki/Hunan#Administrative_divisions, 2019.

ii) Xiangtan City

180. Xiangtan City is a prefecture-level city located in the east central Hunan Province, directly south of Changsha. It has an area of 5,006 km², and is divided into 2 urban districts Yuhu and Yuetang District, which make up Xiangtan City proper, 2 county-level cities, and 1 rural county (Figure 47). Within the two urban districts there is a 151 km² core urban area (Figure 48).

Figure 47: Xiangtan City administrative map



Source: <https://en.wikipedia.org/wiki/Xiangtan>

iii) Program Area

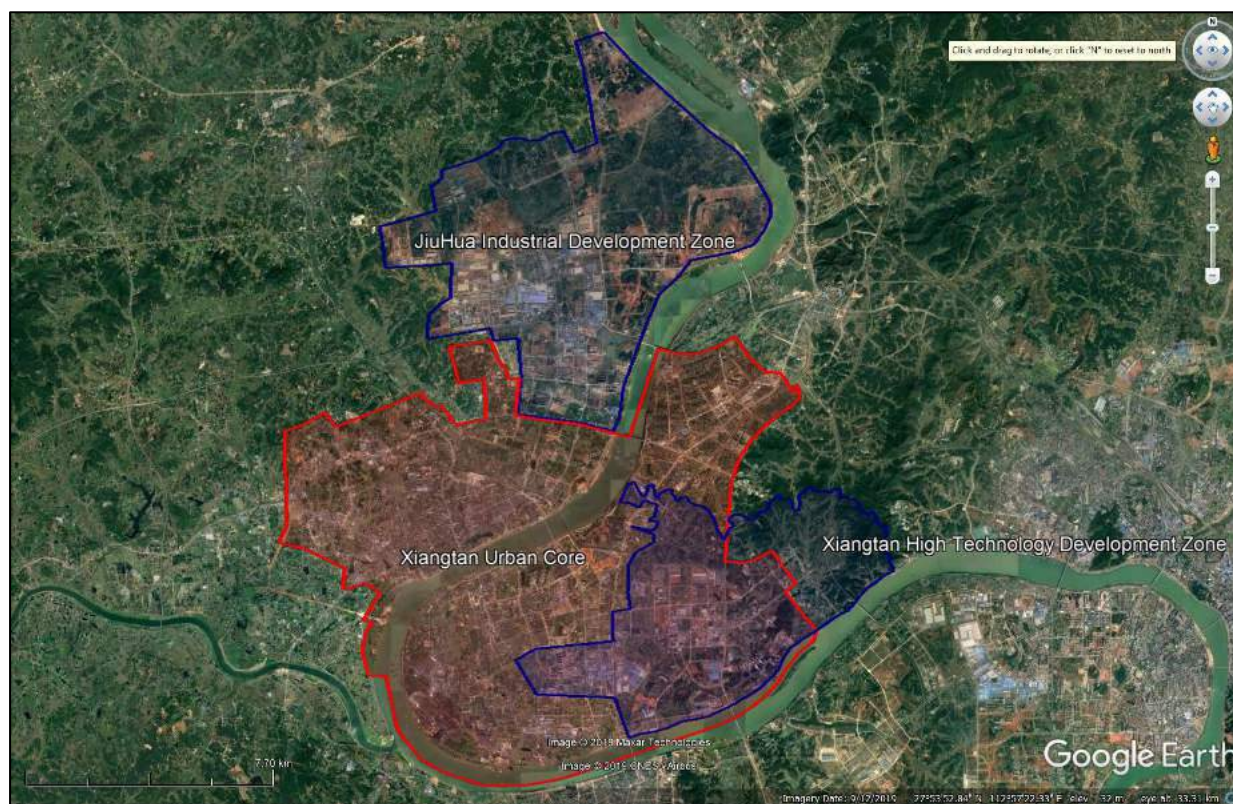
181. The program area includes the 151 km² core urban area, as well as the Jiuhua Economic and Technological Development Zone and the Xiangtan High Technology Development Zone (part of the latter overlaps with the urban core) (Figure 48).

B. Physical Resources

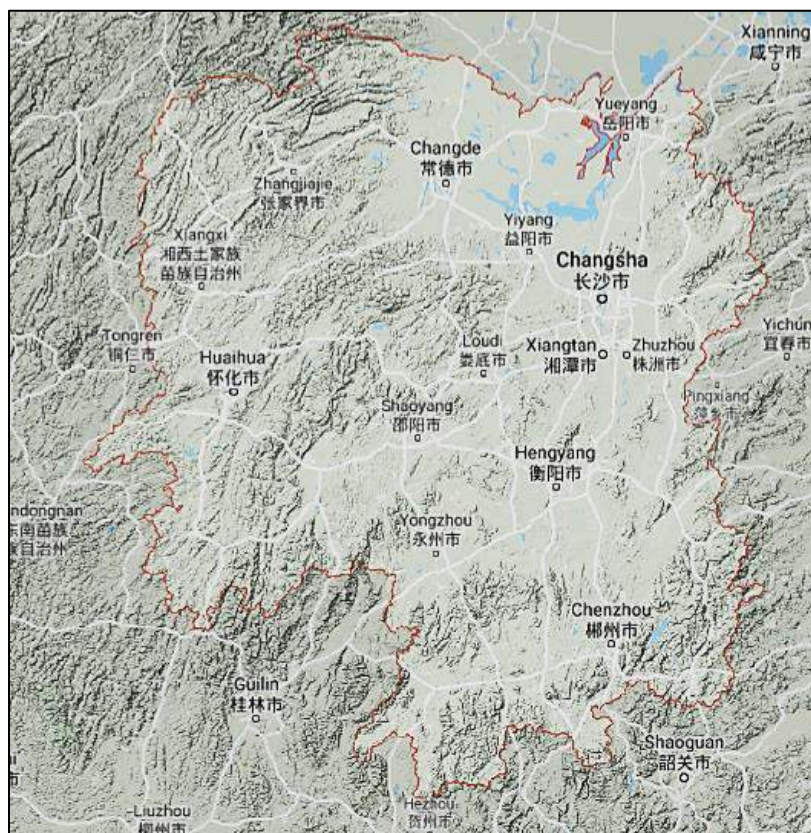
i) Topography

182. Hunan is located about half way along the south bank of the Yangtze River. The province lies within a U-shaped geosyncline, with high mountains and hills in the eastern, southern and western regions draining to the lower Dongting Lake plain in the north. Mountains and hills occupy approximately 66.6% of the province, and orographic uplift caused by this topography is one of the reasons why Hunan has intense rain storms. The low lying areas in the north (Dongting Lakes) are part of the Yangtze River floodplain (Figure 49).

Figure 48: Program area



Source: Google Maps 2019.

Figure 49: Hunan Province topography

Source: Google Maps 2019.

183. The majority of Hunan Province consists of relatively low lying basins, hills and terraces. 44.27% of the province is below 400 masl; 22.58% is between 300 to 500 masl; 18.43% is between 500 to 800 masl; and 11.72% is above 800 masl. The highest mountains range from 1,500 to 2,000 masl and are found in the western part of the province. Sedimentary rocks (including sandy, carbonate and red rocks, and Quaternary loose deposits) account for 57.75% of the total area; metamorphic rock accounts for 24.99%; and igneous rocks including magma landforms account for 8.87% of the total land area.

184. Much of Hunan Province lies within the catchments of four major tributary rivers which flow into the Yangtze River: the Xiangjiang, Zishui, Yuanjiang and Lishui Rivers. These are collectively called the Mountain Rivers.

185. Xiangtan City is located on the lower reaches of the Xiangjiang River. It has a maximum east-west breadth of 108 km and a maximum north-south length of 81 km. The city is part of the Wei Mountain, Heng Mountain and Qinchui basin-mountain system, and has typical low-mountain/hill topography. Elevations range from approximately 30 to 800 masl. Landforms are highest in the north, west and south, and lower in the center and to the east (Figure 50). The highest point is in the west at 793 masl, and the lowest is in the east at 30.7 masl. The urban districts span both banks of Xiangjiang River basin, and are relatively flat, with elevations ranging from 40 to 80 masl (Figure 51).

i) Landuse

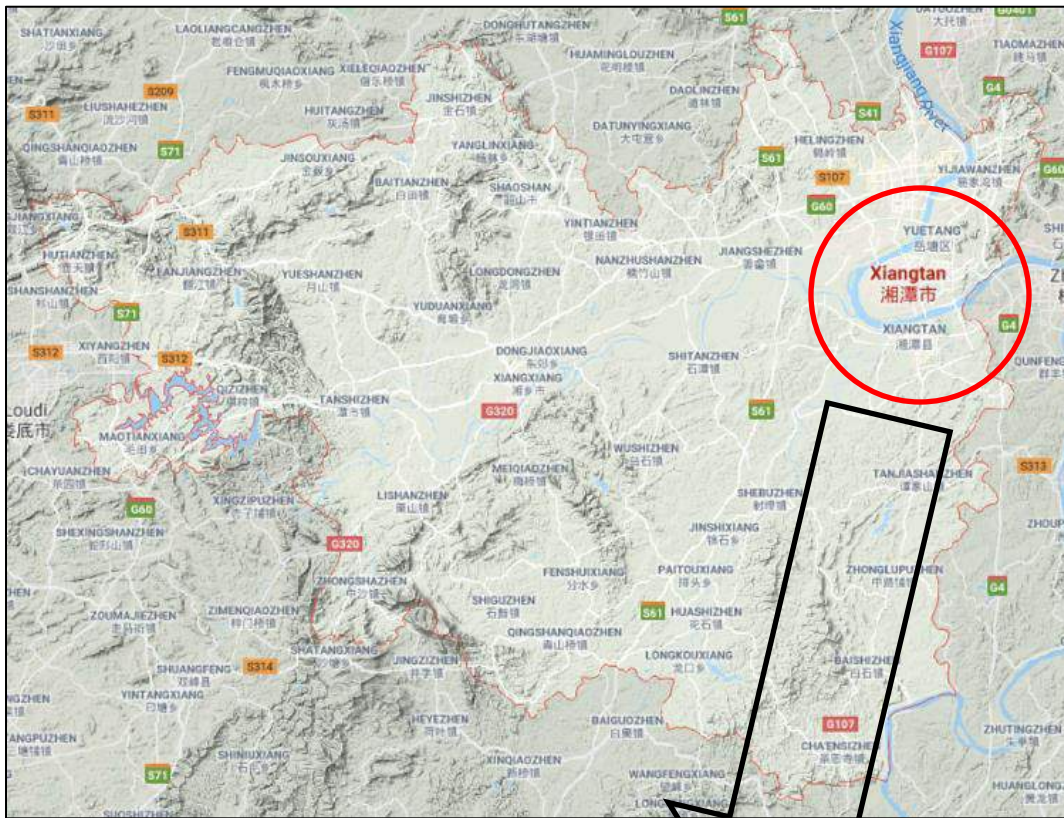
186. As part of China's Chang-Zhu-Tan Economic Development Region, Xiangtan City is undergoing rapid development, including the urban area (Yuhu and Yuetang districts), Shaoshan county-level city, and Xiangtan and Xiangxiang counties. Figure 52 presents the Xiangtan Urban Masterplan (2010-2020) for the urban core. The masterplan was developed in 2010 and revised in 2017. The masterplan designates 1,069 km² for urban development, including 33.07 km² of residential land, 12.54 km² of public administration and service areas, 12.32 km² of commercial areas, 15.25 km² of industrial areas and 14.55 km² of parkland (Table 1). The plan also designates Xiangtan to be a pilot "sponge city".²⁴

ii) Seismicity

187. The PRC classifies seismic intensity into 12 grades under the *China Seismic Intensity Table* (GB/T 17742-2008), based on the severity of "shaking" of the earth surface and the extent of potential impacts. According to the *China Seismic Ground Motion Parameters Zoning Map* (GB18306-2015), the program area is relatively stable with a seismic basic intensity of Grade 6, a peak ground acceleration of 0.05 g, a 10% probability of exceedance in 50 years, and a return period of 475 years. The Grade 6 seismicity intensity will be applied for the design and construction bus stations, charging stations, and roads as per the requirements of *Code for Seismic Design of Buildings* (GB 5011-2010).

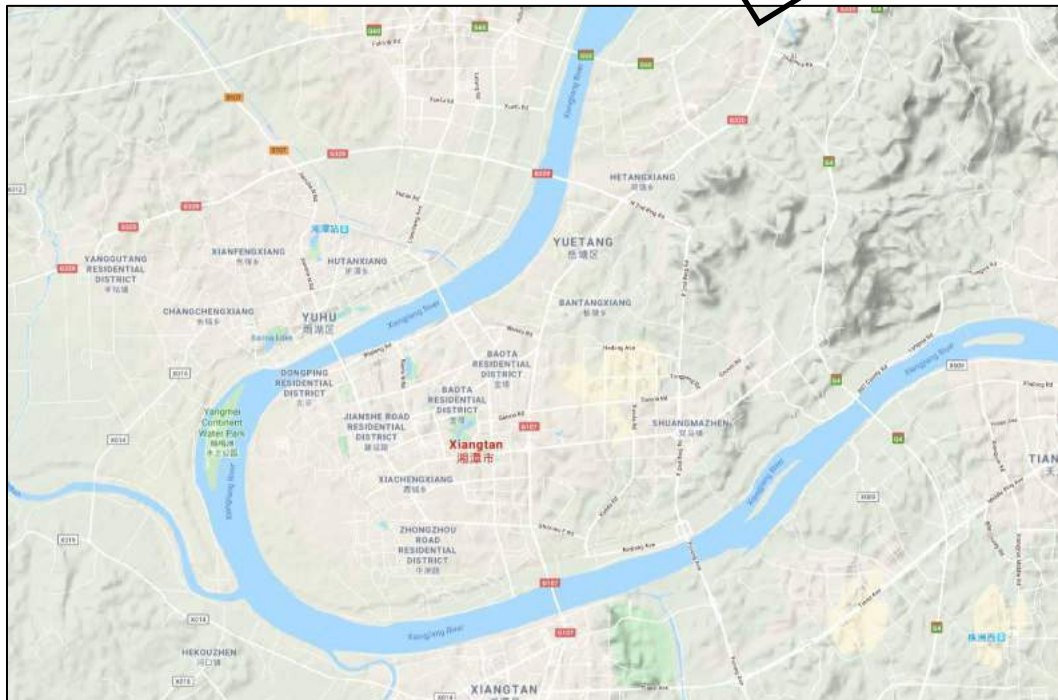
²⁴ In 2014 China initiated a nationwide Sponge City Plan, under which 80 % of its urban cities are to harvest and reuse 70 % of rainwater. Sponge cities are to be structured and designed to absorb and capture rain water and utilize it to reduce floods. Rain water harvested can be repurposed for irrigation and for home use. It is a form of a sustainable drainage system on an urban scale. The Sponge City Plan (SCP) calls for the use of natural processes such as soil and vegetation as part of the urban runoff control strategy, which is similar to that of low impact development and green infrastructure practices being promoted in many parts of the world. The SCP includes as its goals not only effective urban flood control, but also rainwater harvest, water quality improvement and ecological restoration.

Figure 50: Xiangtan City topography



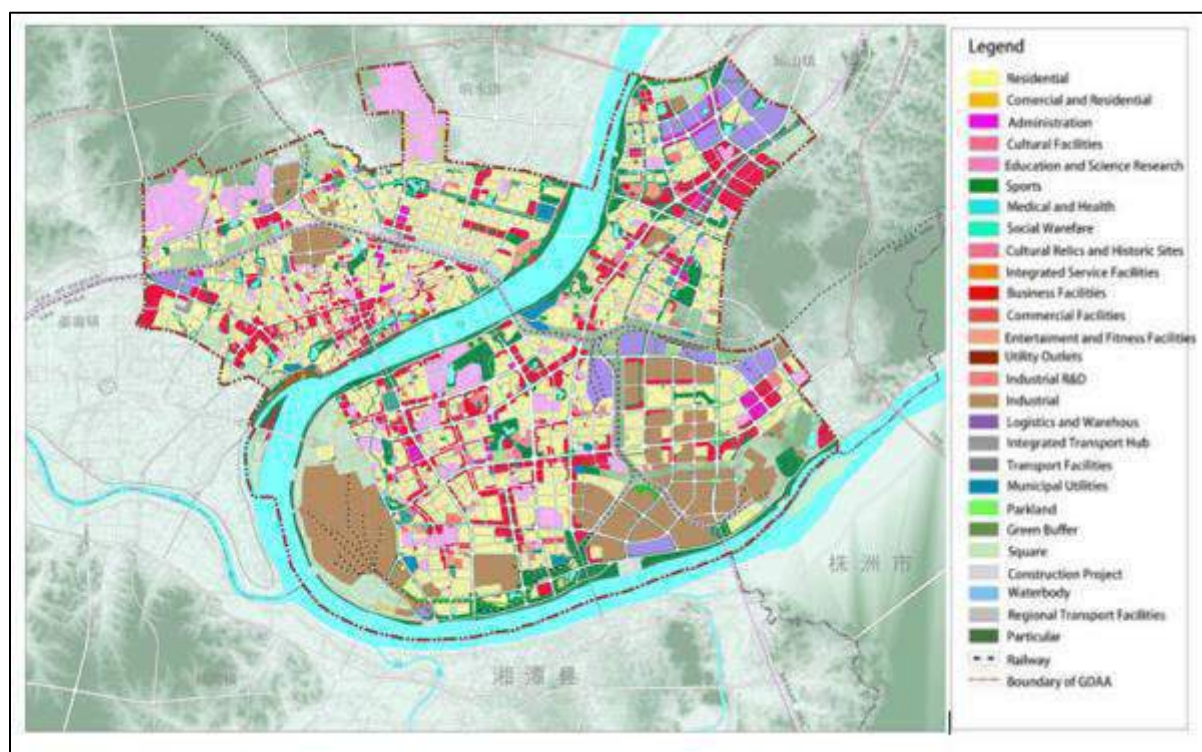
Source: Google Maps 2019.

Figure 51: Xiangtan City urban core area topography



Source: Google Maps 2019.

Figure 52: Landuse plan for the urban core of Xiangtan City for the 2020 planning horizon



Source: Xiangtan Urban Master Plan 2010-2020 (revised in 2017).

Table 22: Landuse allocation for the urban core of Xiangtan City for the 2020 planning horizon

Land Use	Area km ²
Planned Xiangtan Urban Areas	
Residential areas	33.07
Public administration and public service area	12.54
Administrative office space	1.14
Land for cultural facilities	0.67
Education and scientific research sites	8.95
Of Which: Sports sites	0.5
Health sites	0.84
Land for social welfare	0.26
Land for commercial and service facilities	12.32
Industrial land	15.25
Logistics and warehouse space	4.22
Roads and transportation facilities	16.88
Utilities	1.23
Green space	14.55
Of Which: Parks	13.29
Subtotal	110

Source: Xiangtan Urban Masterplan 2010-2020 (2017).

iii) Climate

188. Hunan Province is located in the subtropical climatic zone. It is cold in the winter and spring, and wet and mild in the summer and autumn. The average annual temperature is 17.5 °C, while monthly average 24-hour temperature ranges from 3 °C in January to 35 °C in July. Annual rainfall is 1,046 to 1,923 mm, the majority of which falls in the summer months.

189. The mean annual temperature in Xiangtan City is 17.4 °C. The mean temperature in the coldest month (January) is 5 °C, and 35 °C in the hottest month (July). The maximum and minimum recorded temperatures are 41.8 and -12.1 °C, respectively.

190. The maximum annual recorded precipitations at Xiangtan City's climatological stations are 1,923.3 mm (Xiangtan Station, 2002), 1,865.4 mm (Xiangxiang Station, 1994), and 1,719.9 mm (Lushan Station, 1970). The maximum recorded daily precipitation is 143.6 mm. Precipitation is concentrated in spring and summer, with average monthly precipitation highest in June and lowest in December. Of the average annual rainfall, 36% occurs in the spring (March to May); 32% in summer (June to August); 16% in autumn (September to November); and 15% in winter (December to February). April to September is the flood season, with precipitation ranging from 873.7 to 908.6 mm, accounting for 64% of the total annual precipitation; and the heavy flood season is from April to June, with that period accounting for 41% of the annual precipitation. Temperature and rainfall data is presented in Figure 53.

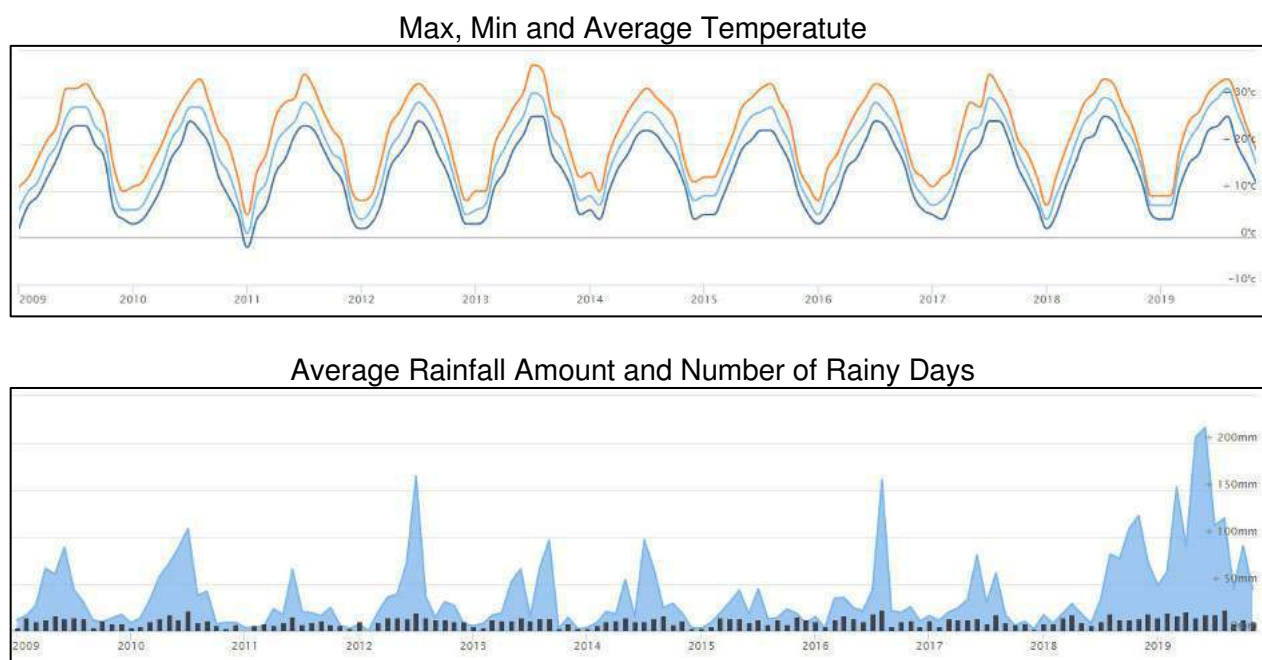
191. On average there are 300 frost-free days per year. The annual mean relative humidity is 80%. Annual mean sunshine duration is 1406 hours.

192. Annual mean wind speed is in the range of 1.8-2.9 m/s, and the maximum wind speed (2-min average speed) by monthly mean is in the range of 10-20 m/s. The prevailing wind direction is from north or northwest in winter, while the wind direction in summer changes frequently.

193. Floods are the most frequent and serious climate hazard in Xiangtan, with heavy rains being the main cause during the flood season. High rainfall events cause abrupt water-level rises and sudden floods, and pose a risk to both life and property. Rainfall events over a 24 hour period are classified as follows: heavy rain is precipitation ≥ 50 mm; a rainstorm is precipitation ≥ 100 mm; and a heavy rainstorm is precipitation ≥ 200 mm. A flood is defined as: any 10 days in the flood season (during April to September) in which the total precipitation ≥ 200 mm; or compared with normal case, precipitation increases $\geq 20\%$ in flood season (April to September); or $\geq 30\%$ during the heavy flood season (April to June).

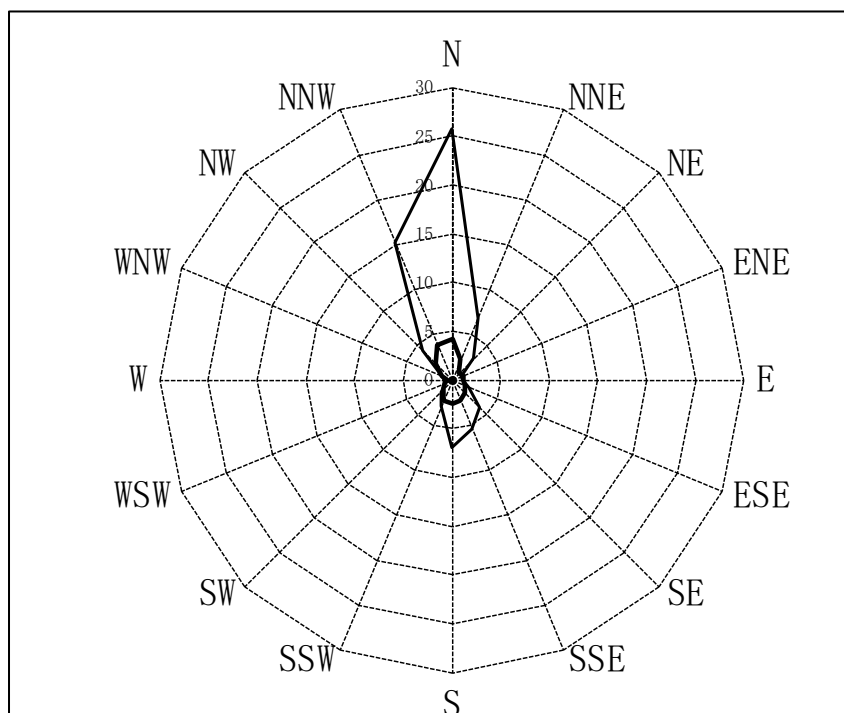
194. As part of the program PPTA process, a Xiangtan flood hazard map was produced to identify flood prone zones and vulnerable areas in the urban districts of Xiangtan City (Figure 55). The map shows that two of the program activities are in high flood risk areas, Fuxing Middle Road rehabilitation, and the site of the First Traditional Chinese Medicine Hospital (see Chapter III for a description of these activities). Based on the results of the modeling, flood and climate resilience measures have been incorporated into the scope of these program components.

Figure 53: Temperature and rainfall data for Xiangtan City, 2009 to 2019



Source: <https://www.worldweatheronline.com/xiangtan-weather-averages/hunan/cn.aspx>

Figure 54: Wind rose, Xiangtan City, showing frequency of wind directions and wind speeds, for 1981-2010



Source: Xiangtan Weather Bureau

iv) Surface Water Resources

195. Xiangtan City is located on the lower reaches of the Xiangjiang River. Surface water resources in the program area are presented in Figure 56. These include the Xiangjiang River, the much smaller Lianshui and Juanshui Rivers, both of which are tributaries of the Xiangjiang River, and several reservoirs

196. The Xiangjiang River is the largest river in Hunan Province, with a mainstream length of 844 km and a watershed area of 9,4660 km². It drains to the north into Dongting Lake, one of the biggest reservoirs of the Yangtze River. The Yangtze River then drains to the East China Sea.

197. Municipal drinking water is extracted from the Xiangjiang River at two locations:

- The 1st water extraction point is at Yaowan (Figure 56). In accordance with the *Water Pollution Prevention Law*, a Class I drinking water source protection zone has been established, with warning signs and protection nets set at 1 km upstream and 500 m downstream of the intake (Figure 57).
- The 2nd water extraction point is located approximately 3 km downstream of the first intake (Figure 56). Again, a Class I drinking water source protection has been set up with warning signs and protection nets set at 1 km upstream and 500 m downstream of the intake.

Figure 55: Flood hazard map of Xiangtan core urban area

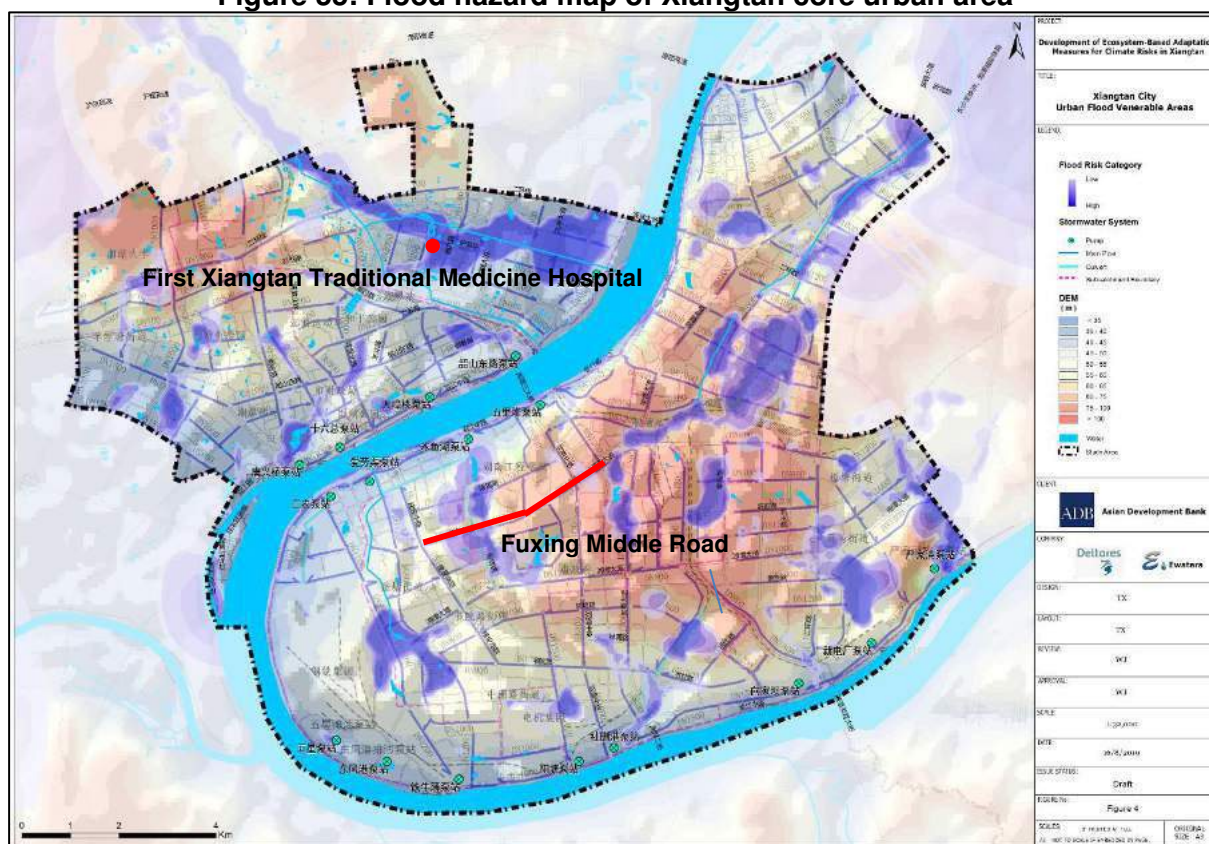
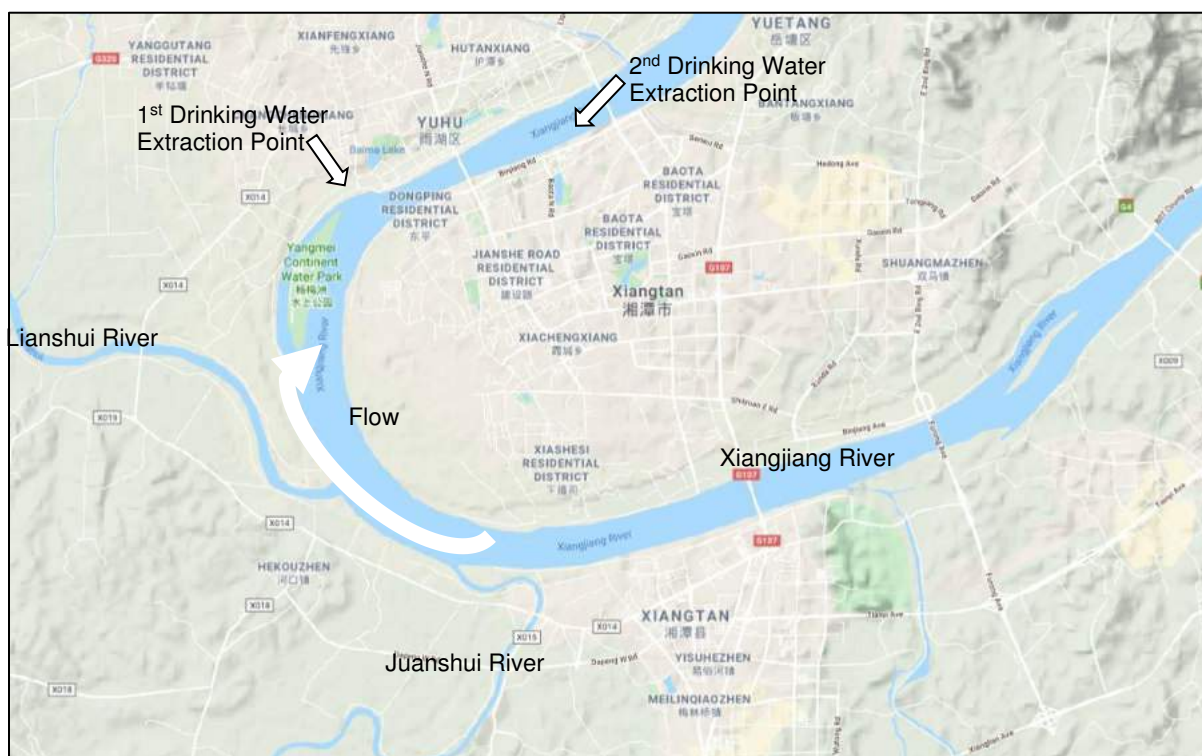


Figure 56: Water resources in the program area



Source: ADB PPTA consultant 2019; Google Earth 2019.

Figure 57: Warning sign at Yaowan water intake



Source: PMO, 2019.

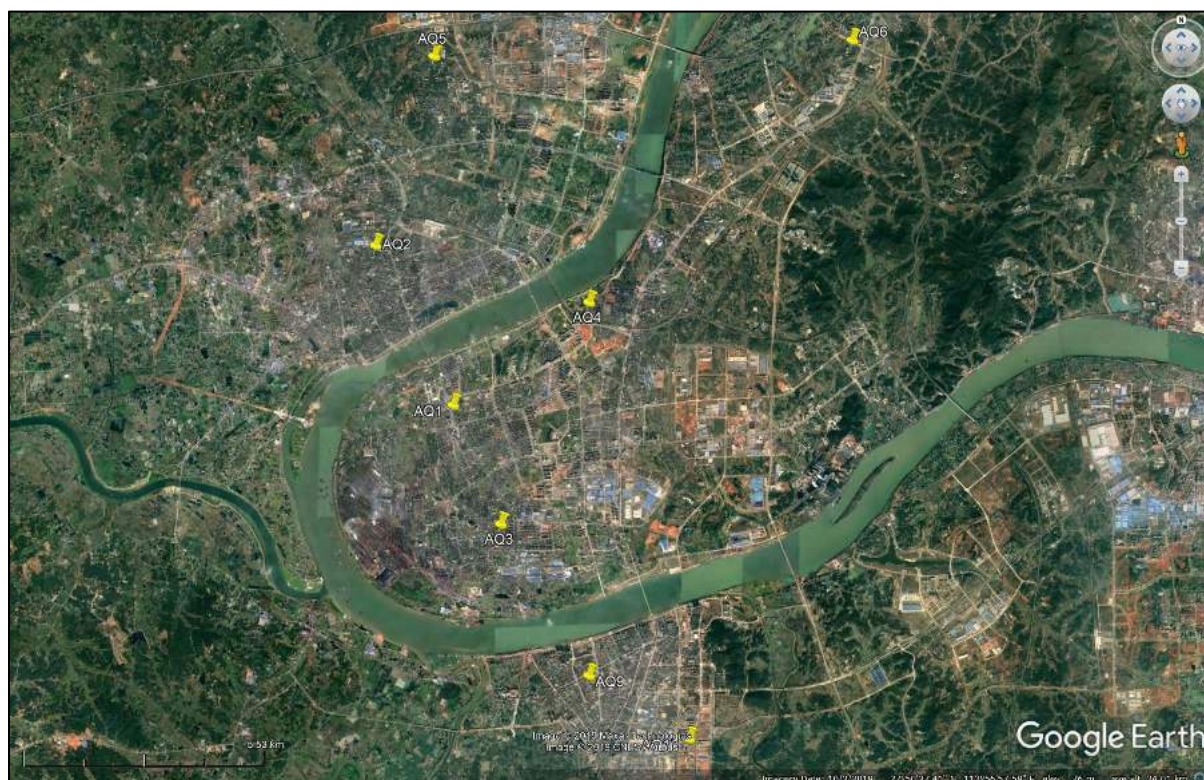
v) Environmental Baseline Data

198. Baseline environmental data in Xiangtan City was collected from monitoring undertaken by Xiangtan Ecology and Environment Bureau (XEEB).

a. Air Quality

199. Baseline air quality was assessed based on monitoring undertaken at six XEEB monitoring stations (Figure 58). Stations AQ1 to AQ4 covers the urban core of Xiangtan City, while AQ5 is located in the northwest part in the same area as the Jiuhua Industrial Zone, and AQ6 is located in the northeast part, close to the transportation link between national highway G60, G4 and Xiangtan City. As AQ9 and AQ10 are located out of the program area, monitoring results from these two stations were not included in the analysis.

Figure 58: Location of XEEB air quality monitoring stations in Xiangtan



Source: XEEB 2019; Google Earth 2019.

Note: AQ7, AQ8, AQ11 and AQ12 are located approximately 40 km to the west, and are not shown on the above map.

200. Hourly average concentrations of PM₁₀, PM_{2.5}, SO₂ and NO₂ for the past three years (2016-2018) were collected from stations AQ1 to AQ6, processed and analyzed by month, with the maximum, minimum and average 1-hour and 24-hour means selected or calculated. Invalid data due to monitoring failure or other errors were deleted. The results were compared to the relevant Class II limits specified in the *Ambient Air Quality Standards* (GB3095-2012) and the WHO/EHS Air Quality Guidelines, and findings are presented in Figure 59 to Figure 64. The worst case 1-hour and 24-hour values, and average values for each year are presented in Table 23 to Table 25, and compared to the relevant standards.

Figure 59: SO₂, max, min and average 1-hour values by month, 2016 - 2018, at AQ1-AQ6

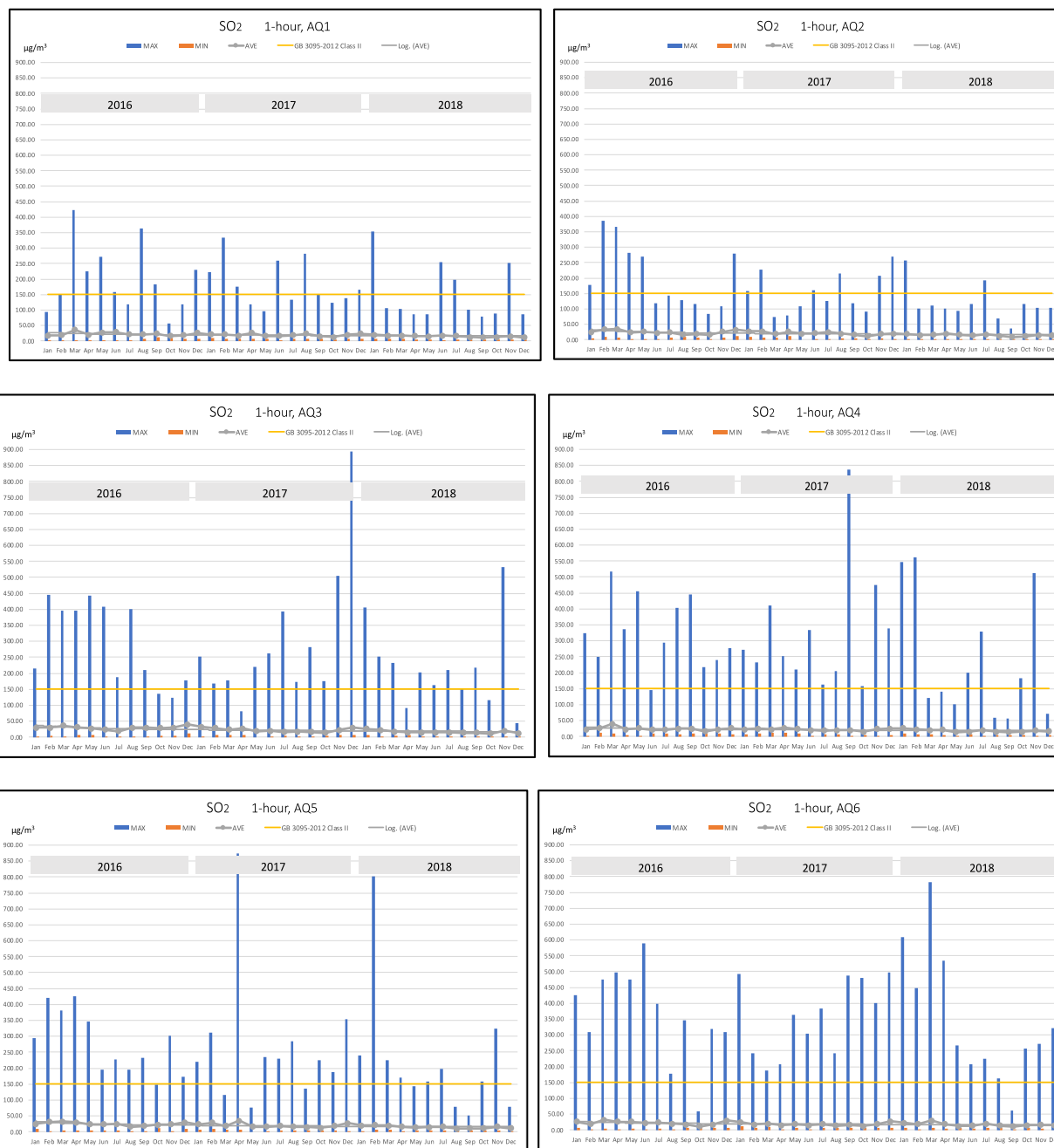


Figure 60: NO₂, max, min and average 1-hour values by month, 2016 - 2018, at AQ1-AQ6

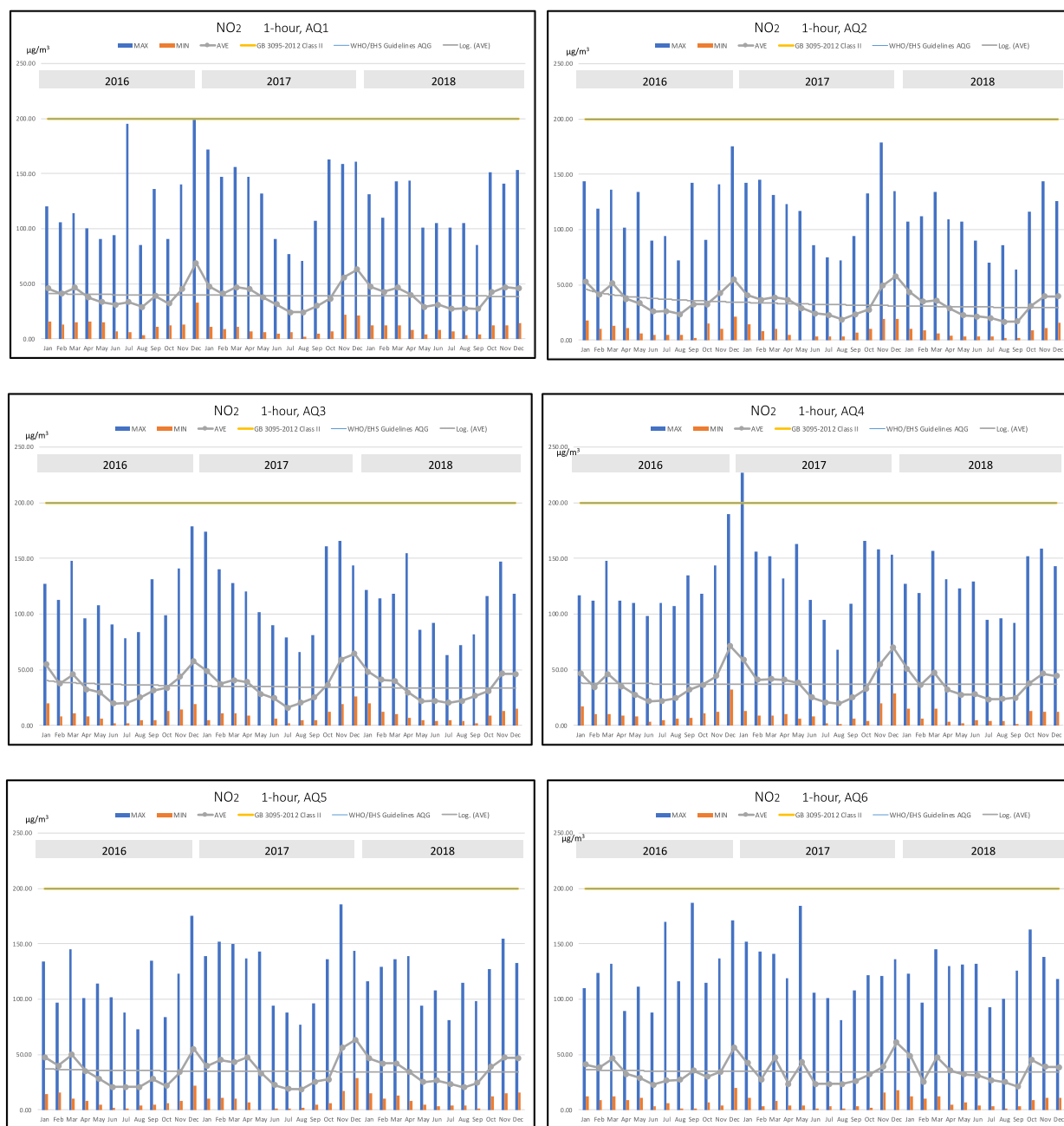


Figure 61: PM₁₀, 24-hour values by month, 2016 - 2018, at AQ1-AQ6

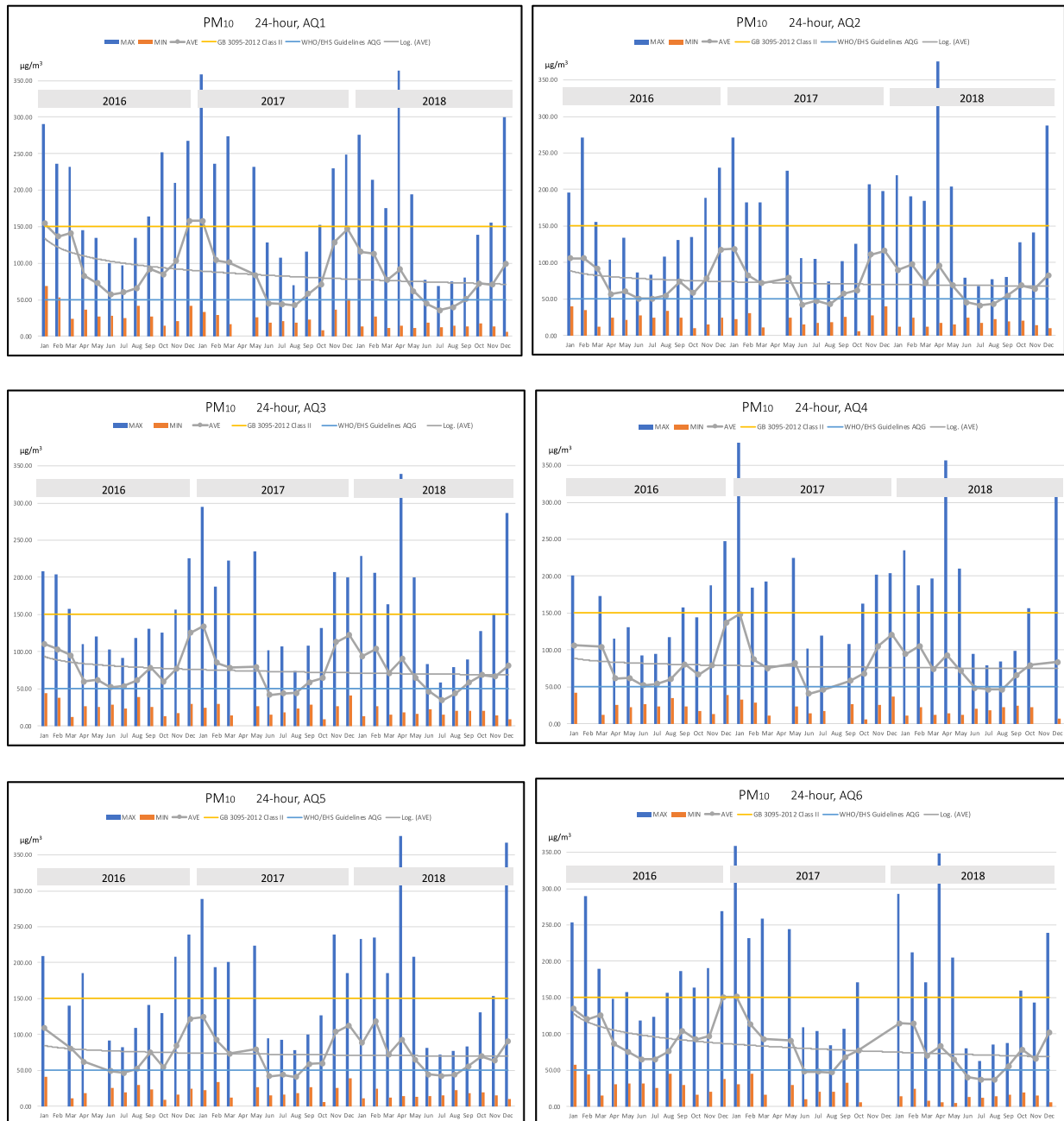


Figure 62: PM_{2.5}, 24-hour values by month, 2016 - 2018, at AQ1-AQ6



Figure 63: SO₂, 24-hour values by month, 2016 - 2018, at AQ1-AQ6



Figure 64: NO₂, 24-hour values by month, 2016 - 2018, at AQ1-AQ6

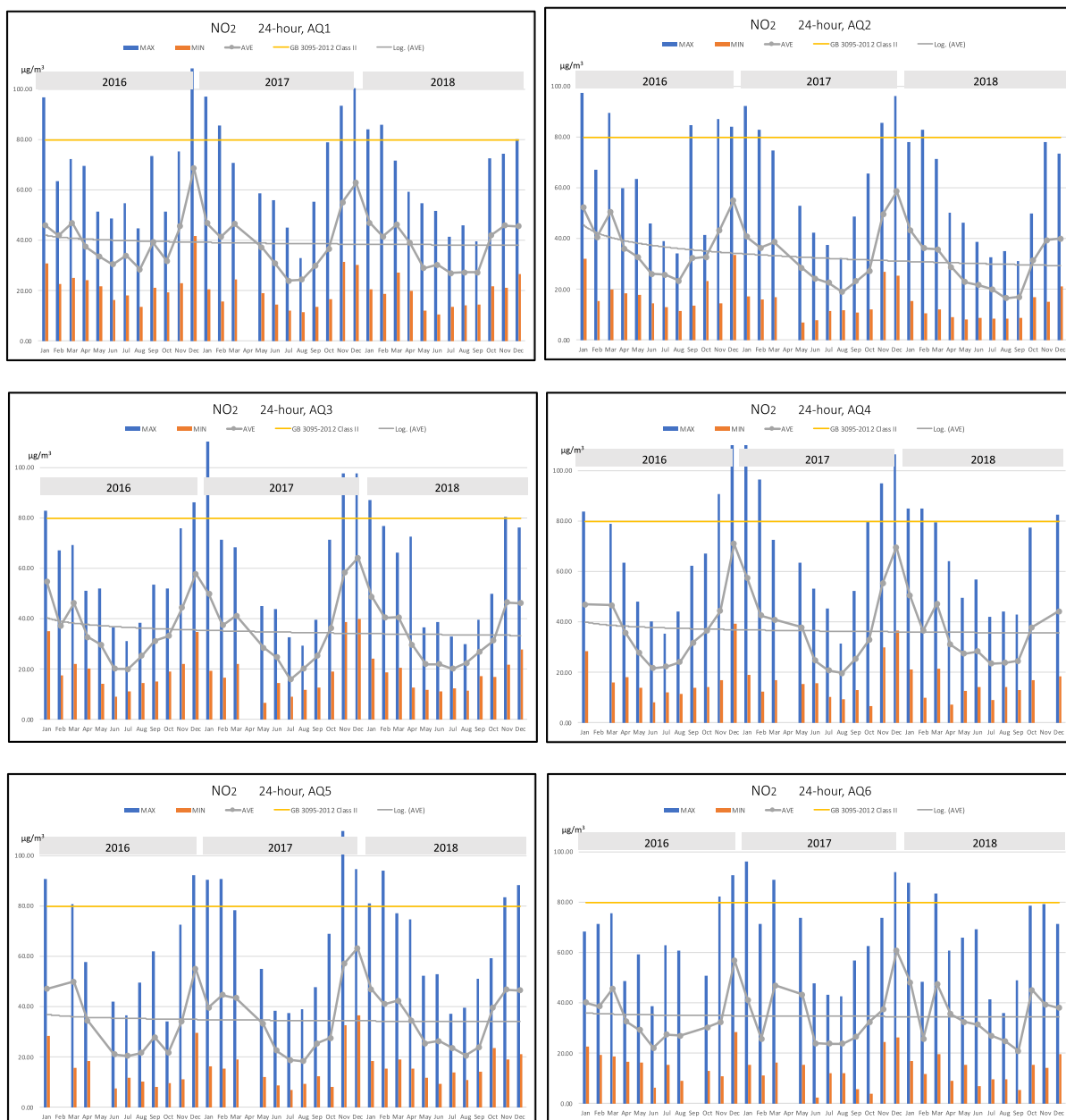


Table 23: Worst case 1-hour ambient air quality monitoring results, 2016-2018, 6 XEEB urban air quality monitoring stations

No.	Station Name	Worst Case 1-hour Pollutant Concentration (µg/m³)				Ambient Air Quality Standards (GB3095-2012) (µg/m³)	WHO/EHS Guidelines (µg/m³)
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂	Class II	AQG
2016							
AQ1	XEEB	264	782	423	200		
AQ2	Jiang Lu	405	781	386	175		
AQ3	Yue Tang	283	582	445	179		
AQ4	Ban Tang	272	437	518	190		
AQ5	Ke Da	254	493	426	175		
AQ6	Shao Shan	508	726	590	187		
2017							
AQ1	XEEB	419	620	335	172	PM _{2.5} : n/a PM ₁₀ : n/a SO ₂ : 500 NO ₂ : 200	PM _{2.5} : n/a PM ₁₀ : n/a SO ₂ : n/a NO ₂ : 200
AQ2	Jiang Lu	385	603	270	179		
AQ3	Yue Tang	429	592	893	174		
AQ4	Ban Tang	427	525	836	227		
AQ5	Ke Da	409	602	874	186		
AQ6	Shao Shan	426	557	492	184		
2018							
AQ1	XEEB	381	469	355	153		
AQ2	Jiang Lu	353	469	257	144		
AQ3	Yue Tang	378	425	531	155		
AQ4	Ban Tang	380	439	562	159		
AQ5	Ke Da	338	445	801	155		
AQ6	Shao Shan	366	436	782	163		

Source: XEEB, 2016-2018.

Note: Results that exceeded *Ambient Air Quality Standards (GB3095-2012)* are marked in red.**Table 24: Worst case 24-hour ambient air quality monitoring results, 2016-2018, 6 XEEB urban air quality monitoring stations**

No.	Station Name	Worst Case 24-hour Pollutant Concentration (µg/m³)				Ambient Air Quality Standards (GB3095-2012) (µg/m³)	WHO/EHS Guidelines (µg/m³)	
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂	Class II	AQG	
2016							PM _{2.5} : 75; PM ₁₀ : 150; SO ₂ : 150; NO ₂ : 80.	PM _{2.5} : 25; PM ₁₀ : 50; SO ₂ : 20; NO ₂ : n/a.
AQ1	XEEB	152	290	92	108			
AQ2	Jiang Lu	224	272	111	97			
AQ3	Yue Tang	283	226	107	86			
AQ4	Ban Tang	166	248	113	118			
AQ5	Ke Da	160	239	134	92			
AQ6	Shao Shan	261	290	174	91			
2017								
AQ1	XEEB	211	359	101	101			
AQ2	Jiang Lu	222	271	71	80			
AQ3	Yue Tang	214	295	138	119			

No.	Station Name	Worst Case 24-hour Pollutant Concentration (µg/m³)				Ambient Air Quality Standards (GB3095-2012) (µg/m³)	WHO/EHS Guidelines (µg/m³)
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂	Class II	AQG
AQ4	Ban Tang	234	385	141	145		
AQ5	Ke Da	206	289	97	110		
AQ6	Shao Shan	219	359	120	96		
2018							
AQ1	XEEB	294	364	65	86		
AQ2	Jiang Lu	306	375	81	83		
AQ3	Yue Tang	237	340	100	87		
AQ4	Ban Tang	281	357	120	85		
AQ5	Ke Da	304	376	100	94		
AQ6	Shao Shan	233	349	172	88		

Source: XEEB, 2016-2018.

Note: Results that exceeded *Ambient Air Quality Standards (GB3095-2012)* are marked in red.

Table 25: Annual-average ambient air quality monitoring results, 2016-2018, 6 XEEB urban air quality monitoring stations

No.	Station Name	Annual-average pollutant Concentration (µg/m³)				Ambient Air Quality Standards (GB3095-2012) (µg/m³)	WHO/EHS Guidelines (µg/m³)
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂	Class II	AQG
2016						PM _{2.5} : 35; PM ₁₀ : 70; SO ₂ : 60; NO ₂ : 40.	PM _{2.5} : 10; PM ₁₀ : 20; SO ₂ : n/a; NO ₂ : 40.
AQ1	XEEB	51	101	23	40		
AQ2	Jiang Lu	52	75	25	38		
AQ3	Yue Tang	54	78	29	36		
AQ4	Ban Tang	48	79	24	37		
AQ5	Ke Da	49	74	24	33		
AQ6	Shao Shan	55	99	22	35		
2017							
AQ1	XEEB	53	89	19	40		
AQ2	Jiang Lu	54	76	21	34		
AQ3	Yue Tang	55	79	22	37		
AQ4	Ban Tang	51	83	21	39		
AQ5	Ke Da	53	76	19	36		
AQ6	Shao Shan	47	82	18	35		
2018							
AQ1	XEEB	50	73	15	37		
AQ2	Jiang Lu	49	69	15	29		
AQ3	Yue Tang	49	69	16	33		
AQ4	Ban Tang	49	74	18	34		
AQ5	Ke Da	50	71	15	35		
AQ6	Shao Shan	45	72	17	35		

Source: XEEB, 2016-2018.

Note: Results that exceeded *Ambient Air Quality Standards (GB3095-2012)* are marked in red.

201. From Figure 59 to Figure 64, it can be observed that air quality is most degraded during the winter and is best from June to October of each year. Although there is no formal winter heating season in Xiangtan it may still be in part be a result of increased winter time heating and power consumption. In addition, the prevailing winter wind direction is from the north/northwest, and pollution sources to the north (e.g. Jiuhua Industrial Zone, Highways G4 and G60, etc.) may have significant contributions to winter time urban air quality.

202. Average pollutant values showed a slight reduction at each station over the three year period. According to the XEEB, a program to reduce pollutant emission from heavy industries in Xiangtan City was undertaken from 2015 to 2017, focusing on industries with significant emission sources such as heating boilers and power plants. The monitoring results indicate that these efforts have had some positive effects but the impact seems to be leveling off.

203. The average 1-hour means of both SO_2 and NO_2 were in compliance with the applicable standard, Class II of *Ambient Air Quality Standards (GB3095-2012)*. This means although the worst case 1-hour means exceeded the standard (see below), the hourly averages were in compliance.

204. The average 24-hour means for both $\text{PM}_{2.5}$ and PM_{10} showed exceedance of the PRC standard in the winter time. This means that fine particles pose pollution risk for urban inhabitants on a both worst case and daily average in the winter time. For SO_2 , although the average 24-hour mean complied with the Chinese standard in all three years, it still exceeded the WHO standard in most of 2016 and 2017.

205. From Table 23 to Table 25 it can be observed that the worst case SO_2 1-hour values exceeded the standard in AQ3, AQ4, AQ5 and AQ6 during the past three years. The number of monitoring stations with high SO_2 worst case 1-hour concentration increased over the years, showing a trend that SO_2 pollution is expanding geographically within the city.

206. There are no relevant 1-hour value standards for PM_{10} and $\text{PM}_{2.5}$, and thus no evaluation was undertaken for those two factors on a 1-hour basis.

207. Almost all of the worst case 24-hour values for PM_{10} , $\text{PM}_{2.5}$ and NO_2 exceeded the relevant PRC standards. SO_2 was generally in compliance with the PRC standard except at AQ6 in 2016 and 2018, but was not compliant if compared to WHO standard. This indicates that, in worst case conditions, the entire program area was exposed to degraded air quality conditions.

208. The mean annual values of both PM_{10} and $\text{PM}_{2.5}$ at all six monitoring stations exceeded both the PRC and WHO standards, while SO_2 and NO_2 were both in compliance. This may be a result of PM_{10} and $\text{PM}_{2.5}$ pollution being less likely to be diluted as a result of wind or other weather conditions, and indicates that on an annual basis the entire program area was exposed to degraded air quality conditions.

209. A summary of the worst case 1-hour, 24-hour and annual results compared to PRC standards is presented in Table 26.

b. Surface Water Quality

210. Surface water quality was assessed based on monitoring undertaken once a month at five XEEB monitoring stations (Figure 65) throughout 2018. SW3 and SW4 are considered the most relevant monitoring locations in regards to the program as they are located on the main stem of

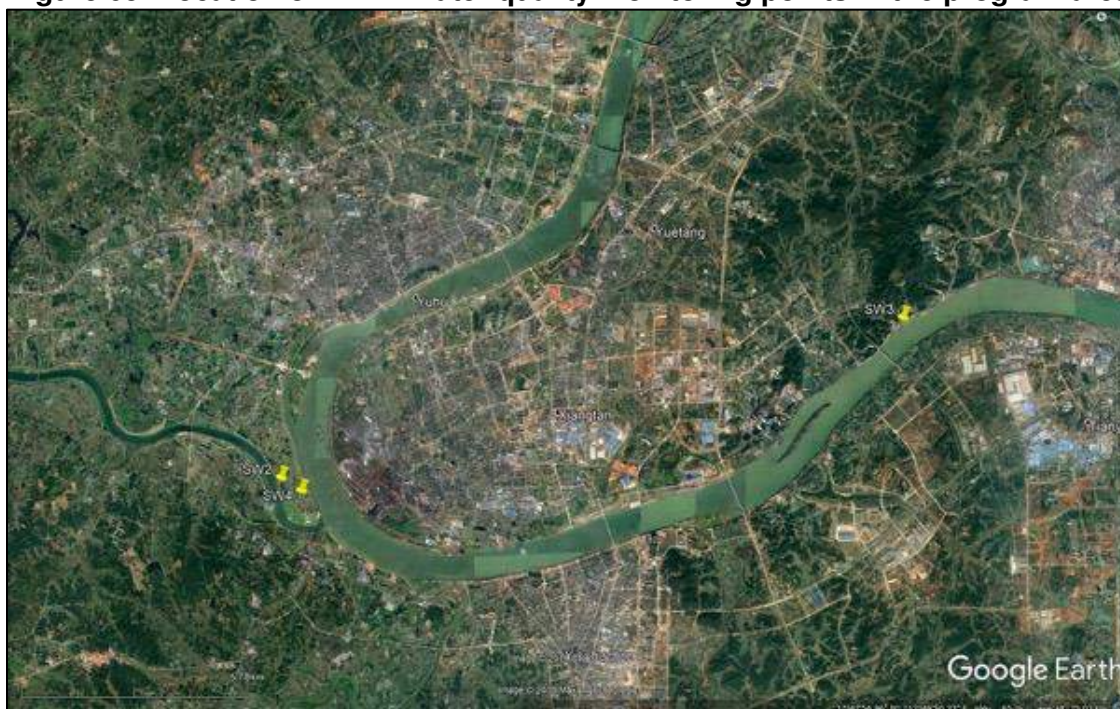
the Xiangjiang River within the program area. Water quality at both SW3 and SW4 is good, and is in compliance with Level III standard in the *Environmental Quality Standards for Surface Water* (GB3838-2002) (Table 6 and Table 7).

Table 26: Compliance of worst case and annual ambient air quality monitoring results from 2016 to 2018 with applicable PRC standards

No.	Station Name	Applicable Air Quality Class (GB3095-2012)	Actual Air Quality Class, 2016-2018	Exceedance of Standard
AQ1	XEEB	Level II	Level II	Worst case 24-hour: PM _{2.5} , PM ₁₀ , NO ₂ ;
AQ2	Jiang Lu	Level II	Level II	Annual: PM _{2.5} , PM ₁₀ .
AQ3	Yue Tang	Level II	Level II	Worst case 1-hour: SO ₂ ;
				Worst case 24-hour: PM _{2.5} , PM ₁₀ , NO ₂ ;
				Annual: PM _{2.5} , PM ₁₀ .
AQ4	Ban Tang	Level II	Level II	Worst case 1-hour: SO ₂ , NO ₂ ;
				Worst case 24-hour: PM _{2.5} , PM ₁₀ , NO ₂ ;
				Annual: PM _{2.5} , PM ₁₀ .
AQ5	Ke Da	Level II	Level II	Worst case 1-hour: SO ₂ ;
				Worst case 24-hour: PM _{2.5} , PM ₁₀ , SO ₂ , NO ₂ ;
				Annual: PM _{2.5} , PM ₁₀ .
AQ6	Shao Shan	Level II	Level II	Worst case 1-hour: SO ₂ ;
				Worst case 24-hour: PM _{2.5} , PM ₁₀ , SO ₂ , NO ₂ ;
				Annual: PM _{2.5} , PM ₁₀ .

Source: XEEB, 2016-2018.

Figure 65: Location of XEEB water quality monitoring points in the program area



Source: XEEB 2019; Google Earth 2019.

Note: SW1 and SW5 are located approximately 30 to 80 km to the west, and are not shown on the above map.

Table 27: Water quality monitoring data and standard, SW3 cross-section of Xiangjiang River, 2018

Monitoring period	6-9	≤20	≤1.0	≤10	≤1.0	≤0.1	≤0.05	≤0.0001	≤0.005	≤0.3	≤250
	pH	COD _{Cr}	Ammonia nitrogen	Nitrate	Copper	Manganese	Arsenic	Mercury	Cadmium	Iron	Sulfate
January	8.22	8	0.44	1.83	0.002	0.04	0.0032	--	0.0003	0.03	34.4
February	7.67	6	0.34	1.73	--	0.04	0.0033	0.00003	0.0003	0.06	28.9
March	8.36	8	0.31	1.49	0.004	--	0.0042	--	0.0002	--	31.1
April	7.73	8	0.42	1.72	0.004	0.04	0.0042	--	0.0002	--	24.1
May	7.77	8	0.34	1.80	0.002	0.02	0.0062	--	0.0002	--	26.9
June	8.18	8	0.09	1.61	0.012	0.02	0.0052	--	0.0004	--	22.6
July	8.12	9	0.21	1.72	0.003	--	0.0079	--	0.0002	--	21.4
August	8.25	8	0.04	1.12	0.003	0.02	0.0083	--	0.0002	--	19.8
September	7.89	8	0.07	1.00	0.005	--	0.009	--	0.0002	--	21.9
October	7.49	7	0.05	1.43	0.002	0.02	0.006	0.00004	0.0001	--	19.8
November	7.88	8	0.07	1.24	0.004	0.01	0.0051	--	0.0002	--	23.6
December	7.74	6	0.24	1.48	0.002	0.03	0.0058	--	0.0002	0.03	25.0
In conformity with standard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: *Monitoring Report on drinking water resource of Xiangtan city, 2018.*

Table 28: Water quality monitoring data and standard, SW4 cross-section of Xiangjiang River, 2018

Monitoring period	6-9	≤20	≤1.0	≤10	≤1.0	≤0.1	≤0.05	≤0.0001	≤0.005	≤0.3	≤250
	pH	COD _{Cr}	Ammonia nitrogen	Nitrate	Copper	Manganese	Arsenic	Mercury	Cadmium	Iron	Sulfate
January	8.50	7	0.34	1.85	0.001	0.04	0.0037	0.00003	0.0005	0.02	35.6
February	7.79	7	0.36	1.73	0.0007	0.04	0.0031	--	0.0002	0.07	28.0
March	8.25	6	0.30	1.45	0.004	--	0.0028	0.00002	0.0004	0.02	28.4
April	7.77	8	0.37	1.73	0.003	0.03	0.0042	--	0.0002	--	25.2
May	7.78	8	0.32	1.79	0.004	0.02	0.0063	0.00001	0.0002	--	25.6
June	8.12	7	0.10	1.61	0.002	0.01	0.0055	--	0.0001	--	21.6
July	8.07	9	0.22	1.73	0.002	--	0.0049	--	--	--	23.6
August	8.22	8	0.05	1.13	0.002	--	0.0076	--	--	--	19.7
September	7.86	7	0.05	0.99	0.005	--	0.009	--	0.0002	--	19.8
October	7.58	7	0.05	1.45	0.007	0.01	0.0062	0.00001	0.0004	--	20.0
November	8.47	7	0.09	1.23	0.003	0.02	0.0047	0.00001	0.0002	--	24.6
December	7.72	9	0.20	1.47	0.003	0.02	0.0048	0.00001	0.0002	0.03	23.4
In conformity with standard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: *Monitoring Report on drinking water resource of Xiangtan city, 2018.*

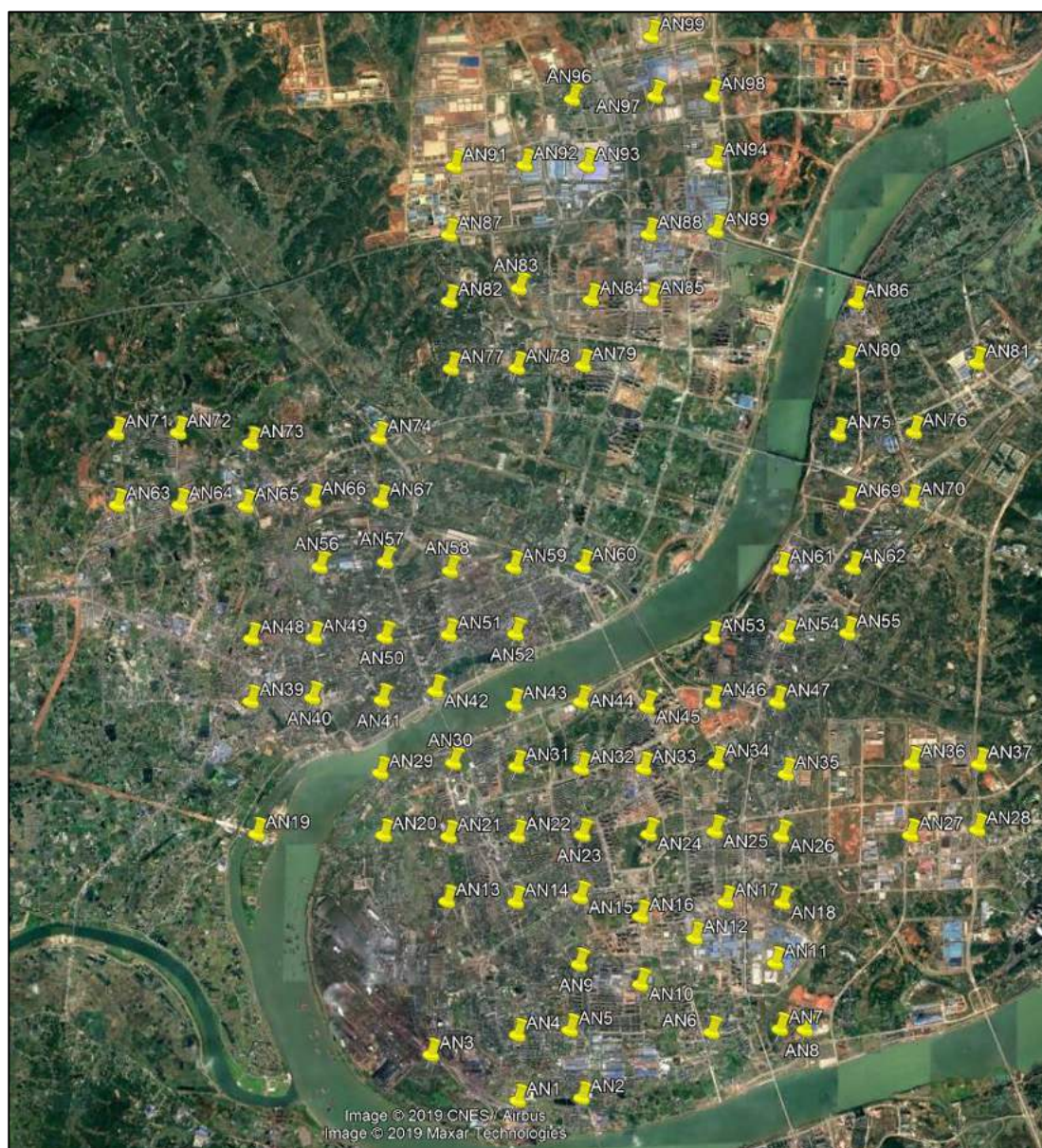
c. Groundwater Quality

211. The XEEB states that groundwater quality in the program area is in compliance with Level III water quality specified in the *Quality Standard for Groundwater* (GB/T14848-2017). However, there is no data available to review due to PRC data security policies.

d. Noise

212. Urban environment noise level was assessed based on monitoring undertaken at 100 monitoring stations installed in 1 km x 1 km grid and monitored by XEEB (Figure 66). According to the *Annual Monitoring Report on Ambient Noise of Xiangtan* (2018, XEEB), monitoring stations are categorized in 4 classes, corresponding to Class I, II, III, IV b in the national standard *Environmental Quality Standard for Noise* (GB309-2008), respectively. The monitoring results are presented in Table 8. The monitoring takes place once a year for day-time noise, and once every five years for night time noise. In the past three years from 2016 to 2018, night-time monitoring only took place in 2018, though day-time monitoring was carried out every year.

Figure 66: Location of XEEB ambient noise monitoring stations in the program area



Source: XEEB, 2019, and Google Earth, 2019.

Note: AN38, AN68, AN90, AN95 and AN100 are located approximately 40 to 90 km to the west, and are not shown on the above map.

Table 29: Ambient day and nighttime noise monitoring data, XEEB, 2016-2018

Point No.	Applicable Standard Class	Monitoring Result						Complies with Standard? Yes / No	
		Day time dB(A)			Standard dB(A)	Night time dB(A)			Standard dB(A)
		2016	2017	2018		2018			
AN25	Class I	49.6	57.1	59.1	55	53.3	45	No	
AN63	Class I	54.5	52.7	51.8	55	44.6	45	Yes	
AN64	Class I	49.6	54.7	51.7	55	49.5	45	No	
AN71	Class I	55.9	53.8	48.9	55	42.6	45	No	
AN73	Class I	57.8	56	49	55	42.2	45	No	
AN78	Class I	52.4	55.4	60.8	55	45.3	45	No	
AN82	Class I	53.6	54.4	58.4	55	41.9	45	No	
AN83	Class I	53.1	54.3	55.9	55	40.3	45	No	
AN84	Class I	53.5	51	49.7	55	45.6	45	No	
AN2	Class II	46.6	49.8	48.8	60	41	50	Yes	
AN4	Class II	53.1	59.7	59.5	60	42.6	50	Yes	
AN5	Class II	52.7	60.3	54.5	60	43.9	50	No	
AN6	Class II	49.5	54.1	52.5	60	41.9	50	Yes	
AN7	Class II	50.6	53.7	52.8	60	45.7	50	Yes	
AN8	Class II	58.2	49.4	52.3	60	42	50	Yes	
AN9	Class II	49.6	49.9	52.8	60	45.7	50	Yes	
AN10	Class II	51.4	55.7	51.7	60	45.1	50	Yes	
AN11	Class II	49.6	50.3	51.9	60	42.6	50	Yes	
AN13	Class II	57.8	50.1	52	60	52.1	50	No	
AN14	Class II	54.8	54.5	57.2	60	45.2	50	Yes	
AN15	Class II	52.5	57.8	50.4	60	42.9	50	Yes	
AN18	Class II	53	57.3	56.7	60	48.5	50	Yes	
AN19	Class II	49.7	48.9	48.6	60	38.8	50	Yes	
AN24	Class II	46.5	54.5	55.9	60	46.2	50	Yes	
AN30	Class II	50.8	50.2	53.1	60	41.1	50	Yes	
AN31	Class II	55.6	47.8	50.3	60	44.7	50	Yes	
AN34	Class II	53.1	52.7	47.6	60	46.3	50	Yes	
AN35	Class II	49.7	52.6	51.5	60	42.3	50	Yes	
AN36	Class II	48.4	55	47.9	60	41.9	50	Yes	
AN37	Class II	49.4	57.7	48	60	41.2	50	Yes	
AN39	Class II	56.5	53.7	53.5	60	45.5	50	Yes	
AN40	Class II	55.9	52.5	51.9	60	48.2	50	Yes	
AN41	Class II	56.6	50.5	53.2	60	46.4	50	Yes	
AN42	Class II	57	61	53	60	50.9	50	No	
AN44	Class II	59.3	51.5	51.1	60	41.7	50	Yes	
AN45	Class II	52.7	50.7	58	60	41.6	50	Yes	
AN46	Class II	50.1	47	48.8	60	41.2	50	Yes	
AN48	Class II	52.5	52.4	47.4	60	47.7	50	Yes	
AN49	Class II	50.1	52.9	50.1	60	42.9	50	Yes	
AN50	Class II	52.9	54.7	52	60	38.2	50	Yes	
AN51	Class II	52.7	52.1	50.8	60	42.5	50	Yes	
AN52	Class II	50.3	56.6	45.1	60	42.4	50	Yes	
AN53	Class II	52.9	52.2	54	60	44	50	Yes	
AN55	Class II	52.6	53.5	53.8	60	40.9	50	Yes	
AN56	Class II	50.3	59.5	61.5	60	48.8	50	No	
AN57	Class II	46.3	47.4	53	60	44.2	50	Yes	
AN58	Class II	52.6	52.7	50.4	60	48.8	50	Yes	
AN59	Class II	55.4	51.3	49.8	60	48.1	50	Yes	

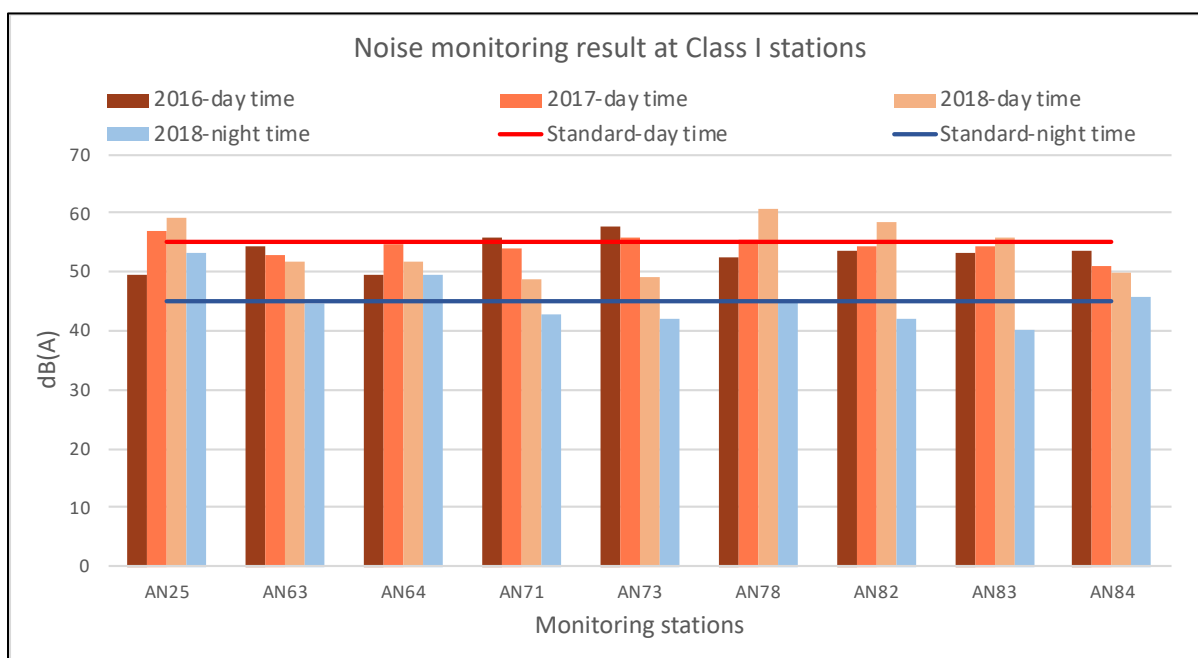
Point No.	Applicable Standard Class	Monitoring Result						Complies with Standard? Yes / No
		Day time dB(A)			Standard dB(A)	Night time dB(A)	Standard dB(A)	
		2016	2017	2018				
AN60	Class II	55.8	52.8	60.7	60	39.2	50	No
AN61	Class II	58.5	51	53.3	60	47.5	50	Yes
AN62	Class II	51.2	53.8	56.2	60	44.1	50	Yes
AN69	Class II	51.4	52.2	55.5	60	44.7	50	Yes
AN70	Class II	49.3	51.4	52.9	60	46.2	50	Yes
AN72	Class II	50.7	52.9	51.7	60	40.4	50	Yes
AN74	Class II	59.4	62.8	58.7	60	51.3	50	No
AN75	Class II	51.1	45.8	47.3	60	51.7	50	No
AN76	Class II	52.9	51.8	52.9	60	44.3	50	Yes
AN77	Class II	44.4	57.6	56.5	60	41.2	50	Yes
AN79	Class II	55.8	58.1	58.8	60	39.8	50	Yes
AN85	Class II	58.8	51.4	56.7	60	41.1	50	Yes
AN92	Class II	50.3	55.4	49.4	60	46.9	50	Yes
AN96	Class II	57.6	60.5	56.1	60	41.5	50	No
AN1	Class III	55.8	61.8	53.6	65	38.7	55	Yes
AN3	Class III	59.6	59.2	57	65	51.3	55	Yes
AN12	Class III	52.6	55.3	55.7	65	48.9	55	Yes
AN16	Class III	52.7	59.5	53.8	65	41.9	55	Yes
AN17	Class III	50.1	57.8	58.1	65	46.1	55	Yes
AN21	Class III	--	51.2	55.7	65	40.9	55	Yes
AN22	Class III	52.2	53.2	54.3	65	49.3	55	Yes
AN23	Class III	56.7	60.4	60.8	65	51.4	55	Yes
AN26	Class III	55.5	55.8	49.5	65	45.7	55	Yes
AN27	Class III	52.2	60.1	54.9	65	50.7	55	Yes
AN28	Class III	50.7	55.1	50.3	65	44.4	55	Yes
AN29	Class III	44.5	58.5	54.1	65	42.1	55	Yes
AN33	Class III	57.8	58.9	59.4	65	39.1	55	Yes
AN47	Class III	52.9	50.5	53.6	65	45.1	55	Yes
AN65	Class III	54	50.5	53.6	65	47	55	Yes
AN80	Class III	55.3	53.5	47.6	65	43.8	55	Yes
AN81	Class III	50.3	47.2	52.1	65	47	55	Yes
AN88	Class III	54.3	53.9	50.6	65	49.9	55	Yes
AN89	Class III	55.7	52.7	61	65	46.8	55	Yes
AN91	Class III	45.3	51.5	61	65	47	55	Yes
AN94	Class III	52.8	57.6	57.6	65	47	55	Yes
AN97	Class III	43.2	53.9	56.3	65	46.2	55	Yes
AN20	Class IV b	49.1	54.9	52.1	70	51.5	60	Yes
AN32	Class IV b	52.3	51.4	53.2	70	45.4	60	Yes
AN43	Class IV b	61.2	54.7	59.2	70	49.4	60	Yes
AN54	Class IV b	58.5	59.9	59.6	70	50.1	60	Yes
AN66	Class IV b	57.7	52.6	52.6	70	49.5	60	Yes
AN67	Class IV b	53.6	65.2	52.5	70	46.6	60	Yes
AN86	Class IV b	64.7	60	63.8	70	54.9	60	Yes
AN87	Class IV b	58.5	63	56.3	70	41.3	60	Yes
AN92	Class IV b	45	52.9	51.1	70	48.8	60	Yes
AN93	Class IV b	47.8	61.2	58.8	70	48.6	60	Yes
AN98	Class IV b	50.3	53.9	54.8	70	51.2	60	Yes
AN99	Class IV b	52.2	61.8	51.9	70	53	60	Yes

Source: *Monitoring results of Ambient Noise Quality, XEEB, 2019.*

Notes: 1, monitoring took place at each station one time per year. 2, the results which exceeded applicable standard are marked in red.

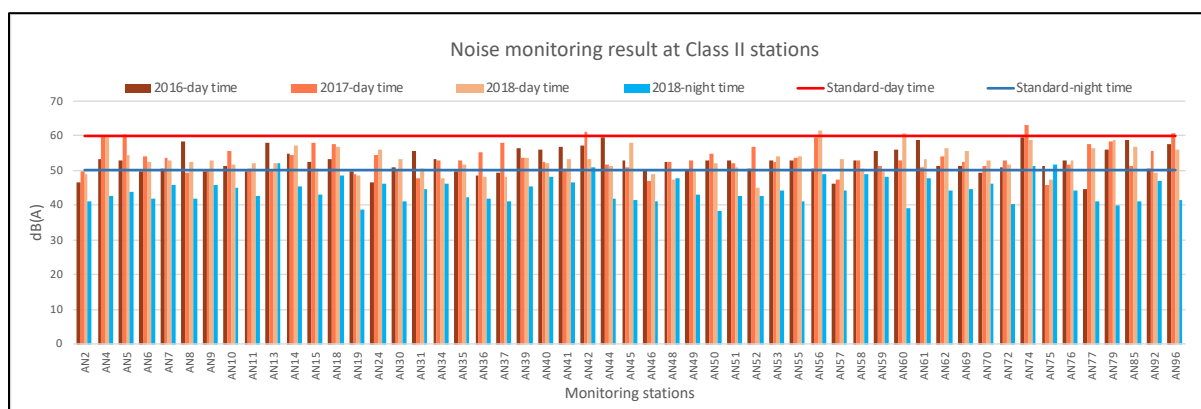
213. Class I stations are in highly noise sensitive areas; only one Class I station was in full compliance with the relevant standard over the time period. For Class II stations, 85% met the standard but eight locations exceeded standard. All Class III and Class IV b stations complied with the standard (Figure 67 to Figure 70).

Figure 67: Noise monitoring results at Class I stations

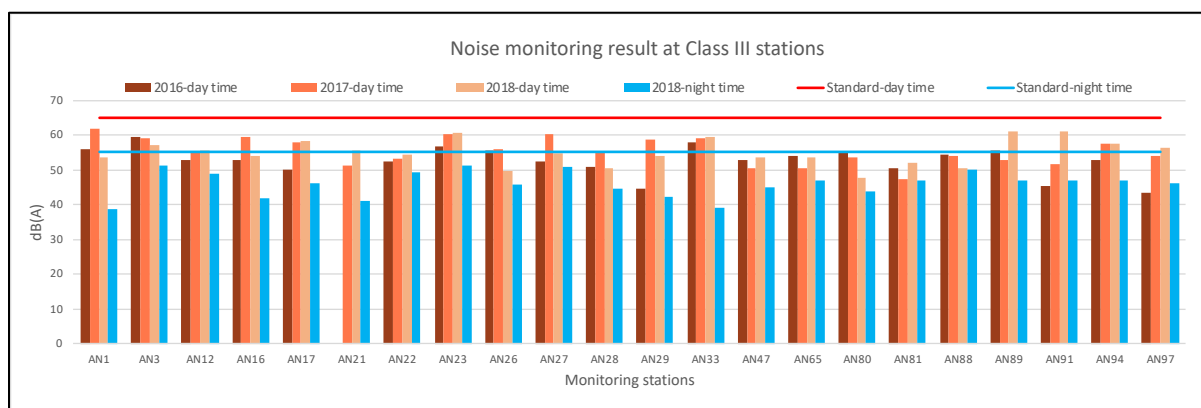


Source: *Monitoring results of Ambient Noise Quality, XEEB, 2019.*

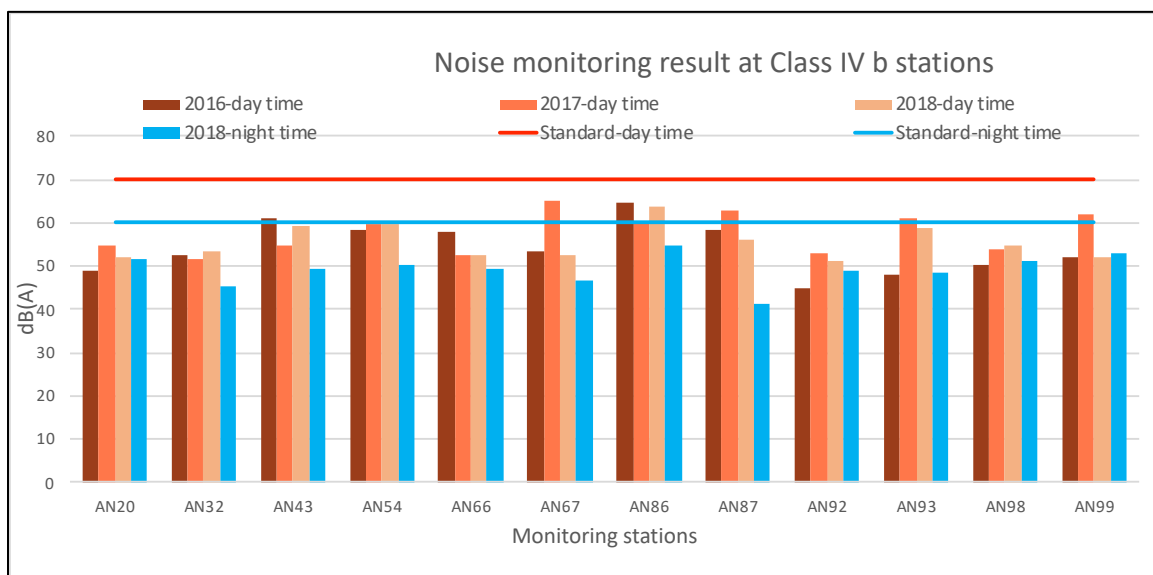
Figure 68: Noise monitoring results at Class II stations



Source: *Monitoring results of Ambient Noise Quality, XEEB, 2019.*

Figure 69: Noise monitoring results at Class III stations

Source: Monitoring results of Ambient Noise Quality, XEEB, 2019.

Figure 70: Noise monitoring results at Class IVb stations

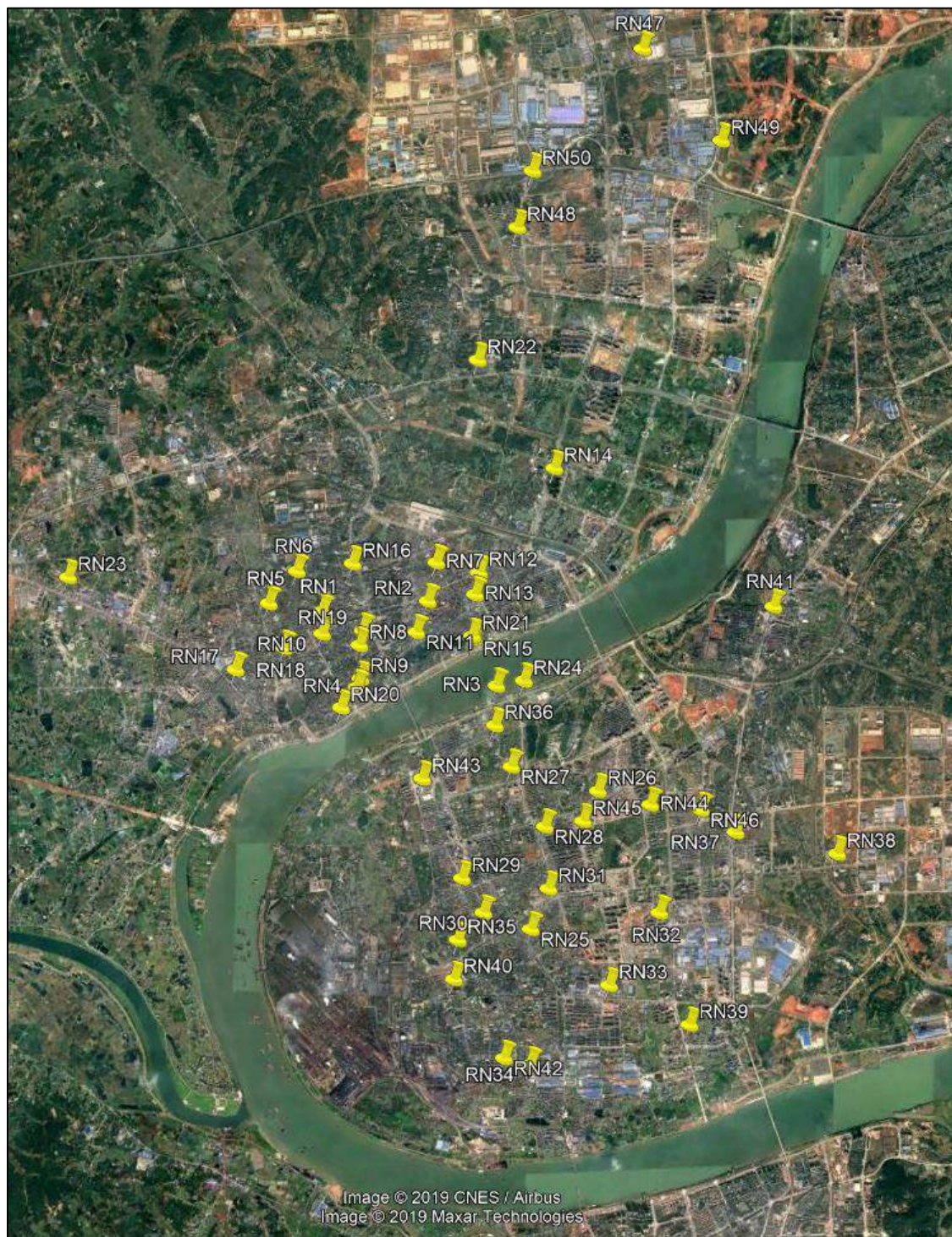
Source: Monitoring results of Ambient Noise Quality, XEEB, 2019.

214. Noise levels at main roads in the program area were also assessed through monitoring undertaken at 50 XEEB road side noise monitoring stations (Figure 71). According to the *Annual Monitoring on Road Noise of Xiangtan* (XEEB, 2018), all the monitoring stations were installed within 200 m from the center line of the road, with monitoring taking place once every year for day-time noise, and once every five years for night-time noise. The monitoring results are presented in Table 9.

215. Of the 50 monitoring stations, only 8 complied with the Class IV *Environmental Quality Standard for Noise* (GB3096-2008), and 84% of the locations exceeded the standard. Night time noise levels had the most non-compliances.

216. The monitoring results for Fuxing Middle Road (RN27) showed that the day time noise level was non-compliant with the standard during the 2017 monitoring, and night time was non-compliant during the 2018 monitoring.

Figure 71: Location of XEEB road noise monitoring stations in the program area



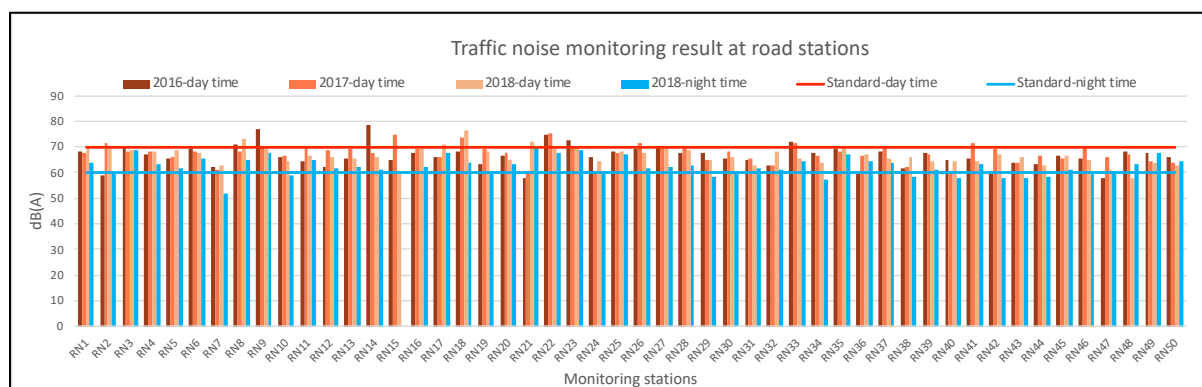
Source: XEEB, 2019, and Google Earth, 2019.

Table 30: Road noise monitoring data, XEEB, 2016-2018

Point No.	Monitoring Result						Complies with Standard? Yes / No
	2016	Day time dB(A)		Standard dB(A)	Night time dB(A)	Standard dB(A)	
		2017	2018				
RN1	68.2	67.7	70.3	70	63.9	60	No
RN2	58.8	71.2	69.7	70	59.9	60	No
RN3	69.9	68.1	68.6	70	68.6	60	No
RN4	66.9	68	67.9	70	63.1	60	No
RN5	65.6	66.1	68.9	70	61.5	60	No
RN6	69.1	68.4	67.5	70	65.6	60	No
RN7	62	61.1	62.6	70	52	60	Yes
RN8	70.8	68.2	73	70	64.7	60	No
RN9	77	70.2	69.3	70	67.5	60	No
RN10	66.1	66.6	64.1	70	58.8	60	Yes
RN11	64.2	70	66.5	70	64.8	60	No
RN12	62.2	68.6	65.9	70	61.6	60	No
RN13	65.3	69.4	65.7	70	62.1	60	No
RN14	78.8	67.6	65.8	70	61.3	60	No
RN15	64.8	74.8	59.4	70	/	60	No
RN16	67.5	69.4	69.8	70	62.2	60	No
RN17	66	66	71	70	67.6	60	No
RN18	68.4	73.6	76.1	70	64	60	No
RN19	63.2	69.3	68.2	70	60.5	60	No
RN20	66.8	67.4	64.8	70	63.2	60	No
RN21	57.7	60.7	72.1	70	69.6	60	No
RN22	74.6	75.3	69.8	70	67.7	60	No
RN23	72.6	70	70.2	70	68.5	60	No
RN24	66.2	60.6	64.2	70	60.7	60	No
RN25	68.2	67.8	68.2	70	66.9	60	No
RN26	69.1	71.3	67.6	70	61.7	60	No
RN27	70	70.6	69.6	70	62.3	60	No
RN28	67.5	69.7	68.8	70	62.9	60	No
RN29	67.8	65	64.8	70	58.4	60	Yes
RN30	65.3	68	66.2	70	60.7	60	No
RN31	65.1	65.3	62.6	70	61.8	60	No
RN32	62.8	62.6	68	70	61.3	60	No
RN33	72.2	71.3	65.2	70	64.6	60	No
RN34	67.8	66.3	63.7	70	57	60	Yes
RN35	69	68.3	70.4	70	67.1	60	No
RN36	59.4	66.7	66.9	70	64.1	60	No
RN37	68	70.3	65.2	70	63.9	60	No
RN38	61.8	62.2	66.1	70	58.5	60	Yes
RN39	67.6	67.2	64.6	70	60.8	60	No
RN40	64.7	60.5	64.2	70	57.7	60	Yes
RN41	65.6	71.3	64.6	70	63	60	No
RN42	59.6	69.3	67.3	70	57.7	60	Yes
RN43	63.6	63.6	65.9	70	57.8	60	Yes
RN44	63.2	66.6	62.5	70	58.5	60	Yes
RN45	66.4	65.6	66.7	70	60.9	60	No
RN46	65.6	69.7	64.8	70	60.5	60	No
RN47	57.7	65.8	61.1	70	60.5	60	No
RN48	68.2	67	58	70	63.2	60	No
RN49	67.6	64.1	63.9	70	67.4	60	No
RN50	66	63.7	62.9	70	64.3	60	No

Source: *Annual Monitoring on Road Noise of Xiangtan*, XEEB, 2019.

Notes: 1, monitoring took place at each station one time per year. 2, the results which exceeded applicable standard are marked in red.

Figure 72: Traffic noise monitoring results at road side noise monitoring stations

Source: Annual Monitoring on Road Noise of Xiangtan, XEEB, 2019.

C. Ecology and Sensitive Resources

i) Parks and Green Space

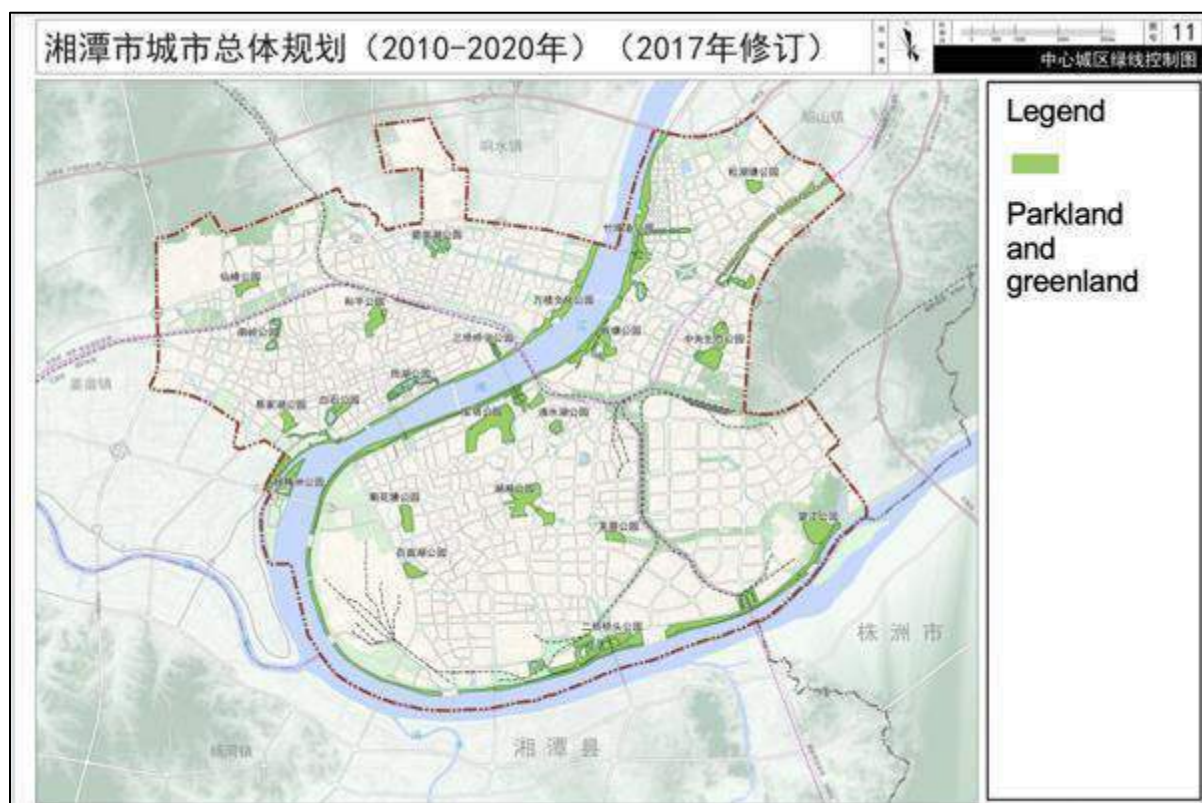
217. Xiangtan City has a total area of 1,069 km², with a 151 km² urban core. As noted above, by 2020 this urban development area is to include 33.07 km² of residential land, 12.54 km² of public administration and service areas, and 14.55 km² of parkland and greenland (Table 10). As of 2015, 8.2 km² of this parkland and greenland had been established (Table 31 and Figure 73).

Table 31: Planned greenspace, Xiangtan urban core area

Planned Parks	Area by 2020 (km ²)	Location
Baishi Park	0.17	West of Dahu Road, Hexi area
Heping Park	0.07	North of Guangyun Road, Hexi area
Yuhu Park	0.14	South of Yuhu Road, Hexi area
Wanlou Culture Park	0.19	East of Jiuhua Avenue (south section), Hexi area
Nanling Park	0.1	East of Nanling Dong Road, Hexi area
Biquan Lake Park	0.12	North of Huran Road, Hexi area
Yijia Lake Park	0.1	West of Baoqing Road, Hexi area
Xianfeng Park	1.0	West of Xianfeng Road, Hexi area
Sanqiao Bridge Park	0.05	End of Sanqiao Bridge, Hexi area
Juhuatang Park	0.09	West of Dongsu Road, Hedong area
Bantang Park	0.11	Yuetang New District, Hedong area
Central Ecological Park	0.13	Yuetang New District, Hedong area
Baota Park	0.55	North of Fuxing Road, Hedong area
Huxiang Park	0.33	Central District, Hedong area
Songhutang Park	0.08	East of Shangcheng Road, Hedong area
Wangjiang Park	0.35	North of Beingjiang Nan Road, Hedong area
Furong Park	0.3	East of Furong Road, Hedong area
Baimu Lake Park	0.09	Xiangtan Avenue, Tieniu Road, Hedong area
Dishui Lake Park	0.06	Huoju North Road, Fuxing East Road, Hedong area
Zhufugang Park	0.25	West of Jiangbei Road, Hedong area
Ergiao Bridge Park	0.34	End of Ergiao bridge, Hedong area
Yangmeizhou Park	0.14	Yangmeizhou Island, Xiang River
Subtotal	4.76	
Planned protective Greenspace	1.59	Protective greenland along main roads, high-way, rail ways, and around industrial parks, public utility sites, etc.
Total	6.35	

Source: Xiangtan Master Plan (2010-2020), 2017 revised version.

Figure 73: Location of planned parkland and greenspace, Xiangtan urban core area



Source: Xiangtan Master Plan 2010-2020, 2017 revised version.

ii) Ecology

218. The program is situated in an urban core undergoing rapid growth, and most program sites are in areas that have already been mostly or fully developed including main trunk roads, pedestrian paths, cycle paths, parking lots, bus and train stations, office buildings, and industrial parks. Original vegetation cover has been previously removed at these sites, and they have little ecological value. There are no sites in or near any protected areas, urban green space areas, or areas of critical habitat.

219. The Xiangtan First Traditional Chinese Medicine Hospital is located in a new development area, with a public park and roads to the north, and several villages and a railway station to the south. The land has been previously cleared and is currently an abandoned mixed plantation of Camphor tree (*Cinnamomum camphora*) and *Osmanthus Fragrans*, with some vegetables gardens tended by nearby farmers nearby (Figure 74).

220. Based on interviews with the XEEB, site surveys and a literature review, there are no known rare or endangered flora or fauna, species with international, national or provincial protection status, areas of natural or critical habitat²⁵, parks, nature reserves, or areas with special national, regional or local ecological significance within or adjacent to any of the program sites.

²⁵ Natural habitat is land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions. Critical habitat are areas with high biodiversity value, including habitat required for the survival of critically

Figure 74: Abandoned plantation at the Xiangtan First Traditional Chinese Medicine Hospital



Source: ADB PPTA consultant, 2019.

iii) Sensitive Receptors

221. Mapping of sensitive receptors such as schools and hospitals within the program area was undertaken by the Xiangtan Natural Resource and Planning Bureau. The results are presented in Table 32 and Figure 75.

222. The mapping identified 110 sensitive receptors for air and noise impacts in the program area of influence, including 44 hospitals, 40 schools, and 26 villages and residential areas. The schools and hospitals and residential areas are considered as sensitive receptor to be potentially influenced by the construction of roads, bus stations, and charging stations. Hongxing village specifically is considered to be potentially influenced by construction of the hospital. However, as program operation intends to reduce traffic noise and pollution emissions, the sensitive receptors for roads and bus and charging stations are unlikely to receive impacts during the operation phase. Hongxing Village, near the First Chinese Traditional Medicine Hospital will be relocated as part of the Xiangtan urbanization prior to the start of hospital operation. Thus, there will be no sensitive receptors during program operation for the hospital component.

endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities (Environment Safeguards: A Good Practice Sourcebook, ADB, 2012).

Table 32: Sensitive receptors in the program area, Xiangtan City

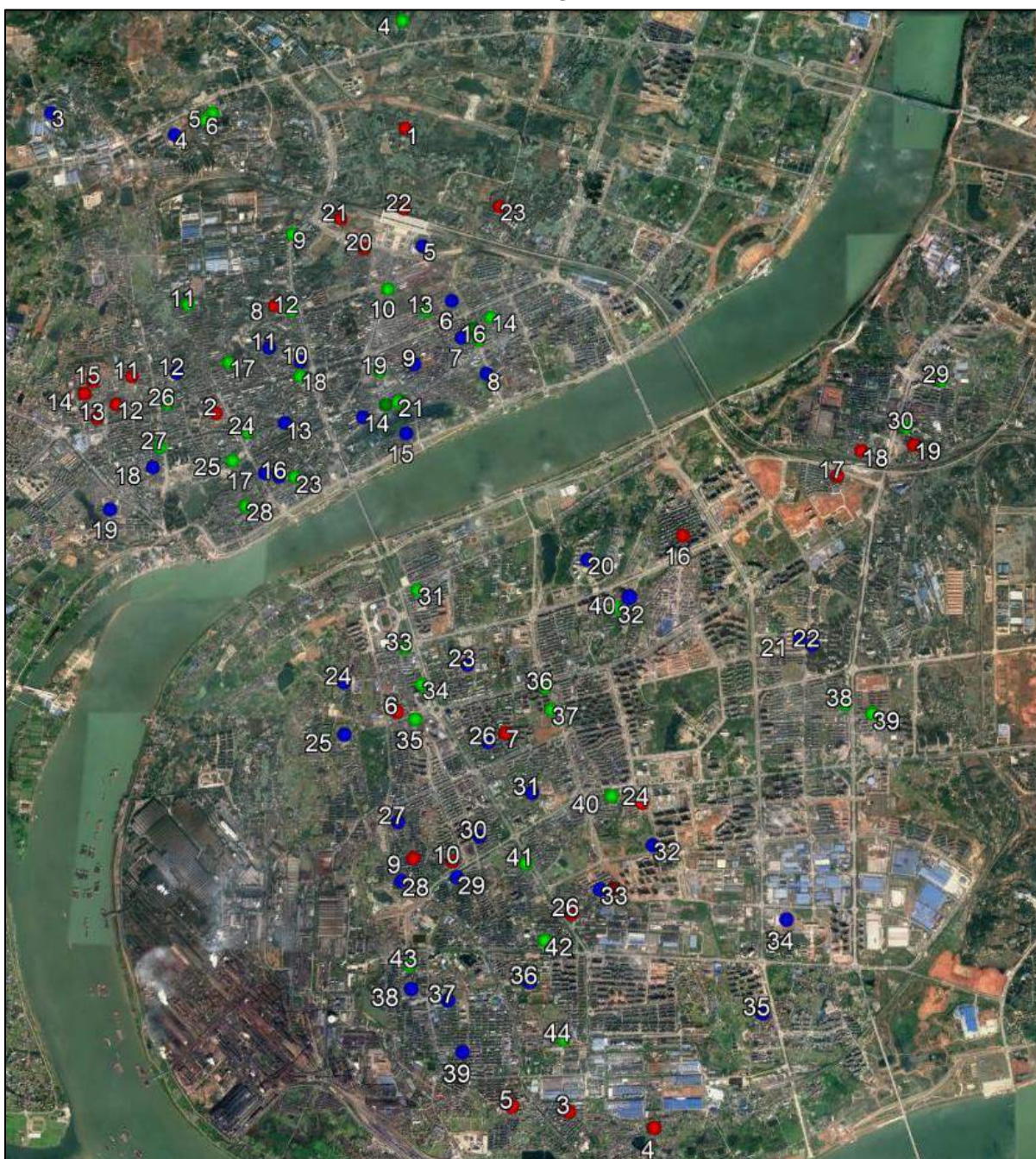
No.	Name	Type
Hospitals (marked in green on Figure 75)		
1	Xiangtan city Jiuhua Huimin Hospital	Community hospital
2	Xiangtan Xianghua Hospital	Community hospital
3	Xiangtan Technology University Hospital	Normal hospital
4	Xiangtan Youse Ershisanye Hospital	Normal hospital
5	Fifth Xiangtan People's Hospital	Normal hospital
6	Xiangtan Public Medical Care center	Community hospital
7	Xiangtan University Hospital	Normal hospital
8	Yangke Orthopaedic Hospital	Specialized hospital
9	Xiangtan Anorectal Hospital	Specialized hospital
10	Xiangtan Apollo Hospital	Community hospital
11	Jianglu Hospital	Normal hospital
12	Xiangtan New Era Hospital	Normal hospital
13	Xiangtan Jianchun Hospital	Normal hospital
14	Xiangtan City Bo'ai Hospital	Normal hospital
15	Xiangtan City Chinese Traditional Medicine Hospital (North Branch)	Specialized hospital
16	Xiangtan Tongji Hospital	Community hospital
17	Xiangtan Kelin Hospital	Community hospital
18	Xiangtan Kangmei Hospital	Community hospital
19	Xiangtan City Central Hospital	Normal hospital
20	Xiangtan Fajian Hospital	Normal hospital
21	Xiangtan Ci'ai Hospital	Community hospital
22	Xiangtan Stomatological Hospital (Yuhu Road)	Specialized hospital
23	Xiangtan Aimin Hospital	Community hospital
24	Second Xiangtan City People's Hospital	Normal hospital
25	Hunan Third Engineering Company Staff Hospital	Community hospital
26	Xinlai Stomatological Hospital	Specialized hospital
27	Xiangtan Minkang Hospital	Community hospital
28	Xiangtan City Chinese Traditional Medicine Hospital	Specialized hospital
29	Xiangtan Erkang Hospital	Community hospital
30	Third Xiangtan City People's Hospital	Normal hospital
31	Xiangtan Maternal and Child Health Hospital	Specialized hospital
32	Sixth Xiangtan City People's Hospital	Normal hospital
33	Xiangtan Ai'er Ophthalmology Hospital	Specialized hospital
34	Xiangtan Longhua Hospital	Community hospital
35	Yuetang District Integrated Chinese and Western Hospital	Specialized hospital
36	Xiangtan You'ai Hospital	Community hospital
37	Xiangtan Diabetes Hospital	Specialized hospital
38	Xiangtan Oversea Chinese Traditional Hospital	Community hospital
39	Xiangtan Chengde Chinese Traditional Hospital	Specialized hospital
40	Xiangtan Furong Hospital	Community hospital
41	Xiangtan Minkang Rehabilitation Hospital	Specialized hospital
42	First Xiangtan City People's Hospital	Normal hospital
43	Xiangtan City Central Hospital (South Branch)	Normal hospital
44	First Xiangtan City People's Hospital (South Branch)	Normal hospital
Universities, Schools (marked in blue on Figure 75)		
1	Hunan Technology University	University
2	Xiangtan University	University
3	Xiangtan Radio and Television University	University
4	Xiangtan City Industrial Trading Secondary School	Secondary School
5	Xiangtan City Yuhu District Hutun School	Middle School
6	Fourth Xiangtan City Middle School	Middle School
7	Xichun Road Yifu Primary School	Primary School
8	Hunan Technology University Yuhu Branch	University

No.	Name	Type
9	Xiangtan Profession Technical School (Medical School)	Secondary School
10	First Xiangtan City Middle School	Middle School
11	Xiangtan City Yizhi Middle School	Middle School
12	Xiangtan Railway Engineering School	Secondary School
13	Second Xiangtan City Middle School	Middle School
14	Heping Primary School	Primary School
15	Sixteenth Xiangtan Middle School	Middle School
16	Eleventh Xiangtan Middle School	Middle School
17	Jinting School	Primary School
18	Shaoxi Yifu Primary School	Primary School
19	Jinting School (Branch)	Primary School
20	Hunan Institute of Engineering (Main Campus)	University
21	Xiangtan Medicine&Health Vocational College	College
22	Xiangtan Huoju Primary School	Primary School
23	Hunan Vocational Institute of Technology	College
24	Hunan Economy and Trading Senior Technician School	College
25	Third Xiangtan Middle School	Middle School
26	Yuetang District Jianshe Road School	Primary School
27	Third Xianggang School	Primary and middle School
28	Second Xianggang School	Primary and Middle School
29	First Xianggang School	Primary and Middle School
30	Ciguang Experimental School	Primary School
31	Twelfth Xiangtan Middle School	Middle School
32	Chuangxin Primary School	Primary School
33	Xiangtan City Yuetang District Youyi School	Primary School
34	Hunan Chengjian Professional Technician School (Gaoxin Branch)	Secondary School
35	Hongxia Primary School	Primary School
36	Hunan Engineering College	College
37	Hunan Electric Machinery School	Primary and Middle School
38	First Xianggang Middle School	Middle School
39	Xiangji Primary School	Primary School
40	Yuetang District Hongqi Primary School	Primary School
Villages and Residential Areas (marked in red on Figure 75)		
1	Hongxing Village	Village
2	Jinzhuyuan residential area	Residential area
3	Dongyuancun residential area	Residential area
4	Zailian Kangqiao residential area	Residential area
5	Nanguo village	Village
6	Lanyuan residential area	Residential area
7	Xiaguang residential area	Residential area
8	Jianglu Xincheng residential area	Residential area
9	Xianggang Xinsicun residential area	Residential area
10	Xianggang Furong residential area	Residential area
11	Jinhong Mingyuan residential area	Residential area
12	Wuxiandian residential area	Residential area
13	Dangui Huating residential area	Residential area
14	Longfeng Jiayuan residential area	Residential area
15	Yangguang Shanzhuang residential area	Residential area
16	Panlong Mingfu residential area	Residential area
17	Yunpan Village Governmental Dormitory	Residential area
18	Shachang Street residential area	Residential area
19	Xuwei residential area	Residential area
20	Yuntang residential area	Residential area
21	Heshengyuan residential area	Residential area
22	Nongchang Village	Village

No.	Name	Type
23	Fuqiang Village	Village
24	Xincheng Tingyuan residential Area	Residential area
25	Dongtang village	Village
26	Chengshi Xingzuo residential area	Residential area

Source: XEEB, 2019, and Google Earth, 2019.

Figure 75: Map of sensitive receptors in the program area (hospitals in green, universities and schools in blue, villages and residential areas in red)



Source: XEEB, 2019, and Google Earth, 2019.

223. As Xiangtan is undergoing massive new urban development, sensitive receptors may change overtime. In order to correctly capture sensitive receptors for the program, regular assessment, verification of identified sensitive receptors and identification of new sensitive receptors shall be carried out during pre-construction, construction, and operation phases of the program. Sensitive receptors are given special attention in the assessment of impacts (Section V) and the EMP (Appendix A), including the environmental monitoring program.

D. Socioeconomic Conditions

i) Area and Population

224. Hunan Province has an area of 211,800 km² and a population of 69 million (2018).²⁶ Xiangtan City has an area of 5,006 km² and a population of 2.87 million permanent residents in 2018, of which approximately 1.80 million live in urban areas, giving an urbanization rate of 62.9%. Of this, 52% are male and 48% female. Xiangtan is dominated by the Han ethnic group, and ethnic minority groups accounted for only approximately 15,000 persons in 2018.

225. Xiangtan City is comprised of five districts (Yuhu, Yuetang, Xiangtan, Xiangxiang and Shaoshan) and four demonstration zones (Xiangtan High-tech zone, Xiangtan Economic Development Zone, Zhaoshan Demonstration Zone and Tianyi Demonstration Zone).

Table 33: Xiangtan administrative divisions in the program area

Region	Area Km ²	Town\ Township	Street Office	Village	Community
Xiangtan City	5,006	4	17	85	120
Yuhu District	451	4	8	69	72
Yuetang District	206	0	9	16	48

Source: XMG website.

226. The program area includes the 151 km² core urban area, as well as the Jiuhua Economic and Technological Development Zone and the Xiangtan High Technology Development Zone (part of the latter overlaps with the urban core) (Figure 48). According to the Xiangtan City Masterplan, there are 14 residential areas within the Xiangtan urban area (Table 34 and Figure 31).

Table 34: Planned residential areas in the main urban area of Xiangtan City

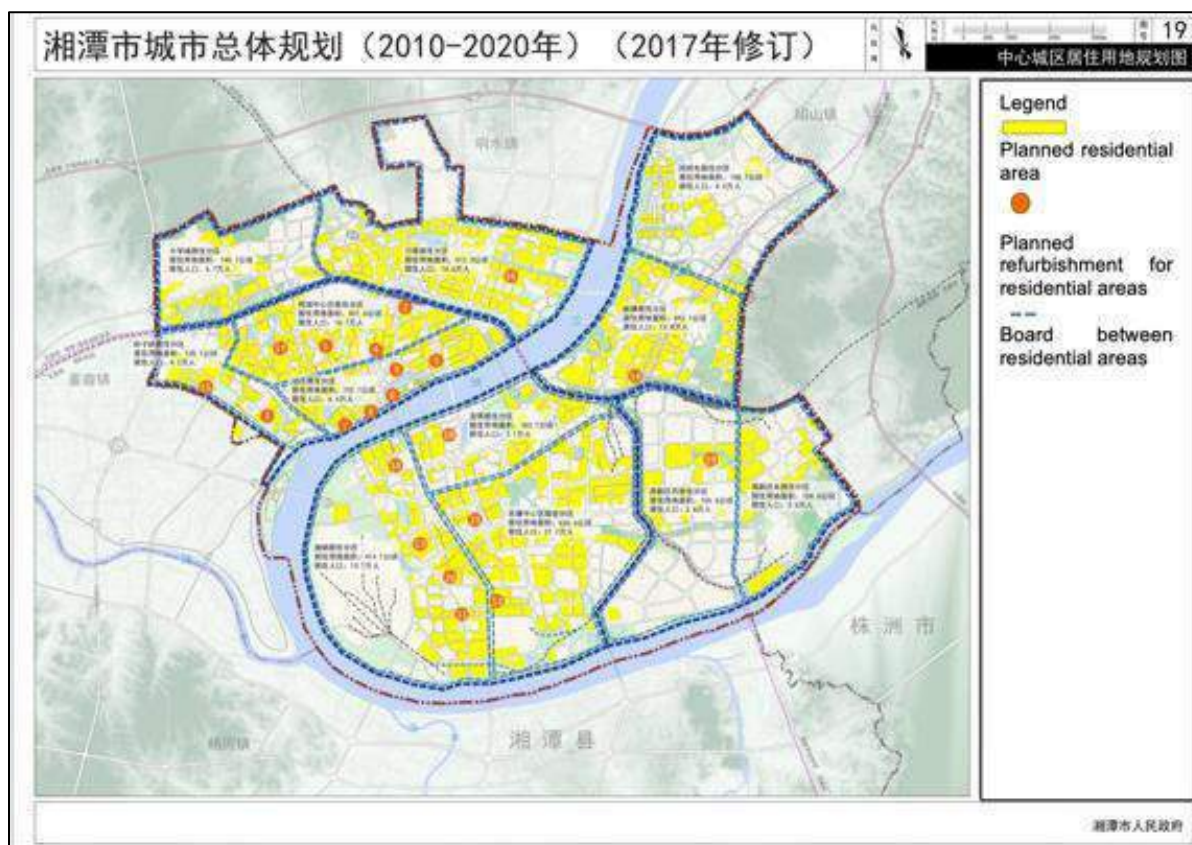
No.	Name of Area	Land Area (km ²)	Planned Population (10,000 persons)
1	Baota	1.71	5.7
2	Yuetang core area	2.53	8.4
3	Gaoxin core area	2.50	8.3
4	Xiashesi	12.2	4.1
5	Xianggang	3.63	12.1
6	Yanjiang	2.20	7.3
7	Yuhu core area	3.12	10.4
8	Shaziling	1.40	2.6
9	Gaoxin area West	1.46	4.8

²⁶ Statistical Communique of Hunan Province on National Economic and Social Development, 2018.

No.	Name of Area	Land Area (km ²)	Planned Population (10,000 persons)
10	Gaoxin area East	1.51	5.0
11	Siqiao East	1.36	4.5
12	Bantang	4.04	13.4
13	University Town	1.49	4.9
14	Wanlou	4.92	16.4
Total		33.07	110

Source: Xiangtan Master Plan 2010-2020, 2017 revised version.

Figure 76: Map of planned residential areas in the core urban area of Xiangtan City



Source: Xiangtan Master Plan 2010-2020, 2017 revised version.

ii) Economy

227. Xiangtan possesses strategic importance nationally and regionally. Xiangtan is a part of nation-wide initiatives as an integrated transport hub and a “two-oriented society comprehensive reform” area under the Changsha-Zhuzhou-Xiangtan two-oriented society national comprehensive reform zone.²⁷ There are three development objectives for the zone: (i) develop a resource-efficient society to attract talent and business; (ii) conserve the natural environment to ensure a healthy and green city; and (iii) foster eco-tourism, with a focus on resource conservation and environmental protection. It is one of the leading cities in central region of China to implement

²⁷ “Two-oriented society” refers to the concept of sustainable socioeconomic development through resource conservation and environment protection.

“The Rise of Central China Strategy”. It is also a low-carbon pilot city, and is currently implementing the Xiangtan Low-Carbon City Pilot Implementation Plan 2017–2030.

228. Hunan Province is one China’s main production bases for both agriculture and industry. Its gross domestic product (GDP) was 3.64 trillion CNY in 2018, a year-on-year increase of 7.8%, ranking it 9th in the country. Of this, the output value ratio of primary, secondary, tertiary industries was 8.5/39.7/51.8. The tertiary industry, including retail international trade, foreign investment, labor outsourcing, etc., has shown rapid growth in the recent years.

229. In 2017 the average disposable income per capita in Hunan was CNY 23,102. In the urban area income was CNY 33,948, and in rural areas CNY 12,936. The national average in 2017 was CNY 25,974.

230. In 2018 Xiangtan’s GDP was 216.14 billion CNY, a year-on-year increase of 7.8%. Of this, the output value ratio of primary, secondary, tertiary industries was 5.8/48.2/46. In the same year, Xiangtan’s average disposable per capita income was CNY 29,872, a year-on-year increase of 8.7%, and higher than the provincial and national averages CNY 28,228 (Table 14 and Table 36).

Table 35: Comparison of GDP in Xiangtan City to Hunan Province and China (2018)

Area	GDP (CNY Billion)	Primary Industry		Secondary Industry		Tertiary Industry		Growth Rate	Average disposable income per capita
		Output	%	Output	%	Output	%		
PRC	90030.9	6437.4	7.2	36600.1	40.7	46957.5	52.2	6.6	28,228
Hunan	3642.6	308.3	8	1445.35	40	1888.87	52	7.8	25,974
Xiangtan City	216.14	12.51	6	104.2	48	99.43	46	7.8	29,872

Source: 2018 Economic and Social Development Statistical Bulletins (National, Guizhou, Guiyang); Guiyang Statistical Yearbook (2018).

Table 36: Economic status of the program area (2018)

Item	Ratio of primary, secondary, tertiary industries		Revenue	Financial expenditure
	Units	%		
Xiangtan Municipality		5.8:48.2:46.0	21.48	30.15
Yuhu District		2.2:42.8:55.0	2.06	1.7
Yuetang District		0.9:53.7:45.4	8.59	3.49

Source: Xiangtan Municipality, Yuhu District and Yuetang District’s Statistical Bulletin on National Economic and Social Development (2018).

iii) Education

231. In 2017 there were 10 colleges/universities in Xiangtan, with 133,000 students. There were 10,000 students in ordinary secondary vocational schools, 116,000 students in ordinary middle schools, and 149,000 students in ordinary primary schools.

iv) Road Network

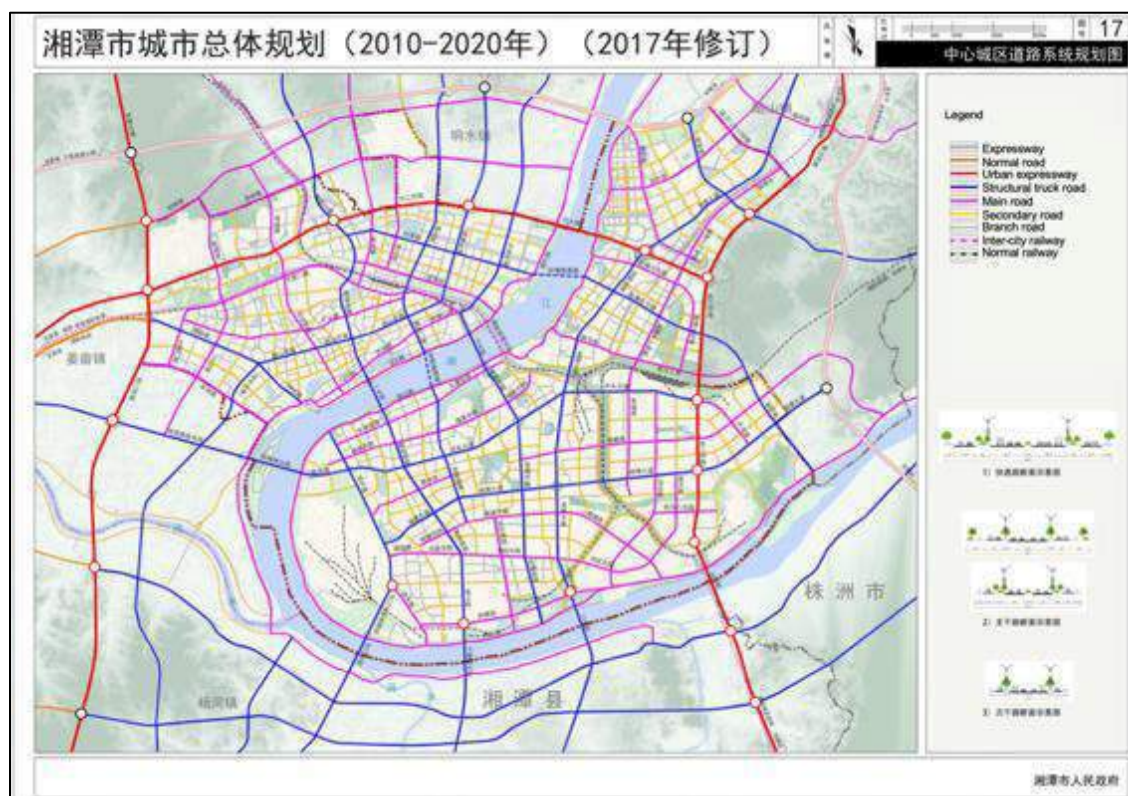
232. There is an existing road network in the Xiangtan urban core (Figure 77), which is undergoing extensive expansion as per the Xiangtan Urban Masterplan (2010-2020). The network includes the Beijing-Hongkon-Makaw expressway G4, Shanghai-Kunming expressway G60,

Changsha-Xiangtan expressway S41, Yueyang-Linwu expressway S61, national highways G320 and G107, 5 provincial highways and 7 county roads. The road network connects the north and the central parts of Xiangtan City. The planned road network (Figure 78) will be a comprehensive system consisting of expressways, urban expressways, structural trunk roads, main roads, secondary roads, and others, covering the entire Xiangtan City and connecting counties and nearby cities. According to the Masterplan, by 2020 the road density of Xiangtan will reach 2.5 km per km² for main roads, and 6 km per km² for branch roads.

Figure 77: Existing road network, Xiangtan City urban core



Source: Google Maps, 2019.

Figure 78: Planned road network, Xiangtan City urban core

Source: Xiangtan Master Plan 2010-2020, 2017 revised version.

233. The Changsha Huanghua International Airport is 67 km from the Xiangtan urban core. The Hunan-Guizhou Railway and Beijing-Guangzhou Railway Line go through the urban core, with two railway stations, Xiangtan and Xiangtan East stations (the latter is for cargo only). The Chang-Zhu-Tan inter-city express railway also goes through the city and has four stations, Shaoshan, Hetang, Bantang and Xiangtan stations. The Shanghai-Kunming high-speed railway also goes through the city and has one station, Xiangtan North Station.

v) Water Supply

234. The Xiangtan City urban core is currently served by two water supply plants: water supply plant number 1, located on the west side of Xiangjiang River and extracting water through 1st water extraction point in Figure 21; and water supply plant number 3, located on the east side of Xiangjiang River and extracting water through the 2nd water extraction point in Figure 21. Water supply plant number 1 has a design capacity of 175,000 m³/d, while water supply plant number 3 has capacity of 100,000 m³/d. According to the Master Plan, by 2020 the city will have a peak daily water demand of 495,000 m³/d and a total supply capacity of 575,000 m³/d once water plant number 4 is commissioned:

- water supply plant: 175,000 m³/d;
- the third water supply plant (expansion): 300,000 m³/d;
- the fourth water supply plant (newly constructed): 100,000 m³/d.

vi) Wastewater Treatment

235. There are two urban wastewater treatment plants (WWTPs) in operation in the Xiangtan City urban core: the Hexi WWTP (current capacity 150,000 m³/d); and the Hedong WWTP (current capacity 100,000 m³/d). According to the Masterplan, these two WWTPs will be expanded by 2020 to reach 250,000 m³/d for the Hexi WWTP, and 150,000 m³/d for the Hedong WWTP, capable of serving 1,200,000 people. The effluent of all WWTPs is required to be in compliance with the Class IA standard of GB18918-2002.

vii) Solid Waste Management

236. There are 3 sanitary landfills in Xiangtan City which serve the urban core area: Shangma Municipal Solid Waste Landfill (MSWL); Quanhua MSWL, and Xiaotianshi MSWL. The landfills have been designed, and are operated, according to relevant PRC standards for sanitary landfills.²⁸

viii) Hazardous Waste Management.

237. There were 14 MEE permitted hazardous waste management contractors in Xiangtan City by 2017, including the Hunan Jingyi Xiangtai Environmental Technology Co., Ltd., Hunan Ruixing Xinye Co. Ltd, and Hunan Qingyuan Environmental Technology Co. Ltd. Tongren City Hongfa Mercury-contained Product Disposal Co. Ltd, and Tongren Yinhu Chemical Industry Co. Ltd.

238. There are no medical waste incineration facilities in Xiangtan. Medical wastes are transported to the adjacent Zhuzhou Municipality for incineration in an approved facility supervised by the Zhuzhou Municipal Government.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

239. This chapter presents an assessment of potential impacts in the program zone of influence, and associated mitigation measures. Pre-construction, construction and operation phases are each considered separately. Mitigation measures are presented in detail in the EMP (Appendix A).

²⁸ The standards and regulations include:

- a. For landfill construction:
 - i. Pollution control standard of domestic solid waste landfill (GB16889-2008)
 - ii. Technical standard of domestic solid waste landfill (GB50869-2013)
 - iii. Technical guidance of domestic solid waste handling (No. 61, 2010)
 - iv. Engineering project construction standard of domestic solid waste landfill (124-2009)
 - v. Leakage prevention system engineering technical standard of domestic solid waste landfill (CJJ113-2007)
 - vi. Geotechnical engineering standard of domestic solid waste landfill (CJJ176-2012)
 - vii. Leachate treatment engineering standard of domestic solid waste landfill (HJ 564-2010)
- b. For landfill operation:
 - i. Operation and Maintenance technical standard of domestic solid waste landfill (CJJ93-2011)
 - ii. Environmental monitoring technical standard of domestic solid waste landfill (GB/T18772-2008)
 - iii. Site closure technical standard of domestic solid waste landfill (CJJ112-2007)

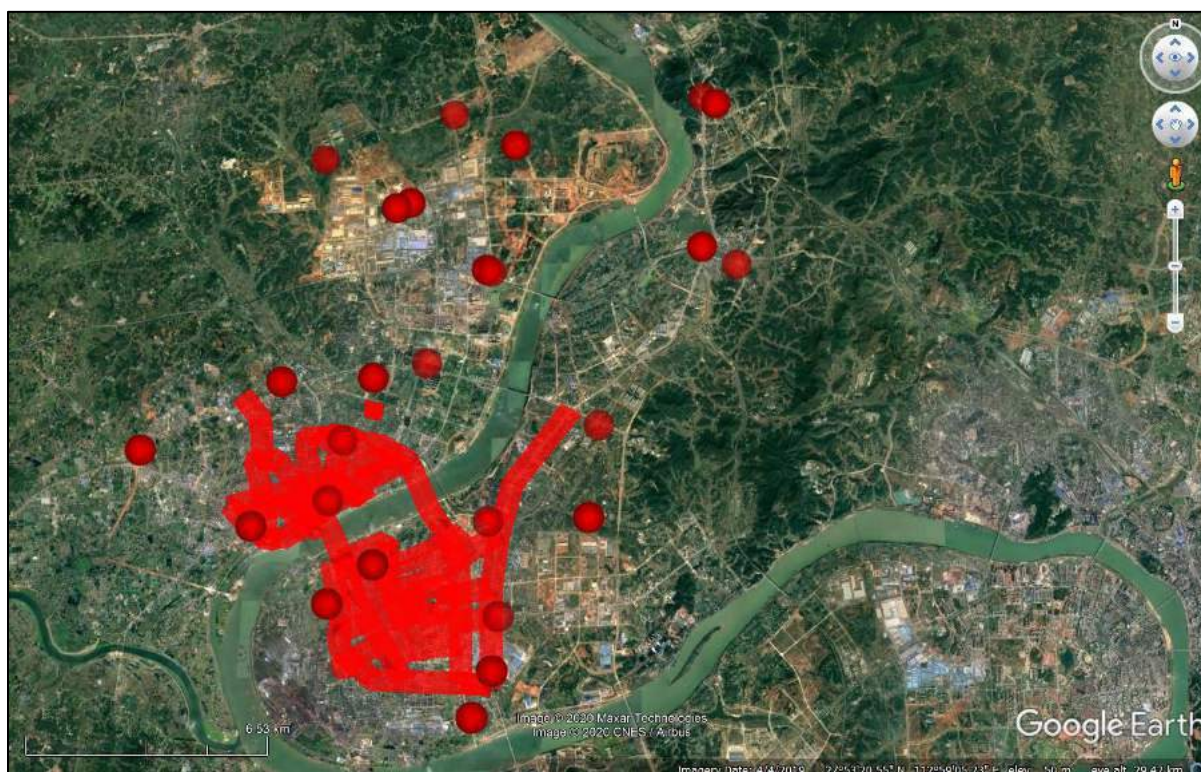
A. Program Zone of Influence

240. The program zone of influence focusses on areas where physical works will be undertaken, and is defined as:

- i) 500 m zones around the boundary of the program work sites, including multi-modal stations, buildings, the hospital, e-charging stations, and other sites, with respect to noise, air pollution and other impacts;
- ii) 500 m zones perpendicular to either side of the roads or lines (including bus stops, cycle ways, pedestrian walk ways, and safe islands) with respect to noise, air pollution and other impacts.

241. The program zone of influence is presented in Figure 79.

Figure 79: Program zone of influence



Source: FSRs (2019 and 2020), Google Earth (2020), and PPTA consultants, FSRs (2019 and 2020).

B. Anticipated Impacts Associated with Program Location, Detailed Design and Pre-Construction Phase

242. **Siting and Land Acquisition.** The program will not require any new land acquisition or building or house demolition. The construction of hospital buildings and the 110 kV Liwei Substation will require permanent land occupation of 88.33 mu (5.89 ha) of land, all of which is existing state-owned land. The 220 kV Jiuhuabei Substation, an associated facility of the program, has a total land area of 13.16 mu (0.88 ha) which was also previously acquired by the local government.

243. The program has been classified as ADB resettlement category C. The component will not entail any permanent or temporary physical displacement or economic displacement. This is because:

- (i) The ADB PPTA resettlement consultant has carried out due diligence for the associated facility and for components where land acquisition had already been completed. Compensation work for land acquisition of the hospital and substations has been completed and all compensation fees have been paid to the APs. The state-owned land use right certificate (SLURC) for the hospital has been obtained in 2019, the SLURC of Liwei Substation will be obtained before construction starts, and the SLURC of Jiuhuabei Substation is in process and expected to be obtained in May 2020. Land acquisition has been completed for those components, and was found to be in compliance with PRC and ADB requirements.
- (ii) The compensation rates, resettlement program, and compensation distribution program have been determined through repeated consultations. Compensation for acquired land has been paid to the affected households timely and in full. The consultant was informed by the officer from Land Acquisition and House Demolition Office of Jiuhua Economic Zone that, there have been no complaints to the grievance redress mechanism. The compensation rates and resettlement program comply with the applicable state and provincial regulations and policies, and ADB's involuntary resettlement safeguard principles.

244. Overall, the program will not result in any involuntary land acquisition, resettlement or physical displacement. There will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

245. **Measures to be Implemented during Pre-construction.** A number of environmental management measures will be implemented in the pre-construction phase to ensure the program's environment management readiness (see EMP, Appendix A). These include:

- (i) **Institutional Strengthening**
 - a. Recruitment, including (a) appointment of a qualified Environment, Health and Safety Officer (PMO EHSO) within the PMO by the EA; (b) contracting of a Loan Implementation Environmental Consultant (LIEC) by the IA (as part of the PMC); (c) contracting of a qualified 3rd party Environmental Monitoring Company by the IA to conduct environmental quality monitoring.
 - b. Prior to the start of construction, the construction phase institutional strengthening and training program will be delivered by the LIEC (Table 6, Appendix A). The training will focus on ADB's and PRC's relevant environmental, health and safety laws, regulations and policies; implementation of the EMP, environmental monitoring, chance find procedures for PCRs, and the GRM. Training will be provided to the IA, relevant PMO staff, and contractors.
- (ii) **Re-Identification and Updating of Sensitive Receptors in the IEE:** Mapping of sensitive receptors such as schools and hospitals within the program area was undertaken by the Xiangtan Natural Resource and Planning Bureau during the

preparation of the program IEE. As Xiangtan is undergoing massive new urban development, sensitive receptors may change overtime. Any changes in sensitive receptors to the program shall be checked, and the sensitive receptors tables will be updated in the IEE or as an addendum to the IEE to reflect any significant changes.

- (iii) **Grievance Redress Mechanism.** In accordance with the GRM (see Chapter VIII and Appendix A), the PMO EHSO will assume overall responsibility for the GRM. GRM training will be provided for PMO members and GRM access points. The PMO will issue public notices to inform the public within the program area of the GRM, and contact information (GRM website address, PMO address and telephone number, PMO contact point email address) for the PMO and local entry points (e.g. contractors) will be disseminated at each construction site. The PMO EHSO will develop and maintain a Complaints Register to document all complaints.
- (iv) **Updating the EMP:** Mitigation measures defined in this EMP and the EMoP will be updated based on final technical design. This will be undertaken by the EIA Institute under the supervision of the PMO EHSO and the LIEC. The updated EMP will be submitted to XEEB and ADB for approval, and disclosed on the ADB website.
- (v) **Tender Documents:** All EMP obligations will be included in tender documents and will explicitly reference the EMP and EMoP.

C. Anticipated Construction Phase Impacts and Mitigation Measures

246. **Impact Screening.** Potential impacts during road, charger station, multi-modal station and building construction and renovation could include air pollution (particularly dust), noise, water pollution, solid waste and poor occupational health and safety practices.

247. Potential air quality impacts could occur due to fugitive dust generated at construction sites from stockpiles of uncovered earth materials, vehicles hauling materials, and vehicle emissions. 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 and solid waste, although as this is an urban program, there will be no requirement for worker camps or on-site canteens. There will be no demolition of buildings. However, 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. Potential impacts are assessed and addressed below. Identified impacts are short-term and localized, and can be readily addressed through the application of good construction site environmental management and health and safety practices in accordance with PRC requirements and the *EHS Guidelines*.

1. Impact on Physical Resources

248. **Soil Erosion and Spoil.** Typical construction activities such as excavation and filling activities may lead to surface erosion. The most vulnerable soil erosion areas include excavation sites, spoil sites, temporary construction sites, and other areas where surface soil or other surface material (e.g. current bituminous pavement) is disturbed. Soil erosion can also be more serious on slopes or near water bodies. Construction activities may also generate surplus spoil.

249. To minimize soil erosion and spoil production, good construction soil and spoil management construction practices will be adopted, including managing site storm water and runoff, appropriate storing of fill, stockpile management, balancing fill and cut to the extent possible, and ensuring appropriate disposal of spoil (see EMP). There are three legal spoil disposal sites in Xiangtan designated by Xiangtan Civil Affairs Bureau, which will be used for final disposal of spoil that cannot be otherwise reused.

250. **Air Quality.** Fugitive dust generated from vehicle movement and hauling loads (especially if loads are uncovered), construction and earth works, and equipment exhaust fumes are expected to be the main air pollutants during the construction stage. Fugitive emissions are regulated under PRC's *Air Pollutant Integrated Emission Standard (GB16297-1996)*, which sets 120 mg/m³ as the maximum allowable emission concentration and ≤ 1.0 mg/m³ as the concentration limit at the boundary of construction sites (with no specification on particle diameter).

251. Based on local PRC experience, dust from vehicle movement accounts for over 60% of fugitive dust at construction sites. In the dry season where the problem is most serious, vehicle related fugitive dust can be calculated as follows:

$$Q=0.123 \times (V/5)(W/6.8)^{0.85}(P/0.5)^{0.72}$$

Where: Q – air borne dust generated by vehicle driving, kg/km per vehicle;

V - vehicle speed, km/h;

W - vehicle carrying capacity, t;

P - amount of dust on the road surface, kg/m².

252. Table 37 presents the relationship between fugitive dust generation and vehicle speed and road cleanliness, and shows that reduced vehicle speeds and reduced on road dust and dirt both reduce fugitive emissions. The vehicle carrying capacity is assumed to be 5t, which is common in urban areas. Table 38 presents the results of water spraying as a mitigation technique.

Table 37: Vehicle related fugitive dust generation and relationship to vehicle speed and road cleanliness. Unit: kg/vehicle km.

Vehicle speed	Amount of dust on the road surface					
	0.1 (kg/m ²)	0.2 (kg/m ²)	0.3 (kg/m ²)	0.4 (kg/m ²)	0.5 (kg/m ²)	1.0 (kg/m ²)
5 (km/h)	0.0297	0.0490	0.0656	0.0807	0.0947	0.1560
10 (km/h)	0.0595	0.0979	0.1311	0.1613	0.1894	0.3120
15 (km/h)	0.0892	0.1469	0.1967	0.2420	0.2841	0.4680
20 (km/h)	0.1189	0.1959	0.2623	0.3226	0.3788	0.6240
25 (km/h)	0.1486	0.2448	0.3278	0.4033	0.4736	0.7800
30 (km/h)	0.1784	0.2938	0.3934	0.4839	0.5683	0.9360

Source: PPTA experts, 2019.

Table 38: Water spraying and dust suppression at construction site test results

Distance (m)		5	20	50	100
Hourly average concentration of TSP (mg/m ³)	No Water Spraying	10.14	2.89	1.15	0.86
	With Water Spraying	2.01	1.40	0.67	0.60

Source: PPTA experts, 2019.

253. Wind-borne fugitive dust can also be generated from construction activities, uncovered earth material stockpiles on construction sites and spoil storage and disposal areas. Equipment, especially if unmaintained, can generate exhaust contains SO₂, CO, NO₂ and other pollutants.

254. On-site asphalt batching can also generate toxic fumes. However, only pre-mixed commercial asphalt will be procured negating the need for asphalt mixing on construction sites, and asphalt fumes will only be generated during road paving. Fumes will contains small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOCs) and poly-aromatic hydrocarbons (PAHs), however fumes will be considerably less than would have been generated if doing on site batching, and once the paved asphalt is cooled to <82° C asphalt fumes will be reduced substantially and then be totally eliminated when the asphalt is solidified. Impacts will thus be short-term in duration, localized in scale, low in magnitude, and in line with typical road works that occur on a daily basis in cities throughout China and the world.

255. To minimize fugitive dust production good practice air quality construction measures will be implemented as described in the EMP, including controlling vehicle speeds, covering loads, and watering surfaces. With mitigation measures the amount of dust can be reduced by 70% or more. Particular attention will be paid to dust suppression near sensitive receptors identified in the IEE. Overall impacts will be short-term and localized, and in line with typical construction works that occur on a daily basis in cities.

256. **Noise – Roads Component.** Noise will be emitted by PME used during road modifications, including driller, rollers and transport vehicles (Table 39).

Table 39: Road works construction machinery noise intensity at full load/power, no noise shields

No.	Equipment	Distance from source (m)	Noise level dB (A)	Remarks
1	Wheel loader	5	90	
2	Grader	5	90	
3	Vibratory road roller	5	86	Wheel type
4	Driller	1	87	Percussion drill
5	Paver	5	87	
6	Air compressor	5	78	
7	Electricity generator	1	98	
8	Transport (Trucks, dump trucks)	7.5	89	The greater the carrying capacity of the truck, the higher the noise level
9	Mobile crane	7.5	89	

Source: Table C.3.1 of Appendix C in the *Specifications for Environmental Impact Assessment of Roads* (JTGB03-2006).

257. An analysis was undertaken utilizing the sound impact model in the *Technical Guidelines for Noise Impact Assessment* HJ2.3-2009:

$$L_A(r) = L_A(r_0) - 20 \lg \left(\frac{r}{r_0} \right)$$

Where: $L_A(r)$ - noise level value at r away from the noise source, dB(A);

$L_A(r_0)$ - noise level value at the reference position r_0 , dB(A);

r - distance from the predicted point to the noise source, m;

r_0 - distance from the reference point to the noise source, 1 m.

258. Table 40 presents the predicted noise levels of the machinery running at full load, and Table 41 shows the distance from noise source at which compliance with the relevant standard is met. It can be seen that construction machinery, without shields, is in compliance with *Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011)* at 50.0 m or less in the daytime and at a maximum of 280 m at nighttime.

Table 40: Road construction machinery noise intensity at full load/power at different distances from source, no noise shields

No.	Machinery type and noise levels at distance dB (A)	Distance from noise source								
		5 m	10 m	20 M	40 m	60 m	80 m	100 m	150 m	200 m
1	Wheel loader	90.0	84.0	78.0	71.9	68.4	65.9	64.0	60.5	58.0
2	Grader	90.0	84.0	78.0	71.9	68.4	65.9	64.0	60.5	58.0
3	Vibratory road roller	86.0	80.0	74.0	67.9	64.4	61.9	60.0	56.5	54.0
4	Driller	73.0	67.0	61.0	55.0	51.4	48.9	47.0	43.5	41.0
5	Paver	87.0	81.0	75.0	68.9	65.4	62.9	61.0	57.5	55.0
6	Air compressor	78.0	72.0	66.0	59.9	56.4	53.9	52.0	48.5	46.0
7	Electricity generator	84.0	78.0	72.0	66.0	62.4	59.9	58.0	54.5	52.0
8	Transport (Trucks, dump trucks)	92.5	86.5	80.5	74.5	70.9	68.4	66.5	63.0	60.5
9	Mobile crane	92.5	86.5	80.5	74.5	70.9	68.4	66.5	63.0	60.5

Source: PPTA expert, 2019

Table 41: Road construction machinery noise levels compliance with relevant standard, no noise shields

No.	Machinery type	Standard value		Distance to be in conformity with the Standard (JTGB03-2006)	
		Daytime	Nighttime	Daytime	Nighttime
1	Wheel loader	70	55	50.0	281.2
2	Grader	70	55	50.0	281.2
3	Vibratory road roller	70	55	31.5	177.4
4	Driller	70	55	7.1	8.0
5	Paver	70	55	35.4	199.1
6	Air compressor	70	55	12.6	70.6
7	Electricity generator	70	55	25.1	28.3
8	Transport (Trucks, dump trucks)	70	55	66.8	563.8
9	Mobile crane	70	55	66.8	563.8

Source: PPTA expert, 2019.

259. To mitigate potential road construction noise, good construction site noise management practices in accordance with PRC requirements and EHS Guidelines will be adopted, and monitoring will be undertaken at sensitive sites and compared against WHO noise guidelines.

260. **Noise – Building Construction and Renovations.** Noise from the construction of multi-modal stations, and building renovations includes machinery noise, construction works noise and transport vehicle noise. Machinery noise is mainly caused by machinery such as excavator, bull dozers, and concrete vibrators; construction work noise is associated with dismantling of existing works, building erection, etc.; and transport vehicle noise refers to associated traffic noise. Of these sources machinery noise has the greatest impact on the acoustic environment, and thus was the focus of the assessment.

261. To assess noise levels at sensitive sites generated by multiple noise sources, the following model was used:

$$Leq(T) = 10lg \sum_{i=1}^n 10^{0.1Li}$$

Where: $L_{eq}(T)$ - total noise level at the predicted point, dB(A);

L_i – any point source of noise

n - number of outdoor noise source(s).

262. Table 42 presents predicted construction noise levels at various distances from the source.

Table 42: Predicted construction machinery noise intensity at full load/power at different distances from source, no noise shields

Works	Main noise source	Noise level dB(A)	Noise level at distance from source $L_{pA}dB(A)$					Characteristics of noise source
			10m	30m	60m	120m	240m	
Earthwork	Bulldozer	87.5	59.5	59.0	44.0	38.0	31.9	The noise spreads in random directions
	Excavator	86.5	58.5	49.0	43.0	37.0	30.9	
	Road roller	82.5	54.5	45.0	39.0	33.0	26.9	
	Transport vehicle	85	57.0	47.5	41.5	35.5	29.4	
Foundation construction	Percussion drill	83.5	55.5	46.0	40.0	34.0	27.9	The noise spreads in random directions
	Air compressor	98.5	70.5	61.0	55.0	49.0	43.0	
Structure construction	Vibrator	96	68.0	59.5	52.6	46.5	40.4	The exterior wall of buildings can attenuate the influence of the noise.
	Electric saw	106	78.0	68.5	62.5	56.5	50.4	
Finishing	Grinding machine	102	74.0	64.5	58.5	52.5	46.4	
	Cutting machine	100	72.0	62.5	56.5	50.5	44.4	

Source: PPTA expert, 2019.

263. Table 43 presents predicted construction noise levels at the relevant sensitive sites (schools, hospitals, etc.) identified in Table 32 and compliance with the relevant standard (Level I or II) of *Environmental Quality Standard for Noise (GB3096-2008)*. For sensitive receptors close

to the program roads, as the construction work will mainly take place at the safety islands, those receptors close to safety islands were assessed. The table assumes the same level of construction noise for both day and night times. The results show that daytime earthworks foundation works noise levels are mostly predicted to be in compliance with the relevant standards. There are some predicted exceedances for daytime structure construction. However, the majority of exceedances are related to works at night time, structure work or finishing, and are due to the proximity of the sensitive sites to the construction sites. For structure work and finishing it should be noted that predicted exceedances do not take into account the very significant noise attenuation that is expected as the buildings will be at lock-up stage with walls and roofs.

264. To mitigate program sites construction noise to acceptable levels, good practice construction noise management measures in accordance with PRC requirements and the *EHS Guidelines* will be applied, including selecting low noise equipment, ensuring equipment has appropriate mufflers, scheduling high noise activities during daytime and restricting construction at nighttime, and using temporary noise barriers at sensitive areas identified in Table 32. Construction phase noise monitoring will be undertaken at sensitive sites and compared to WHO guidelines, and mitigation measures will be adjusted if necessary based on the monitoring results. Additional measures could include consultation with affected parties, the use of more effective sound barriers, optimizing construction methods and schedules, and other measures deemed necessary.

Table 43: Predicted building renovation construction machinery noise intensity at sensitive sites and compliance with relevant standard (assumes 2.5 m construction boundary wall and noise barriers).

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard							
	Earthworks		Foundation		Structures		Finishing	
	Day	Night	Day	Night	Day	Night	Day	Night
Applicable Standard:								
Level II Sensitive Sites	Level II, <i>Environmental Quality Standard for Noise</i> (GB3096-2008): 60 dB at daytime and 50 dB at nighttime)							
Program Roads (safety islands are considered the major construction noise source)								
Chengshi Xingzuo residential area, 270m SE of a safety island	43.1		50		57.8		55.5	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Hongtang village, 238m SE of a safety island	44.2		51.1		58.9		56.6	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Xianggang Furong residential area, 134m NW of a safety island	49.2		56.1		63.9		61.6	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Panlong Mingfu residential area, 347m NW of a safety island	41		47.8		55.6		53.3	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Yunpan Village Governmental Dormitory, 490m NW of a safety island	38		44.8		52.6		50.3	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Jinzhivuan residential area,	40.6		47.4		55.2		52.9	

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard							
	Earthworks		Foundation		Structures		Finishing	
	Day	Night	Day	Night	Day	Night	Day	Night
363m E of a safety island								
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Dangui Huating residential area 363m E of a safety island		40.6		47.4		55.2		52.9
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Wuxiandian residential area, 382m W of a safety island		40.1		47		54.8		52.5
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Longfeng Jiayuan residential area, 423m NE of a safety island		39.2		46.1		53.9		51.6
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Yuetang residential area, 251m W of a safety island		43.8		50.6		58.4		56.1
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Heshengyuan residential area, 258m E of a safety island		43.5		50.4		58.2		55.9
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Multi-modal stations								
Yunpan Village Governmental Dormitory, 50m South of Xiangtan InterCity Railway Station		57.8		64.7		72.4		70.1
Compliance with the Standard	Yes	No	No	No	No	No	No	No
Shachang street residential area, 126m North of Xiangtan InterCity Railway Station		49.8		56.6		64.4		62.1
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Nongchang village, 200m N of Xiangtan Railway Station		45.7		52.6		60.4		58.1
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
Buildings								
Fuqiang Village, 526m SE of Xiangtan Traditional Chinese Medicine Hospital First		37.4		44.2		52		49.7
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Xincheng Tingyuan Residential Area, 30m South and West of Low Carbon Education and Training Building		62.2		69.1		76.9		74.6
Compliance with the Standard	No	No	No	No	No	No	No	No
Applicable Standard:								
Level I, <i>Environmental Quality Standard for Noise</i> (GB3096-2008): 55 dB at daytime and 45 dB at nighttime)								
Xiangtan City Yuhu District Hutian School, 160m SEE of Xiangtan Railway Station		47.7		54.6		62.3		60
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan Furong Hospital,		43.4		50.3		58		55.8

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard							
	Earthworks		Foundation		Structures		Finishing	
	Day	Night	Day	Night	Day	Night	Day	Night
262m West of Low Carbon Education and Training Building								
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Chuangxin Primary School, 451m S of Low Carbon Education and Training Building		38.7		45.6		53.3		51
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Xiangtan New Era Hospital, 65m NW of a safety island		55.5		62.4		70.2		67.9
Compliance with the Standard	No	No	No	No	No	No	No	No
Xiangtan Anorectal Hospital, 234m SW of a safety island		44.4		51.3		59		56.7
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan Apollo Hospital, 61m E of a safety island		56.1		62.9		70.7		68.4
Compliance with the Standard	No	No	No	No	No	No	No	No
Xiangtan City Yuhu District Hutun School, 292m E of a safety island		42.5		49.3		57.1		54.8
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
Fourth Xiangtan City Middle School, 184m NW of a safety island		46.5		53.3		61.1		58.8
Compliance with the Standard	Yes	No	Yes	No	No	No	No	No
Xichun Road Yifu Primary School, 223m S of a safety island		44.8		51.7		59.4		57.2
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan City Bo'ai Hospital, 256m E of a safety island		43.6		50.5		58.2		56
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan City Chinese Traditional Medicine Hospital (North Branch), 244m N of a safety island		44		50.9		58.7		56.4
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan Tongji Hospital, 77m N of a safety island		54		60.9		68.7		66.4
Compliance with the Standard	Yes	No	No	No	No	No	No	No
Xiangtan Profession Technical School (Medical School), 315m N of a safety island		41.8		48.7		56.4		54.2
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
First Xiangtan City Middle School, 122m NW of a safety island		50		56.9		64.7		62.4
Compliance with the Standard	Yes	Yes	No	No	No	No	No	No
Xiangtan City Yizhi Middle School, 300m N of a safety		42.2		49.1		56.9		54.6

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard							
	Earthworks		Foundation		Structures		Finishing	
	Day	Night	Day	Night	Day	Night	Day	Night
island								
Compliance with the Standard	Yes	Yes	Yes	Yes	No	No	Yes	No
Xiangtan Kelin Hospital, 312m NE of a safety island	41.9		48.8		56.5		54.2	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
Xiangtan Railway Engineering School, 436m NW of a safety island	39		45.8		53.6		51.3	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Xinlai Stomatological Hospital, 62m E of a safety island	55.9		62.8		70.6		68.3	
Compliance with the Standard	No	No	No	No	No	No	No	No
Hunan Third Engineering Company Staff Hospital, 470m NW of a safety island	38.3		45.2		53		50.7	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Second Xiangtan City Middle School, 347m W of a safety island	41		47.8		55.6		53.3	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
Xiangtan Ci'ai Hospital, 127m W of a safety island	49.7		56.6		64.3		62	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan Stomatological Hospital (Yuhu Road), 57m N of a safety island	56.7		63.5		71.3		69	
Compliance with the Standard	No	No	No	No	No	No	No	No
Xiangtan Aimin Hospital, 268m NE of a safety island	43.2		50.1		57.9		55.6	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Eleventh Xiangtan Middle School, 206m NE of a safety island	45.5		52.4		60.1		57.8	
Compliance with the Standard	Yes	No	Yes	No	No	No	No	No
Xiangtan City Chinese Traditional Medicine Hospital, 227m SW of a safety island	44.6		51.5		59.3		57	
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Sixth Xiangtan City People's Hospital, 545m NE of a safety island	37		43.9		51.7		49.4	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Hunan Vocational Institute of Technology, 516m SE of a safety island	37.5		44.4		52.2		49.9	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Xiangtan Ai'er Ophthalmology Hospital, 113m SW of a safety island	50.7		57.6		65.4		63.1	
Compliance with the Standard	Yes	No	No	No	No	No	No	No

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard							
	Earthworks		Foundation		Structures		Finishing	
	Day	Night	Day	Night	Day	Night	Day	Night
Xiangtan Longhua Hospital, 261m NW of a safety island		43.4		50.3		58.1		55.8
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Xiangtan You'ai Hospital, 44m SW of a safety island		58.9		65.8		73.5		71.3
Compliance with the Standard	No	No	No	No	No	No	No	No
Xiangtan Diabetes Hospital, 238m SW of a safety island		44.2		51.1		58.9		56.6
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Twelfth Xiangtan Middle School, 418m NE of a safety island		39.3		46.2		54		51.7
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No		No
Second Xianggang School, 273m NW of a safety island		43		49.9		57.7		55.4
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Ciguang Experimental School, 300m NW of a safety island		42.2		49.1		56.9		54.6
Compliance with the Standard	Yes	Yes	Yes	No	No	No	Yes	No
Xiangtan Minkang Rehabilitation Hospital, 230m SE of a safety island		44.5		51.4		59.2		56.9
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
First Xiangtan City People's Hospital, 396m NW of a safety island		45.7		52.6		60.4		58.1
Compliance with the Standard	Yes	Yes	Yes	No	No	No	No	No
Hunan Electric Machinery School, 501m SW of a safety island		37.8		44.6		52.4		50.1
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Hunan Engineering College, 480m SE of a safety island		38.1		45		52.8		50.5
Compliance with the Standard	Yes	Yes	Yes	Yes	No	No	Yes	No

Source: PPTA experts, 2019.

265. Noise – Charging Stations. Thirty electric charging stations will be established in existing bus stations and parking lots. Installation of charging station will generate sound levels similar to typical facility renovations, and can be mitigated through good construction practices.

266. Construction noise at the nearest boundary of adjacent receptors was modeled using the sound impact model in the *Technical Guidelines for Noise Impact Assessment* HJ2.3-2009, as described above. The modelling assumed basic mitigations such as 2.5 m boundary walls at the construction site, and noise reduction barriers at the sensitive receptors. The results, presented in Table 44, assume the same level of construction noise for both day and night times. The results show that: most of the earthwork noise and foundation noise at day time are predicted to be in compliance with relevant standards. There are however some predicted exceedances for nighttime foundation work, and structure work. As with charging stations, to mitigate construction

noise to acceptable levels, good practice construction noise management measures will be applied. In addition, construction phase noise monitoring will be undertaken at sensitive sites and compared to WHO guidelines, and mitigation measures will be adjusted if necessary based on the monitoring results. Additional measures could include consultation with affected parties, the use of more effective sound barriers, optimizing construction methods and schedules, and other measures deemed necessary.

Table 44: Predicted charging station construction machinery noise intensity at sensitive sites and compliance with relevant standard (assumes 2.5 m construction boundary wall and noise barriers)

Sensitive Sites	Predicted noise levels by construction stages dB(A) and compliance with relevant standard					
	Earthworks		Foundation		Structures	
	Day	Night	Day	Night	Day	Night
Level I Sites	Applicable Standard: Level I, <i>Environmental Quality Standard for Noise</i> (GB3096-2008): 55 dB at daytime and 45 dB at nighttime					
Heping Primary School, 170m N of Chezhan road bus station	42.3		54.0		61.8	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Jinting School (Branch), 137m SW of Yuhu sanitation parking area	44.2		55.9		63.7	
Compliance with the Standard	Yes	Yes	No	No	No	No
Third Xiangtan Middle School, 137m SW of Garden Maintenance Team No.2	42.2		53.9		61.7	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Fifth Xiangtan People's Hospital, 203m SE of Hexi Urban Sanitation Parking area	40.8		52.5		60.3	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Xiangtan City Yuhu District Hutan School, 135m SE of Xiangtan Station	44.3		56		63.8	
Compliance with the Standard	Yes	Yes	No	No	No	No
Hunan Third Engineering Company Staff Hospital, 101m SW of Baishi Square	46.9		58.5		66.3	
Compliance with the Standard	Yes	No	No	No	No	No
Heping Primary School, 211m SE of Stereo Parking Building	40.5		52.1		59.9	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Hospital 39, 312m N of East bust hub	37.1		48.8		56.5	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Hospital 38, 437m NW of East bust hub	34.1		45.8		53.6	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
School 15, 411m E of Chezhan road bus terminal	34.7		46.4		54.1	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 22, 372m NE of Chezhan road bus terminal	35.5		47.2		55	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 21, 446m NE of Chezhan road bus terminal	34		45.6		53.4	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 20, 469m NE of Chezhan road bus terminal	33.5		45.2		53	

Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
School 19, 392m NE of Yuhu sanitation parking area	35.1		46.8		54.5	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 35, 476m E of Garden Maintenance Team No.2	33.4		45.1		52.9	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 6, 236m S of Hexi Urban Sanitation Parking area	39.5		51.2		59	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Hospital 24, 217m N of Baishi Square	40.2		51.9		59.7	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
School 17, 285m SE of Baishi Square	37.8		49.5		57.3	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
School 16, 415m SE of Baishi Square	34.6		46.3		54.1	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
School 13, 480m NE of Baishi Square	33.3		45		52.8	
Compliance with the Standard	Yes	Yes	Yes	Yes	Yes	No
Hospital 40, 346m SW of Dongfanghong Square	36.2		47.9		55.6	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Hospital 19, 329m NE of Stereo Parking Building	36.6		48.3		56.1	
Compliance with the Standard	Yes	Yes	Yes	No	No	No

Applicable Standard:

Level II Sites

Level II, *Environmental Quality Standard for Noise* (GB3096-2008): 60 dB at daytime and 50 dB at nighttime

Dangui Huating residential area, 228m N of West bus hub. (Level II)	39.8		51.5		59.3	
Compliance with the Standard	Yes	Yes	Yes	No	Yes	No
Some residential area, 132m E of Jiangnan Avenue Charging / Exchange Stations	44.5		56.2		64	
Compliance with the Standard	Yes	Yes	Yes	No	No	No
Lanyuan residential area, 329m NE of Garden Maintenance Team No.2	36.6		48.3		56.1	
Compliance with the Standard	Yes	Yes	Yes	No	No	No

Source: PPTA expert, 2020.

267. **Water Quality.** Inappropriate disposal of construction wastewater (from construction site runoff, drainage of excavation and drilling, pouring and curing concrete, washing construction equipment and vehicles, and oil-containing wastewater from machinery repairs) could potentially pollute nearby water bodies and clog local drains. Workers will also generate domestic wastewater.

268. There are two sensitive surface water resource (Class I drinking water source protection zones) in the urban area of Xiangtan, shown in Table 32. However, the majority of the construction on roads, bus stops, safety islands, buildings and charging stations will not be conducted near the water resource. Nevertheless, in order to prevent pollution of water resources, good practice wastewater management practices will be implemented, including housing of workers in local accommodation in accordance with IFC/EBRD worker accommodation guidance (there will be no worker camps onsite) such that sewage produced from living quarters is collected in the municipal sewage system and will be treated in municipal wastewater treatment plants. For the construction on multi-modal stations and buildings, temporary toilets will be provided on-site and effluent will be regularly emptied and disposed off-site into the sewage system. Construction wastewater from

each site will be directed to temporary detention and settling ponds or tanks, and then treated and recycled for use in dust control. All necessary measures will be undertaken to prevent construction materials and waste from entering drains and water bodies, and maintenance of construction equipment and vehicles will not be allowed on sites so as to reduce wastewater generation.

269. **Solid Waste.** Solid waste generated during construction will include construction and demolition (C&D) waste dominated by excavated spoil and pavement, and domestic refuse generated by construction workers (0.5 kg/worker).²⁹

270. No building demolition will be required, but C&D will include rubble from several bus stops, pedestrian walkways and government building sites which have existing concrete pavements, barriers or building structures, and which will need to be removed. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

271. To prevent environmental degradation good solid waste management practices will be adopted in accordance with PRC requirements and *EHS Guidelines*, including reusing and recycling C&D wastes to the extent possible, providing construction and domestic waste containers at all construction sites, and ensuring all wastes that cannot be reused or recycled are disposal at a licensed MSWL. Building rubble will be tested and either reused as fill if appropriate or treated as hazardous if testing so indicates. Sites will be excavated and resurfaced with clean fill in accordance with relevant PRC regulations and *EHS Guidelines*.

272. **Hazardous Materials.** Hazardous material including petroleum products could be used during paving, building construction or retrofitting. Asbestos containing materials could be encountered during building retrofit. Inappropriate transportation, storage, use and spills of hazardous materials can cause soil, surface and groundwater contamination.

273. These potential impacts will be effectively mitigated through good practice hazardous materials management in accordance with relevant PRC regulations and *EHS Guidelines*. This will include appropriate hazardous materials transport, storage and disposal, and the spill and asbestos response procedures.

2. Impact on Ecological Resources

274. **Flora and Fauna, Protected Areas.** All program sites are developed at modified industrial, commercial and residential urban environments. Original vegetation cover has been previously removed, and existing site vegetation is either non-existent due to pavement and building cover or the site being barren land; or is grasses and shrubs, low value roadside landscaping, or abandoned farmland. Based on the site surveys, there are no known rare or endangered flora or fauna, species with international, national or provincial protection status, areas of natural or critical habitat, parks, nature reserves, or areas with special national, regional or local ecological significance within or adjacent to any of the sites.

275. Although the program is not expected to have a negative impact on flora and fauna, measures will be implemented to protect any remaining forested areas, and green EbA landscaping will be implemented at the program sites and along the roadways. The planting of native trees will improve urban quality, provide shade and screening and is in line with the vision for Xiangtan city as a green urban development.

²⁹ Note – earthworks and spoil are discussed above, and are not included in this section.

3. Impact on Socioeconomic Resources

276. **Occupational Health and Safety.** Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, electrocution, fire hazards, chemical hazards such as toxic fumes and vapors, and others risks.

277. To address these risks the Contractor's Environment, Health and Safety Officer will develop and implement an Occupational Health and Safety Plan (OHSP), maintain records concerning health, safety and welfare and regularly report on accidents, incidents and near misses. The OHSP will provide adequate precautions to protect the health and safety of their workers, including but not necessarily limited to construction site sanitation, including waste removal and provision of potable water and sanitation facilities; occupational safety, including provision of appropriate personal protective equipment (PPE) such as safety hats, shoes, goggles, ear plugs and respiratory masks; electrical safety; traffic safety; emergency response, including procedures for medical, fire and other emergencies; and training. The OHSP will be reviewed and approved by the LIEC and PMO.

278. **Community Health and Safety.** Traffic congestion may worsen as construction traffic in the urban area increases during rush hours, and some of traffic lanes are temporarily occupied, causing temporary inconvenience to traffic, residents, commercial operations, and institutions and the risk of accidents. The program may also contribute to road accidents through the use of heavy machinery on existing roads, temporarily blocking pavements for pedestrians etc.

279. Construction sites for bus stops are in some cases located close to residential areas, presenting a potential threat to public health and safety. Assessments of dust and construction noise impacts indicate that with the implementation of mitigation measures described in this report, such impacts will not adversely affect nearby sensitive receptors and the public health of occupants at these sensitive receptors.

280. 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.

281. To mitigate potential impacts on community health and safety contractors will implement good practice community health and safety measures, including traffic safety measures, informing residents about construction activities and potential disruptions, and prohibiting the public from entering construction sites.

282. **Physical Cultural Resources.** Based on both sites surveys and a review of relevant literature, there are no known PCRs within the work site footprints. However, construction activities have the potential to disturb as yet unknown subsurface PCRs.

283. To address this issue, a Chance Find Procedure, developed in accordance with PRC's *Cultural Heritage Protection Law*, will be established and training will be provided by the LIEC on what constitutes a PCR and the Chance Find Procedure. The procedure will be activated if any chance finds of PCRs are encountered at any site (see EMP).

D. Anticipated Operation Phase Impacts and Mitigation Measures

284. **Impact Screening.** Potential negative operation phase impacts include runoff from roads and stations which may pollute surface waters; wastewater produced in the buildings; emissions from buildings and vehicles in stations; noise from stations, buses and cars, and buildings; hazardous materials from stations and buildings; end-of-life buses and batteries that require replacement; and safety risks on the program roads, stations and buildings. These impacts can be effectively mitigated through good design and management, including, for example, road-side bio-retention facilities to treat storm water runoff, and noise control measures incorporated into station and building design; good waste and health and safety management practices including effective recycling of busses and bus batteries; and good safety plans on charging stations, multi-modal stations and buildings. All facility designs will be in accordance with PRC requirements and health and safety requirements of the *EHS Guidelines*.

1. Impact on Physical Resources

285. **Runoff and Storm Water.** Rain events will generate runoff from the program roads and other sites. Depending on the amount and type of traffic, rainfall intensity, and season, runoff may be contaminated with suspended sediments, petroleum products and high organic loads. Chang'an University studied pavement runoff on the Xi'an - Sanyuan Highway under a one hour rainfall event generating 81.6 mm of precipitation; water samples were collected and analyzed at different times during the rainfall event, and the results are presented in Table 45. The results indicate that pollution levels are highest during the initial 20 to 30 minutes of rainfall.

Table 45: Pollutant concentration in road runoff

Item	5-20 min	20-40 min	40-60 min	Average value
pH	7.0-7.8	7.0-7.8	7.0-7.8	7.4
SS (mg/L)	231.42-158.22	158.22-90.36	90.36-18.71	100
BOD ₅ (mg/L)	7.34-7.30	7.30-4.15	4.15-1.26	5.08
Petroleum pollutant (mg/L)	22.30-19.74	19.74-3.12	3.12-0.21	11.25

Source: PPTA experts, 2019.

286. In this program no new roads will be constructed, and road works will only be done on existing urban roads and pedestrian/cycle ways with existing stormwater drains. Fuxing Middle Road will have innovative EbA measures to collect and treat storm water. A drainage systems will collect all rainwater from roads, parking lots, sidewalks, etc. The drainage systems will be sized to be able to collect even high intensity rainfall events induced by climate change. Runoff will be treated in bio-retention facilities, located in the green belts along both sides of the roads. These facilities are designed to remove contaminants and sediments from storm water runoff utilizing grass buffer strips, sand beds, ponding areas, organic or mulch-layer, and soil and plants.

287. The hospital will also be equipped with extensive EbA facilities to collect, treat and store all stormwater. Existing buildings that are renovated and the multi-modal stations will be connected to the existing Xiangtan stormwater system. E-charging stations will also be equipped with drainage systems. Runoff will be directed to on-site oil-water separators, and then discharged to the municipal stormwater system.

288. In addition, the Integrated Urban Catchment Management Plan in program Output 2 will provide detailed guidance for Xiangtan government to improve the catchment and treatment capacity for runoff and stormwater in the city area, allowing more innovative mitigation measures, such as bio-retention facilities, to be used more extensively. Finally, the development of the Smart Early Flood Warning System, serving 1,069 km² of urban districts of Xiangtan, will enable flood risk assessment, information dissemination and emergency responses during flood events.

289. **Wastewater and Sewage.** All wastewater and sewage generated in program buildings or multi-modal stations will be discharged to the municipal sewage system and treated in one of two municipal Waste Water Treatment Plants (WWTPs). The final discharge from municipal WWTPs will be required to meet the Level III limit in Integrated Wastewater Discharge Standard (GB8979-1996).

290. E-charging stations will not have sanitary facilities, and therefore will not generate sewage.

291. The capacities of the two municipal WWTPs have been assessed, and all are capable of handling planned population growth and the loads that are expected to be generated through program operation. In addition, it is expected that the program will reduce water consumption through the implementation of water saving measures, and thus the total generation of wastewater will also be reduced compared to a non-program scenario.

292. **Air Quality – roads and bus lines.** Vehicle operation along the program roads will generate emissions. However, the priority bus system, smart bus stops, BEBs, e-charging stations, non-motorized transport systems, and optimization of the Xiangtan ITS system will reduce traffic loads, improve the overall efficiency of traffic system, reduce low-speed traffic flows and traffic jams, and reduce, and reduce overall vehicle emissions.

293. It should be noted that vehicle emissions increase significantly during low vehicle speeds. In addition, operation of the 100 zero-emission BEBs will result in substantial reductions in emissions compared to operation of a similar fossil fueled bus fleet, or the provision of equivalent transportation through private cars.

294. Overall, program operation is expected to reduce GHG emissions from program roads by 265,800 tons of CO_{2e} per year.

295. **Air Quality – e-charging stations.** Operation of the 30 zero-emission e-charging stations will not generate air emission, and thus no mitigation measures are required.

296. **Air Quality – multi-modal train stations.** Operation of the user-friendly facilities in the multi-modal stations will generate some localized automotive emissions. However, it is predicted that there will be a decrease in emissions as more passengers will be able to use public transport as opposed to taxis and private cars, and the more efficient layout and car and taxi loading and unloading processes will result in reduced waiting and idling times, therefore reducing associated emissions.

297. **Air Quality – hospital heating, cooling and electricity** Operation of the CCHP system in the Xiangtan First Traditional Chinese Medicine Hospital will generate air emissions due to natural gas combustion. The emission will typically include NO_x, SO₂, PM and CO₂. The CCHP system is designed to supply heating, cooling and electricity, and replace the corresponding quantity of energy supplied by municipal electricity grid in the original design.

298. Mitigation measures will include low-NOx burners and boilers. According to a 2007 survey of industrial natural gas boilers in the PRC, natural gas boilers typically have a NOx emission of 137.31 mg/m³. This emission level is in compliance with both the PRC national natural gas boiler emission standard of 150 mg/m³ (PRC Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers GB 13217-2014), and the 2007 EHS Guidelines of 240 mg/m³ for boilers. However, to in order to maximize environmental benefits, low NOx natural gas boilers with less than 100 mg/m³ NOx emissions will be used in the hospital.

299. A low NOx boiler is designed to optimize flame shape. Staged combustion technology is used, resulting in a cooler flame which suppresses thermal NOx formation. The swirl-stabilized primary area is responsible for producing a very stable flame. Combustion chambers are designed to match the low NOx burners. In addition, smart fuel-air compound control generates the optimum conditions for the combustion air through a joint fan with a frequency converter. The combination of low NOx combustion, large combustion chambers, smart control systems and efficient combustion technology benefits the environment as well as the operator and ensures that NOx emissions are less than 100 mg/m³.

300. A DeNOx system (Selective Non-Catalytic Reduction or SNCR) will be installed on the gas engine to ensure NOx emissions are less than 30 mg/Nm³. The system will utilize urea as a reagent, which is non-toxic and more easily handled and stored than ammonia.

301. Considering the overall energy saving of 4,459 MWh/year and 3,243 tons CO_{2e} estimated from achieving the EDGE certification, the overall emission from the hospital will be reduced versus the baseline situation.

302. **Noise – roads and bus lines.** Vehicle operation along the program roads will generate emissions. However, it is predicted that there will be a decrease in noise compared to the base line as more passengers will be able to use low noise BEB public transport as opposed to noisier gas-fired buses, taxis and private cars. In addition, operation of the ITS system is expected to improve the overall efficiency of traffic system, and reduce low-speed traffic flows or traffic jams. Overall, program interventions are expected to lead to reduced traffic noise.

303. **Noise – e-charging stations.** Noise from charging station operation will be generated from equipment operation and users, both people and vehicles (Table 46). Low noise equipment will be selected where possible, noisy machinery will be installed in insulated equipment rooms, and the building walls will be insulated for sound protection. Predicted charging station operating noise impacts with sound proofing mitigations in place are presented in Table 47.

Table 46: Charging station predicted noise sources, (dB(A))

Noise Source	Location	Source strength
Vehicles	Entrances / exists of the station	75-80
People	Inside station	65-70
Equipment	Inside station	50-55

Source: PPTA expert, 2019.

Table 47: Predicted noise impacts during operation, (dB(A))

Noise Source	Noise level after mitigation	Predicted impact value by distance						Impact value by distance accumulated with background noise					
		5 m	10 m	20 m	30 m	50 m	100 m	5 m	10 m	20 m	30 m	50 m	100 m
		Day ¹	Day	Day	Day	Day	Day	Day	Day	Day	Day	Day	Day
Vehicles	75-80	66	60	53.9	50.5	46	40						
People	65-70	56	50	43.9	40.4	36	30	68.0	64.8 ²	63.4	63.1	62.9	62.83
Equipment	50-55	41	35	28.7	25.4	21	15						

Source: PPTA experts, 2019.

Notes:

¹ The estimation only calculated day time noise due to limited operation after 22:00 h. Background noise refers to the maximum day time value of 62.8 dB(A) of class I and class II stations according to "Table 8 Ambient day and nighttime noise monitoring data, XEEB, 2016-2018" of Chapter IV.

304. The results in Table 47 indicate that the largest noise sources are from users and their vehicles, and that an up to 5.2 dB(A) increase may occur at a distance of 5 m. To further mitigate noise, i) use of horns while in or entering or leaving the station will be prohibited, and idling of engines will not be allowed; ii) low-noise equipment, will be selected where possible; iii) as noted above, noisy equipment will be installed in sound insulated equipment rooms, and building wall will also be sound insulated; iv) sites will be surrounded by vegetation; v) sound barriers will be installed between charging stations and any adjacent sensitive receptors. Overall, with these mitigations in place, charging station operation is not expected to cause significant changes in the sound quality of the current regional acoustic environment or impact surrounding residents.

305. **Domestic Solid Waste – roads, bus lines and charging stations.** Solid waste generated during the operation phase will primarily consist of domestic garbage generated from passengers and operational staff, and will include plastic bags, paper and other trash. The following solid waste management measure will be implemented:

- (i) Program roads and bus lines will be equipped with appropriate garbage and recycling containers installed every 80 to 100 m.
- (ii) E-charging stations will be equipped with appropriate garbage and recycling containers.
- (iii) Domestic garbage and recyclables will be collected on a regular basis. Recyclables will be collected by an appropriate recycling facility and garbage by the local sanitation department for disposal at a municipal solid waste landfill.

306. **Battery Electric Bus (BEB) Recycling.** Over the lifetime of the program it is expected that some BEBs will need to be replaced due to either mechanical failure or accident. Non-functional BEBs will be recycled to the maximum extent possible. The XMG, as the owner and operator of the BEBs, will be responsible for overseeing vehicle scrapping and recycling. They will entrust the procedure to a nationally certified vehicle write-off company who will be responsible for all aspects of vehicle scrapping and recycling including collection, remanufacturing of allowed components if suitable (engine assembly, steering assembly, transmission assembly, front and rear axles, and frame), and recycling of components that cannot be remanufactured, in accordance with relevant PRC regulations, including the *Regulations on Vehicle Recycling Management*. This will also apply to existing buses which program buses replace.

307. **Hazardous Materials and Waste.** Toxic, hazardous, and harmful materials present in the operation of the program include used batteries³⁰, used lubricating oil and grease (O&G) from maintenance facilities, sludge for oil-water separators, and medical wastes from the hospital. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

308. These potential impacts will be effectively mitigated through good practice hazardous materials management in accordance with relevant PRC regulations. This will include appropriate hazardous materials transport, storage and disposal, battery reuse or recycling, and the development of emergency spill response procedures.

309. When a battery capacity is lower than 80%, it will no longer be used on buses. It will be moved to a battery cluster within the bus stations to provide electricity for slow chargers working in the night time. When capacity is too low to function in that manner, they will be recycled.

310. PRC *Interim Measures for the Administration of Recycling and Utilization of New Energy Vehicles' Power Battery* (2018) August 1, 2018 makes EV manufacturers responsible for the recovery and recycling of EV batteries. In compliance with the Interim Measures, and to ensure appropriate battery recycling, the battery providers will be responsible for collection, recycling (or reuse again if possible) of batteries. Battery providers will also be required to have a "traceability" system that enables the identification of owners of discarded batteries, and easily dismantled product designs to help automate the recycling process.

311. Medical waste production from the hospital is estimated at 0.68 kg/bed day.³¹ All medical wastes will be treated as hazardous waste as per HW01 in *Directory of National Hazardous Wastes (2016 Revision)*, and will be collected and transferred to Zhuzhou City for centralized incineration. The process will be managed by *Xiangtan Medical Waste Handling Center Co., Ltd.*, the only qualified medical waste contractor in Xiangtan City. The company holds a valid business license issued by the Xiangtan Municipal Industrial and Commercial Administration Bureau, and a valid operation license issued by the XEEB (Figure 80). The contractor has the capacity to handle 3500 tons a year of medical waste.

³⁰ Bus batteries in China have a typical life span of 8 years (based on a reserve ratio of minimum 10% and an SOC of 90%).

³¹ Yong, Zhang & Xiao, Gang & Wang, Guanxing & Tao, Zhou & Dawei, Jiang. (2009). Medical Waste Management in China: A Case Study of Nanjing. Waste management (New York, N.Y.). 29. 1376-82. 10.116/j.wasman.2008.10.023.

Figure 80: Business (top) and operations (bottom) licenses of the *Xiangtan Medical Waste Handling Center Co. Ltd.*



Source: Xiangtan Medical Waste Handling Center Co. Ltd., 2020.

312. Collection and transport to Zhuzhou City will be managed by a qualified contractor, the *Zhuzhou Zhongcheng Medical Waste Transportation Co. Ltd.* The contractor holds a valid business license issued by Zhuzhou Municipal Industrial and Commercial Administration Bureau, and a valid operation license issued by Zhuzhou Road Transportation Administration Bureau (Figure 81). The waste incineration company is qualified and supervised by Zhuzhou Municipality.

315. To address these risks the operators Environment, Health and Safety Officer will undertake a risk assessment and implement an Occupational Health and Safety Plan (OHSP) to address the risks, maintain records concerning health, safety and welfare and regularly report on accidents, incidents and near misses. The OHSP will provide adequate precautions to protect the health and safety of their workers, including but not necessarily limited to sanitation, including waste removal and provision of potable water and sanitation facilities; occupational safety, including provision of appropriate personal protective equipment (PPE) such as safety hats, shoes, goggles, ear plugs and respiratory masks; electrical safety; traffic safety; emergency response, including procedures for medical, fire and other emergencies; and training in accordance with *EHS Guidelines*. The OHSP will be reviewed and approved by the LIEC and PMO.

316. **Traffic Safety.** Operation of the zero emission modern bus network includes inherent risk of traffic accidents. This risk will be mitigated through regularly inspect and maintaining corridor roads and drains, appropriate training and licensing of bus drivers and provision of PPE; strict enforcement of traffic laws and regulations, especially speed limits. For pedestrian safety busses will also be equipped with Acoustic Vehicle Alerting Systems (AVAS), which will emit warning sounds at speeds less than 30 km/h, and there will be public awareness on BEB safety.

317. Upgrading of non-motor ways and implementation of user-friendly facilities are mitigation measures towards traffic safety risks. The provision of lanes for pedestrians and non-motorized vehicles and improved designs of road junctions and frequent pedestrian crossings will reduce risks for both passengers and surrounding residents. In addition, traffic laws will be strictly enforced.

318. **Ecology.** Program operation is not expected to have any significant negative impacts on flora and fauna. All program sites are situated within modified industrial, commercial and residential and urban environments. Based on the site surveys, there are no known rare or endangered flora or fauna, species with international, national or provincial protection status, areas of natural or critical habitat, parks, nature reserves, or areas with special national, regional or local ecological significance within or adjacent to any of the sites.

319. **Visual Aesthetics.** The overall visual character of the program zone of influence is that of an urbanized area. The bus stations and roads have been developed in the central urban area, along with the associated green landscaping. The facilities developed by the program are a positive contribution that are fully compatible with the existing and planned surrounding urban facilities and infrastructure.

E. Policy Loan Impacts

320. Policy loan actions are overwhelmingly positive. The policy loan will support the support the low carbon transformation of Xiangtan, which will reduce greenhouse gas (GHG) emissions, improve climate resiliency, and improve the quality-of-life for Xiangtan residents. A policy loan impact assessment matrix is presented in Appendix F.

F. Cumulative, Indirect and Induced Impacts

321. Cumulative impacts are defined as the combination of multiple impacts from existing projects, the proposed program, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project. With respect to the construction phase, the program is a very small part of the large scale urban development and expansion underway in Xiangtan City. The very small scale of program works

are such that they are not expected to have any appreciable negative impacts over and above the urban development and expansion that is already underway.

322. Indirect impacts are adverse and/or beneficial environmental impacts which cannot be immediately traced to a project activity but can be causally linked. Induced impacts are adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project which may occur later or at a different location.

323. The bus priority systems and non-motor systems will provide human-friendly system for the people in central Xiangtan area, and the ITS, smart bus stops, multi-modal bus stations, zero-emission buses and charging stations will improve public transport in the overall Xiangtan City. These program outputs have been developed in accordance with the Urban Master Plan of Xiangtan (2010-2020). With their completion traffic function and public transport service will be improved, and there will be positive indirect economic and health benefits to residents.

324. The EbA measures on Fuxing Middle Road and the Smart Early Flood Warning System will improve the climate resilience capacity of Xiangtan. The improved building facilities will establish user-friendly and environment-friendly, and will demonstrate green measures for the overall urban development for Xiangtan. The completion of these systems will follow the “human-centered” and “ecology-friendly” principles defined in the Urban Master Plan of Xiangtan (2010-2020), and reduce the impact of flooding and GHGs.

325. The priority bus system, smart bus stops, BEBs, e-charging stations, non-motorized transport systems, and optimization of the Xiangtan ITS system will reduce traffic loads, improve the overall efficiency of traffic system, reduce low-speed traffic flows and traffic jams, and reduce, and reduce overall vehicle emissions. In addition, operation of the 100 zero-emission BEBs will result in substantial reductions in emissions compared to operation of a similar fossil fueled bus fleet, or the provision of equivalent transportation through private cars. Overall, program operation is expected to reduce GHG emissions from program roads by 265,800 tons of CO_{2e} per year.

F. Climate Risk

326. A separate Climate Risk and Vulnerability Assessment (CRVA) was undertaken for the program.³² Data from the Coupled Model Inter-comparison Project Phase 5 (CMIP5) climate models for the program area were compiled and reviewed. The downscaled climate scenarios that were derived from the General Circulation Model (GCM) runs conducted under the CMIP5 were established for Xiangtan. The CRVA was conducted for greenhouse gas emission scenarios known as Representative Concentration Pathways (RCPs) used in the Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC).

327. The CMIP5 climate projections were obtained through model simulations for four different scenarios, RCP2.6, RCP4.5, RCP6.0, and RCP8.5, respectively, which represent different levels of greenhouse gas emission. The scenario of RCP2.6 represents the lowest level of greenhouse gas emission that corresponds to the agreed outcomes of the Paris agreement (no more than 2.0 °C of temperature increase over pre-industrial). RCP4.5 and RCP6.0 are the medium and high scenarios but their differences are mainly in late of this century with little difference by 2050. RCP8.5 is the extreme case that represents the highest level of emission with the most significant degree of climate change.

³² Climate Risk and Vulnerability Assessment (CRVA) prepared for the Proposed Xiangtan Low-Carbon Transformation Sector Development Program in the People's Republic of China (PRC). ADB, 2019.

328. A conservative approach was adopted to use the RCP4.5 as a reference scenario and RCP8.5 as a challenging scenario for this CRVA analysis. Future climate hazards, such as floods and temperature extremes, etc. were derived by analyzing these two scenarios at a local level. This is to ensure that both the climate change impact assessment and the resulting proofing measures are adequate for the proposed program components.

329. The simulated climate data from the General Circulation Model (GCM) used in this assessment include both the historical baseline and future timeframes under both the RCP 4.5 and RCP 8.5 scenarios, respectively. The historical scenario covers the GCM precipitation data for a 55-year historical baseline period from 1950 to 2005, while the RCP4.5 and RCP8.5 scenarios include a 80-year projection period (2021-2100). The GCM model data for each period of time scale can be viewed as a statistical realization of that climatic period.

330. The precipitation and temperature data from the GCM were applied in the CRVA to project future climate change conditions. A combination of different RCP and climate sensitivities could be used to characterize the future climate change scenarios and their associated uncertainty ranges. The RCP4.5 scenario with low-climate sensitivity and RCP8.5 with high-climate sensitivity were used as an indicator of the corresponding low and high bound of the uncertainty range. Projected precipitation/temperature data were obtained for the following three climate change scenarios: Historical, RCP 4.5 and RCP 8.5.

331. Three key period timeframes were defined for the CRVA: (i) PA, the past 30 years from 1976 to 2005; (ii) NF, the near-term future from 2021 to 2050; and (iii) LF, the long-term future from 2071 to 2100. Projected climate variables (such as maximum temperature, minimum temperature and precipitation) that may cause hazardous to the proposed program in Xiangtan were obtained for the three periods, respectively.

332. The CRVA analysis predicts that climate change will have moderate impacts of on extreme events in Xiangtan. Mean temperature will change very little from current levels by 2050. Precipitation amounts for each return period event increase but only by a small percentage by 2030 and 2050. Temperature extremes do increase and return periods shorten, but extreme temperature already occurring with a one in 50-year event becoming a one in five year event, which while more frequent is potentially not critically impactful for infrastructure unless it is already maladapted to the current climate. There is evidence of roofs being lost in storms however extreme cyclone wind speeds change very little through to 2050 and risk from wind events changes very little from current risk levels.

333. One critical area identified in the CRVA for many sectors is flooding and inundation. As for precipitation and rainfall intensity, the impact is more significant on the intensity of heavy rainfall and storm events than on the total amount of annual precipitation. The increased rainfall intensity of individual storm events may result in higher flood peak flows and impose higher flooding risks to the program components. Therefore, the impact of climate change on extreme rainfall has been factored into the program design, including the Xiangtan pluvial flood assessment; EbA measures at the Fuxing Middle Road Improvement Demonstration Project; EbA measures at the Xiangtan First Traditional Chinese Medicine Hospital; the development of Integrated Urban Catchment Management Plans; and the development of the Xiangtan Smart Early Flood Warning System. The potential effects of increased flooding due to climate change will also be considered in siting the locations of important facilities and water-proofing program components including electrical equipment.

G. Associated Facilities

334. Associated facilities are 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 program.

335. The only associated facility that has been identified for the program is the Jiuhuabei substation to which the 110 kV Liwei substation and transmission line will connect. A due diligence review of the Jiuhuabei substation is presented in Appendix G.

H. Positive Impacts and Environmental Benefits

336. The program will benefit 1.8 million residents of the Xiangtan urban area, including both public transport users and residents in general (Table 48).

- (i) Once operational, ridership on the priority bus network is expected to reach 883,685 passenger trips per day. Users will benefit from a quiet, intelligent and highly efficient, zero-emission bus system. Residents who are non-users will also benefit from access to car charging stations, reduced traffic congestion, improved road safety, and reduced air pollution.
- (ii) An efficient public transport system will reduce the costs of transport in serving major urban and industrial areas and transport hubs, and will provide better accessibility to employment and services in Xiangtan. It will enhance economic growth compared to the existing public transport system.
- (iii) Benefits from improved traffic flows and reduced congestion from ITS implementation include:
 - a. a 51% crash rate reduction and a 76% fatality rate reduction per crash due to speed limit enforcement;
 - b. reduced journey time by car of 57% as a result of reduced congestion, traffic signal coordination, parking management, weather warning and incident management;
 - c. reduced journey time by bus of 63% and increased bus modal share from the current rate of 19.5% by 36.3% as a result of a bus information management system, reduced congestion, bus priority measures, traffic signal coordination, weather warning and incident management;
 - d. reduced vehicle operating costs by 16% as a result of less congestion and reduced stop-start traffic conditions; and,
 - e. reduced vehicle emissions by 16% due to less congestion and reduced stop-start traffic conditions.
 - f. Calculations of GHG emission reduction were estimated and the details of the calculation is provided in Supplementary Documents no.24-no.28 of the program. In the first year after project completion, low-carbon, resilient, inclusive infrastructure, and information and knowledge platforms would result in over 337 ktCO₂e of GHG emission reduction. Combined project and policy actions are expected to reduce emissions more than 770 ktCO₂e in 2026. The total amount of GHG reduction over the project lifetime up to 2045 would be over 7 MtCO₂e with an annual average of 378 ktCO₂e. During the program life-

time up to 2045, a total GHG reduction would be over 48 MtCO₂e with an annual average of 2.4 MtCO₂e. The cumulative abatement gap between the best case and worst case for Xiangtan exceeds 167 MtCO₂e, ranging from a 1.6 MtCO₂e annual abatement gap in 2026 to a 16.6 MtCO₂e gap in 2045. The best-case scenario from the IAMs shows that Xiangtan carbon peaking could be possible in 2032 under the assumption that Xiangtan implements all possible low-carbon measures, policies, and technologies in all sectors. In terms of the XLCTSDP's impacts, the results show that the project component alone could result in only a 5% contribution to the necessary abatement, ranging from 2% to 21% annual contribution to necessary yearly abatement. The combined project and PBL, on the other hand, could lead to a 29% contribution to the cumulative abatement need, ranging from 19% to 49% annual contribution to necessary abatement per year.

Table 48: Program beneficiaries by output

Project	Beneficiaries (areas)	Beneficiaries (persons)
Output 1: Low-Carbon and Resilient Infrastructure Transformation Demonstrated		
(i) installation of comprehensive bus priority lanes and etc.	113 communities of 58 Streets	About 0.5 million local people
(ii) school zone transformation for children's road safety at five primary schools	5 schools	713 teachers, 11,256 students, and their parents
(iii) street transformation for climate resilient and multi-purposed street for people	6 communities of 2 Streets	65,516 local people
(iv) the first "EDGE-certified" hospital building	whole city	Over 190 thousand patient · times per year
(v) improvement of public facilities and other urban infrastructure at 20 urban communities	20 communities	Over 180 thousand local people
Output 2: Information and Knowledge Platforms Established for Informed Decision Making and Behavior Changes		
Output 3: Low-Carbon Transformation Policy Reforms Adopted	The whole city	1.8 million local people
Output 4: Capacity Building and Program Management Enhanced		
TOTAL	The whole city	1.8 million local people

VI. ANALYSIS OF ALTERNATIVES

337. An analysis of program alternatives was undertaken during the feasibility phase to determine the most financially and technically feasible way of achieving the program objectives while minimizing environmental and social impacts.

A. No-Program Alternative

338. The consequences of the 'no-program' alternative are analyzed by program activity, below, with a focus on output (i).

339. The consequences of the 'no-program' alternative for the program's low-carbon and resilient transportation infrastructure are overcrowded road networks, poor traffic management, parking difficulties, inadequate provision and use of public transport, high rates of traffic incidents, and increased fuel consumption and emissions that contribute to pollution and climate change. Development of bus priority systems, traffic management systems, low emission buses, improved accessibility at multimodal stations, etc., is crucial for continued economic growth and sustainable urbanization.

340. The consequences of the 'no-program' alternative for the Fuxing Middle Road demonstration project include an overcrowded road, poor cycling ways and walkways, parking difficulties, high flood risk and poor drainage capacity, and other ecological and economic risks due to flooding. Demonstration of a modern road system combining cycling ways, walkways and ecosystem-based adaptation (EbA) measures is necessary for knowledge sharing and progressing LCT. Development of flood warning and management system is crucial for XMG to be pro-active for controlling ecological and economic losses.

341. The consequences of the 'no-program' alternative for the Xiangtan First Traditional Chinese Medicine Hospital are high energy consumption, high carbon emissions, high flood risks and low climate resilience. Development of green, low-carbon emission and resilient buildings is crucial for such a sensitive and important public facility, considering the necessity of its efficiency and safety for users. It is also an important to show case the development of green buildings in order to reduce carbon emission and increase utilization efficiency of water, solar, and other resources.

342. The consequences of the 'no-program' alternative for low-carbon community improvements are high-level building energy consumption, leading to high GHG and other pollutant emissions.

343. The consequences of the 'no-program' alternative for information and knowledge platforms are inefficient and incomplete ICT platforms, high emission behaviors within key sectors such as building and industrial production, and diffuse capacity for environmental monitoring. The 'no-program' alternative would limit the function of ICT platforms for providing long-term support for the LCT of Xiangtan City, and insufficient capacity to support policy and decision-making activities across different sectors. For the purpose of identifying and estimating carbon reduction potentials it is necessary to make action plans across sectors, monitor the long-term results, and synchronize ICT platforms with improved functions across key sectors.

344. With the program, the XMG will have an extensive, cleaner and sustainable urban management system. Overall, the benefits of the program are significant and long-term, and the 'no-program' alternative is rejected.

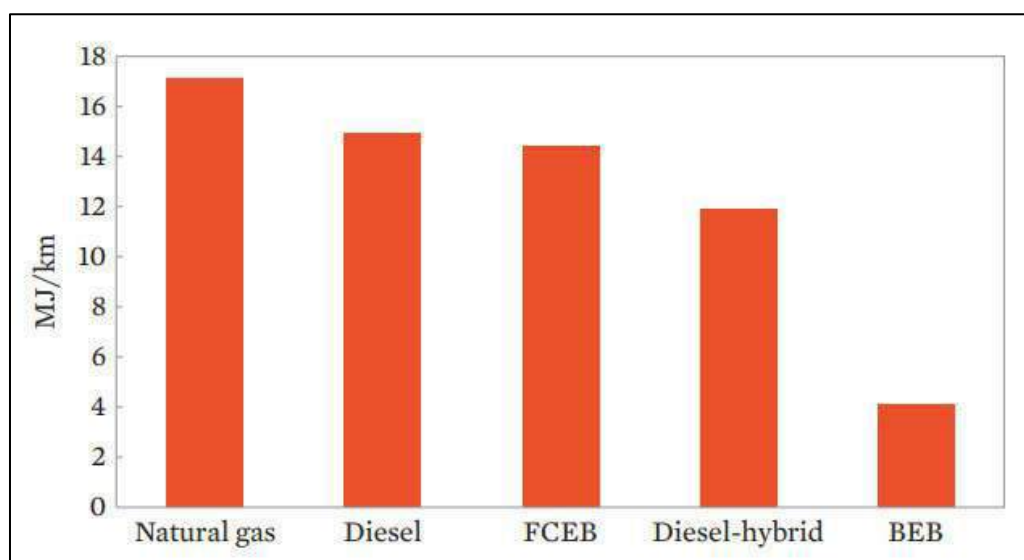
B. Locations of Trunk Roads, Cycle and Pedestrian Paths, Bus Stops and Charging Stations

345. The locations of the proposed trunk roads, cycling ways and pedestrian walkways were dictated by Xiangtan Urban Transportation System Plan (2015-2030), prepared by the China Urban Planning Design and Research Institute (Shanghai Branch), and the FSR for Charging Pile Construction Project of Xiangtan City (2017), prepared by the Xiangtan Planning and Architecture Design Institute. The road lanes and sites were selected based on factors such as population distribution, expected passenger flows, bus routes, vehicle flows and loads of traffic centers, the locations of other transport infrastructure such as subway stations, and land use and land use zoning. Some proposed sites were rejected due to non-suitability, and at other sites facility boundaries were adjusted to fit local conditions.

C. Bus Types

346. The transition to battery powered electric buses (BEBs) will reduce energy consumption and GHG emissions compared to fossil fueled buses. Figure 82 shows the relation of energy usage to the different fuel types expressed in megajoule (MJ) for standard 10–12 m buses (the most used bus size type in the PRC). Natural gas buses use around 17% more energy than diesel units. Fossil fuel units use four times more energy than electric buses, which clearly shows electric bus efficiency.

Figure 82: Energy usage of standard urban 10–12 meter buses in the PRC, 2016, (MJ/km)



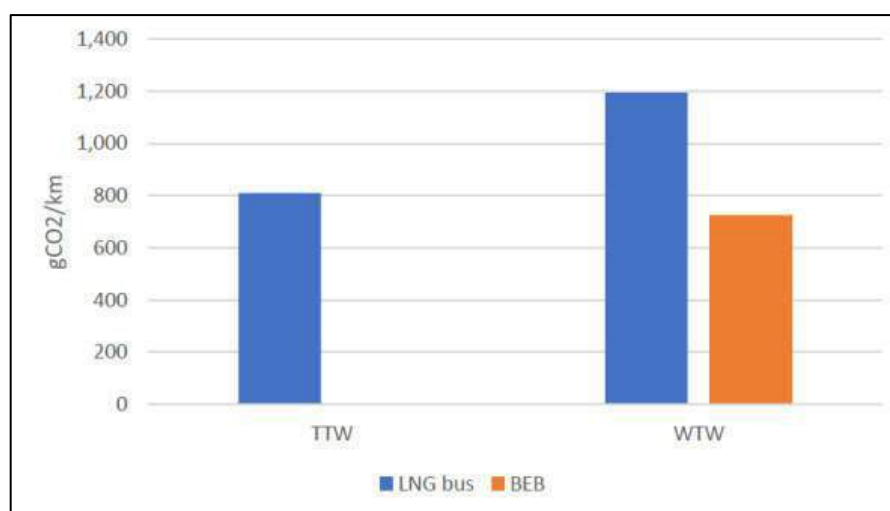
BEB = battery electric bus, FCEB = fuel cell (hydrogen) electric bus, km = kilometer, m = meter, MJ = megajoule. Note: Fuel consumption values are based on average consumption values in cities in the People's Republic of China.

Source: ADB, 2018.

347. A significant proportion of buses currently used in Xiangtan are LNG fueled. A comparison was undertaken of BEBs to LNG buses GHG impact based on direct or tank-to-wheel (TTW) emissions and indirect or well-to-wheel (WTW) emissions. The latter includes upstream fuel extraction, refinery and distribution as well as methane slip, and for electric buses emissions from the production of electricity including grid losses.

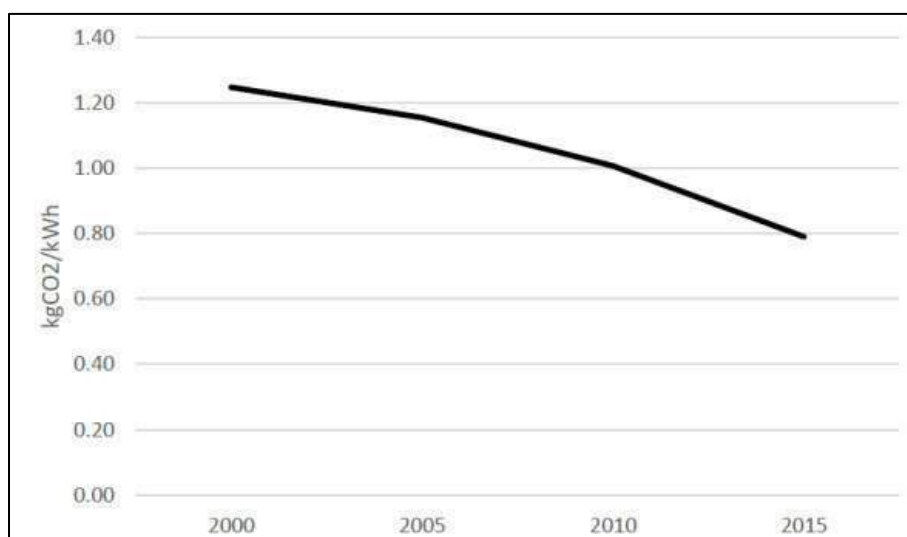
348. Figure 83 compares GHG TTW and WTW emissions of LNG and BEBs per kilometer. BEBs reduce around 40% of GHG emissions compared to LNG buses (WTW comparison). GHG reductions are expected to increase as the Chinese electricity grid is getting greener (Figure 52). The average national carbon factor of the grid decreased on average 3% per annum over the last 15 years.

Figure 83: GHG emissions of LNG buses and BEBs



Source: ADB PPTA Team.

Figure 84: Reductions in grid factor in China over time



Source: Calculated by ADB PPTA Team with data from OECD and IEA; based on net electricity generation (production minus losses).

D. Climate Adaptation

349. According to the Xiangtan Urban Transportation System Plan (2015-2030), the planned roads for entire program area in Xiangtan will be constructed of asphalt concrete pavement because it is relatively easy to apply and repair, and has lower traffic noise compared to rigid cement concrete. However, a flood risk modelling was performed and a number of locations with high flood risks were identified (see Section IV.B). Climate adaptation measures have been incorporated into the program works in these areas. Not undertaking these adaptation measures may lead to exacerbated flooding and associated economic losses in the future.

E. Building Energy and Water Systems

350. Options for building energy and water systems were assessed in the FSR of the Xiangtan Traditional Chinese Medicine Hospital Integrated Relocation Project, prepared by Xiangtan Engineering Consulting Company in 2017; and Energy Saving Assessment Report of Xiangtan Traditional Chinese Medicine Hospital Integrated Relocation Project, prepared by Xiangtan Desheng Energy Saving Service Company in 2017. Alternative facilities for electricity supply and utilization, heating and cooling systems, and water supply and utilization systems were assessed. Electricity utilization processes including lighting and heat, and plug-in electric facilities were analyzed, and different heating and cooling solutions including water-source and ground-source heat pumps, gas boilers, electric chillers, gas-fired tri-generation system with absorption chillers were compared. Water consumption units and recycling methods were assessed to improve water efficiency. According to the Assessment Report, after the adaptation of all proposed measures, energy consumption at the hospital will be reduced by 5,771.65 MWh per year; carbon dioxide emissions will be reduced by 2916.46 ton per year; and, water consumption will be reduced by 24,150.59 tons per year.

F. Medical Waste Disposal

351. Medical wastes could be transported for disposal at one of the 3 sanitary landfills in Xiangtan City. However, as per PRC requirements, medical wastes are consider hazardous wastes, and must be incinerated. There are no medical waste incineration facilities in Xiangtan. Medical wastes will be transported to the adjacent Zhuzhou Municipality for incineration in an approved facility supervised by the Zhuzhou Municipal Government.

F. Community Facilities

352. Conventional community facilities include natural gas boilers for domestic hot water, sodium street lights, coal-fired cooking stoves in low-income families, combined storm water and domestic wastewater sewage, and poor rooftop and building insulation. These are inefficient and utilize high levels of energy. Cleaner and greener community facilities will support Xiangtan's LCT.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

353. Meaningful participation and consultation during 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.

354. **PRC Requirements.** Public participation and environmental information disclosure provisions are among the most significant changes introduced in the amended *Environmental Protection Law* (2014). The legislative framework also includes decrees on the methods for public participation in environmental protection (Table 1, item 20), information disclosure on construction project EIAs by government (item 22), preparation of EIA summaries for public disclosure (item 24), and technical guidelines for public participation in EIAs (Table 2, item 9). The public disclosure and consultation process undertaken during the preparation of the EIT was undertaken in compliance with the relevant PRC requirements.

355. **ADB Requirements.** ADB's SPS (2009) has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

356. The SPS requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders. In addition, in order to make key documents widely available to the general public, the SPS requires submission to ADB for posting on the ADB website as follows:

- (i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration, and/or environmental assessment and review frameworks before project appraisal, where applicable;
- (ii) the final EIA/IEE;
- (iii) a new or updated EIA/IEE and corrective action plan prepared during project implementation, if any; and
- (iv) environmental monitoring reports.

357. The SPS also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, the project GRM, and ADB's Accountability Mechanism. For category A projects, such consultations should include consultations both at an early stage of EIA field work and when the draft EIA report is available.

B. Information Disclosure during Program Preparation

358. Program related information, including program description, potential environmental impacts and relevant mitigation measures, was disclosed on the XMG website, (http://www.xiangtan.gov.cn/109/181/content_820895.html) (Figure 85). The EIT, which is under preparation, will also be disclosed when it is available.

Figure 85: Program information, potential impacts and proposed mitigation measures disclosed on XMG website



Source: XMG, 2020.

C. Consultation and Participation during Program Preparation

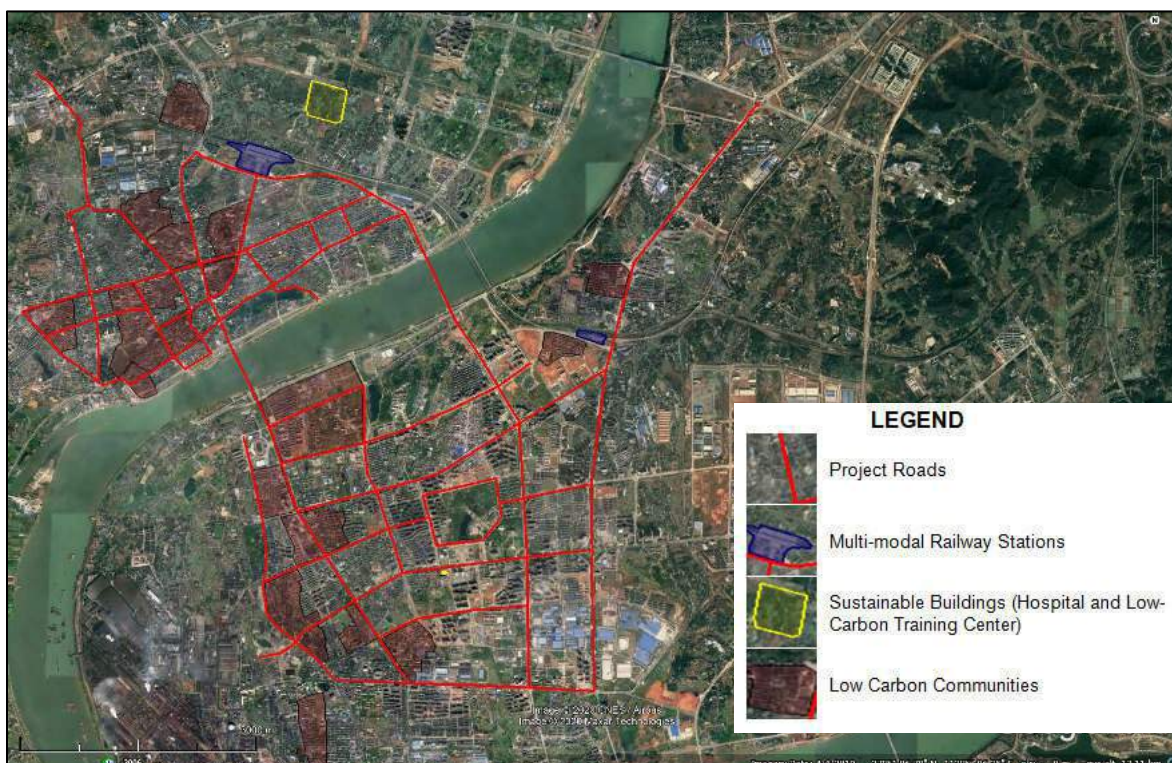
359. Public consultation activities took place during an unprecedented and ongoing outbreak of coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus. As of February 26, 2020 the WHO reports that globally there are 80,239 people confirmed as infected, with 77,780 confirmed in China. There have been 2,666 deaths globally, of which 2,459 have occurred in the PRC. As a result of government restrictions to fight the spread of COVID-19, public meetings and face-to-face surveys have been strictly prohibited. To address this challenge, public consultations were conducted through on-line questionnaire surveys to cover targeted communities and personnel. The questionnaires were distributed and responses received utilizing WeChat, a popular messaging and social media app in China.

360. Three questionnaire were designed and carried out by Xiangtan PMO and local community staff, to collect feedbacks and concerns from relevant stakeholders and affected people in three main program areas of influence:

- (i) communities near program roads (covering bus lane modifications, smart bus stops, smart bus information platform, e-bus procurement, e-charging stations, Fuxing Middle Road, bike paths, pedestrian paths, and pedestrian safety islands, the two multi-modal railway stations and the);
- (ii) communities near the Xiangtan First Traditional Chinese Medicine Hospital site;
- (iii) the low-carbon communities (LCCs).

361. Other program components have no physical works and pose no environment impact towards surrounding communities (e.g. early flood warning system), and thus public consultation is not required.

Figure 86: Areas covered by public information disclosure and consultations



Source: ADB PPTA consultant, 2020.

362. As part of the questionnaire process information was provided introducing and describing the program, its potential environmental impact and relevant mitigation measures, and the purpose of the public consultation. In total 348 valid questionnaires were distributed and collected through the on-line survey system. Screenshots from the survey are presented in Figure 87. The participants were selected so as to maximize coverage of age, occupation and education levels. The on-line system recorded details including the IP address, the time duration of filling the questionnaire, the submittal time and the software utilized in completing the survey, in order to assess the validity of each collected questionnaire (Figure 88). The results were automatically analyzed and presented by the system (Figure 89).

Figure 87: Screenshots of the on-line public consultation questionnaire

<p>公众参与调查问卷 (新中医院)</p> <p>完成湘潭市中医院建设，且采用世界银行绿色建筑EDGE标准并通过认证。主要管理措施包括改造建筑外墙隔热、安装太阳能系统，增强建筑节能系统的能源效率，雨水回收和中水回用等等。</p> <p>潜在环境影响在施工现场主要为在建筑工地上堆积的未覆盖的土壤材料、车辆运输材料、扬尘、噪音、废水和固体废物等。运行期主要受运营产生的废水。</p> <p>减缓措施主要为：(1) 采用良好的施工土壤和土方管理施工规范；(2) 按照EMP中的规定实施良好的粉尘管理措施，包括洒水、覆盖物料和土方等；(3) 选择低噪音设备；(4) 尽可能重复利用和回收建筑垃圾；(5) 所有设施的设计均应符合环境、健康安全指南的国家要求。</p> <p>*一、基本信息</p> <p>1.姓名 <input type="text"/></p> <p>2.性别 <input type="radio"/> 男 <input type="radio"/> 女</p> <p>3.年龄 <input type="radio"/> <30 <input type="radio"/> 31-40 <input type="radio"/> >40</p> <p>4.民族 <input type="radio"/> 汉 <input type="radio"/> 其他</p> <p>5.教育水平 <input type="text"/></p>	<p>公众参与调查问卷 (低碳社区)</p> <p>公共服务能力提升和低碳社区建设项目，对湘潭区10个社区和岳塘区10个社区进行改造，升级基础设施，提升公共服务能力，进行低碳社区示范，将采用的生态系统适应性措施主要包含：改造雨水和排水系统、保护路面、提高雨水等建筑功能、安装太阳能板和节能路灯、安装充电桩等。</p> <p>潜在环境影响在施工现场主要为在建筑工地上堆积的未覆盖的土壤材料、车辆运输材料、扬尘、噪音、废水和固体废物等。</p> <p>减缓措施主要为：(1) 采用良好的施工土壤和土方管理施工规范；(2) 按照EMP中的规定实施良好的粉尘管理措施，包括洒水、覆盖物料和土方等；(3) 选择低噪音设备；(4) 尽可能重复利用和回收建筑垃圾；(5) 所有设施的设计均应符合环境、健康安全指南的国家要求。</p> <p>*一、基本信息</p> <p>1.姓名 <input type="text"/></p> <p>2.性别 <input type="radio"/> 男 <input type="radio"/> 女</p> <p>3.年龄 <input type="radio"/> <30 <input type="radio"/> 31-40 <input type="radio"/> >40</p> <p>4.民族 <input type="radio"/> 汉 <input type="radio"/> 其他</p> <p>5.教育水平 <input type="text"/></p> <p>6.职业 <input type="text"/></p>
<p>Questionnaire for communities near the Xiangtan First Traditional Chinese Medicine Hospital site</p>	<p>Questionnaire for LCC communities</p>

Figure 88: Sample of details recorded by the on-line survey system for questionnaire validity assessment

公众参与调查...

统计&分析

查看下载答卷

答案来源分析

完成率分析

预览问卷

★	操作	序号	提交答卷时间	所用时间	来源	来源详情	来自IP(?)
★	👁️🗑️	31	2020/2/19 11:43:07	78秒	微信	N/A	湖南湘潭
★	👁️🗑️	32	2020/2/19 11:43:42	433秒	微信	N/A	湖南湘潭
★	👁️🗑️	33	2020/2/19 11:44:54	75秒	微信	N/A	湖南湘潭
★	👁️🗑️	34	2020/2/19 15:00:01	142秒	微信	N/A	湖南湘潭
★	👁️🗑️	35	2020/2/19 15:01:45	151秒	微信	N/A	湖南湘潭
★	👁️🗑️	36	2020/2/19 15:06:52	298秒	微信	N/A	湖南湘潭
★	👁️🗑️	37	2020/2/19 15:11:18	341秒	微信	N/A	湖南湘潭
★	👁️🗑️	38	2020/2/19 15:11:22	251秒	微信	N/A	湖南湘潭
★	👁️🗑️	39	2020/2/19 15:13:53	275秒	微信	N/A	湖南长沙
★	👁️🗑️	40	2020/2/19 15:31:44	297秒	微信	N/A	湖南湘潭

Source: PMO, 2020.

Figure 89: Respondent age analyzed and presented by the on-line survey system



Source: PMO, 2020.

363. The results from the three questionnaires are discussed below.

364. For roads and transportation system areas, 71 questionnaires were completed and collected (Table 49). Of those surveyed, the male to female ratio was 45:55, the age range was

11% below 30 years old, 41% between 30 to 40, and 48% above 40. Over 80% of participants had a higher than college level education.

365. The analyzed results are and presented in Table 50. It shows that 87.33% of participants recognize the local environment quality as satisfactory or above. Of the environmental pollution problems identified, noise (42.25%) and solid waste (40.85%) were the most serious concerns. 49.3% of participants thought that the program construction would lightly impact noise in the local environment, but most participants thought the program construction would have no impact on local ecology (52.11%) or traffic flows (30.99%). The most serious concern during program operation phase is regarding noise (36.62%). Most (35.21%) participants agreed that the program operation will have no impact on quality of life, while 36.62% of participants anticipated a positive impact of the program on the local economy. In general, 70.42% of participants supported the implementation of the program.

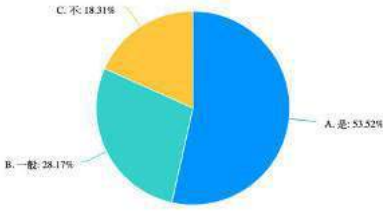
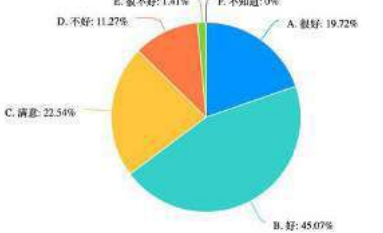
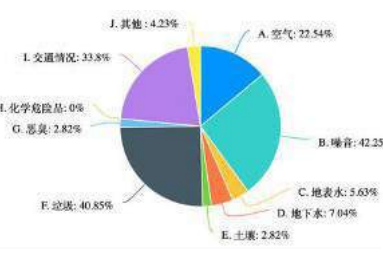

Table 49: Program public consultation questionnaire – roads and transportation systems

Name	Sex	Age
Nationality	Education level	Occupation
Company	Title	Contact number
1. Are you familiar with the proposed project? A. Yes B. Somewhat C. No		
2. What is your opinion of the environmental quality of your living area? A. Very good B. Good C. Satisfactory D. Not good E. Very poor F. Not clear		
3. What are the main environment pollution problems in your living area? (multiple choices OK) A. Air B. Noise C. Surface Water D. Ground Water E. Soil F. Solid waste G. Odor H. Hazardous chemicals I. Traffic congestion J. Other		
4. Do you think construction of the project will negatively impact air quality? A. Severe pollution B. Heavy pollution C. Moderate Pollution D. Light pollution E. No pollution		
5. Do you think construction of the project will negatively impact water quality? A. Severe pollution B. Heavy pollution C. Moderate pollution D. Light pollution E. No pollution		
6. Do you think construction of the project will negatively impact noise quality? A. Severe pollution B. Heavy pollution C. Moderate Pollution D. Light pollution E. No pollution		
7. Do you think construction of the project will negatively impact ecological quality? A. Severe impact B. Heavy impact C. Moderate impact D. Light impact E. No impact		
8. Do you think construction of the project will negatively impact traffic flow and safety? A. Severe Risk B. Moderate Risk C. Low Risk D. No Risk E. Unknown		
9. Do you think construction of the project will negatively impact quality of life? A. Severe Risk B. Moderate Risk C. Low Risk D. No Risk E. Unknown		
10. Are you satisfied with the construction environmental and safety mitigation measures proposed by the project EA? A. Very Satisfied B. Satisfied C. Barely Satisfied D. Very Unsatisfied E. Do Not Know		
11. Do you think project operation will have a positive or negative effect on air quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
12. Do you think project operation will have a positive or negative effect on water quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
13. Do you think project operation will have a positive or negative effect on noise quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
14. Do you think project operation will have a positive or negative effect on ecological quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
15. Do you think project operation will have a positive or negative effect on traffic flow and safety?		

A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact
16. Do you think project operation will have a positive or negative effect on quality of life? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact
17. Do you think project operation will have a positive or negative effect on local economic development? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact
18. Are you satisfied with the operational environmental and safety measures proposed by the project EA? A. Very Satisfied B. Satisfied C. Barely Satisfied D. Very Unsatisfied E. Do Not Know
19. Do you support implementation of the project? A. Yes B. No C. Not clear
20. Suggestions or recommendations for the project:

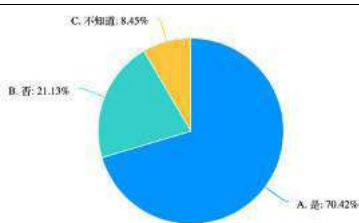
Source: PMO, 2020.

Table 50: Program public consultation result analysis – roads and transportation systems

Question	Options	Pie chart
1. Are you familiar with the proposed project?	A. Yes.....53.52% B. Somewhat28.17% C. No.....18.31%	
2. What is your opinion of the environmental quality of your living area?	A. Very good.....19.72% B. Good45.07% C. Satisfactory.....22.54% D. Not good.....11.27% E. Very poor.....1.41% F. Not clear.....0%	
3. What are the main environment pollution problems in your living area? (multiple choices OK)	A. Air22.54% B. Noise.....42.25% C. Surface Water.....5.63% D. Ground Water.....7.04% E. Soil2.82% F. Solid waste.....40.85% G. Odor2.82% H. Hazardous chemicals.....0% I. Traffic congestion.....33.8% J. Other.....4.23%	
4. Do you think construction of the project will negatively impact air quality?	A. Severe pollution.....4.23% B. Heavy pollution.....0% C. Moderate Pollution.....7.04% D. Light pollution.....57.75% E. No pollution.....30.99%	

Question	Options	Pie chart
5. Do you think construction of the project will negatively impact water quality?	A. Severe pollution.....1.41% B. Heavy pollution.....0% C. Moderate pollution.....8.45% D. Light pollution.....39.44% E. No pollution.....50.7%	<p>A. 严重污染: 1.41% B. 重污染: 0% C. 污染: 8.45% D. 轻污染: 39.44% E. 无污染: 50.7%</p>
6. Do you think construction of the project will negatively impact noise quality?	A. Severe pollution.....5.63% B. Heavy pollution.....1.41% C. Moderate Pollution.....9.86% D. Light pollution.....49.3% E. No pollution.....33.8%	<p>A. 严重污染: 5.63% B. 重污染: 1.41% C. 污染: 9.86% D. 轻污染: 49.3% E. 无污染: 33.8%</p>
7. Do you think construction of the project will negatively impact ecological quality?	A. Severe impact.....2.82% B. Heavy impact.....2.82% C. Moderate impact.....5.63% D. Light impact.....36.62% E. No impact.....52.11%	<p>A. 严重污染: 2.82% B. 重污染: 2.82% C. 污染: 5.63% D. 轻污染: 36.62% E. 无污染: 52.11%</p>
8. Do you think construction of the project will negatively impact traffic flow and safety?	A. Severe Risk.....4.23% B. Moderate Risk.....4.23% C. Low Risk.....23.94% D. No Risk.....30.99% E. Unknown.....36.62%	<p>A. 严重危险: 4.23% B. 危险: 4.23% C. 轻度危险: 23.94% D. 无危险: 30.99% E. 不知道: 36.62%</p>
9. Do you think construction of the project will negatively impact quality of life?	A. Severe Risk.....0% B. Moderate Risk.....5.63% C. Low Risk.....21.13% D. No Risk.....33.8% E. Unknown.....39.44%	<p>A. 严重危险: 0% B. 危险: 5.63% C. 轻度危险: 21.13% D. 无危险: 33.8% E. 不知道: 39.44%</p>
10. Are you satisfied with the construction environmental and safety mitigation measures proposed by the project EA?	A. Very Satisfied.....15.49% B. Satisfied.....12.68% C. Barely Satisfied.....30.99% D. Very Unsatisfied.....0% E. Do Not Know.....40.85%	<p>A. 非常满意: 15.49% B. 满意: 12.68% C. 基本满意: 30.99% D. 非常不满意: 0% E. 不知道: 40.85%</p>
11. Do you think project operation will have a positive or negative effect on air quality?	A. Strong positive impact....11.27% B. Somewhat positive impact..18.31% C. No impact.....40.85% D. Somewhat negative impact.....29.58% E. Strong negative impact ...0%	<p>A. 严重正面影响: 11.27% B. 一定程度的正面影响: 18.31% C. 没有影响: 40.85% D. 一定程度的负面影响: 29.58% E. 强烈的负面影响: 0%</p>

Question	Options	Pie chart
12. Do you think project operation will have a positive or negative effect on water quality?	A. Strong positive impact.....9.86% B. Somewhat positive impact..11.27% C. No impact47.89% D. Somewhat negative impact.....30.99% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
13. Do you think project operation will have a positive or negative effect on noise quality?	A. Strong positive impact.....9.86% B. Somewhat positive impact.15.49% C. No impact.....30.03% D. Somewhat negative impact.....36.62% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
14. Do you think project operation will have a positive or negative effect on ecological quality?	A. Strong positive impact.....9.86% B. Somewhat positive impact..16.9% C. No impact.....43.66% D. Somewhat negative impact.....29.58% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
15. Do you think project operation will have a positive or negative effect on traffic flow and safety?	A. Strong positive impact.....12.68% B. Somewhat positive impact..26.76% C. No impact.....29.58% D. Somewhat negative impact.....30.99% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
16. Do you think project operation will have a positive or negative effect on quality of life?	A. Strong positive impact.....15.49% B. Somewhat positive impact.25.35% C. No impact35.21% D. Somewhat negative impact.....23.94% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
17. Do you think project operation will have a positive or negative effect on local economic development?	A. Strong positive impact.....16.9% B. Somewhat positive impact..36.62% C. No impact.....29.58% D. Somewhat negative impact.....16.9% E. Strong negative impact.....0%	<p>Legend: A. 强正向影响, B. 一定程度的正向影响, C. 无影响, D. 一定程度的负向影响, E. 强负向影响</p>
18. Are you satisfied with the operational environmental and safety measures proposed by the project EA?	A. Very Satisfied.....16.9% B. Satisfied.....25.35% C. Barely Satisfied.....26.76% D. Very Unsatisfied.....0% E. Do Not Know.....30.99%	<p>Legend: A. 非常满意: 16.9%, B. 满意: 25.35%, C. 基本满意: 26.76%, D. 非常不满意: 0%, E. 不知道: 30.99%</p>

Question	Options	Pie chart
19. Do you support implementation of the project?	A. Yes.....70.42% B. No.....21.13% C. Not clear.....8.45%	

Source: PMO, 2020.

366. For the application of energy-efficiency solutions and EbA measures at the Xiangtan First Traditional Chinese Medicine Hospital, the public consultation questionnaire is presented in Table 51, and the results in Table 52. 40 questionnaires were completed and collected. Of those surveyed, the male to female ratio was 50:50, the age range was 20% below 30 years old, 35% between 30 to 40, and 45% above 40. Over 65% of participants had a higher than college level education.

367. The results show that 95% of participants recognize the local environment quality as satisfactory or above. Of the environmental pollution problems identified, air (42.5%), noise (42.5%) and solid waste (45%) were the most serious concerns. 40% of participants thought that the program construction would lightly impact air quality in local environment, 50% of participants thought that the program construction would lightly impact noise in local environment, and 45% of participants thought the program construction would lightly impact local ecology. Most participants thought that program operation will have no impact on either the overall environmental quality at the hospital (50%), or the quality of patient life (45%). In general, 87.5% of participants supported the construction of the hospital, and 77.5% of participants supported the implementation of the program.

Table 51: Program public consultation questionnaire – Xiangtan First Traditional Chinese Medicine Hospital site

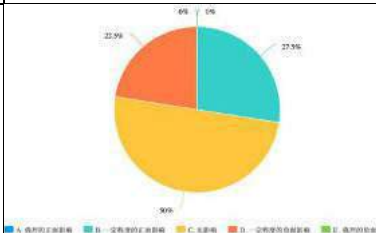
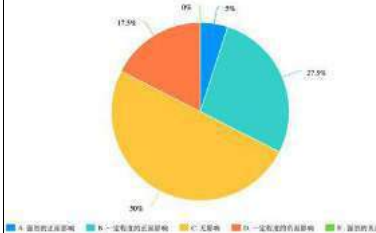
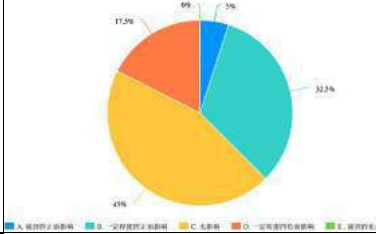

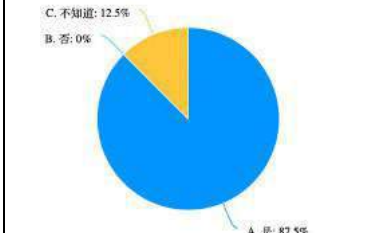
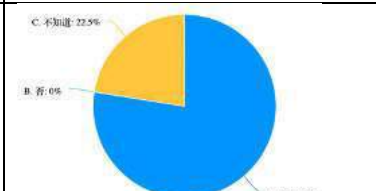
Name	Sex	Age
Nationality	Education level	Occupation
Company	Title	Contact number
1. Are you familiar with the proposed project? A. Yes B. Somewhat C. No		
2. What is your opinion of the environmental quality of your living area? A. Very good B. Good C. Satisfactory D. Not good E. Very poor F. Not clear		
3. What are the main environment pollution problems in your living area? (multiple choices OK) A. Air B. Noise C. Surface Water D. Ground Water E. Soil F. Solid waste G. Odor H. Hazardous chemicals I. Traffic congestion J. Other		
4. Do you think construction of the project will negatively impact air quality? A. Severe pollution B. Heavy pollution C. Moderate Pollution D. Light pollution E. No pollution		
5. Do you think construction of the project will negatively impact water quality? A. Severe pollution B. Heavy pollution C. Moderate pollution D. Light pollution E. No pollution		
6. Do you think construction of the project will negatively impact noise quality? A. Severe pollution B. Heavy pollution C. Moderate Pollution D. Light pollution E. No pollution		
7. Do you think construction of the project will negatively impact ecological quality? A. Severe impact B. Heavy impact C. Moderate impact D. Light impact E. No impact		
8. Do you think construction of the project will negatively impact traffic flow and safety? A. Severe Risk B. Moderate Risk C. Low Risk D. No Risk E. Unknown		
9. Do you think construction of the project will negatively impact quality of life? A. Severe Risk B. Moderate Risk C. Low Risk D. No Risk E. Unknown		
10. Are you satisfied with the construction environmental and safety mitigation measures proposed by the project EA? A. Very Satisfied B. Satisfied C. Barely Satisfied D. Very Unsatisfied E. Do Not Know		
11. Do you think project operation will have a positive or negative effect on air quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
12. Do you think project operation will have a positive or negative effect on water quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
13. Do you think project operation will have a positive or negative effect on noise quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
14. Do you think project operation will have a positive or negative effect on ecological quality? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
15. Do you think project operation will have a positive or negative effect on traffic flow and safety? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
16. Do you think project operation will have a positive or negative effect on quality of life? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
17. Do you think project operation will have a positive or negative effect on local economic development? A. Strong positive impact B. Somewhat positive impact C. No impact D. Somewhat negative impact E. Strong negative impact		
18. Are you satisfied with the operational environmental and safety measures proposed by the project EA? A. Very Satisfied B. Satisfied C. Barely Satisfied D. Very Unsatisfied E. Do Not Know		
19. Do you support implementation of the project? A. Yes B. No C. Not clear		
20. Suggestions or recommendations for the project:		

Source: PMO, 2020.

Table 52: Program public consultation result analysis – Xiangtan First Traditional Chinese Medicine Hospital site

Question	Options	Pie chart
1. Are you familiar with the planned Xiangtan First Traditional Chinese Medicine Hospital?	A. Yes.....55% B. Somewhat17.5% C. No.....27.5%	<p>A. 是: 55% B. 一般: 17.5% C. 否: 27.5%</p>
2. Are you familiar with the Xiangtan Low-Carbon Transformation Sector Development Program, which aims to reduce flood impacts at the hospital through the application of ecosystem-based adaptation measures, including a rainwater garden, permeable pavement, and an urban wetland?	A. Yes.....52.5% B. Somewhat30% C. No.....17.5%	<p>A. 是: 52.5% B. 一般: 30% C. 否: 17.5%</p>
3. What is your opinion of the environmental quality of your living area?	A. Very good.....22.5% B. Good32.5% C. Satisfactory.....40% D. Not good.....5% E. Very poor.....0% F. Not clear.....0%	<p>很好: 22.5% 好: 32.5% 满意: 40% 不好: 5% 很差: 0% 不清楚: 0%</p>
4. What are the main environment pollution problems in your living area? (multiple choices OK)	A. Air42.5% B. Noise.....42.5% C. Surface Water.....20% D. Ground Water.....5% E. Soil0% F. Solid waste.....45% G. Odor2.5% H. Hazardous chemicals.....10% I. Traffic congestion.....10% J. Other2.5%	<p>A. 空气: 42.5% B. 噪音: 42.5% C. 地表水: 20% D. 地下水: 5% E. 土壤: 0% F. 垃圾: 45% G. 异味: 2.5% H. 危险化学品: 10% I. 交通拥堵: 10% J. 其他: 2.5%</p>
5. Do you think construction of the project will negatively impact air quality?	A. Severe pollution.....2.5% B. Heavy pollution.....2.5% C. Moderate Pollution.....25% D. Light pollution.....40% E. No pollution.....30%	<p>A. 严重污染: 2.5% B. 重污染: 2.5% C. 污染: 25% D. 轻污染: 40% E. 无污染: 30%</p>

Question	Options	Pie chart
6. Do you think construction of the project will negatively impact water quality?	A. Severe pollution.....2.5% B. Heavy pollution.....0% C. Moderate pollution.....30% D. Light pollution.....35% E. No pollution.....32.5%	<p>A. 严重污染: 2.5% B. 重污染: 0% C. 污染: 30% D. 轻污染: 35% E. 无污染: 32.5%</p>
7. Do you think construction of the project will negatively impact noise quality?	A. Severe pollution.....0% B. Heavy pollution.....2.5% C. Moderate Pollution.....20% D. Light pollution.....50% E. No pollution.....27.5%	<p>A. 严重污染: 0% B. 重污染: 2.5% C. 污染: 20% D. 轻污染: 50% E. 无污染: 27.5%</p>
8. Do you think construction of the project will negatively impact ecological quality?	A. Severe impact.....0% B. Heavy impact.....0% C. Moderate impact.....20% D. Light impact.....45% E. No impact.....35%	<p>A. 严重污染: 0% B. 重污染: 0% C. 污染: 20% D. 轻污染: 45% E. 无污染: 35%</p>
9. Do you think construction of the project will negatively impact traffic flow and safety?	A. Severe Risk.....0% B. Moderate Risk.....2.5% C. Low Risk.....37.5% D. No Risk40% E. Unknown.....20%	<p>A. 严重危险: 0% B. 危险: 2.5% C. 轻度危险: 37.5% D. 无危险: 40% E. 不知道: 20%</p>
10. Do you think construction of the project will negatively impact quality of patient life?	A. Severe Risk.....0% B. Moderate Risk.....5% C. Low Risk.....15% D. No Risk.....52.5% E. Unknown.....27.5%	<p>A. 严重危险: 0% B. 危险: 5% C. 轻度危险: 15% D. 无危险: 52.5% E. 不知道: 27.5%</p>
11. Are you satisfied with the construction environmental and safety mitigation measures proposed by the project EA?	A. Very Satisfied.....5% B. Satisfied.....22.5% C. Barely Satisfied.....37.5% D. Very Unsatisfied.....0% E. Do Not Know.....35%	<p>A. 非常满意: 5% B. 满意: 22.5% C. 基本满意: 37.5% D. 非常不满意: 0% E. 不知道: 35%</p>

Question	Options	Pie chart
12. Do you think the operation of ecosystem-based adaptation measures will reduce flood risks and impacts at the hospital?	A. Strong positive impact....0% B. Somewhat positive impact..27.5% C. No impact.....50% D. Somewhat negative impact 22.5% E . Strong negative impact ...0%	
13. Do you think the operation of the project will have a positive or negative effect on overall environmental quality at the hospital?	A. Strong positive impact.....5% B. Somewhat positive impact..27.5% C. No impact50% D. Somewhat negative impact.17.5% E. Strong negative impact.....0%	
14. Do you think the operation of the project will have a positive or negative effect on quality of life for patients?	A. Strong positive impact.....5% B. Somewhat positive impact.32.5% C. No impact.....45% D. Somewhat negative impact.....17.5% E . Strong negative impact.....0%	
15. Are you satisfied with the operational environmental and safety measures proposed by the project EA?	A. Very Satisfied.....5% B. Satisfied.....27.5% C. Barely Satisfied.....37.5% D. Very Unsatisfied.....0% E. Do Not Know.....30%	
16. Do you support construction of the Xiangtan First Traditional Chinese Medicine Hospital'?	A. Yes.....87.5% B. No.....0% C. Not clear.....12.5%	
17. Do you support implementation of the project at the hospital?	A. Yes.....77.5% B. No.....0% C. Not clear.....22.5%	

Source: PMO, 2020.

368. For low carbon communities, the public consultation questionnaire presented in Table 49 was utilized. Results are presented in Table 53.

369. The result showed that 91.63% of participants recognize the local environment quality as satisfactory or above. Among the environmental pollution problems identified, air (38.49%), noise

(43.51%) and solid waste (48.95%) are the most serious concerns. 44.35% of participants thought that the program construction would not impact air quality, 55.23% thought construction would not impact water quality, 44.35% thought construction would not impact noise ecology, 57.74% thought construction would not impact ecology, and 52.3% thought construction would not impact traffic flow and safety. 84.66% of participants were basically satisfied or above with the proposed mitigation measures during program construction. Regarding program operation, 89.12% of participants were basically satisfied or above with the proposed mitigation measures during program operation, and overall 89.54% of participants support the implementation of the program.

Table 53: Program public consultation result analysis – low carbon communities

Question	Options	Pie chart
1. Are you familiar with the proposed project?	A. Yes.....75.31% B. Somewhat19.67% C. No.....5.02%	<p>A. 是: 75.31% B. 一般: 19.67% C. 不: 5.02%</p>
2. What is your opinion of the environmental quality of your living area?	A. Very good.....34.73% B. Good25.52% C. Satisfactory.....31.38% D. Not good.....7.53% E. Very poor.....0.42% F. Not clear.....0.42%	<p>A. 很好: 34.73% B. 好: 25.52% C. 满意: 31.38% D. 不好: 7.53% E. 很差: 0.42% F. 不清楚: 0.42%</p>
3. What are the main environment pollution problems in your living area? (multiple choices OK)	A. Air38.49% B. Noise.....43.51% C. Surface Water.....5.86% D. Ground Water.....20.08% E. Soil1.26% F. Solid waste.....48.95% G. Odor5.02% H. Hazardous chemicals.....2.09% I. Traffic congestion.....29.71% J. Other.....6.69%	<p>A. 空气: 38.49% B. 噪音: 43.51% C. 地表水: 5.86% D. 地下水: 20.08% E. 土壤: 1.26% F. 垃圾: 48.95% G. 异味: 5.02% H. 危险化学品: 2.09% I. 交通拥堵: 29.71% J. 其他: 6.69%</p>
4. Do you think construction of the project will negatively impact air quality?	A. Severe pollution.....0% B. Heavy pollution.....1.26% C. Moderate Pollution.....12.55% D. Light pollution.....41.84% E. No pollution.....44.35%	<p>A. 严重污染: 0% B. 重污染: 1.26% C. 中度: 12.55% D. 轻度: 41.84% E. 无污染: 44.35%</p>
5. Do you think construction of the project will negatively impact water quality?	A. Severe pollution.....0% B. Heavy pollution.....0.42% C. Moderate pollution.....8.37% D. Light pollution.....35.98% E. No pollution.....55.23%	<p>A. 严重污染: 0% B. 重污染: 0.42% C. 中度: 8.37% D. 轻度: 35.98% E. 无污染: 55.23%</p>
6. Do you think construction of the project will negatively impact noise quality?	A. Severe pollution.....0.42% B. Heavy pollution.....2.51% C. Moderate Pollution.....9.62% D. Light pollution.....43.1% E. No pollution.....44.35%	<p>A. 严重污染: 0.42% B. 重污染: 2.51% C. 中度: 9.62% D. 轻度: 43.1% E. 无污染: 44.35%</p>
7. Do you think construction of the project will negatively impact ecological quality?	A. Severe impact.....0.42% B. Heavy impact.....0.42% C. Moderate impact.....7.95% D. Light impact.....33.47% E. No impact.....57.74%	<p>A. 严重影响: 0.42% B. 重影响: 0.42% C. 中度: 7.95% D. 轻度: 33.47% E. 无影响: 57.74%</p>

Question	Options	Pie chart
8. Do you think construction of the project will negatively impact traffic flow and safety?	A. Severe Risk.....0% B. Moderate Risk.....2.93% C. Low Risk.....26.36% D. No Risk52.3% E. Unknown.....18.41%	<p>A. 严重危险: 0% B. 危险: 2.93% C. 轻度危险: 26.36% D. 无危险: 52.3% E. 不知道: 18.41%</p>
9. Do you think construction of the project will negatively impact quality of life?	A. Severe Risk.....0% B. Moderate Risk.....2.51% C. Low Risk.....22.59% D. No Risk.....55.65% E. Unknown.....19.25%	<p>A. 严重危险: 0% B. 危险: 2.51% C. 轻度危险: 22.59% D. 无危险: 55.65% E. 不知道: 19.25%</p>
10. Are you satisfied with the construction environmental and safety mitigation measures proposed by the project EA?	A. Very Satisfied.....31.38% B. Satisfied.....30.54% C. Barely Satisfied.....23.01% D. Very Unsatisfied.....0.84% E. Do Not Know.....14.23%	<p>A. 非常满意: 31.38% B. 满意: 30.54% C. 基本满意: 23.01% D. 非常不满意: 0.84% E. 不知道: 14.23%</p>
11. Do you think project operation will have a positive or negative effect on air quality?	A. Strong positive impact....17.15% B. Somewhat positive impact..28.45% C. No impact.....41.84% D. Somewhat negative impact 12.55% E . Strong negative impact ...0%	<p>A. 强烈正面影响: 17.15% B. 一定程度正面影响: 28.45% C. 无影响: 41.84% D. 一定程度负面影响: 12.55% E. 强烈负面影响: 0%</p>
12. Do you think project operation will have a positive or negative effect on water quality?	A. Strong positive impact.....17.15% B. Somewhat positive impact..23.43% C. No impact48.95% D. Somewhat negative impact.10.46% E. Strong negative impact.....0%	<p>A. 强烈正面影响: 17.15% B. 一定程度正面影响: 23.43% C. 无影响: 48.95% D. 一定程度负面影响: 10.46% E. 强烈负面影响: 0%</p>
13. Do you think project operation will have a positive or negative effect on noise quality?	A. Strong positive impact.....19.67% B. Somewhat positive impact..22.59% C. No impact.....48.12% D. Somewhat negative impact.....9.62% E . Strong negative impact.....0%	<p>A. 强烈正面影响: 19.67% B. 一定程度正面影响: 22.59% C. 无影响: 48.12% D. 一定程度负面影响: 9.62% E. 强烈负面影响: 0%</p>
14. Do you think project operation will have a positive or negative effect on ecological quality?	A. Strong positive impact.....19.67% B. Somewhat positive impact..27.62% C. No impact.....44.35% D. Somewhat negative impact.....8.37% E . Strong negative impact....0%	<p>A. 强烈正面影响: 19.67% B. 一定程度正面影响: 27.62% C. 无影响: 44.35% D. 一定程度负面影响: 8.37% E. 强烈负面影响: 0%</p>

15. Do you think project operation will have a positive or negative effect on traffic flow and safety?	A. Strong positive impact.....17.15% B. Somewhat positive impact..28.03% C. No impact.....43.1% D. Somewhat negative impact..11.72% E . Strong negative impact.....0%	<p>Detailed description: A pie chart with five segments. The largest segment is yellow (C, No impact) at 43.1%. The next largest is orange (B, Somewhat positive impact) at 28.03%. A blue segment (A, Strong positive impact) is at 17.15%. A teal segment (D, Somewhat negative impact) is at 11.72%. A small red segment (E, Strong negative impact) is at 0%.</p> <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>A. Strong positive impact</td><td>17.15%</td></tr><tr><td>B. Somewhat positive impact</td><td>28.03%</td></tr><tr><td>C. No impact</td><td>43.1%</td></tr><tr><td>D. Somewhat negative impact</td><td>11.72%</td></tr><tr><td>E. Strong negative impact</td><td>0%</td></tr></table>	Response	Percentage	A. Strong positive impact	17.15%	B. Somewhat positive impact	28.03%	C. No impact	43.1%	D. Somewhat negative impact	11.72%	E. Strong negative impact	0%
Response	Percentage													
A. Strong positive impact	17.15%													
B. Somewhat positive impact	28.03%													
C. No impact	43.1%													
D. Somewhat negative impact	11.72%													
E. Strong negative impact	0%													
16. Do you think project operation will have a positive or negative effect on quality of life?	A. Strong positive impact.....23.01% B. Somewhat positive impact..27.2% C. No impact41.84% D. Somewhat negative impact7.95% E . Strong negative impact.....0%	<p>Detailed description: A pie chart with five segments. The largest segment is yellow (C, No impact) at 41.84%. The next largest is orange (B, Somewhat positive impact) at 27.2%. A blue segment (A, Strong positive impact) is at 23.01%. A teal segment (D, Somewhat negative impact) is at 7.95%. A small red segment (E, Strong negative impact) is at 0%.</p> <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>A. Strong positive impact</td><td>23.01%</td></tr><tr><td>B. Somewhat positive impact</td><td>27.2%</td></tr><tr><td>C. No impact</td><td>41.84%</td></tr><tr><td>D. Somewhat negative impact</td><td>7.95%</td></tr><tr><td>E. Strong negative impact</td><td>0%</td></tr></table>	Response	Percentage	A. Strong positive impact	23.01%	B. Somewhat positive impact	27.2%	C. No impact	41.84%	D. Somewhat negative impact	7.95%	E. Strong negative impact	0%
Response	Percentage													
A. Strong positive impact	23.01%													
B. Somewhat positive impact	27.2%													
C. No impact	41.84%													
D. Somewhat negative impact	7.95%													
E. Strong negative impact	0%													
17. Do you think project operation will have a positive or negative effect on local economic development?	A. Strong positive impact.....18.83% B. Somewhat positive impact..34.73% C. No impact.....42.26% D. Somewhat negative impact..4.18% E . Strong negative impact.....0%	<p>Detailed description: A pie chart with five segments. The largest segment is yellow (C, No impact) at 42.26%. The next largest is orange (B, Somewhat positive impact) at 34.73%. A blue segment (A, Strong positive impact) is at 18.83%. A teal segment (D, Somewhat negative impact) is at 4.18%. A small red segment (E, Strong negative impact) is at 0%.</p> <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>A. Strong positive impact</td><td>18.83%</td></tr><tr><td>B. Somewhat positive impact</td><td>34.73%</td></tr><tr><td>C. No impact</td><td>42.26%</td></tr><tr><td>D. Somewhat negative impact</td><td>4.18%</td></tr><tr><td>E. Strong negative impact</td><td>0%</td></tr></table>	Response	Percentage	A. Strong positive impact	18.83%	B. Somewhat positive impact	34.73%	C. No impact	42.26%	D. Somewhat negative impact	4.18%	E. Strong negative impact	0%
Response	Percentage													
A. Strong positive impact	18.83%													
B. Somewhat positive impact	34.73%													
C. No impact	42.26%													
D. Somewhat negative impact	4.18%													
E. Strong negative impact	0%													
18. Are you satisfied with the operational environmental and safety measures proposed by the project EA?	A. Very Satisfied.....39.33% B. Satisfied.....25.1% C. Barely Satisfied.....24.69% D. Very Unsatisfied.....0.84% E. Do Not Know.....10.04%	<p>Detailed description: A pie chart with five segments. The largest segment is blue (A, Very Satisfied) at 39.33%. The next largest is orange (B, Satisfied) at 25.1%. A yellow segment (C, Barely Satisfied) is at 24.69%. A small red segment (D, Very Unsatisfied) is at 0.84%. A teal segment (E, Do Not Know) is at 10.04%.</p> <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>A. Very Satisfied</td><td>39.33%</td></tr><tr><td>B. Satisfied</td><td>25.1%</td></tr><tr><td>C. Barely Satisfied</td><td>24.69%</td></tr><tr><td>D. Very Unsatisfied</td><td>0.84%</td></tr><tr><td>E. Do Not Know</td><td>10.04%</td></tr></table>	Response	Percentage	A. Very Satisfied	39.33%	B. Satisfied	25.1%	C. Barely Satisfied	24.69%	D. Very Unsatisfied	0.84%	E. Do Not Know	10.04%
Response	Percentage													
A. Very Satisfied	39.33%													
B. Satisfied	25.1%													
C. Barely Satisfied	24.69%													
D. Very Unsatisfied	0.84%													
E. Do Not Know	10.04%													
19. Do you support implementation of the project?	A. Yes.....89.54% B. No.....1.67% C. Not clear.....8.79%	<p>Detailed description: A pie chart with three segments. The largest segment is blue (A, Yes) at 89.54%. A small orange segment (B, No) is at 1.67%. A small teal segment (C, Not clear) is at 8.79%.</p> <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>A. Yes</td><td>89.54%</td></tr><tr><td>B. No</td><td>1.67%</td></tr><tr><td>C. Not clear</td><td>8.79%</td></tr></table>	Response	Percentage	A. Yes	89.54%	B. No	1.67%	C. Not clear	8.79%				
Response	Percentage													
A. Yes	89.54%													
B. No	1.67%													
C. Not clear	8.79%													

370. For all three questionnaires there were no responses to question number 20, “Suggestions or recommendations for the project”.

D. Future Plans for Public Participation

371. Contractors will be required to communicate and consult with the communities in the program area of influence, especially those near the bus stations. Public notice boards will be setup at each major work site to provide information on the purpose of the program activity, the duration of disturbance, the responsible entities on-site (contractors, IA), and the program level Grievance Redress Mechanism (GRM). Contact information of all GRM entry points and the PMO will be disclosed on the construction site information boards. The GRM is presented in summary in Chapter VIII and in detail in the Environmental Management Plan (EMP) in Appendix A. In addition, the IA will be supported by the Gender, Social and Communication Specialist to develop two-way communication approaches and user-friendly tools (i.e., graphics, bulletins, and using

Weibo/WeChat) not just to make up-to-date program information available and accessible but also allow stakeholder feedback.

372. Program environmental information has, or will be, disclosed as follows: (i) this IEE will be available for review at the ADB's website (www.adb.org); (ii) the domestic EIT (in Chinese) will be available on request at the PMO and at the XMG website (<http://www.xiangtan.gov.cn>); and, (iii) environment progress will be reported in quarterly program progress reports and annual environmental monitoring reports, which will be disclosed on the ADB's project website (www.adb.org).

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

373. A project grievance is an actual or perceived project-related problem that gives ground for complaint by an affected person (AP). As a general policy, the PMO will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the project has strong public support, significant grievances are unlikely. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a project Grievance Redress Mechanism (GRM) has been developed in accordance with ADB requirements and Government practices. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable period of time.

B. ADB Requirements

374. The ADB's Safeguards Policy Statement (SPS, 2009) requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction as well as operation phase of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address affected people's concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

C. Current GRM Practices in the PRC

375. At the national level a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005) codifies a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. MEE "Decree No. 34 Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints. When APs are negatively affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local environmental bureaus. If the issue is not resolved they may take legal action, though that is typically considered as a last option. The weaknesses of the current system are: (i) the lack of dedicated personnel to address grievances; and (ii) the lack of a specific timeframe for the redress of grievances. The project GRM addresses these weaknesses.

D. Program GRM

376. The objective of the program GRM is to prevent and address community concerns, reduce risks, and assist the program to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the program; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by program implementation and operations. The GRM will be accessible to all members of the community.

377. The GRM approach is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The PMO EHSO will be responsible for implementation of the GRM. The PMO EHSO will be supported by the social safeguards unit and the Social, Gender and Communication Specialist to develop materials and online communication tools to ensure that the GRM is promoted and made accessible to affected persons. The details of the GRM, including a time-bound flow chart of procedures, are included in the program EMP (Appendix A).

IX. CONCLUSIONS

A. Expected Program Benefits

378. The program will benefit 1.8 million residents of the urban Xiangtan, including both public transport users and residents in general.

- (iv) Once operational, ridership on the priority bus network is expected to reach 883,685 passenger trips per day. Users will benefit from a quiet, intelligent and highly efficient, zero-emission bus system. Residents who are non-users will also benefit from access to car charging stations, reduced traffic congestion, improved road safety, and reduced air pollution.
- (v) An efficient public transport system will reduce the costs of transport in serving major urban and industrial areas and transport hubs, and will provide better accessibility to employment and services in Xiangtan. It will enhance economic growth compared to the existing public transport system.
- (vi) Benefits from improved traffic flows and reduced congestion from ITS implementation include:
 - a. a 51% crash rate reduction and a 76% fatality rate reduction per crash due to speed limit enforcement;
 - b. reduced journey time by car of 57% as a result of reduced congestion, traffic signal coordination, parking management, weather warning and incident management;
 - c. reduced journey time by bus of 63% and increased bus modal share from the current rate of 19.5% by 36.3% as a result of a bus information management system, reduced congestion, bus priority measures, traffic signal coordination, weather warning and incident management;

- d. reduced vehicle operating costs by 16% as a result of less congestion and reduced stop-start traffic conditions; and, reduced vehicle emissions by 16% due to less congestion and reduced stop-start traffic conditions.

- (vii) The annual average of GHG emission reductions over the program lifetime is around 2.4 MtCO_{2e}.

B. Adverse Impacts and Mitigation Measures

379. During construction, dust from construction sites, noise from power mechanical equipment, wastewater and solid wastes generated on construction sites, worker health and safety risks, and traffic disruptions will be primary adverse impacts. These impacts are short-term and localized. Good construction practice management measures will be implemented to reduce impacts to acceptable levels.

380. Potential negative operation phase impacts include runoff from roads and stations which may pollute surface waters; wastewater produced in the buildings; emissions from buildings and vehicles in stations; noise from stations, buses and cars, and buildings; hazardous materials from stations and buildings; end-of-life buses and batteries that require replacement; safety risks on the program roads, stations and buildings. These impacts can be effectively mitigated through good design, including, for example, road-side bio-retention facilities to treat storm water runoff, and noise control measures incorporated into station and building design; good waste and health and safety management practices including effective recycling of busses and bus batteries; and good safety plans on charging stations, multi-modal stations and buildings. All facility designs will be in accordance with PRC requirements and health and safety requirements of the *EHS Guidelines*.

381. Operation of the program is not expected to impact any rare or endangered flora or fauna, species with international, national or provincial protection status, areas of natural or critical habitat, parks, nature reserves, or areas with special national, regional or local ecological significance within or adjacent to any of the sites. The program is not expected to impact any physical cultural resources.

C. Risks and Assurances

382. **Risks.** Most program components have few technical risks and conventional engineering designs with proven reliability and performance will be adopted. From an environment safeguards perspective, the main risk relates to the failure of the PMO to monitor environmental impacts and implement the EMP during the construction and operation phases.

383. **Environmental Assurances.** Assurances will form part of the loan and program agreements, including:

Program Design

XMG shall ensure that:

- a. all Works to be carried out under the program are designed by experienced and qualified design institutes and that sufficient counterpart funds are available for the engagement of such institutes;

- b. the qualified design institutes complete relevant geological (including earthquake) and geotechnical investigations for works in the detailed design phase in accordance with relevant national, provincial and local design codes and standards, incorporate adequate risk mitigation measures into the designs and design all infrastructure and facilities in accordance with national standards and specifications;
- c. construction management, quality control, contract management, final completion and acceptance for works comply with all applicable national, provincial and local laws and regulations; and
- d. design of program structures will include measures to address climate risks.

Operation and Maintenance

XMG shall ensure that all Goods and Works under the program will be inspected, operated and maintained in accordance with prescribed standards, specifications and regulations, and sound practices.

XMG shall (a) prepare sustainable operations and maintenance (“O&M”) plans for all program Goods and Works; (b) prepare O&M budget plans on an annual basis; and (c) provide sufficient financial and staffing resources for the relevant administrative agencies to implement the O&M plans.

Environment

XMG shall ensure that the preparation, design, construction, implementation and operation of the program and all program facilities comply with (a) all applicable laws and regulations of the Borrower relating to environment, health and safety; (b) the Environmental Safeguards; and (c) all measures and requirements set forth in the IEE and the EMP, and any corrective or preventative actions (i) set forth in a safeguards monitoring report; or (ii) agreed between XMG and ADB.

XMG shall ensure that verification, confirmation and record of any changes in sensitive receptors be carried out during pre-construction, construction, and operation phases of the program and ensure that any new sensitive receptors are not located in the impact zones for noise and air emissions as established in the IEE.

XMG shall ensure that the disposal and recycling of e-buses and batteries comply with the *PRC Interim Measures for the Administration of Recycling and Utilization of New Energy Vehicles' Power Battery (2018)*.

Ethnic Minorities

XMG shall ensure that the program does not have any indigenous peoples impacts within the meaning of the SPS. In the event that the program does have any such impact, XMG shall, to take all steps required to ensure that the program complies with the applicable laws and regulations of the Borrower and with the SPS.

Human and Financial Resources to Implement Safeguards and Other Requirements

XMG shall make available the necessary budgetary and human resources to fully implement the EMP and the SDGAP.

Safeguards – Related Provisions in Bidding Documents and Works Contracts

XMG shall ensure that all bidding documents and contracts for program works contain provisions that require contractors to:

- a. comply with the measures relevant to the contractor set forth in the IEE, the EMP and any corrective or preventative actions set forth in (i) a safeguards monitoring report; or (ii) agreed between ADB and XMG;
- b. make available a budget for all such environmental and social measures;
- c. provide ADB with written notice of any unanticipated environmental, resettlement or indigenous peoples or ethnic minorities risks or impacts that arise during construction, implementation or operation of the program that were not considered in the IEE, the EMP or Social Safeguard Due Diligence Report (SSDDR);
- d. adequately record the condition of roads, agricultural land and other infrastructure prior to starting to transport materials and construction; and,
- e. reinstate pathways, other local infrastructure, and agricultural land to at least their pre-program condition as soon as possible and no later than the completion of construction.

Safeguards Monitoring and Reporting

XMG shall do the following:

- a. submit safeguards monitoring reports to ADB in respect of implementation and compliance with the Environmental Safeguards and the EMP, annually during the construction and implementation of the program and the EMP, and thereafter annually during operation until the issuance of the program completion report unless a longer period is agreed;
- b. if any unanticipated environmental and/or social risks and impacts arise during construction, implementation or operation of the program that were not considered in the IEE, the EMP and the SSDDR, promptly inform ADB of the occurrence of such risks or impacts, with detailed description of the event and proposed corrective action plan; and,
- c. report any actual or potential breach of compliance with the measures and requirements set forth in the EMP promptly after becoming aware of the breach.

Conditions for Award of Contracts

XMG shall ensure that no Works contract is awarded until:

- a. relevant provisions from the EMP have been incorporated into the Works contract.

Labor Standards, Health and Safety

XMG shall cause the PMO and contractors and service providers to (a) give equal pay for equal work regardless of gender, ethnicity or social group; (c) give priority to women in the employment and training opportunities generated in the program's construction and operation phases; (d) maximize the employment of local people who meet the job and efficiency requirements for program construction, operation and maintenance; (e) provide workers with adequate on-the-job and safety training; (f) disseminate information on sexually transmitted diseases (including HIV/AIDS) and human trafficking to sub-

contractors/employees and local communities surrounding the program construction sites; (g) implement HIV/AIDS awareness and prevention training for sub-contractors/employees in collaboration with the Center for Disease Control; (h) implement human trafficking awareness activities; (i) provide necessary measures to ensure the safety and health of its subcontractors/ employees; and (j) observe local customs concerning acceptable behavior towards the local population.

XMG shall ensure that the core labor standards and the PRC's applicable laws and regulations are complied with during program implementation and that specific provisions are included in bidding documents and contracts financed by ADB under the program requiring that the contractors, among other things: (a) comply with the PRC's applicable labor law and regulations and incorporate applicable workplace occupational safety norms; (b) do not use child labor; (c) do not discriminate workers in respect of employment and occupation; (d) do not use forced labor; and (e) do not restrict workers from developing any legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment.

XMG shall strictly monitor compliance with the requirements set forth above and provide ADB with regular reports.

Social Development and Gender Action Plan

XMG shall ensure that (a) the SDGAP is implemented in accordance with its terms in a timely manner; (b) the bidding documents and contracts include relevant provisions for contractors to comply with the measures set forth in the SDGAP; (c) adequate funds and other resources are allocated for implementation of the SDGAP; (d) progress on implementation of the SDGAP, including progress toward achieving key gender outcome and output targets, are monitored and reported in semi-annual progress reports to ADB; (e) key gender outcome and output targets are met, including, but not limited to ensuring (i) women's participation during consultations with the general public in public hearings, in decision-making processes, and in any local decision-making bodies and structures; (ii) the prioritization of job opportunities for women during and after program implementation, and providing appropriate training; (iii) women are included as participating members in program-related seminars, workshops, and meetings; (iv) the collection of sex disaggregated data where appropriate; and (v) focus on women's involvement in the program-related public awareness campaigns; (f) actions under the program include (i) integrating social development aspects in [transport development planning]; (ii) giving local residents, including the poor, education, training and employment opportunities; (iii) participation of residents in program design and implementation; (iv) minimizing and mitigating adverse social impacts, including impacts of construction activities on nearby; and (v) improving public awareness on environmental management and other program-related matters; and (g) SDGAP implementation is monitored and reported in semi-annual progress reports to ADB.

Communication Plan

XMG shall ensure that the communication plan for the program, as described in the PAM, is fully implemented and shall devote sufficient financial and other resources to support proper implementation of all plan requirements.

Grievance Redress Mechanism

XMG shall ensure that a safeguards grievance redress mechanism is established in accordance with the provisions of the IEE and the EMP at the PMO, within the timeframes specified in the IEE and EMP, to consider safeguards complaints.

Prohibited List of Investments

XMG shall ensure that no proceeds of the Loan are used to finance any activity included in the list of prohibited investment activities provided in Appendix 5 of the SPS.

Governance and Anticorruption

XMG shall ensure that XMG, the PMO and any other government owned or government controlled organizations involved in the program (a) comply with ADB's Anticorruption Policy (1998, as amended) and acknowledge ADB's right to investigate, directly or through its agents, any alleged corrupt, fraudulent, collusive or coercive practices relating to the program; and (b) agree to cooperate, and cause all other government offices, organizations and entities involved in implementing the program to cooperate, fully with any such investigation and to extend all necessary assistance, including providing access to all relevant books and records, as may be necessary for the satisfactory completion of any such investigation.

XMG shall ensure that relevant provisions of ADB's Anticorruption Policy (1998, as amended) are included in all bidding documents for the program, including provisions specifying the right of ADB to audit and examine the records and accounts of XMG, the PMO, other government-owned or government-controlled entities involved in the program, contractors, suppliers, consultants, and other service providers as they relate to the program.

Change in Ownership

XMG shall ensure that in the event any change in ownership or control of any of the program facilities is anticipated, XMG will consult with ADB at least 6 months prior to the implementation of such change and will ensure that no such change will impair its ability to perform its obligations under the program agreements or the PAM or to achieve the purposes of the ADB loan.

D. Overall Conclusion

384. The program IEE has: (i) identified potential negative environment impacts and established mitigation measures; (ii) assessed public support from the program beneficiaries and affected people; (iii) established a program GRM; and (iv) prepared a program EMP, including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

385. It is concluded that the program will not result in adverse environmental impacts that are irreversible, diverse, or unprecedented. Any minimal adverse environmental impacts associated with the program will be prevented, reduced, or minimized through the implementation of the program EMP.

APPENDICES

Appendix A: Program Environmental Management Plan (EMP)

Appendix B: Domestic Environmental Assessment Approval

Appendix C: E-Charging Stations Technical Data

Appendix D: Section-by-section modifications, Fuxing Middle Road

Appendix E: Low Carbon Activities at 20 Communities in Yuhu and Yuetang Districts, Xiangtan

Appendix F: Policy Loan Impact Assessment Matrix

Appendix G: Due Diligence Review of Associated Facilities

APPENDIX A: EMP

DRAFT ENVIRONMENTAL MANAGEMENT PLAN

April 2020

PRC: Xiangtan Low-Carbon Transformation Sector Development
Program

Prepared by the Xiangtan Municipal Government for the Asian Development Bank (ADB)

ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

1. This Environmental Management Plan (EMP) for the proposed Xiangtan Low-Carbon Transformation Sector Development Program (Xiangtan LCT SDP) in Xiangtan City, Hunan Province, in the People's Republic of China (PRC).

2. The program will have four outputs: (i) low-carbon and resilient infrastructure transformation demonstrated; (ii) information and knowledge platforms established for informed decision making and behavioral changes; (iii) low-carbon transformation policy reforms adopted; and, (iv) capacity building and program management enhanced. Outputs (i), (ii), and (iv) will be under the project loan, while output (iii) will be supported by the policy-based loan. The program's physical works are primarily in output (i) and to a lesser extent output (ii), and are the primary focus of this IEE report.

3. The EMP was report has been prepared based on domestic Feasibility Study Reports (FSRs); technical due diligence reviews of the FSRs undertaken by ADB PPTA technical specialists; additional baseline data collection and analyses undertaken by ADB PPTA technical specialists; site visits and analyses conducted by the ADB PPTA team; ADB review missions discussions and agreements with relevant government agencies; and consultations with affected persons and stakeholders.

4. The objectives of the EMP are to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) program compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS. Organizational responsibilities and budgets are identified for EMP execution, monitoring and reporting.

5. The EMP is to be implemented in all phases of the program – detailed design, pre-construction, construction, and operation. The EMP will be updated at the end of the detailed design. The final EMP will be disclosed on the ADB public website (www.adb.org) and be included in the project administration manual (PAM).

6. The 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 provide for EMP implementation costs in their bids for program works.

B. EMP Implementation Arrangements

7. The Xiangtan Municipal Government (XMG) will be the program executing agency (EA) and implementing agency (IA). All program procurement will be carried out by XMG and all assets procured and acquired will remain as XMG's properties. The Hunan Provincial Government (HPG) will provide guidance and supervision to the municipal government in project processing and implementation.

8. A project management office (PMO) has been established under the EA to manage the project implementation on a daily basis. The primary responsibilities of the PMO at the project preparation stage include (i) coordination with central/provincial governments, ADB, and related government agencies; (ii) preparing required reports and obtaining approvals from upper level governments/authorities; (iii) organizing project preparation activities, like consultant recruitment

and report preparation (project proposal, feasibility studies, land acquisition and resettlement plan, environment and social assessments, etc.); and, (iv) arranging project implementation.

9. During implementation, the PMO will be responsible for (i) coordination among central/provincial governments, ADB, the EA, and related government agencies and entities; (ii) implementation planning, arrangement, and quality control; (iii) loan disbursement and financial management; (iv) compliance of environment and social safeguards; and, (v) procurement and contract management including supervision of contractors and construction supervision company (CSC).

10. The PMO will be led by the Secretary General of the XMG. It will be suitably staffed, including a full-time qualified **Environment and Safety Officer (PMO ESO)**, who will take overall responsibility for supervising the implementation of environment mitigation measures, coordinating the project level GRM and preparing monitoring reports for submission by the IA to ADB. The PMO will include representatives from the XMG and the private sector:

- Transportation Bureau
- Housing, Urban and Rural Construction Bureau
- Water Conservation Bureau
- Ecology and Environment Bureau
- Municipal Health Commission
- Municipal Big Data Center
- Jiuhua Industrial Zone.

11. A **Project Management Consultant (PMC)** will be provided to support the PMO in project management, technical support, safeguards policy compliance and monitoring, social development and gender action plan and communication strategy implementation.

12. The PMC will include a **Loan Implementation Environmental Consultant (LIEC)**, a part-time national environmental, health and safety specialist, who will support the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The LIEC will also support contractors in developing site-specific Construction Environmental Management Plans (CEMPs) prior to construction and operation.

13. A qualified **Construction Supervision Company** will be responsible for supervising and guiding construction contractors during project construction phase. The CSC will have a qualified Health, Safety and Environment Supervision Engineer who will be responsible for supervising construction contractors to ensure proper the implementation of EMP and CEMPs; and preparing and submitting consolidated quarterly environmental monitoring reports to the PMO based on the CEMPs implementation.

14. A qualified 3rd party **Environmental Monitoring Company** will be engaged by the IA to undertake construction and operation phase ambient environmental monitoring, as per the requirements of the Environmental Monitoring Plan (EMoP) presented in this EMP.

15. **Construction Contractors** will be responsible for implementing the mitigation measures during construction under supervision of the IA and the PMO. In their bids the contractors will prepare CEMPs which detail the means by which the contractors will comply with the EMP. Each contractor will identify a lead focal point for environmental issues (e.g. Environment, Health and Safety Officer), who will oversee CEMP implementation, take all reasonable measures to minimize the impact of construction activities on the environment, develop and prepare monthly reports for submission to the IA. Contractors are also required to report any spills, near misses, accidents, and grievances received, and take appropriate action. The

Environment, Health and Safety Officer will also be responsible for developing CEMPs and an Occupational Health and Safety Plan (OHSP).

16. **ADB** will conduct environmental compliance review of the project during project review missions. ADB will also review and perform quality control on the annual environmental monitoring reports submitted by the PMO and will disclose the reports on its website. If the PMO fails to meet safeguards requirements described in the EMP, ADB will seek corrective measures and advise the EA/IA on items in need of follow-up actions.

17. The project implementing agencies and their roles and responsibilities for the EMP are presented in Table A-1. The project implementation arrangement chart is presented in Figure 1. Terms of reference for the PMO ESO, LIEC and CSC are presented in Annex 1.

Table A-1: Agencies involved in implementation of the project EMP

Organization	Role and Responsibility for the EMP
Xiangtan Municipal Government (XMG)	- The project executing agency (EA) implementing agency (IA), and project contact point for ADB. Responsible for overall implementation and compliance with loan assurances and the EMP.
Project Management Office (PMO)	<ul style="list-style-type: none"> - Responsibilities at the project preparation stage include (i) coordination with central/provincial governments, ADB, and related government agencies; (ii) preparing required reports and obtaining approvals from upper level governments/authorities; (iii) organizing project preparation activities, like consultant recruitment and report preparation (project proposal, feasibility studies, land acquisition and resettlement plan, environment and social assessments, etc.); and, (iv) arranging project implementation. - Responsibilities at implementation include: (i) coordination among central/provincial governments, ADB, the EA, and related government agencies and entities; (ii) implementation planning, arrangement, and quality control; (iii) loan disbursement and financial management; (iv) compliance of environment and social safeguards; (v) procurement and contract management; and (iv) direct implementation of some project subcomponents.
Implementation Consultants (Project Management Company-PMC)	- Will assist the PMO in day to day activities of the project including project management, construction supervision, capacity building program implementation, and financial auditing.
Loan Implementation Environmental Consultant (LIEC), under PMC	<ul style="list-style-type: none"> - Review the updated IEE and EMP. - Confirm that mitigation measures have been included in detailed engineering design. - Review bidding documents to ensure that the EMP clauses are incorporated. - Review CEMPs to ensure compliance with the EMP. - Provide technical assistance and support to the PMO and contractors on mitigation measures and EMP implementation. - Deliver the construction and operation phase capacity building programs to the staff of the IA, PMO, and contractors. - Conduct site inspections in compliance with the environmental monitoring plan. - Review reports prepared by contractors and the EM, and assist the PMO in preparing annual environmental monitoring reports.
Environmental Monitoring Company	- Qualified local environmental monitoring company, recruited to implement the ambient monitoring portion of the environmental monitoring plan.
CSC	<ul style="list-style-type: none"> - Responsible for supervising and guiding construction contractors during project construction phase. - The CSC will have a qualified Environmental Supervision Engineer who will be responsible for supervising construction contractors to ensure proper the implementation of EMP and CEMPs; and preparing and submitting consolidated quarterly environmental monitoring reports to the PMO based on the CEMPs implementation
Contractors	- Ensure sufficient funding and human resources for proper and timely implementation of required mitigation and monitoring measures in the EMP throughout the construction phase.

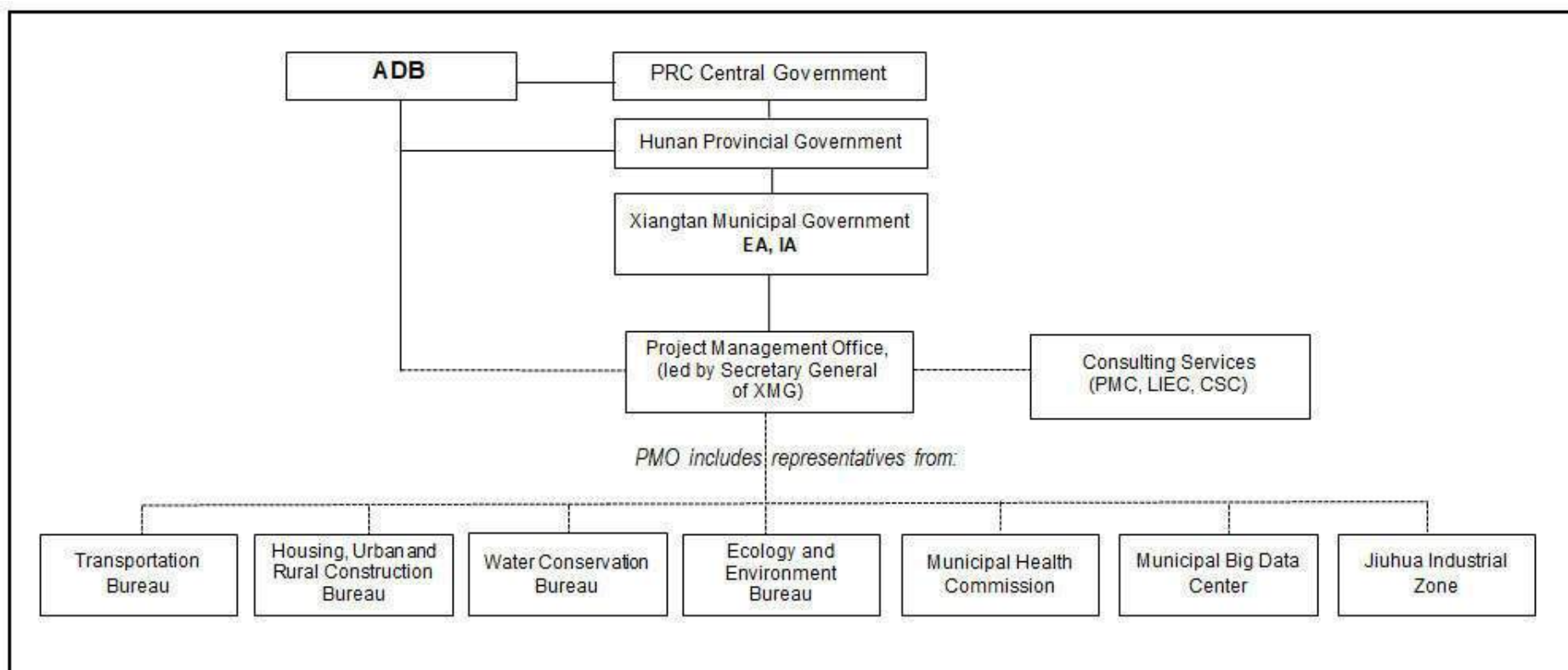
Organization	Role and Responsibility for the EMP
	<ul style="list-style-type: none"> - Prepare CEMP(s) prior to the construction commencement. - Appoint an environment, health and safety (EHS) officer to oversee EMP implementation related to environment, occupational health and safety on construction site - Ensure health and safety - Implement mitigation measures - Act as a local entry point for the project GRM
XEEB	<ul style="list-style-type: none"> - Review and approve EIT (when available) - Review project monitoring results at their discretion. - Conduct periodic monitoring and inspections at their discretion. - Conduct acceptance inspections on completion of the project.
ADB	<ul style="list-style-type: none"> - Review and approve the IEE and EMP and disclose on ADB website. - Approve updated IEE/EMP, and disclose on ADB website - Provide guidance to the executing and implementing agencies. - Conducting review missions. - Monitoring status of compliance with loan and project covenants, including safeguards. - Regularly updating the project performance review reports with the assistance of executing and implementing agencies. and - Regularly updating the project information documents for public disclosure at ADB web site, including the safeguards documents.

C. Potential Impacts and Mitigation Measures

18. Potential impacts of the program during each phase have been identified and appropriate mitigation measures developed (Section V of the project IEE) in accordance with PRC requirements and the *EHS Guidelines*. Potential impacts and the mitigation measures are presented in Table A-2.

19. The mitigation measures defined in the EMP will be (i) checked and, where necessary, updated during detailed design and other project implementation stages (see Section J. Mechanisms for Feedback and Adjustment); (ii) incorporated into tender documents (where appropriate), construction contracts, and O&M manuals; and (iii) implemented by contractors under supervision of the PMO. The effectiveness of these measures will be evaluated based on the results of the compliance inspections undertaken by the PMO ESO and LIEC and environmental quality monitoring conducted by a qualified environmental monitoring company.

Figure A-1: Program implementation arrangements



ADB = Asian Development Bank, CSC = construction supervision consultants, LIEC = Loan Implementation Environmental Consultant, PMC = project management consultants, PMO = project management office, XMG = Xiangtan Municipal Government.

Source: ADB PPTA consultant, 2020.

Table A-2: Potential Impacts and Mitigation Measures

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Pre-Construction Phase					
Sensitive receptors			- Carry out verification, confirmation and record of any changes in sensitive receptors prior to the start of construction.	PMO, LIEC	EA
Institutional strengthening	Human Resources	Lack of environment management capacity within PMO	Recruitment, including: <ul style="list-style-type: none"> - appointment of a qualified Environment and Safety Officer (PMO ESO) within the PMO; - contracting of an external Loan Implementation Environmental Consultant (LIEC) by the IA (as part of the PMC); and - contracting of a qualified 3rd party Environmental Monitoring Company by the IA to conduct environmental quality monitoring. 	PMO	EA, ADB
			Capacity Building: <ul style="list-style-type: none"> - Prior to the start of construction, the institutional strengthening and training program will be delivered by the LIEC (Table A-7). 	LIEC	EA, ADB
GRM	Program Affected Persons (APs)	Inadequate complaint mechanisms	<ul style="list-style-type: none"> - The PMO ESO will assume overall responsibility for the GRM. - GRM training will be provided for PMO members and GRM access points. - The PMO will issue public notices to inform the public within the project area of the GRM, and contact information (GRM website address, PMO address and telephone number, PMO contact point email address) for the PMO and local entry points (e.g. contractors) will be disseminated at all major access points. - PMO ESO will develop 	PMO	EA, ADB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			and maintain a Complaints Register to document all complaints.		
EMP update	Revised project detailed design	Out of date EMP/IEE	<ul style="list-style-type: none"> - Review mitigation measures defined in this EMP and the EMoP, and update to reflect detailed design. - Any changes in sensitive receptors to the project will be checked, and the sensitive receptors tables will be updated in the IEE or as an addendum to the IEE to reflect any significant changes. - Submit to ADB for approval, and disclose updated IE/EMP on ADB website. 	EIA Institute, PMO, LIEC,	EA, ADB
	Sensitive receptors	As Xiangtan is undergoing massive new urban development, sensitive receptors may change overtime	<ul style="list-style-type: none"> - Any changes in sensitive receptors to the program shall be checked, and the sensitive receptors tables will be updated in the IEE or as an addendum to the IEE to reflect any significant changes. 	EIA Institute, PMO, LIEC,	EA, ADB
Tender documents	Various	Various	<ul style="list-style-type: none"> - All EMP obligations will be included in tender documents and will explicitly reference the EMP and EMoP. 	PMO, LIEC	EA, ADB
Construction Phase					
	Sensitive receptors		<ul style="list-style-type: none"> - Carry out semi-annual assessment, verification, confirmation and record of any changes in sensitive receptors 	PMO, LIEC	EA
Good construction site soil management practices in accordance with PRC requirements	Soil resources	Spoil erosion and spoil management	<ul style="list-style-type: none"> - At each construction site the potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, 	Contractors	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
and EHS Guidelines			<p>including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff.</p> <ul style="list-style-type: none"> - Land excavation and filling will be balanced so as minimize the requirement for fill transportation. - During earthworks the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management. - Topsoil will be stripped and stored in a stockpile for reuse in restoration. - Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored at the conclusion of storage activities. - Spoil will be reused on-site to the maximum extent feasible as fill. - Excess spoil that cannot be used on-site will be transported to a spoil disposal site approved by designated by Xiangtan Civil Affairs Bureau. - Spoil and aggregate piles will be covered with landscape material and/or regularly watered. - Waste construction material such as residual concrete, asphalt, etc. will be properly handled for re-use or disposal. - Construction and material handling activities will be limited or halted during periods of rains and high winds. - Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to 		

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> protect and stabilize the soil. Once construction is complete disturbed surfaces will be properly revegetated. To the extent possible and practical, selected plant species will be (a) native (i.e. naturally occurring) to Guizhou province; (b) sourced from local stock within Guizhou province. No species listed on the PRC's "Database of Invasive Alien Species" (http://www.chinaias.cn) will be permitted. Conduct project completion audit to confirm that spoil disposal site rehabilitation meets required standard, hold contractor liable in case of non-compliance. 		
Good construction site air quality management practices in accordance with PRC requirements and <i>EHS Guidelines</i>	Air quality	Dust (TSP) during construction	<ul style="list-style-type: none"> Transport routes and delivery schedules will be planned to avoid densely populated and sensitive areas, and high traffic times. Trucks transporting earth materials will be equipped with covers or tarpaulin, and will not be overloaded. Fine materials will be transported in fully contained trucks. Vehicles will maintain legal speeds while on public roads, and low speeds while on construction sites. Muddy or dusty materials on public roads outside the exits of works areas will be cleaned immediately. Water will be sprayed on sites with the potential to cause fugitive dust including unpaved areas, backfill areas and unpaved haul roads, as necessary. 	Contractors	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> - Construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or watered if necessary. Powdered materials such as cement and lime will be stored in sealed bags or containers. - Particular attention will be paid to dust suppression near sensitive receptors identified in the IEE such as schools, hospitals, and residential areas. - Construction and material handling activities will be limited or halted during periods of high winds if nuisance dusts are being generated. - Vehicles and equipment will be properly maintained and will use quality fuels. - Asphalt and concrete will be purchased commercially, with no need for mixing on site. - On-site burning of wastes is prohibited. - Disturbed sites will be revegetated as soon as possible after the completion of works. 		
Good construction site noise management practices in accordance with PRC requirements and <i>EHS Guidelines</i>	Noise	Noise from Powered Mechanical Equipment (PME) and vehicles	<ul style="list-style-type: none"> - Construction and renovation activities will be planned in consultation with local authorities and 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 the least disturbance. - Multiple high-noise activities will be avoided to the extent practical near sensitive sites identified in the IEE. - Construction sites will 	Contractors	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> have sound attenuating fences. - Sensitive sites will be protected with temporary sound barriers during high noise activities such that WHO guidelines are achieved. - Construction is not prohibited between the hours of 22:00 and 06:00 and 12:00 to 14:00. If circumstance requires construction during those times: <ul style="list-style-type: none"> - approval should be obtained from the local environment department; and, - nearby residents should be notified in advance. - Low-noise equipment that conforms to PRC noise standard GB12523-2011 will be selected as much as possible. - Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. - Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum. - Noise personnel protective equipment (PPE) will be provided to workers in accordance with the PRC Labor Law (1994), Occupational Disease Prevention and Control Law (2001 and other relevant requirements, and the <i>EHS Guidelines</i> health and safety requirements. - Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive 	3rd party qualified environmental monitoring company	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>areas and high traffic times.</p> <ul style="list-style-type: none"> - Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations. - Construction phase noise monitoring will be undertaken at sensitive sites and compared to WHO guidelines, and mitigation measures will be adjusted if necessary based on the monitoring results. 		
Good construction site water quality management practices in accordance with PRC requirements and <i>EHS Guidelines</i>	Water quality	Pollution of adjacent water resources	<ul style="list-style-type: none"> - Sufficient portable toilets will be provided for the workers (at minimum 1 per every 10 males, and 2 per every 10 females) and will be cleaned and discharged to the municipal sewerage system on a regular basis - Construction wastewater from each site will be directed to temporary detention and settling ponds or tanks, and then treated water will be recycled for use in dust control. - All necessary measures will be undertaken to prevent construction materials and waste from entering drains and water bodies. - Maintenance of construction equipment and vehicles will not be allowed on sites so as to reduce wastewater generation. 	Contractors	PMO, LIEC, CSC
Good construction site solid waste management practices in accordance with PRC	Solid waste	Construction and demolition (C&D) waste and domestic refuse	<ul style="list-style-type: none"> - C&D wastes will be reused or recycled to the extent possible. Existing building rubble at bus and charging stations sites (where relevant) will be tested and either reused as fill if appropriate or 	Contractors, Waste Management Companies	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
requirements and <i>EHS Guidelines</i>			<p>treated as hazardous if testing so indicates. Sites will be excavated and resurfaced with clean fill in accordance with relevant PRC regulations and <i>EHS Guidelines</i>. If assessment determines any hazardous wastes are present they will be collected and disposed at a sanitary landfill in an appropriate manner.</p> <ul style="list-style-type: none"> - C&D waste dumpsters will be provided at all work sites. C&D waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements. - Littering by workers will be prohibited. - Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements. - There should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited. - Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction. 		

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Good construction site hazardous waste management practices in accordance with PRC requirements and <i>EHS Guidelines</i>	Hazardous materials	Soil, surface and groundwater contamination	<p>Good waste management practices implemented:</p> <ul style="list-style-type: none"> - Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes with a storage capacity of at least 110% of the capacity of the hazardous materials stored, and at least 300 m from drainage structures, important water bodies and other sensitive receptors identified in the IEE. - In addition, storage facilities will be required to be in compliance with <i>Standard for Pollution Control on Hazardous Waste Storage (GB18597-2001)</i> and the No. 36 Announcement of the Ministry of Environmental Protection in 2013 "Announcement on Issuing the Modification List of <i>Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB18599-2001)</i> and Two Other National Pollutant Control Standards". - Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. - Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. - A spill and environmental emergency response 	Contractors, Suppliers	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>plan will be developed in accordance with <i>Management Method of Enterprises and institutions for Filing of Emergency Plans for Environmental Incidents (Trial)</i>, including:</p> <ul style="list-style-type: none"> - Maintaining a stock of absorbent materials (e.g. sand, earth or commercial products) on site to deal with spillages and training 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 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 PMO and LIEC. - Asbestos response procedure: <ul style="list-style-type: none"> - If materials containing asbestos are encountered, the contractor's Environment, Health and Safety Officer PMO ESO should be alerted. - A qualified asbestos removal specialist should be hired to dispose 		

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			<p>of the asbestos materials before beginning any other work. Workers are prohibited from working with, or disposing, asbestos materials.</p> <ul style="list-style-type: none"> - Vehicles and equipment will be properly maintained and refueled either off-site in local garages or other similar facilities. Washing or repair of machinery in or near surface waters is prohibited. 		
Good construction site ecological protection and enhancement in accordance with PRC requirements and <i>EHS Guidelines</i>	Ecology	Protection of vegetation and restoration of disturbed areas	<ul style="list-style-type: none"> - Access roads to stations must not traverse any forested areas. - Green landscaping will be implemented at bus stations and along roads as per the revegetation and EbA requirements in the FSRs. To the extent possible and practical, selected plant species will be (a) native (i.e. naturally occurring) to Hunan Province; (b) sourced from local stock within Guizhou province. No species listed on the PRC's "Database of Invasive Alien Species" (http://www.chinaias.cn) will be permitted. 	Contractors	PMO, LIEC, CSC
Good construction site PCR protection in accordance with PRC requirements and <i>EHS Guidelines</i>	Physical cultural resources (PCRs)	Destruction of cultural relics	<p>Training will be provided by the LIEC on what constitutes as a PCR, and the Chance Find Procedure.</p> <p>Chance find procedure:</p> <ul style="list-style-type: none"> - Construction activities will be immediately suspended if any PCRs are encountered. - Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited. - The local Cultural 	LIEC Contractor	PMO PMO, LIEC, CSC, Cultural Heritage Bureau

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>Heritage Bureau will be promptly informed and consulted.</p> <p>- Construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau.</p>		
Good construction site Health and Safety in accordance with PRC requirements and <i>EHS Guidelines</i>	Occupational health and safety (OHS)	OHS Planning	<p>- The contractor's Environment, Health and Safety Officer will undertake a risk assessment and develop and implement an Occupational Health and Safety Plan (OHSP) to address the risk, maintain records concerning health, safety and welfare and regularly report on accidents, incidents and near misses. The OHSP will be reviewed and approved by the LIEC and PMO.</p> <p>- The OHSP will provide adequate precautions to protect the health and safety of their workers.</p>	Contractor	PMO, LIEC, CSC
		Construction site sanitation	<p>- Sites will be effectively cleaned. Wastes will be removed on a regular basis in accordance with waste management mitigation measures (above).</p> <p>- A clean and sufficient supply of fresh, potable water that has been certified as being in compliance with PRC drinking water standards will be supplied to all work sites. An adequate number of latrines workers (at minimum 1 per every 10 males, and 2 per every 10 females) and other sanitary arrangements will be provided at all work sites and cleaned and maintained in a hygienic state, in accordance with</p>	Contractor	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			water quality mitigation measures (above).		
		Occupational safety	- Workers will be provided with appropriate personal protective equipment (PPE) to workers to minimize risks, including: <ul style="list-style-type: none"> - Safety hats and safety shoes to all construction workers; - Safety goggles and respiratory masks to workers doing asphalt road paving; - Ear plugs to workers working near noisy PME. - Other PPE as required 	Contractor	PMO, LIEC, CSC
		Electrical safety	- Electrical safety risks will be assessed and safety protocols developed.	Contractor	PMO, LIEC, CSC
		Traffic safety	- Provide appropriate safety barriers and warning signs to ensure safety of existing traffic and workers on roads.	Contractor	PMO, LIEC, CSC
		Worker Accommodation	- No worker camps will be constructed. - Workers will be housed on existing off-site accommodations in accordance with in accordance with IFC/EBRD worker accommodation guidance	Contractor	PMO, LIEC, CSC
		Medical emergency response	- Response procedures will be developed covering both workers and community members (when affected by project related activities), including: communication systems and protocols for interaction with local and regional emergency response providers, first	Contractor	PMO, LIEC, CSC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>aid equipment on site, contact information for the nearest ambulance and medical facilities, training for workers on initial on-site emerge response, protocols for informing and transferring injured workers to local or provincial health centers, and record keeping.</p> <p>- At least one trained first-aid worker will be available at each construction site.</p>		
		Emergency response	<p>- Emergency response procedures will be developed, including communication systems and protocols for interaction with local and regional emergency response providers, protocols for shutting down power, firefighting response procedures, provision of appropriate firefighting equipment, training for workers on fire response, and record keeping.</p>	Contractor	PMO, LIEC, CSC
		Training	<p>- An OHS manual will be prepared and disseminated to workers, and training will be provided to workers in all aspects of the OHS plan prior to the start of construction and on a regular basis (e.g. monthly).</p> <p>- No work will be allowed at dangerous heights or with electrical equipment until adequate training in that activity has been provided.</p>	Contractor, LIEC	PMO
	Community health and safety	Temporary traffic management	<p>- 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</p>	Contractor, local traffic police, PMO	PMO, LIEC, CSC

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			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 publicity about the construction activities and provided with the dates and duration of expected disruption.	Contractor	PMO, LIEC, CSC
		Prohibit 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 fencing, barriers or security personnel, as appropriate.	Contractor	PMO, LIEC, CSC
Operational Phase					
			- Carry out annual assessment, verification, confirmation and record of any changes in sensitive receptors	PMO, LIEC	EA
Storm water management in accordance with PRC requirements and <i>EHS Guidelines</i>	Roads, e-charging stations, multi-modal stations, buildings	Water and soil pollution Flooding, including from climate change	- Fuxing Middle Road will have innovative EbA measures to collect and treat storm water. A drainage system will collect all rainwater from roads, parking lots, sidewalks, etc. The drainage system will be sized to be able to collect even high intensity rainfall events induced by climate change. Runoff will be treated in bio-retention facilities,	Facility operators	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>located in the green belts along both sides of the roads. These facilities are designed to remove contaminants and sediments from storm water runoff utilizing grass buffer strips, sand beds, ponding areas, organic or mulch-layer, and soil and plants.</p> <ul style="list-style-type: none"> - The hospital will be equipped with extensive EbA facilities to collect, treat and store all stormwater. - The potential effects of increased flooding due to climate change will be considered in siting the locations of important facilities and water-proofing program components including electrical equipment. - Existing buildings that are renovated and the multi-modal stations will be connected to the existing Xiangtan stormwater system. - E-charging stations will be equipped with drainage systems. Runoff will be directed to on-site oil-water separators, and then discharged to the municipal stormwater system. 		
Wastewater and sewage management in accordance with PRC requirements and <i>EHS Guidelines</i>	Multi-modal stations, buildings	Water and soil pollution	<ul style="list-style-type: none"> - All wastewater and sewage generated in program buildings or multi-modal stations will be discharged to the municipal sewage system and treated in one of two municipal Waste Water Treatment Plants (WWTPs). - The final discharge from municipal WWTPs will be required to meet <i>the Level III limit in Integrated Wastewater Discharge Standard (GB8979-1996)</i>. 	Bus station operator	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Air quality protection in accordance with PRC requirements including and <i>EHS Guidelines</i>	Program Roads and Bus Lines	Vehicle Emissions	<ul style="list-style-type: none"> - Operation of the priority bus system along with associated - Zero emission BEBs will replace existing - Vehicles in the area will be required to comply with relevant PRC emission standards, including <i>Limits and Measurement Methods for Emissions from Light-duty Vehicles (China Stage III and IV) (GB18352.3-2005)</i>. - The ambient air quality at the roads will be required to meet <i>the Level II limit in Environmental Air Quality Standard (GB3095-2012)</i>. - Air quality monitoring will be undertaken at adjacent sensitive receptors, and if not in compliance with WHO AQGs additional measures will be investigated and implemented. 	Relevant authorities	PMO, XEEB
	Multi-modal Train Stations	Automotive Emissions	<ul style="list-style-type: none"> - No increase in emissions is anticipated as the vehicles using these facilities are existing loads for the stations. Instead, it is predicted that there will be a decrease in emissions as more passengers will be able to use public transport as opposed to taxis and private cars, and the more efficient layout and car and taxi loading / unloading processes will result in reduced waiting and idling times, therefore reducing associated emissions. - Air quality monitoring will be undertaken at adjacent sensitive receptors, and if not in 	Station operator	PMO, XEEB
				3rd party qualified environmental monitoring company	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			compliance with WHO AQGs additional measures will be investigated and implemented.		
	CCHP Operation at Xiangtan First Traditional Chinese Medicine Hospital	CCHP Emissions	<p>Hospital will be EDGE certified, including:</p> <ul style="list-style-type: none"> - Low NOx natural gas boilers with less than 100 mg/m³ NOx emissions (exceeds PRC Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers GB 13217-2014), and the 2007 EHS Guidelines of 240 mg/m³ for boilers). - A DeNOx system (Selective Non-Catalytic Reduction or SNCR) will be installed on the gas engine to ensure NOx emissions are less than 30 mg/Nm³ - Considering the overall energy saving of 5771.65 MWh/year estimated in the EDGE certification, the overall emission from the hospital will be reduced versus the baseline situation. - Air quality monitoring will be undertaken at adjacent sensitive receptors, and if not in compliance with WHO AQGs additional measures will be investigated and implemented. 	<p>Hospital operator</p> <p>3rd party qualified environmental monitoring company</p>	<p>PMO, XEEB</p> <p>PMO, XEEB</p>
Noise control in accordance with PRC requirements and <i>EHS Guidelines</i>	Program Roads and Bus Lines	Noise impacts	<ul style="list-style-type: none"> - It is predicted that there will be a decrease in noise compared to the base line as more passengers will be able to use low noise BEB public transport as opposed to noisier gas-fired buses, taxis and private cars. In addition, operation of the ITS system is expected to improve the overall efficiency of traffic system, and reduce low- 	<p>Road operators</p> <p>3rd party environmental monitoring agency</p>	<p>PMO, XEEB</p> <p>PMO, XEEB</p>

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> speed traffic flows or traffic jams. - Noise monitoring will be undertaken at adjacent receptors, and if required sound barriers (or additional barriers) will be put in place to ensure actual noise level compliance with WHO guidelines 		
	E-charging Stations	Noise impacts	<ul style="list-style-type: none"> - Use of horns while in or entering or leaving the station will be prohibited, and idling of engines will not be allowed. - Low-noise equipment, will be selected where possible. - Noisy equipment will be installed in sound insulated equipment rooms, and building wall will also be sound insulated. - Evergreen vegetation will be planted around stations to act as noise barriers. - Noise at site boundary will be in compliance with GB12348-2008 Noise Standards for Industrial Enterprises at Site Boundary. - Sound barriers will be installed between charging stations and any adjacent sensitive receptors. - Noise monitoring will be undertaken at adjacent receptors, and if required sound barriers will be put in place to ensure actual noise level compliance with WHO guidelines 	Charging station operator	PMO, XEEB
Waste management in accordance with PRC requirements and <i>EHS Guidelines</i>	Program Roads, Bus Lines, E-charging Stations	Inappropriate domestic waste disposal	<ul style="list-style-type: none"> - Program roads and bus lines will be equipped with appropriate garbage and recycling containers installed every 80 to 100 m. - E-charging stations will be equipped with 	Road operators, e-charging station operator, Xiangtan Sanitation Department,	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> - appropriate garbage and recycling containers. Domestic garbage and recyclables will be collected on a regular basis. Recyclables will be collected by an appropriate recycling facility and garbage by the local sanitation department for disposal at a municipal solid waste landfill. 	Recycling companies	
	Non-functional buses due to age or damage	Inappropriate scrapping and/or recycling	<ul style="list-style-type: none"> - Non-functional buses, either program buses or existing buses which program buses replace, will be recycled to the maximum extent possible. - The XMG, as the owner and operator of the BEBs, will be responsible for overseeing vehicle scrapping and recycling. They will entrust the procedure to a nationally certified vehicle write-off company who will be responsible for all aspects of vehicle scrapping and recycling including collection, remanufacturing of allowed components if suitable (engine assembly, steering assembly, transmission assembly, front and rear axles, and frame), and recycling of components that cannot be remanufactured, in accordance with relevant PRC regulations, including the <i>Regulations on Vehicle Recycling Management</i>. 	XMG	PMO, XEEB
Hazardous waste management in accordance with PRC requirements and <i>EHS</i>	Hazardous materials and waste at charging stations and other project facilities	<p>Fuels, oil, chemicals and other hazardous materials</p> <p>New and waste</p>	<ul style="list-style-type: none"> - Storage facilities for fuels, oil, chemicals and other hazardous materials will be stored within a secured weatherproof facility on impermeable surfaces provided 	O&M units, battery providers, qualified waste battery and lubricating oil recycling	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
<i>Guidelines</i>		batteries Lubricating oil and grease (O&G)	(impervious concrete, a clay layer at least 1m in thickness (permeability coefficient $\leq 10^{-7}$ cm/s), high density polyethylene 2mm in thickness, or other artificial materials at least 2mm in thickness (permeability coefficient $\leq 10^{-10}$ cm/s), with a storage capacity of at least 110% of the capacity of the hazardous materials stored (10 m ³), and at least 300 m from drainage structures, important water bodies and other sensitive receptors identified in the IEE. - Hazardous wastes shall be put in labeled containers and then placed in vented cabinets or containers. Incompatible hazardous wastes shall be stored separately or in areas separated by impermeable partitions. - A standalone site within each storage facility will be designated for hazardous wastes including scrap batteries - In addition, storage facilities will be required to be in compliance with <i>Standard for Pollution Control on Hazardous Waste Storage (GB18597-2001)</i> and the No. 36 Announcement of the Ministry of Environmental Protection in 2013 "Announcement on Issuing the Modification List of <i>Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB18599-2001)</i> and Two Other National Pollutant Control	companies	

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<p>Standards".</p> <ul style="list-style-type: none"> - Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. - Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. - A spill and environmental emergency response plan will be developed in accordance with <i>Management Method of Enterprises and institutions for Filing of Emergency Plans for Environmental Incidents (Trial)</i>, including: <ul style="list-style-type: none"> - Maintaining a stock of absorbent materials (e.g. sand, earth or commercial products) on site to deal with spillages and training 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 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 		

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			<p>report to PMO and LIEC.</p> <ul style="list-style-type: none"> - Licensed companies will be hired to collect, transport, and dispose hazardous materials in accordance with relevant PRC regulations and requirements. Hazardous wastes will only be disposed at nationally or provincially licensed hazardous waste facilities. - When a battery capacity is lower than 80%, it will no longer be used on buses. It will be moved to a battery cluster within the bus stations to provide electricity for slow chargers working in the night time. When capacity is too low to function in that manner, they will be recycled. - Battery providers will be responsible for collection, recycling (or reuse again if possible) of batteries on a regular basis in compliance with - In compliance relevant PRC regulations, including <i>Interim Measures for the Management of Recycling and Utilization of Power Batteries for New Energy Vehicles</i>, (2018, Ministry of Industry and Information Technology (MIIT) and six other authorities) and <i>Interim Provisions on the</i> 		

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			<p><i>Management of Traceability of Recycling and Utilization of New Energy Vehicles</i>, (MIIT, 2018), battery providers will be responsible for collection, recycling (or reuse again if possible) of batteries. Battery providers will also be required to have a “traceability” system that enables the identification of owners of discarded batteries, and easily dismantled product designs to help automate the recycling process.</p> <ul style="list-style-type: none"> - Qualified companies will collect and properly disposal waste O&G, and sludge from the oil-water separators on a regular basis in compliance with all relevant PRC regulations. 		
	Hospital	Medical wastes	<ul style="list-style-type: none"> - Medical wastes will be treated as hazardous waste as per HW01 in “<i>Directory of National Hazardous Wastes (2016 Revision)</i>”, and will be collected and to transferred to Zhuzhou City for centralized incineration. The process will be managed by <i>Xiangtan Medical Waste Handling Center Co., Ltd.</i> - Collection and transport to Zhuzhou City will be managed by the <i>Zhuzhou Zhongcheng Medical Waste Transportation Co., Ltd.</i> 	Xiangtan First Traditional Chinese Medicine Hospital, qualified medical waste management, transport and incineration companies	PMO, XEEB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			<ul style="list-style-type: none"> - The waste incineration company is qualified and supervised by Zhuzhou Municipality. - The Xiangtan First Traditional Chinese Medicine Hospital will establish records for hazardous waste management to monitor generation and collection, and to ensure compliance with the hazardous waste handling management, and relevant PRC legislation. 		
Worker safety in accordance with PRC requirements and <i>EHS Guidelines</i>	Occupational health and safety (OHS)	OHS Planning	<ul style="list-style-type: none"> - EHSO will undertake a risk assessment and implement an Occupational Health and Safety Plan (OHSP) to address the risks, maintain records concerning health, safety and welfare and regularly report on accidents, incidents and near misses. - The OHSP will provide adequate precautions to protect the health and safety of their workers, including but not necessarily limited to sanitation, including waste removal and provision of potable water and sanitation facilities; occupational safety, including provision of appropriate personal protective equipment (PPE) such as safety hats, shoes, goggles, ear plugs and respiratory masks; electrical safety; traffic safety; emergency response, including procedures for medical, fire and other emergencies; and training in accordance with <i>EHS Guidelines</i>. The OHSP will be reviewed and approved by the LIEC and PMO. 	EHSO	PMO, LIEC

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Emergency Response	Medical emergency response	<ul style="list-style-type: none"> - Response procedures will be developed covering both workers and community members (when affected by project related activities), including: communication systems and protocols for interaction with local and regional emergency response providers, first aid equipment on site, contact information for the nearest ambulance and medical facilities, training for workers on initial on-site emergency response, protocols for informing and transferring injured workers to local or provincial health centers, and record keeping. - At least one trained first-aid worker will be available at each construction site. 	PMO, LIEC	EA
		Emergency response	<ul style="list-style-type: none"> - Emergency response procedures will be developed, including communication systems and protocols for interaction with local and regional emergency response providers, protocols for shutting down power, firefighting response procedures, provision of appropriate firefighting equipment, training for workers on fire response, and record keeping. 	PMO, LIEC	EA
		Training	<ul style="list-style-type: none"> - An OHS manual in accordance with <i>EHS Guidelines</i> will be prepared and disseminated to workers, and training will be provided to workers in all aspects of the OHS plan prior to the start of construction and on a regular basis (e.g. monthly). - No work will be allowed 	PMO, LIEC	EA

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			at dangerous heights or with electrical equipment until adequate training in that activity has been provided.		
Traffic safety in accordance with PRC requirements and <i>EHS Guidelines</i>	Bus, car and other vehicular traffic	Low noise BEBs pose a risk to pedestrian safety	- Buses will be equipped with Acoustic Vehicle Alerting Systems (AVAS), which will emit warning sounds at speeds less than 30 km/h.	Manufacturers	PMO, Xiangtan Traffic Police
		Road condition	- Regularly inspect and maintaining corridor roads and drains.	Road Operators	PMO, XMG Roads Department
		Road safety and traffic accidents	- Appropriate training and licensing of bus drivers and provision of PPE.	Road Operators, Xiangtan Traffic Police	XMG
			- Strict enforcement of traffic laws and regulations, especially speed limits.		
			- The provision of lanes for pedestrians and non-motorized vehicles.		
			- Improved designs of road junctions and frequent pedestrian crossings		

Notes: ADB = Asian Development Bank; EA = Executing Agency; EHS = environment, health & safety; EIT = Environmental Impact Table; IA = Implementing Agency; XEEB = Xiangtan Ecology and Environment Bureau; O&M = operation & maintenance; PMO = Project Management Office.

D. Performance Indicators

20. Performance indicators (Table A-3) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table A-3: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including PMO ESO.
		(ii) Qualified LIEC recruited.
		(iii) Qualified 3rd party environmental monitoring company engaged.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated.
		(ii) Environment monitoring cost is sufficiently and timely allocated.
		(iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by PMO ESO and LIEC.
		(ii) Ambient air quality and noise monitoring is conducted by 3 rd party environmental monitoring company.

No.	Description	Indicators
4	Supervision	(i) ADB mission to review EMP implementation at least once a year during the construction phase. (ii) Local environmental authorities to supervise monitoring at their discretion.
5	Reporting	(i) Annual environmental monitoring reports prepared by PMO ESO with the support of LIEC, and submitted to ADB.
6	Capacity Building	(i) Construction Environmental Management Plans are developed and in place before substantive construction activities begin. (ii) Training on Construction Environmental Management Plans, ADB safeguard policy, EMP implementation, and GRM is provided prior to start of construction. (iii) Training on implementation of operation phase EMP and health and safety is provided prior to project operation.
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at PMO, and GRM contact information disclosed to the public before construction. (ii) All complains are recorded and processed within the set time framework in the GRM.
8	Compliance with PRC standards	(i) Program complies with PRC environmental laws and regulations and meets all required standards.

E. Environmental Monitoring Plan

21. An environment monitoring plan (EMoP) will be implemented to monitor (i) the extent and severity of actual environmental impacts against the predicted impacts, (ii) the performance of the environmental protection measures and compliance with regulations, (iii) overall effectiveness of the project EMP; and (iv) need for adjustment of the project EMP. The project monitoring program focuses on the environment within the project's area of influence.

22. Two types of project monitoring will be conducted under the EMoP:

- a) **EMP Implementation Monitoring.** EMP compliance inspections to be conducted by the PMO ESO with support from the LIEC. Inspections will be undertaken on an ongoing basis and will involve monthly, weekly, or when necessary, daily inspections of active work sites to ensure compliance with relevant EMP requirements. Findings of compliance inspections will be reported to the contractor's Environment, Health and Safety Officer and the PMO, and measures to address any non-compliance will be implemented as soon as possible by the contractors.
- b) **Environmental Quality Monitoring.** Table A-4 presents the project environmental quality monitoring program (air and noise), including, scope, location, parameters, duration and frequency of monitoring during the construction and operational stages. Environmental monitoring during construction and operation (first year) will be conducted by a qualified environmental monitoring company, contracted by the IA, supported through information available from XEEB monitoring stations. At the outset of project implementation the PMO ESO with support from the LIEC will update the environmental monitoring program if necessary. The monitoring program and budgets will be included in the project tendering documents and budgets, as well as the construction and operation contracts.

The environmental monitoring results will be compared with relevant PRC performance standards and relevant EHS and WHO guidelines, and any non-compliance will be reported in the EMP progress section under the semi-annual project progress reports. Detailed monitoring results will be reported in annual environmental monitoring reports by the PMO with the support of the LIEC (see reporting plan in Table A-5) as part of consolidated annual reports.

23. In addition, environmental monitoring may also be periodically conducted by the local environmental authorities.

24. ADB will oversee EMP compliance on the basis of (i) the EMP implementation section of semi-annual project progress reports; (ii) annual environmental monitoring reports provided by PMO as part of consolidated annual reports; and, (iii) site visits during ADB review missions (generally once a year).

Table A-4: Ambient environmental quality monitoring plan

Item	Monitoring Parameter	Monitoring Location	Monitoring Frequency	Implementing Entity	Supervising Entity
Pre-construction stage					
Update on sensitive receptors, sensitive locations for environmental monitoring				LIEC	PMO, XEEB
Construction Stage					
Air quality	PM _{2.5} , PM ₁₀ , SO ₂ , NO ₂ (24-hr). Standard: WHO AQGs	10 sensitive locations ⁽ⁱ⁾ (rotating) as selected by PMO ESO and LIEC from sites identified in IEE Table 32 or in an updated IEE; and at hospital boundary.	Monthly	3 rd party qualified environmental monitoring company	PMO, XEEB
Noise	Leq dB(A) (day time and night time). Standard: WHO noise guidelines	10 sensitive locations ⁽ⁱ⁾ (rotating) as selected by PMO ESO and LIEC from sites identified in IEE Table 32 or in an updated IEE; and at hospital boundary..	Monthly	3 rd party qualified environmental monitoring company	PMO, XEEB
Operational Stage (first two years)					
Air quality	PM _{2.5} , PM ₁₀ , SO ₂ , NO ₂ (24-hr) Standard: WHO AQGs	10 sensitive locations ⁽ⁱ⁾ (rotating) as selected by PMO ESO and LIEC from sites identified in IEE Table 32 or in an updated IEE.	Monthly	3 rd party qualified environmental monitoring company	PMO, XEEB
Noise	Leq dB(A) (day time and night time) Standard: WHO noise guidelines	10 sensitive locations ⁽ⁱ⁾ (rotating) as selected by PMO ESO and LIEC from sites identified in IEE Table 32 or in an updated IEE.	Monthly	3 rd party qualified environmental monitoring company	PMO, XEEB

Notes:

(i) "10 sensitive sites" for both construction and operational phase monitoring is indicative only, and the number may be increased or decreased with the agreement of the PMO ESO and the LIEC.

(ii) EMS = Environmental Monitoring Station; IA = Implementing Agency; XEEB = Xiangtan Ecology and Environment Bureau; PMO = Project Management Office.

F. Environmental Standards

25. PRC environmental standards issued by the MEE generally consist of environmental quality (ambient) standards applicable to the receiving environment, and emission standards applicable to the pollution source. The former includes standards for ambient air quality, noise and vibration, surface water, groundwater, etc. The latter includes standards for integrated wastewater discharge, construction and community noise, odor and air pollutants, etc.

26. ADB's SPS requires borrowers to follow environmental standards consistent with good international practice, as reflected in internationally recognized standards such as the World Bank Group's EHS Guidelines. When host country regulations differ from these levels and measures, the borrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower is required to provide justification for any proposed alternatives.

27. Table A-5 presents the environmental standards and guidelines applicable to the Project, which reflects the PRC requirements and the ADB SPS (2009) guidance on the use of international standards.

Table A-5: Environmental standards and guidelines applicable to the project

Parameter / Area of Concern	Applicable Standards and Guidelines	Remarks
Ambient air quality	<i>Ambient Air Quality Standard</i> (GB3095-2012), Class II	<u>Yearly average:</u> PM ₁₀ : 0.070 mg/m ³ PM _{2.5} : 0.035 mg/m ³ SO ₂ : 0.06 mg/m ³ NO ₂ : 0.04 mg/m ³ CO: 4.0 mg/m ³
		<u>Daily average:</u> TSP: 0.30 mg/m ³ PM ₁₀ : 0.15 mg/m ³ PM _{2.5} : 0.075 mg/m ³ SO ₂ : 0.15 mg/m ³ NO ₂ : 0.08 mg/m ³ CO: 4.0 mg/m ³
		<u>Hourly average:</u> SO ₂ : 0.50 mg/m ³ NO ₂ : 0.20 mg/m ³ CO: 10.0 mg/m ³
Construction air pollutant emission	<i>Air Pollutant Integrated Emission Standard</i> (GB16297-1996)	<u>Maximum allowable emission concentration:</u> Particulate matter (PM): 120 mg/m ³ Fumes from asphalt plant: 40 mg/m ³ during production and 75 mg/m ³ during mixing
		<u>Limits for fugitive emission:</u> PM: ≤1.0 mg/m ³ at construction site boundary Fumes from asphalt plant: no obvious emission at asphalt production plant
Environmental noise	<i>Environmental Quality Standard for Noise</i> (GB3096-2008): • Class IVa for areas within 35 m from the boundary line of roads	<u>Class IVa areas:</u> Day time: 70 dB(A) Night time: 55 dB(A) <u>Class II areas:</u>

Parameter / Area of Concern	Applicable Standards and Guidelines	Remarks
	<ul style="list-style-type: none"> Class II for areas 35 to 200 m from the boundary line of roads 	Day time: 60 dB(A) Night time: 50 dB(A)
	WHO Noise Level Guideline	<u>Residential, institutional, and educational receptor</u> Day time: 55 dB(A) Night time: 45 dB(A) <u>Industrial; and commercial receptor</u> Day time: 70 dB(A) Night time: 70 dB(A)
Construction noise	Emission Standard of Environmental Noise for Boundary of Construction Site (GB12523-2011)	<u>Noise level at construction site boundary:</u> Day time: 70 dB(A) Night time: 55 dB(A) <u>Noise level within construction site:</u> Day time: 60 dB(A) Night time: 50 dB(A)
Surface water quality	Environmental Quality Standards for Surface Water (GB3838-2002), see IEE Table 9.	<ul style="list-style-type: none"> Class II standard for Hongfeng Lake and Songbaishan Reservoir (drinking water source) Class III for rivers within the project area.
Wastewater discharge	Integrated Wastewater Discharge Standard (GB8978-1996)	<u>Discharge into Class III water body:</u> COD: ≤100 mg/l BOD ₅ : ≤20 mg/l SS: ≤70 mg/l TPH: ≤5 mg/l NH ₃ -N: ≤15 mg/l <u>Discharge into sewers:</u> COD: ≤500 mg/l BOD ₅ : ≤300 mg/l SS: ≤400 mg/l TPH: ≤30 mg/l
Environmental adverse impacts	WB EHS Guidelines: Environment	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Occupational health and safety	WB EHS Occupational Health and Safety Guidelines	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Community health and safety	WB EHS Community Health and Safety Guidelines	Approaches and measures appropriate to mitigate adverse impacts from the project activities
Construction and Decommissioning	WB EHS Construction and Decommission Guidelines	Approaches and measures appropriate to mitigate adverse impacts from the project activities

Source: PPTA consultant.

G. Reporting

28. **Internal Reporting.** During the construction period the subproject contractors and CSC will be responsible for conducting internal reporting on implementation and compliance with the EMP and CEMPs, including information on all spills, accidents, grievance received, and appropriate actions taken. Results will be reported through quarterly reports to the PMO.

29. The PMO will submit annual reports to the EA on EMP implementation based on subproject contractors and CSC internal reporting and the results of ambient and compliance inspection monitoring.

30. **Annual Environmental Reporting** . The PMO with support from the LIEC will submit environmental monitoring reports annually during construction and operation to the ADB. The annual environmental monitoring reports will include (i) progress made in EMP implementation; (ii) overall effectiveness of the EMP implementation (including public and occupational health and safety performance and incidents); (iii) compliance with loan covenants; (iv) copies of all permits and clearance obtained during the reporting period; (v) environmental monitoring and compliance; (vi) public consultation, information disclosure and details of all grievances and how they were responded to; (vii) any problems encountered during construction and operation, and the relevant corrective actions undertaken; and (ix) institutional strengthening and training. ADB will disclose the English version of the reports on its website. The ADB will reviewing the annual environment monitoring reports and ADB missions will inspect the project progress and implementation on site at least once a year.

31. **Environmental Acceptance Reporting.** Within three months after completion, or no later than one year with permission of the XEEB, an environmental acceptance report shall be prepared by a licensed institute in accordance with the PRC *Regulation on Project Completion Environmental Audit* (MEP, 2001), approved by the relevant environmental authority, and reported to ADB. The environmental acceptance report will indicate the timing, extent, effectiveness of completed mitigation and of maintenance, and the need for additional mitigation measures and monitoring (if any) during operation. Reporting requirements are summarized in Table 6.

H. EMP Institutional Capacity Building and Training

32. The capacity of the PMO (including representatives) and contractors will be enhanced through institutional strengthening and training. All parties involved in implementing and supervising the EMP must have a good understanding of the ADB SPS (2009), the project relevant environmental objectives, methods, and good practices of project environmental management.

33. **Institutional Strengthening.** The capacities of the PMO (including representatives) to coordinate environmental management will be strengthened through:

- (i) The appointment of qualified PMO ESO in charge of EMP coordination, including the GRM.
- (ii) The recruitment of a Loan Implementation Environmental Consultant (LIEC), a part-time national environmental, health and safety specialist who will support the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The LIEC will also support contractors in developing Construction site-specific Environmental Management Plans (CEMPs) prior to construction and operation.
- (iii) The recruitment of a Construction Supervision Company (CSC) responsible for supervising and guiding construction contractors during project construction phase.
- (iv) The recruitment of a qualified Environmental Monitoring Company to collect and analyze air quality and noise data at designated monitoring locations to assess compliance with applicable environmental quality standards during construction.

Table A-6: Environmental reporting plan

Phase/ Reports		From	To	Reporting Frequency
Construction Phase				
EMP and CEMP progress reports	EMP and CEMP progress reports	Contractors, CSC	PMO	Quarterly
Monitoring reports	EMP implementation section under the project environmental progress reports	PMO	EA, ADB	Annual
Environmental Acceptance report	Environmental acceptance monitoring and audit report	Licensed institute	XEEB, ADB	Within 3 months of completion of physical works
Operational Phase				
Environmental monitoring reports to ADB	EMP progress and monitoring report	PMO	IA, EA, ADB	Annually (until project completion)

Notes: ADB = Asian Development Bank; IA = Implementing Agency, XEEB = Xiangtan Ecology and Environment Bureau; LIEC = Loan Implementation Environmental Consultant; PMO = Project Management Office.

34. **Training.** The PMO (including representatives), Project Management Consultant, CSC and construction contractors will receive training on the ADB SPS (2009); PRC safeguard requirements; development and implementation of environment, health and safety (EHS) plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and typical good construction EHS plans and practices (Table 7). Training will be provided by the LIEC.

Table A-7: Training program

Training	Contents	Attendees	Times	Period (days)	No. of persons	Cost (\$/person /day)	Total Cost
Construction Phase							
ADB and PRC EHS laws, regulations and policies	– ADB's safeguard policy statement						
	– Program applicable PRC EHS laws, policies, standards and regulations						
	– International environmental, health and safety management practice in civil construction	PMO, Project Management Consultant, CSC, construction contractors, XEEB	Twice - once prior to start of construction, and once after one year of construction as a refresher	2	30	100	\$12,000
Implementation of construction EHS Plans	– International environmental, health and safety management practice in civil construction						
	– Plan descriptions						
	– Roles and responsibilities						
	– Worker and community EHS concerns and actions						

Training	Contents	Attendees	Times	Period (days)	No. of persons	Cost (\$/person /day)	Total Cost
Implementation of EMP and EMoP	– Impacts and mitigation measures						
	– Monitoring and auditing mechanism						
	– Reporting requirements						
	– Issue of non-compliance and corrective actions for EMP, EMoP and GRM.						
Grievance Redress Mechanism	– GRM structure, responsibilities, and timeframe						
	– Types of grievances and eligibility assessment						
Operation Phase							
Implementation of EMP and EMoP	– Impacts and mitigation measures						
	– Monitoring and auditing mechanism						
	– Reporting requirements						
	– Issue of non-compliance and corrective actions for EMP, EMoP and GRM.	IA	Once prior to project implementation	1	30	100	\$3,000
Implementation of operation EHS Plans	– Plan descriptions						
	– Roles and responsibilities						
	– Worker and community EHS concerns and actions						
Total estimated cost							\$15,000

Notes: PMO = Project Management Office; IA = Implementing Agency, XEEB = Xiangtan Ecology and Environment Bureau.

I. Grievance Redress Mechanism

35. **Program Specific GRM.** A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by an affected person (AP). The PMO will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. The project has strong public support; nonetheless, grievances related to the environment, land acquisition and resettlement will need to be adequately handled. During construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address any complaints, a project specific Grievance Redress Mechanism (GRM) has been developed in accordance with ADB requirements and Government practices. The GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-

related grievances transparently and in a reasonable period of time.

36. The objective of the project GRM is to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM will be accessible to all members of the community.

37. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved.

38. The PMO ESO will be responsible for implementation of the GRM, and will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the project or who have an issue they would like to discuss. Other GRM entry points will include: (i) the contractors; (ii) the IA; and (iii) the Xiangtan Ecology and Environment Bureau (XEEB) for environment issues. The PMO will issue public notices to inform the public within the project area of the GRM, and the PMO's and other entry points phone number, fax, address, email address will be disseminated at all construction and other sites.

39. The PMO will maintain a complaints database and communicate with contractors, CSCs, XEEB, and other relevant local government departments. The PMO ESO will be supported on an as need basis by the Loan Implementation Environmental Consultant (LIEC).

40. **Types of Environment Related Grievances and Eligibility.** Construction phase grievances might relate to issues such as traffic disruptions, access to businesses and residences, and construction dust or noise. Operation phase complaints may relate to service levels, delays or traffic disruptions. Once a complaint is received and filed, the PMO will identify if complaints are eligible. Eligible complaints include those where (i) the complaint pertains to the project; and (ii) the issues arising in the complaint fall within the scope of environmental safeguards. Ineligible complaints include those where: (i) the complaint is clearly not project-related; (ii) the nature of the issue is outside the mandate of the environment GRM (such as allegations of fraud or corruption); and (iii) where other company or community procedures are more appropriate to address the issue. Complaints ineligible to the project or the GRM will be recorded and passed onto relevant authorities. If an ineligible complaint is rejected, the complainant will be informed of the decision and the reasons for rejection.

41. **Environment Related GRM Steps.** The GRM will be implemented through five escalating steps, advancing to the next level only if the grievance was unable to be redressed at the previous level. Note that: (i) at any stage in the GRM, an affected person (AP) may submit their grievance to any agency they feel most comfortable with. If such agency is not listed in the steps below, they will also need to inform at least one of the listed individuals or agencies, to enable the GRM procedures to be implemented; and (ii) the GRM does not replace the role of existing laws and legal procedures. In the event of any grievance, the PMO will immediately inform ADB, and then ensure that ADB is updated on the progress.

Step 1: If a concern arises, the AP should try to resolve the issue of concern directly with the contractor or via the GRM access points (community leaders, neighborhood organizations, XEEB) during the construction phase, and/or the operator during the operation phase. If the concern is resolved successfully no further follow-up is required.

The contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 7 working days or if the complainant is not satisfied with the suggested solution under Step 1, proceed to Step 2.

Step 2: The AP will submit the grievance to the PMO (if not done in Step 1). PMO will record the grievance, assess its eligibility and report back to the AP within 7 working days. If the grievance is eligible, proceed to step 3.

Step 3: The PMO will investigate the complaint, and consult with the EA, LIEC and other stakeholders as appropriate in an attempt to identify a solution. The PMO will give a clear reply to the AP within 5 working days with the suggested solution, and the IA will ensure that implementation of the agreed-upon redress solution begins within 7 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

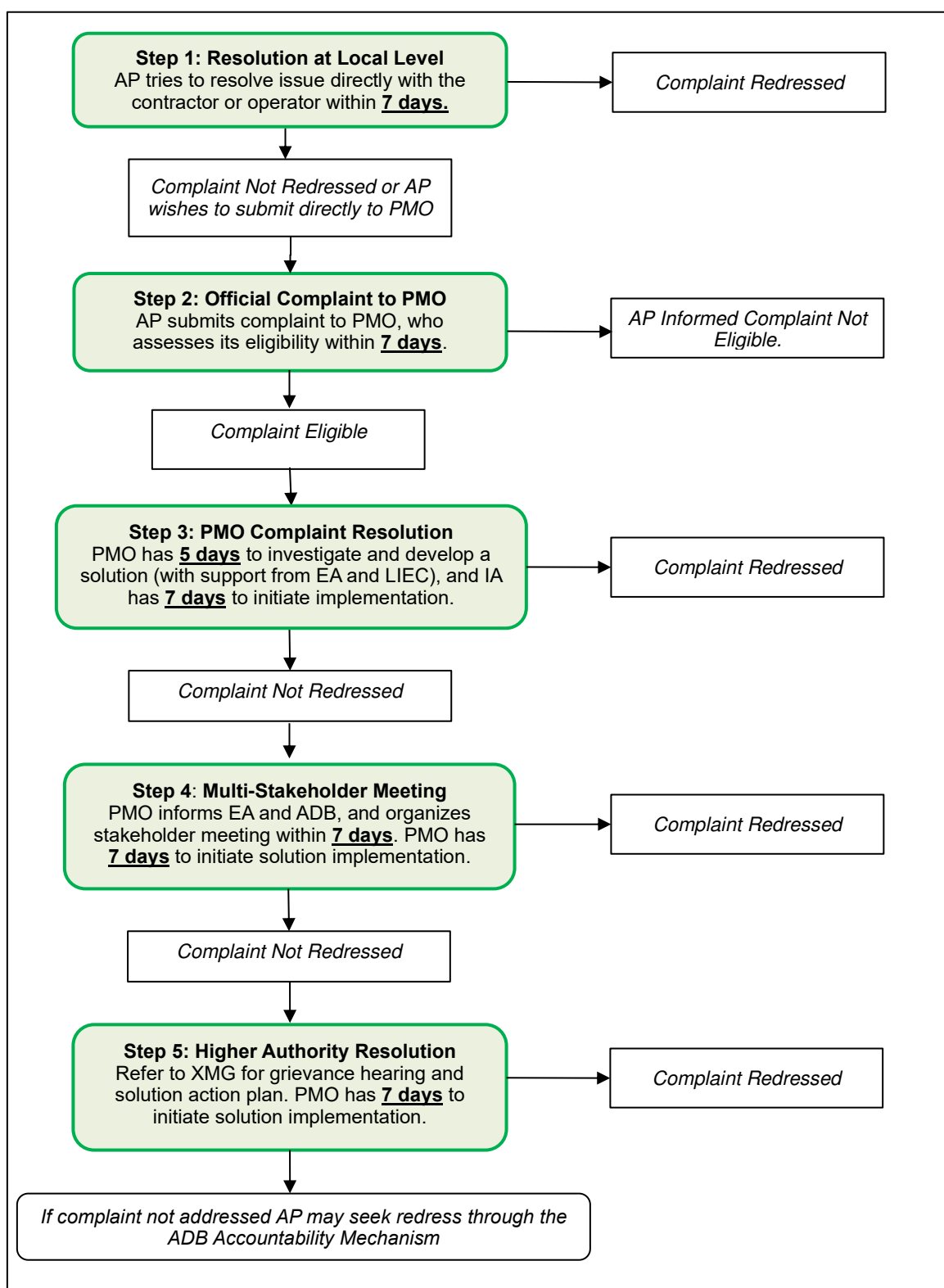
Step 4: The PMO will inform ADB as to the grievance, and will organize a multi-stakeholder meeting within 5 days, where all relevant stakeholders, including the complainant, the EA, IA, ADB and XEEB, can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The PMO will ensure that the implementation of agreed-upon redress solution begins within 7 working days of the completion of the multi-stakeholder meeting.

Step 5: If the complainant is not satisfied with the suggested solution under Step 4, the grievance will be directed to the Xiangtan Municipal Government (XMG). The XMG will direct the EA to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the IA will ensure that the implementation of the agreed-upon redress solution begins within 7 working days of the completion of the hearing.

42. The five GRM steps are illustrated in Figure A-2. If the GRM 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 through Office of the Special Project Facilitator (OSPF) or Office of Compliance Review Panel. 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, APs should make a good faith effort to solve their problems by working with the concerned ADB operations department. Only after doing that, and they are still dissatisfied, should they approach the Accountability Mechanism.¹

¹ See: <http://compliance.adb.org/>

Figure A-2: Five step project GRM



43. APs will not be charged any cost for submitting a grievance to the PMO. All costs for implementing an agreed solution will be paid by the party deemed responsible for causing the grievance. The grievance procedures will remain valid throughout the duration of the project construction and until project closure.

J. Cost Estimates

44. The estimated budgets for environmental monitoring, capacity building, training and public consultation are summarized in Table 8. Construction phase costs are estimated at \$319,000; operation phase mitigation and monitoring costs are estimated at \$143,500 (first two years).

45. 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 impact of climate change on extreme rainfall has been factored into the project design, and is included in the civil work contract costs.

K. Mechanisms for Feedback and Adjustment

46. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, then the PMO ESO and LIEC will consult with the PMO and XEEB and propose appropriate changes to the EMP monitoring and mitigation plan.

47. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as required by the SPS. The revised EMP will be passed on to the contractor(s) for implementation.

Table A-8: EMP Budget (monitoring, capacity building and LIEC)

Construction Phase (4 years)					
1. 3rd Party Independent Ambient Monitoring	Item	Annual Cost	#	Cost USD	Cost RMB
Air (PM2.5, PM10, SO ₂ , NO ₂), Noise	Monthly at 10 sensitive locations (rotating)	\$ 60,000	4	\$ 240,000	¥1,674,480
Subtotal				\$ 240,000	¥1,674,480
2. Capacity Building	Unit	Course Cost	#	Cost USD	Cost RMB
Construction Phase EMP Training	Development and Delivery	\$ 7,500	2	\$ 15,000	¥104,655
Subtotal				\$ 15,000	¥104,655
3. Loan Implementation Env. Consultant	Unit	Unit Cost	#	Cost USD	Cost RMB
Construction Phase LIEC	Person Months	\$ 4,000	16	\$ 64,000	¥446,528
Subtotal				\$ 64,000	¥446,528
TOTAL Construction Phase				Cost USD	Cost RMB
				\$ 319,000	¥2,225,663
Operation Phase (first 2 years)					
1. Ambient Monitoring	Item	Unit Cost	#	Cost USD	Cost RMB
Air (PM2.5, PM10, SO ₂ , NO ₂), Noise	Monthly at 10 sensitive locations (rotating)	\$ 60,000	2	\$ 120,000	¥837,240
Subtotal				\$ 120,000	¥837,240
2. Capacity Building	Unit	Course Cost	#	Cost USD	Cost RMB
Operation Phase EMP Training	Development and Delivery	\$ 7,500	1	\$ 7,500	¥52,328
Subtotal				\$ 7,500	¥52,328
3. Loan Implementation Env. Consultant	Unit	Unit Cost	#	Cost USD	Cost RMB
Operation Phase LIEC	Person Months	\$ 4,000	8	\$ 32,000	¥223,264
Subtotal				\$ 32,000	¥223,264
TOTAL Operation Phase				Cost USD	Cost RMB
				\$ 159,500	¥1,112,832
GRAND TOTAL Construction + Operation				Cost USD	Cost RMB
				\$ 478,500	¥3,338,495

Construction Phase Notes:

Assumes 4 year construction period; Ambient monitoring based on monthly monitoring at ten sensitive sites (residential areas) to be selected by the PMO ESO and LIEC on a rotating basis depending on the progress of construction. Monitoring will be undertaken by a qualified 3rd party monitoring company; Construction phase LIEC part time – 16 months over construction phase. Assumes LIEC based in Xiangtan. Does not include costs for mitigations to be implemented by contractors.

Operation Phase Notes:

Operation phase LIEC part time – 4 months each for first two years of operation.

Appendix A - Annex 1: Draft Terms of Reference for Environment, Health and Safety Positions

1. PMO Environment and Safety Officer (PMO ESO)

A. Background

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

B. Scope and Duration of Work

2. The officer will work on behalf of the PMO to implement the project EMP. The officer will report directly to the PMO. The position is for the entire duration of project construction and at least the first year of project operation.

C. Qualifications

3. The officer will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least 2 years of experience in environmental management, monitoring, and/or impact assessment; (iii) ability to communicate and work effectively with local communities, contractors, and government agencies; (iv) ability to analyze data and prepare technical reports; (v) willingness and health to regularly visit the project construction sites and in different seasons; and (vi) ideally, proficiency in spoken and written English.

D. Detailed Tasks

4. The PMO ESO will have a detailed understanding of the project EMP and supporting documents, including the domestic environmental impact table (EIT) report and the project initial environmental examination (IEE), and project environmental assurances. The officer will have the following tasks.

- (i) Assess the extent to which IEE and EMP requires updating due to any changes in project design, including bus station access roads.
- (ii) Distribute the Chinese language version of the EMP to all relevant agencies, including the implementing agencies. This should occur at least 3 months before construction begins.
- (iii) Conduct meetings with agencies as necessary to ensure they understand their specific responsibilities described in the EMP.
- (iv) Ensure that relevant mitigation, monitoring, and reporting measures in the EMP are included in the bidding documents, contracts, and relevant construction plans.

- (v) Ensure that a qualified environmental monitoring company is recruited.
- (vi) At least 2 months before construction begins, establish and implement the project grievance redress mechanism (GRM) described in the EMP. This will include: (a) preparation of a simple table and budget identifying the type, number, and cost of materials needed to inform local communities about the GRM and starting dates and scope of construction; (b) design, prepare, and distribute these materials, and plan and conduct the community meetings; (c) prepare a form to record any public complaints; (d) preparation of a summary table to record all complaints, including dates, issues, and how they were resolved; and (e) ensure that all relevant agencies, including contractors, understand their role in the GRM.
- (vii) Prior to construction, ensure that the implementation agencies and their contractors have informed their personnel, including all construction workers, of the EMP requirements. This will include all mitigation measures relating to impacts to air, water, noise, soil, sensitive sites, ecological values, cultural values, worker and community health and safety, respectful behavior when communicating with local communities, and responding to and reporting any complaints.
- (viii) Support contractors in developing construction site-specific EMPs (CEMPs), if needed, and approve CEMPs.
- (ix) During project construction, make regular site visits with the loan implementation environment consultant (LIEC) to assess progress, meet with contractors and/or local communities, and assess compliance with the EMP.
- (x) Ensure that all relevant agencies submit required progress reports and information, including environmental monitoring and reports of any issues or grievances.
- (xi) Compile, review, and store environmental progress reports from the implementation agencies, records of any grievances, and any other relevant issues. Maintain digital copies of all information. When necessary, enter data into summary tables in digital format (e.g., to transfer records of grievances from hard copy forms). Ensure that all information is stored in the PMO filing system, backed up, and can be easily retrieved.
- (xii) Prepare annual environment progress reports on behalf of the PMO, to be submitted to ADB.
- (xiii) Work closely with the PMO, loan implementation consultants, and other agencies and personnel as necessary to conduct these tasks.

E. Reporting Requirements

5. EMP implementation section under annual environment monitoring reports (EMRs), using a template reviewed and approved by ADB.

2. Loan Implementation Environmental Consultant (LIEC)

A. Background

6. The project will be coordinated by a PMO whose overall responsibility includes implementation of the project EMP. The loan implementation environmental consultant (LIEC) will support the PMO to implement the project EMP, including EMoP, EMR, and GRM.

B. Scope and Duration of Work

7. This position could be a firm or an individual engaged by the PMO. It is an independent position and is not part of the PMO government staff. The specialist will report directly to the PMO and consulting firm (if the individual has been engaged by a firm). The position is part-time over the entire duration of project construction and the first two years of project operation. The LIEC should be recruited as soon as possible after loan effectiveness.

C. Qualifications

8. The specialist will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least eight (8) years of experience in environmental management, monitoring, and/or impact assessment; (iii) familiarity with ADB project management requirements and national environmental management procedures; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; (vi) willingness and health to regularly visit the subproject sites; and (vii) proficiency in spoken and written English.

D. Tasks

9. Working closely with the PMO ESO, the LIEC will do the following.

Before construction:

- (i) Ensure (a) all bid and tendering documents include, and will comply with, the EMP; and (b) relevant sections of the EMP are incorporated in contractor contracts.
- (ii) Support environmental supervision engineer (ESE) under construction supervision company (CSC), and contractors in developing construction site-specific environmental management plan (CEMPs), which needs to be approved by the PMO and implemented by contractors.
- (iii) Assist the PMO to implement the GRM, including: (i) establish and publicize the GRM; and (ii) collate and evaluate grievances received.
- (iv) Develop procedures to: (i) monitor EMP and CEMPs implementation progress; (ii) collate and evaluate data collected in the EMP environmental monitoring program; and (iii) prepare and submit EMP implementation section of annual environmental monitoring reports (until Project Completion Report).

During project implementation:

- (i) Support the PMO Environment and Safety Officer (PMO ESO) in his/her tasks. The overall aim is to raise the PMO ESO's capacity as needed, so he/she can independently achieve the tasks in his/her Terms of Reference.
- (ii) Accompany the PMO ESO on visits to the project construction sites to assess progress and compliance with the EMP.
- (iii) Assist in the ongoing public consultation process as described in the project EIA.
- (iv) Conduct EMP compliance assessments, identify any environment-related implementation issues, and propose necessary responses in corrective action plans.
- (v) Undertake training of project agencies as required by the EMP training plan.
- (vi) Assist the PMO to prepare annual environmental monitoring progress reports.

E. Logistical Support to be Provided by PMO to the LIEC

- (i) Provision of hard and soft copies of the project EMP, CEMPs, domestic and project environmental reports, feasibility study reports, loan and project agreements, maps,

and other supporting materials as necessary to ensure the LIEC can implement the tasks.

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

3. Environmental Supervision Engineer (ESE) under Construction Supervision Company (CSC)

A. Background

10. Construction supervision company (CSC) will provide advisory services in construction supervision, construction component design and construction, all associated materials testing requirements and overall quality assurance. CSC shall have a qualified ESE who will provide environmental supervision to construction design and construction.

B. Scope and Duration of Work

11. This ESE position shall be a part of CSC. It is an independent position from contractors and is not part of the PMO government staff. The ESE will report directly to the PMO and CSC. The ESE position could be a part-time or full-time over the entire duration of project construction and the first year of project operation. The CSC (and ESE) should be recruited as soon as possible after loan effectiveness.

C. Qualifications

12. The ESE will have: (i) an undergraduate degree or higher in environmental engineer or related field; (ii) at least eight (8) years of experience in environmental engineering, management, inspection and monitoring, and/or impact assessment; (iii) familiarity with ADB environmental requirements, including occupational health and safety and national laws and regulations and procedures on environment, health and safety; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) willingness and health to regularly visit the subproject sites.

D. Tasks

13. Working closely with the PMO, the LIEC, and contractors, the ESE will do the following.

- (i) ensure that contractors comply fully with contractual obligations relating to care of the project environmental management plan (EMP), construction site specific the environment management plan (CEMP), all applicable PRC environment, health and safety laws and regulations; and provide all reports and obtain all permits and permissions required in relation to construction of the project components; any corrective or preventative actions plan set forth in environmental monitoring reports;
- (ii) submit annual reports during construction and annual reports thereafter with separate environmental and social Safeguards Monitoring Reports to ADB, and disclose relevant information from such reports to affected people promptly upon submission;
- (iii) if any unanticipated environmental and/or health and safety impacts arise during construction, implementation or operation of the project that were not considered in the IEE, the EMP, the CEMP, promptly inform PMO with a written notice of the

- unanticipated risks or impacts and/or the occurrence of such risks or impacts, with detailed description of the event and proposed corrective action plan;
- (iv) report any actual or potential breach of compliance with the measures and requirements set forth in the EMP, or the CEMP promptly after becoming aware of the breach;
- (v) review and endorse construction site specific Environmental Management Plans (CEMPs) for the project components, prepared by contractors;
- (vi) ensure that all the environmental mitigation measures required to be implemented are incorporated in contracts;
- (vii) ensure that contractors comply with the measures and requirements relevant to contractors set forth in IEE, EMP, CEMP, and any corrective or preventative actions set out in environment monitoring reports (EMRs);
- (viii) conduct regular environmental inspection to construction sites and ensure that the day-to-day construction activities are carried out in an environmentally sound and sustainable manner;
- (ix) carry out regular progress review meetings, record and distribute the minutes to contractors and PMO;
- (x) prepare and submit quarterly environmental inspection reports on the implementation of EMP and CEMPs to PMO during construction period
- (xi) with respect to the prevention of HIV/AIDs and Human Trafficking, monitor the Contractor's compliance and carry out required actions as provided in the Contract, such as awareness and education of laborers and workers;
- (xii) ensure that contractors do not involve child labor for the execution of the contract in accordance with the provisions of the contract;
- (xiii) inspect construction machinery, materials to ensure adherence to the specification, and approve the sources of materials;
- (xiv) if necessary or requested by PMO, provide additional on-site environment, health, and safety trainings; and,
- (xv) provide any other specialist environment, health and safety related services requested by PMO under conditions to be mutually agreed.




E. Reporting Requirements





- (i) Minutes of environmental progress review meetings; and,
- (ii) Quarterly environment inspection reports to PMO.




APPENDIX B: Domestic Environmental Assessment Approval





To be provided when available.





APPENDIX C: E-Charging Stations Technical Data





#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
I	Public Busses								
I-2	West Bus Hub	Shaoshan west Road, Yuhu District	8364.00	65	60 to 320 kW DC	130	Yuetang District	Jiaofa Group / Bus Station	
I-3	East Bus Hub	No. 108, Furong East Road, Yuetang District	5037.60	85	60 to 320 kW DC	170	Yuetang District	Jiaofa Group / Bus Station	
I-4	Hetang Bus Hub	Near the Hetang inter-city train station	3374.40	3	60 to 320 kW DC	6	Yuetang District	Zhongtie Group / Parking Area	




#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
I-5	Hexi General Bus Hub	South of Baihe Yudu, Liancheng Avenue, Yuhu District	16347.36	98	60 to 320 kW DC	196	Yuhu District	Jiaofa Group / Passenger Depot (Under Construction)	
I-6	Chezhan Road Bus Terminal	Yuhu Bus station	1544.88	16	60 to 320 kW DC	32	Yuhu District	Jiaofa Group / Bus Station	
I-8	Xinxi Station Bus Center	Baoshui Road, Heping street, Yuhu District	2875.44	16	60 to 320 kW DC	32	Yuhu District	Jiaofa Group / Bus Station	
I-9	Xiangtan North Bus Hub	Xinglong village, Yuhu District	1711.20	11	60 to 320 kW DC	22	Yuhu District	Zhongtie Group / Parking Area	


#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
I-10	Zhaoshan Inter-City Train Station Bus Hub	Near the Zhaoshan inter-city train station	1711.20	5	60 to 320 kW DC	10	Yuetang District	Zhongtie Group / Parking Area	
I-11	Zhaoyun Avenue Bus Terminal	Zhaoyun Avenue, Yuetang District	1711.20	22	60 to 320 kW DC	44	Yuetang District	Government Land / Bus Station	
I-13	Chuangxin Road Bus Terminal	Chuangxin Road, Yuhu District	1544.88	7	60 to 320 kW DC	14	Yuetang District	Government Land / Bus Station	

#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
II	Operations Vehicles								
II-1	Yuhu Sanitation Parking Area	South west corner of intersection between Nanling Road and Gaobiao Road	602.40	4	60 to 320 kW DC	8	Yuhu District	Government Land / Sanitation Parking Area	
II-2	Garden Maintenance Team No. 1	South west corner of intersection between North second ring and Jiangnan Avenue	602.40	3	60 to 320 kW DC	6	Yuhu District	Government Land / Sanitation Parking Area	
II-3	Garden Maintenance Team No. 2	South west corner of intersection between Dongs Road and Hedong branch Road	602.40	5	60 to 320 kW DC	10	Yuetang District	Government Land / Sanitation Parking Area	
II-4	Hexi Urban Sanitation Parking Area	North west corner of intersection between North second ring and Tanmeng Road	1378.56	12	60 to 320 kW DC	24	Yuhu District	Government Land / Sanitation Parking Area	

#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
IV-1	Xianfeng Park Parking Area	South east corner of intersection between North second ring and Xiangda Road	279.25	10	60 to 320 kW DC	20	Yuhu District	Park / Parking Area	
IV-2	Xiangtan Station	South square of train station	279.25	10	60 to 320 kW DC	20	Yuhu District	Chengfa Group / Parking Area	
IV-7	Baishi Square	South west corner of intersection between Gaobiao Road and Dahu Road	163.63	5	60 to 320 kW DC	10	Yuhu District	Square / Parking Area	
IV-19	Dongfanghong Square	North of Xiangtan Avenue, East of Huxiang west Road	1828.63	60	60 to 320 kW DC	120	Yuetang District	Square / Parking Area	

#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
IV-27	East Bus Station	North east corner of intersection between Xiangtan Avenue and Furong Avenue	279.25	6	60 to 320 kW DC	12	Gaoxin District	Jiaofa Group / Public Parking	
IV-32	Hetang Inter-City Train Station	South west corner of intersection between Tuanzhu Road and Bantang eleventh Road	348.63	19	60 to 320 kW DC	38	Yuetang District	Zhongtie Group / Inter-City Train Station Parking Area	
IV-37	Xiangtan North Station	North of Jinpeng Road	1204.25	11	60 to 320 kW DC	22	Yuhu District	Zhongtie Group / High Speed Train Station Parking Area	
IV-38	Qingzhu Lake Park Parking Area	West of Baoshui Road, inside Qingzhu lake park	510.50	111	60 to 320 kW DC	111	Yuhu District	Park / Parking Area	

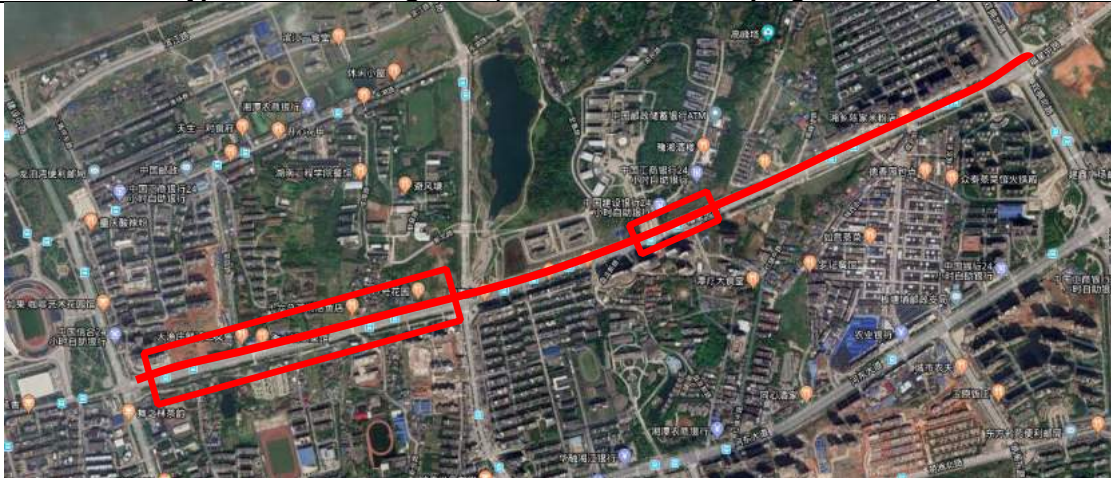
#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
IV-44	Yangtian Lake Parking Area	West of Yanjiang North Road	279.25	8	60 to 320 kW DC	16	Yuhu District	Park / Parking Area	
IV-45	Zhaoshan Inter-City Train Station	Zhaoshan Road inter-city train station	348.63	87	60 to 320 kW DC	174	Yuetang District	Zhongtie Group / Inter-City Train Station Parking Area	
IV-46	Zhaoshan Scenic Zone Parking Area	West of Furong Avenue	464.25	19	60 to 320 kW DC	38	Yuetang District	Scenic Zone / Parking Area	

#	Charging Station Type and Name	Charging Station Location	Land area (m ²)	# of Chargers	Charger Capacity	# of nozzles	District	Land Ownership / Current Land Use	Site Photo
IV-49	Stereo Parking Building	No. 10 Chezhan Road	233.00	13	60 to 320 kW DC	26	Yuhu District	Jiaofa Group / Public Parking Area	
Total	30 Stations		58,500	778		1,445			

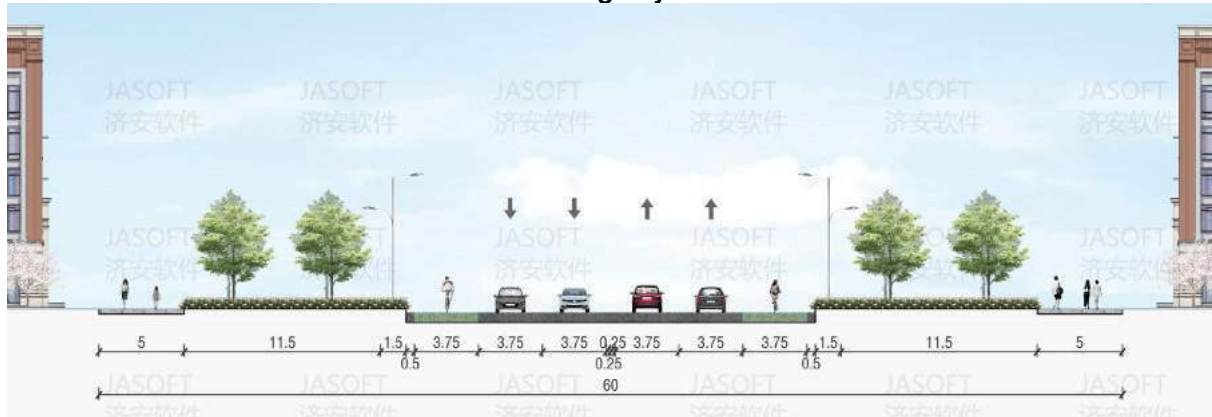
Source: ADB PPTA

APPENDIX D: Section-by-section modifications, Fuxing Middle Road

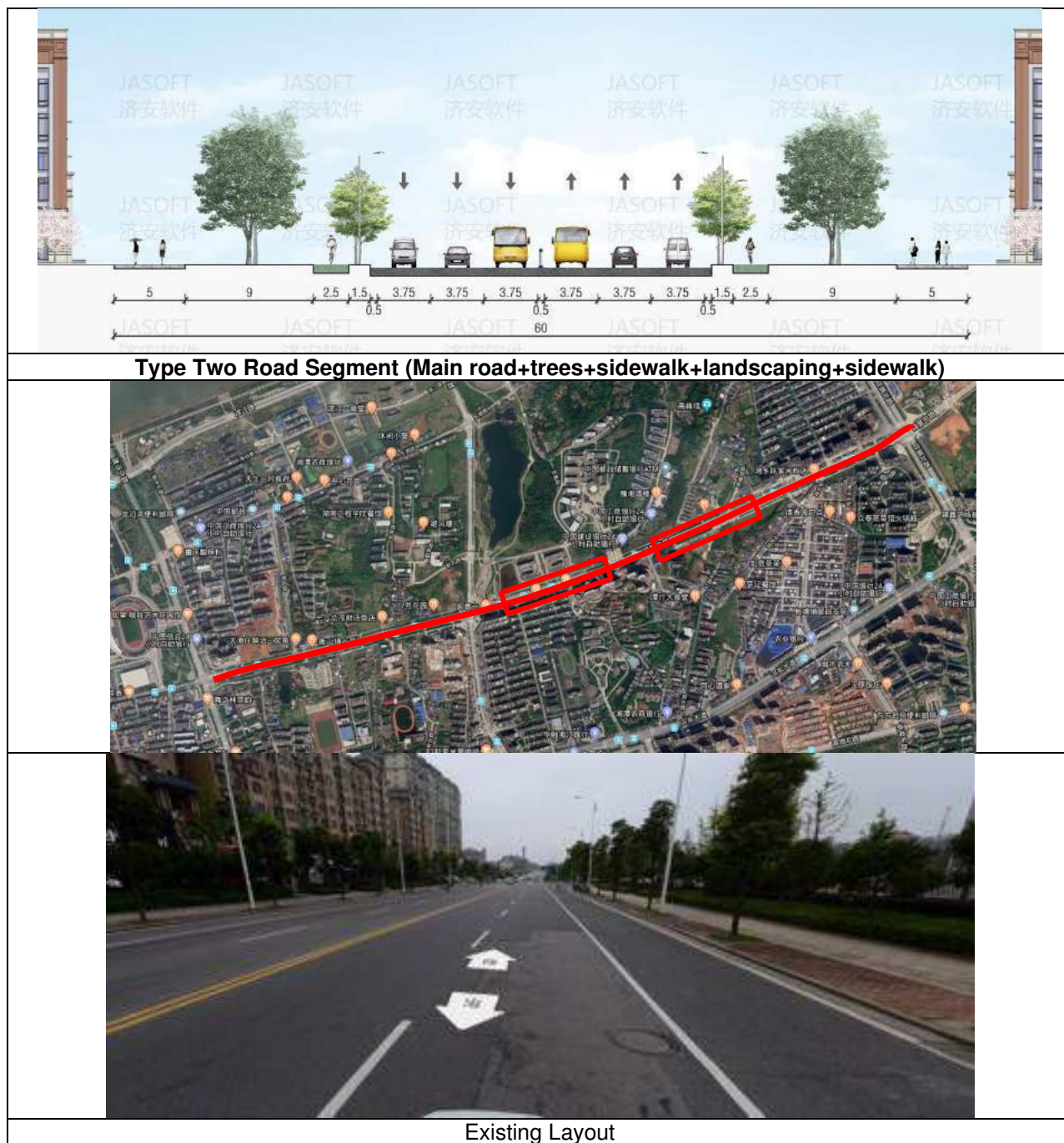
Type One Road Segment (Main road+Landscaping+Sidewalk)

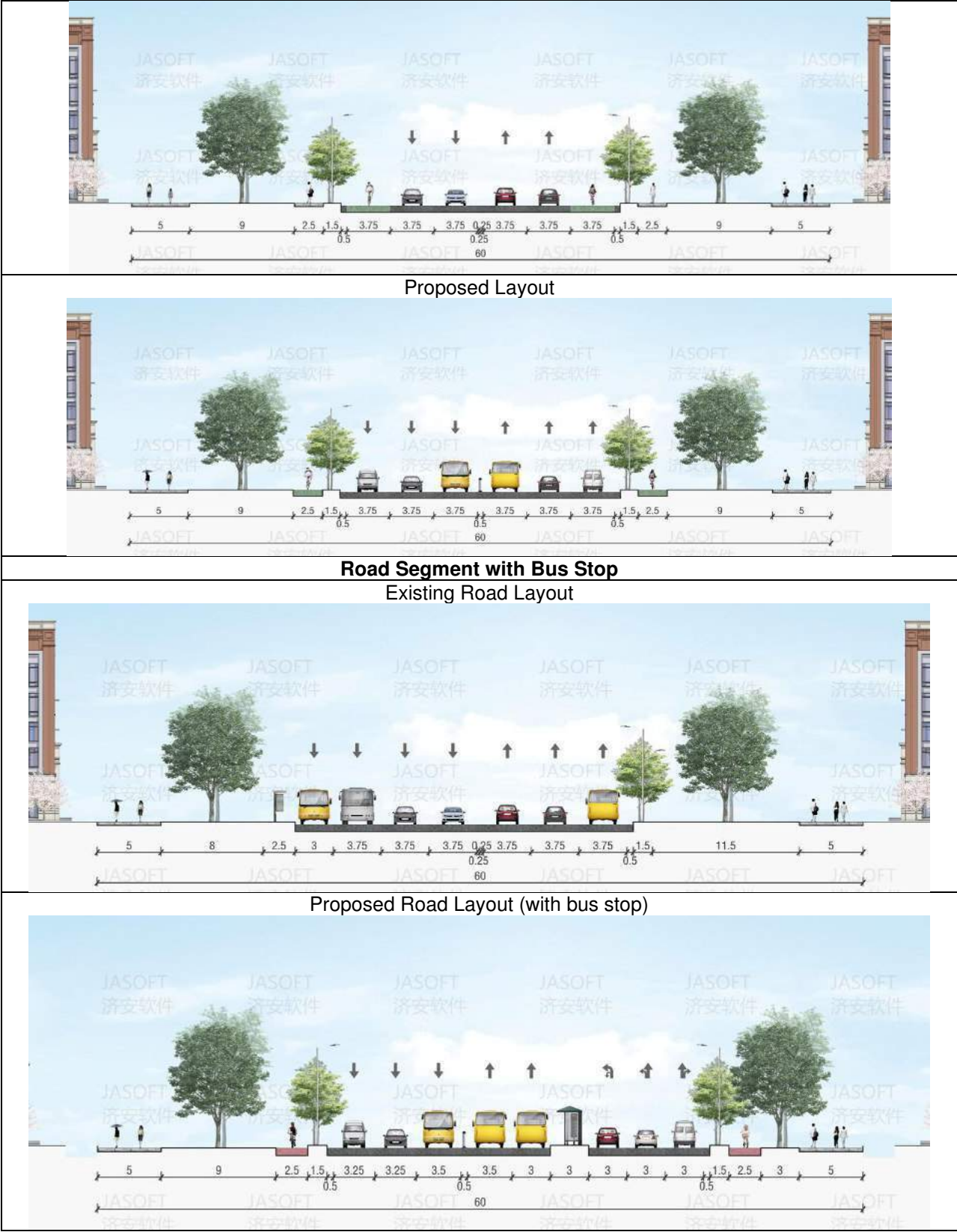


Existing Layout

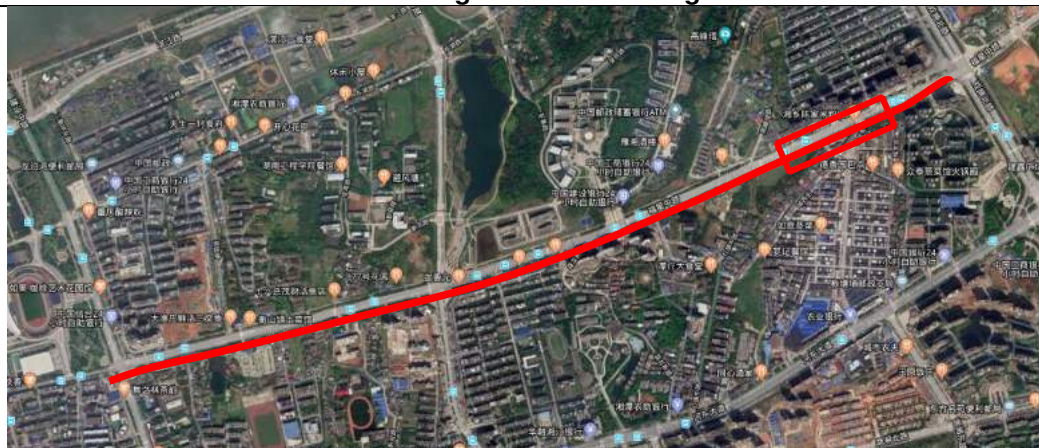


Proposed Layout

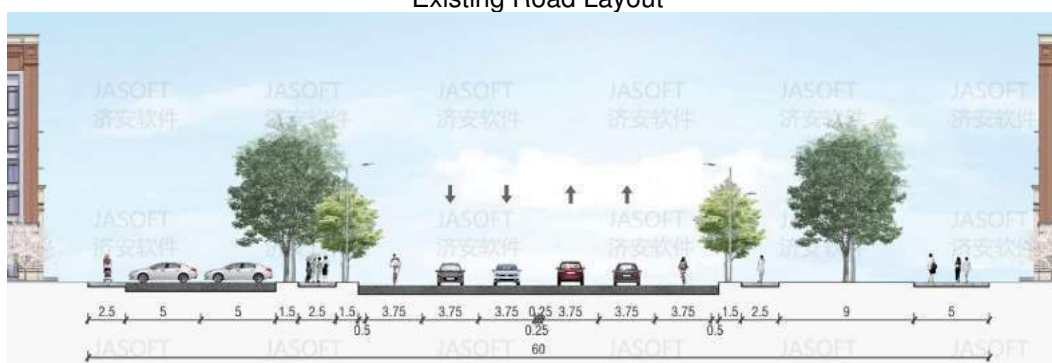




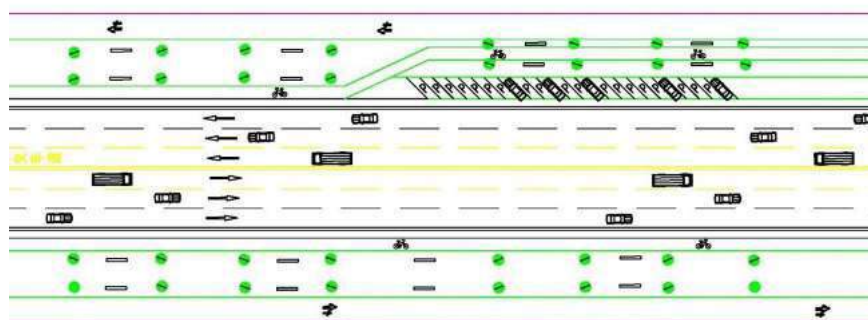
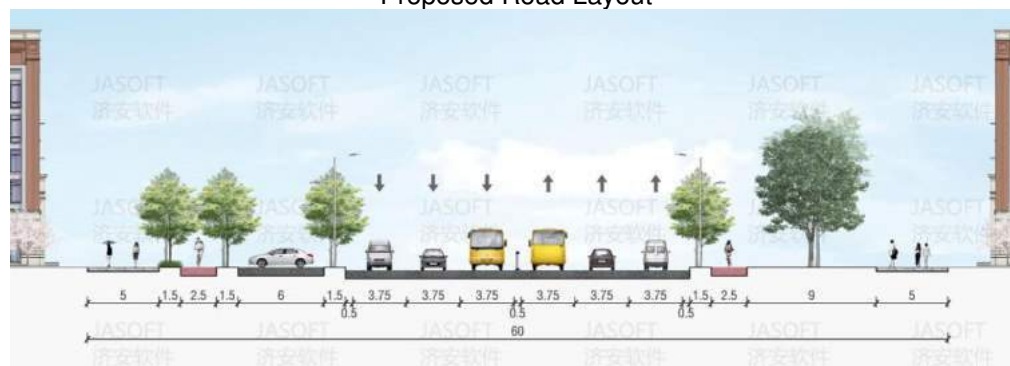
Road Segment with Parking



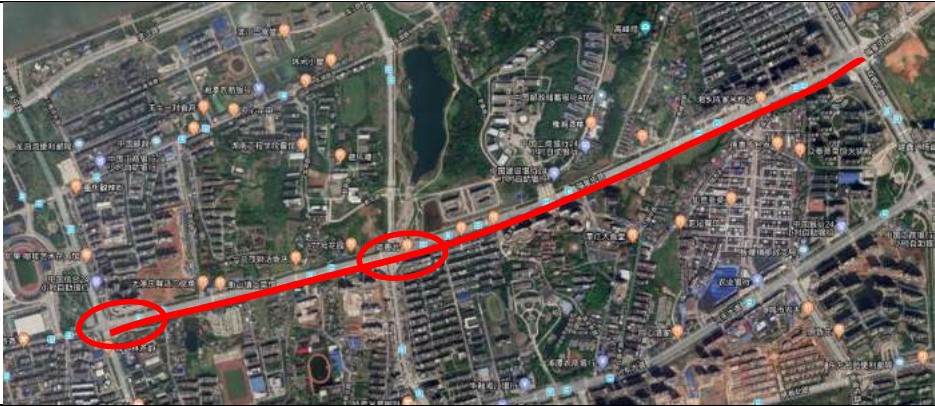
Existing Road Layout



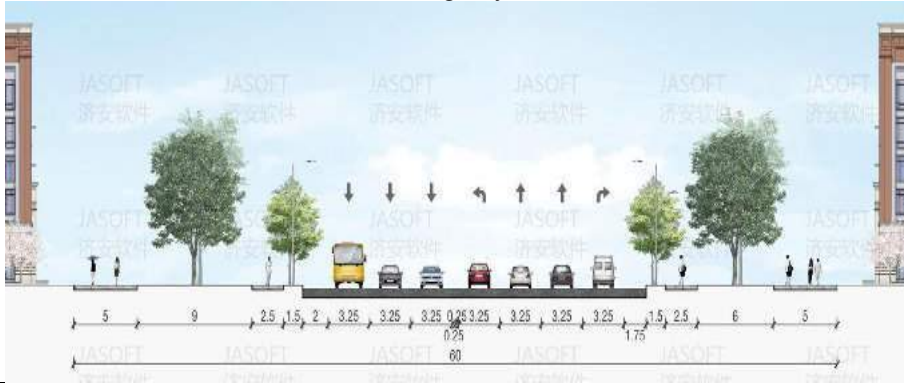
Proposed Road Layout



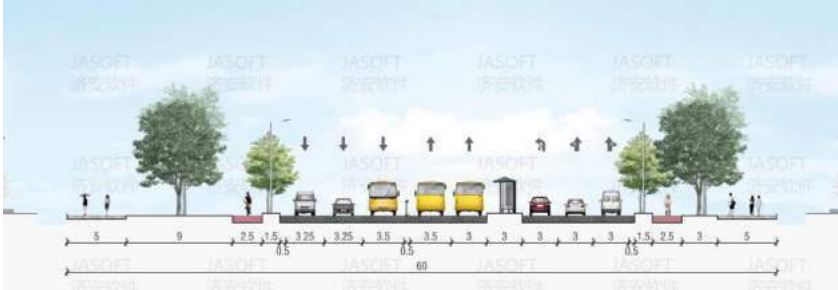
Intersection



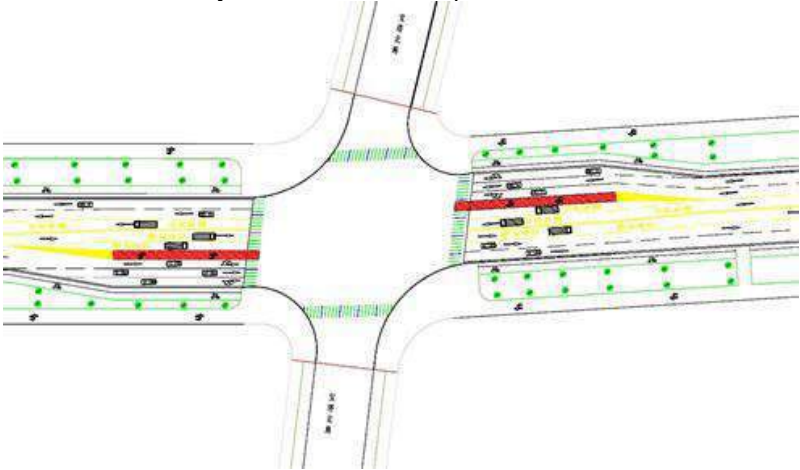
Existing Layout



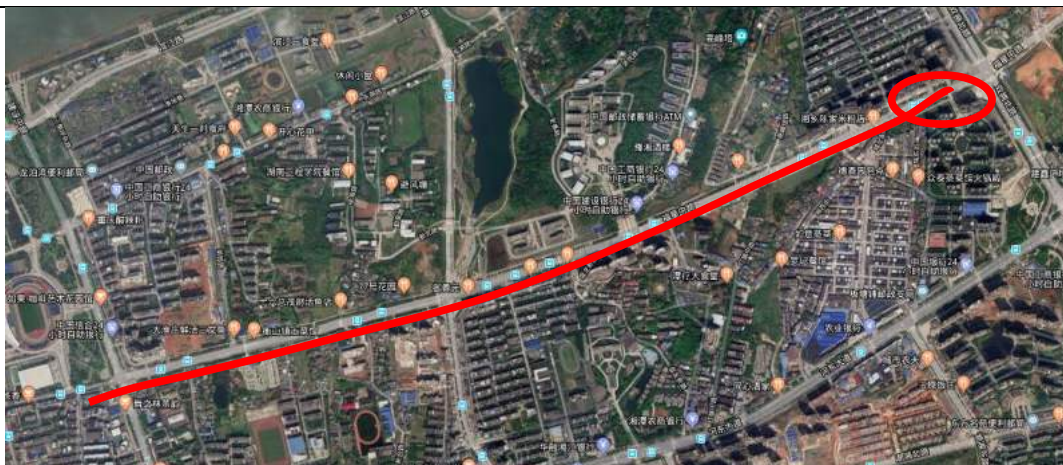
Proposed Layout with a bus stop



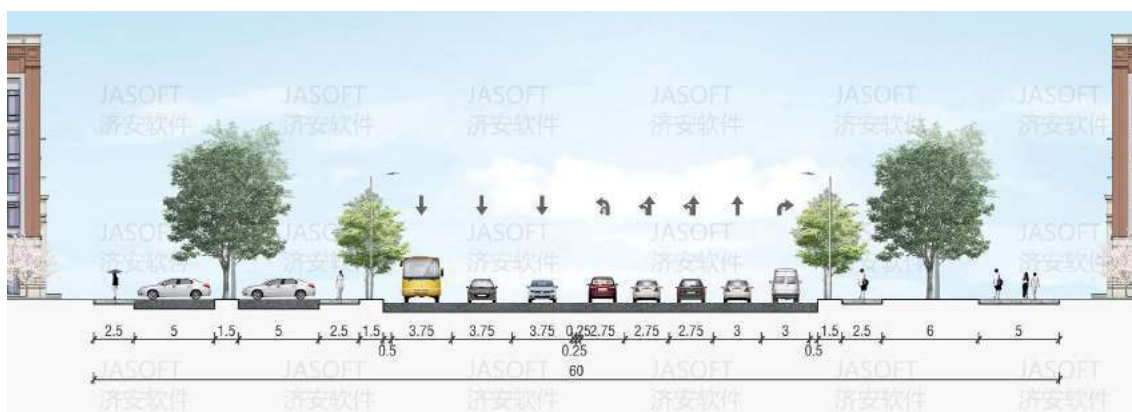
Bird eye view with bus stops at intersection



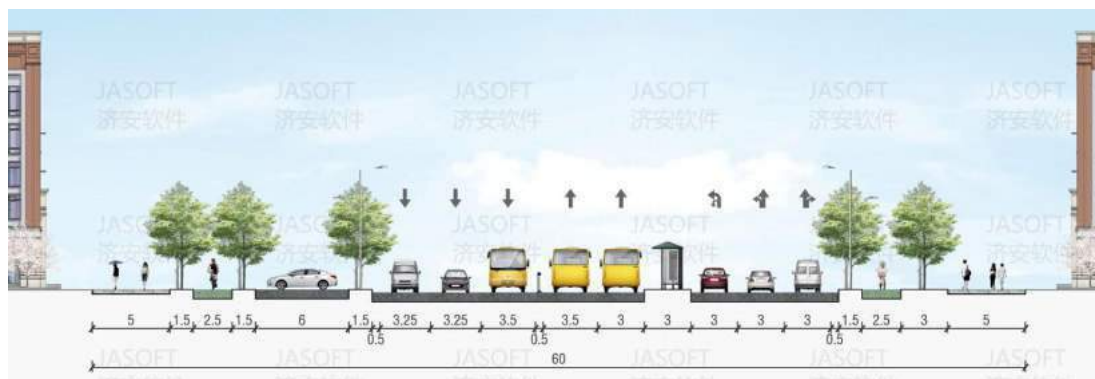
Intersection with Parking



Existing Intersection with Parking



Proposed Intersection with Parking and Bus Stop



Source: ADB PPTA consultant, 2019.

APPENDIX E: Low Carbon Activities at 20 Communities in Yuhu and Yuetang Districts, Xiangtan

Name		Description	Program Activities
Yuhu District			
1	Heiping Community	Heiping community is located north of Guangyun Road and has an area of 0.8 km ² . There are 1,867 households, 5,080 people, and 18 residents groups. Income level is about 2500-3000 CNY per month per person.	<ul style="list-style-type: none"> • Wall and rooftop insulation at community center and residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • LED street lighting; • Upgrading of 946 m of DN500 mm sewage and stormwater pipes; • Installation of 12 charging stations for e-bikes; • Renovation of parking spaces; • EbA measures in community parks.
2	Jintang Community	Jintang community is located west of the Xiangtan Railway Station, with an area of 2.5 km ² . There are 3,614 households, and 10,874 permanent residents. Income level is about 2000 CNY per month per person.	<ul style="list-style-type: none"> • Wall and rooftop insulation at community center and residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • LED street lighting; • Upgrading of 408 m of DN500 mm sewage and stormwater pipes; • Installation of 4 charging stations for e-bikes; • Renovation of parking spaces; • 897 lineal m of road maintenance; • EbA measures in community parks.
3	Luozudian Community	Luozudian Community is located to the west of Jianshe N. Road and to the south of Shaoshan Middle Road. It has an area of 0.25 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • LED street lighting; • Upgrading of 960 m of DN500 mm sewage and stormwater pipes; • Installation of 4 charging stations for e-bikes; • Renovation of parking spaces; • 235 lineal m of road maintenance; • EbA measures in community parks.
4	Chezhanlu (Station Road) Community	Chezhanlu community is located to the west of Jianshe N. Road, and has an area of 0.23 km ² . There are 2,108 households, 7,480 people, 20 resident groups, 1 residential unit, 2 private enterprises, 425 shops on the street, and 50 high residential buildings. Income level is about 3,000 CNY per month per person.	<ul style="list-style-type: none"> • Wall and rooftop insulation at community center and residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 379 m of DN500 mm sewage and stormwater pipes; • Installation of 9 charging stations for e-bikes; • Renovation of parking spaces; • 203 lineal m of road maintenance; • EbA measures in community parks.

	Name	Description	Program Activities
5	Lubandian Community	Lubandian community has 35 resident groups with an area of 0.77 km ² and a permanent population of 2,080 households and 8805 people. It is a densely populated old community. Income level is about 2500 CNY per person per month.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 696 m of DN500 mm sewage and stormwater pipes; • Installation of 6 charging stations for e-bikes; • Renovation of parking spaces; • 206 lineal m of road maintenance; • EbA measures in community parks.
6	Shanshuxiang Community	Shanshuxiang Community is located at No. 515 Guangyun Road, Yuhu District with an area of about 0.9 km ² and a permanent population of 3,668 households and a total of 11,346 people. Income level is about 2500-3000 CNY per month per person.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 470 m of DN500 mm sewage and stormwater pipes; • Installation of 2 charging stations for e-bikes; • 392 lineal m of road maintenance; • EbA measures in community parks.
7	Longzixiang Community	Longzixiang Community is located west of Jianshe Rd N and north of the Xiangjiang River. It has an area of 0.4 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 612 m of DN500 mm sewage and stormwater pipes; • Installation of 1 charging station for e-bikes; • Renovation of parking spaces; • 409 lineal m of road maintenance; • EbA measures in community parks.
8	Tangxingsi Community	Tangxingsi Community is located north of Yanjiang Rd and the Xiangjiang River. It has an area of 2.92 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 396 m of DN500 mm sewage and stormwater pipes; • Installation of 2 charging stations for e-bikes; • Renovation of parking spaces; • 560 lineal m of road maintenance; • EbA measures in community parks.
9	Baofengjie Community	Baofengjie Community is located east of Baoqing Rd and south of Shaoshan Rd. It has an area of 0.81 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Installation of 3 charging stations for e-bikes; • Renovation of parking spaces; • EbA measures in community parks.
10	Wanxin Community	Wanxin Community is located north of Shaoshan Rd and south of Guangyuan Rd. It has an area of 0.8 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving doors and windows in residential buildings; • Upgrading of 1,140 m of DN500 mm sewage and stormwater pipes;

Name	Description	Program Activities
		<ul style="list-style-type: none"> • Installation of 4 charging stations for e-bikes; • Renovation of parking spaces; • 425 lineal m of road maintenance; • EbA measures in community parks.
Yuetang District		
1 Sanjiaoping Community	Sanjiaoping community has 20 residential quarters, 76 residential buildings, 2,340 households, and a total of 7,104 people.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Water saving toilets and faucets in a community service area. • Solar hot water heating in a community service area. • 450 m of natural gas pipeline; • LED street lighting. • Upgrading of 200 mm of DN500 mm sewage and stormwater pipes; • Installation of 2 charging stations for e-bikes; • 1,515 lineal m of road maintenance; • EbA measures in community parks.
2 Wulidui Community	Wulidui community is located east to Hedong Avenue, west to the Yangtze River scenery belt, south to Shuangbei Road, and north to Xiangqian Railway. The community has 10,096 residents and 59 resident groups. It has an area of 1.6,1 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at 14 residential buildings; • LED lights in residential buildings; • Rainwater collection systems in buildings. • Solar hot water heating in a community service area. • 450 m of natural gas pipeline; • LED street lighting. • Upgrading of 1,200 m of DN500 mm sewage and stormwater pipes; • Installation of 5 charging stations for e-cars; • Installation of 6 charging stations for bikes; • Renovation of parking spaces; • 500 lineal m of road maintenance; • EbA measures in community parks.
3 Banbianjie Community	Banbianjie Community is located at the southernmost of Xiashesi Street in Yuetang District, with an area of 2.4 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Energy saving windows and doors in buildings; • Water saving faucets and toilets in buildings; • Solar hot water heating in buildings. • LED street lighting. • Upgrading of 300 m of DN300 mm, 100 m of DN400 mm, and 550 m of DN 500 mm sewage and stormwater pipes; • Installation of 2 charging stations for e-cars; • Installation of 2 charging stations for bikes; • Installation of 2,700 m of underground power cable; • Renovation of parking spaces; • 400 lineal m of road maintenance; • Community service center; • EbA measures in community parks.
4 Xuewei Community	Xuewei community has 7,203 residents and 2,535 households, with an area of 0.21 km ² .	<ul style="list-style-type: none"> • Wall and rooftop insulation in a community service center; • LED lights in residential buildings;

	Name	Description	Program Activities
			<ul style="list-style-type: none"> • Energy saving windows and doors in in a community service center; • Water saving faucets and toilets in a community service center; • Solar hot water heating in a community service center. • LED street lighting. • Upgrading 1900 m of DN400 mm sewage and stormwater pipes; • Installation of 1 charging stations for bikes; • Renovation of parking spaces; • 90 lineal m of road maintenance; • 3,600 m² EbA measures in community parks.
5	Xiaguang Community	Xiaguang Community has an area of 0.8 km ² . The community has 6,198 residents.	<ul style="list-style-type: none"> • Wall and rooftop insulation in residential area; • LED lights in residential area; • Water saving faucets and toilets residential area; • Solar hot water heating in residential area; • LED street lighting. • Installation of 2 charging stations for e-cars; • Installation of 10 charging stations for bikes; • 3,300 lineal m of road maintenance; • Community service centers; • 3,000 m² EbA measures in community parks.
6	Wayatong Community	Wayatong community has the total area of the community is about 2.0 km ² . It is adjacent to Xiaotang Road in the south and Xiaguang West Road in the north. The community has 85 residents groups, 4441 households and 16,000 people.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential buildings; • LED lights in residential buildings; • Rainwater collection systems in residential buildings; • LED street lighting. • Upgrading of 3,760 m of DN 500 mm sewage and stormwater pipes; • Installation of 5 charging stations for e-cars; • Installation of 50 charging stations for bikes; • 9,80 lineal m of road maintenance; • EbA measures in community parks.
7	Xiaotang Community	Xiaotang community is located at Jianshe South Road in the east, Biquan Road in the west, Shuyuan West Road in the south, and Furong West Road in the north. There are 17 residential communities, 98 residential buildings, 3924 households, and a total number of 10,617 people. Income level is about 3,000 CNY per person per month.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential and other buildings; • LED lights in residential and other buildings; • Energy saving windows and doors residential and other buildings; • Water saving faucets and toilets residential and other buildings; • Solar hot water heating residential and other buildings; • Water saving faucets and toilets in residential and other buildings; • Natural gas pipeline to community venter; • Rainwater collection systems in residential and other buildings; • LED street lighting. • Upgrading of 700 m of DN 500 mm sewage and stormwater pipes; • Installation of 13 charging stations for e-cars;

	Name	Description	Program Activities
			<ul style="list-style-type: none"> • Installation of 110 charging stations for bikes; • Installation of 850 m of underground power cable; • Renovation of parking spaces; • 1,700 lineal m of road maintenance; • Community service center; • 1,700 m² EbA measures in community parks.
8	Xintang Community	Xintang Community is located east of South Jianshe Road and south of Xiangtan Ave. It has an area of 0.27 km ² . Most of Xintang Village was built in the 1970s.	<ul style="list-style-type: none"> • Wall and rooftop insulation in residential and other buildings; • LED lights in residential and other buildings; • Energy saving windows and doors in residential and other buildings; • Water saving faucets and toilets in community buildings; • Solar hot water heating in community building; • Natural gas pipeline to community center; • Rainwater collection systems in residential buildings; • LED street lighting. • Upgrading of 1200 m of DN 500 mm and 600 m of DN600 mm sewage and stormwater pipes; • Installation of 75 charging stations for e-cars; • Installation of 13 charging stations for bikes; • Installation of 3,000 m of underground power cable; • Renovation of parking spaces; • 1,550 lineal m of road maintenance; • Community service center; • 300 m² EbA measures in community parks.
9	Daqiao Community	Daqiao community has a total area of 3.2 km ² , located east of Jianzhong Road and South of Binjiang, north of Fuxing Middle Road, west of Baota North Road. The total population is 14,009, with a registered population of 11,632, in 24 communities.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential and other buildings; • LED lights in residential and other buildings; • Energy saving windows and doors residential and other buildings; • Water saving faucets and toilets residential and other buildings; • Solar hot water heating residential and other buildings; • Water saving faucets and toilets in residential and other buildings; • Solar hot water heating in community building; • Natural gas pipeline to residential buildings; • Rainwater collection systems in residential and other buildings; • LED street lighting. • Upgrading of 600 m of DN 500 mm sewage and stormwater pipes; • Installation of 4 charging stations for e-cars; • Installation of 4 charging stations for bikes; • Installation of 450 m of underground power cable; • Renovation of parking spaces; • 100 lineal m of road maintenance; • Community service center; • 400 m² EbA measures in community parks.

	Name	Description	Program Activities
10	Yunhe Community	Yunhe community has an area of 1.1 km ² . There are 10 communities, 2,974 households, 8,435 permanent residents and 68 residential groups. Income level is about 5,000 CNY per month per family.	<ul style="list-style-type: none"> • Wall and rooftop insulation at residential and other buildings; • LED lights in residential and other buildings; • Energy saving windows and doors residential and other buildings; • Water saving faucets and toilets residential and other buildings; • Solar hot water heating residential and other buildings; • Water saving faucets and toilets in residential and other buildings; • Natural gas pipeline; • Upgrading of 1470 m of DN 400 mm, 185 m of DN500 mm, 2200 m of DN600 mm and 360 m of DN800 mm sewage and stormwater pipes; • Installation of 5 charging stations for e-cars; • Installation of 6 charging stations for bikes; • Renovation of parking spaces; • 2,260 lineal m of road maintenance; • Community service center; • 1,000 m² EbA measures in community parks.

Source: Feasibility Studies on low-carbon community improvements, 2019-2020.

APPENDIX F: Policy Loan Impact Matrix

Table F-1: Environmental impact and mitigation measures of policy actions under the policy-based loan

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
Reform area: Low-Carbon, Resilient, and Smart City Development Strategy and Policy Issued					
1	XMG shall have issued the Xiangtan Low-Carbon Development Plan 2020-2030 to set the carbon peaking target by 2028 and provide a framework for low carbon development which includes priorities and requirements by sector, governance and institutional coordination mechanisms, and resource allocation.			Positive. Policy actions will support the support the low carbon transformation (LCT) of Xiangtan, which will reduce greenhouse gas (GHG) emissions, improve climate resiliency, and improve the quality-of-life for Xiangtan residents.	No mitigation measures are required.
2	XMG shall have issued an addendum to Accelerating the Construction of Sponge City to improve climate resilient infrastructure development by including mechanisms for cross-sectoral coordination, training, and clear adoption deadlines for updated design standards that incorporate EbA measures.	20	XMG shall have developed and issued Xiangtan Design Standards, providing technical specifications which incorporate EbA measures for infrastructure development to improve quality and resilience in infrastructure development.	<p>Tranche 1:</p> <p>Positive. Policy actions will support improved flood prediction, response and management capacity, and resilience; and improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will support improved flood and climate change resilience, and will improve the quality-of-life for Xiangtan residents.</p>	<p>Tranche 1:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements. (Note: IEE EMP captures these aspects)</p> <p>EbA design standards will need to conform with all relevant PRC building, construction, and health and safety standards. (Note: IEE EMP captures these aspects)</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
3	XMG shall have issued an addendum to Xiangtan city Flood prevention emergency plan to improve drought and flood warning systems; and strengthen institution and capacity on flood risks response system and other urban resilience.			Positive. Policy actions will support improved flood prediction, response and management capacity; will improve flood resilience; and will improve the quality-of-life for Xiangtan residents.	No mitigation measures are required.
4	XMG shall have endorsed Decision on Accelerating the Construction of Smart Xiangtan to layout strategic plan to implement smart Xiangtan development	21	XMG shall have issued Xiangtan Management Rules on integration of ICT platforms to provide details on management rules on the use of centralized server, improve institutional arrangement, provide user-fee calculation methods, regulate data sharing and strengthen data security.	<p>Tranche 1:</p> <p>Positive. Policy actions will support improve urban planning and management; will reduce air, noise and waste emissions; and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will support improved ICT, which will improve urban planning and management, will reduce air, noise and waste emissions, and will improve the quality-of-life for Xiangtan residents.</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>
5	XMG shall have endorsed Smart Xiangtan Construction Master Plan submitted by Xiangtan Big Data Center to strengthen consolidated efforts to develop various ICT platforms, institutionalize Xiangtan Big Data Center to ensure integration in management, operation, data standards, data sharing, data	22	XMG shall have issued Xiangtan Notice of using smart environmental monitoring and assessment system and governance to enhance institutional arrangement, designate specific roles and tasks on monitoring and data analysis, reporting, evaluation, and information management, provide resource allocation, develop	<p>Tranche 1:</p> <p>Positive. Policy actions will strengthen environmental monitoring, and improve the institutional capacity for environment management of the XMG; and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
	security, and R&D.		coordination and cooperation mechanism with other XMG bureaus.	Positive. Policy actions will strengthen environmental monitoring, and improve the institutional capacity for environment management of the XMG; and will improve the quality-of-life for Xiangtan residents.	
6	XMG shall have issued Xiangtan Framework Low-Carbon Procurement Policy to set the goals, principles, intuitional arrangements and coordination mechanisms to enable the prioritization and integration of low carbon procurement in goods and services in government procurement.	23	XMG shall have issued Xiangtan Low-Carbon Procurement Policy Action Plan to describe specific actions to support implementation of the Procurement Policy, including how to prepare bid criteria, scoring and reporting templates and mechanism, selection of pilot categories, how to design a monitoring and e-procurement system, and capacity buildings activities.	<p>Tranche 1:</p> <p>Positive. Policy actions will provide a policy framework for low carbon procurement; will reduce GHG emissions; and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Will provide an action plan and institutional strengthening to reduce GHG emissions; and will improve the quality-of-life for Xiangtan residents.</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>
7	XMG shall have issued Action Plan for the Reconstruction of the Old Community in Xiangtan City 2020-2022 that adheres to green and low-carbon concept in community improvement activities.			<p>Positive. Policy actions will support the greening and low carbon transition of the Old Community. Will result in reduced GHG emissions, pollution reduction, and improved quality of life of residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. (Note: IEE</p>	<p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal. (Note: IEE</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
				EMP captures these aspects)	EMP captures these aspects)
Reform area: Low-Carbon Mobility Systems Enhanced					
8	XMG shall have issued an addendum to Xiangtan City Public Transport Specific Plan 2014-2030 to indicate the implementation of bus priority system, create public transport promotion fund, provide capacity building activities to enhance integrated land use and transport planning, and carry out feasibility and appropriateness of implementing demand-driven bus routes.	24	XMG shall have issued Xiangtan Notice on Operational Management Rules on city-express and neighborhood buses to expand public bus services by introducing demand-driven bus routes and fare operation.	<p>Tranche 1:</p> <p>Positive. Policy actions will result in reduced GHG emissions as a result of improved public transportation efficiency and reduced utilization of fossil-fueled private cars; and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will result in reduced GHG emissions as a result of improved public transportation efficiency and reduced utilization of fossil-fueled private cars; and will improve the quality-of-life for Xiangtan residents.</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>
9	XMG shall have issued Urban comprehensive transportation system planning in Xiangtan to enhance integrated transportation network, enhance public transport hubs for better integration and easier mode shift, and encourage the development of diversified bus service system.			<p>Positive. Policy actions will result in reduced GHG emissions as a result of improved public transportation efficiency and reduced utilization of fossil-fueled private cars; and will improve the quality-of-life for Xiangtan residents.</p>	No mitigation measures are required.
10	XMG shall have issued an addendum to Xiangtan Cycling and Pedestrian Development Specific Plan to	25	XMG shall have developed and issued Xiangtan Low-Carbon Sustainable Urban Road Design Guidelines, providing design	<p>Tranche 1:</p> <p>Positive. Policy actions will reduce GHG emissions by</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
	enhance safer and more comfortable access for pedestrians, better integration between NMT and public bus facilities, and improve public awareness on active transportation like walking and cycling.		specifications for people-oriented transport infrastructure, including dedicated walk and cycle-ways, dedicated bus lanes, public transport prioritization, hubs, and enhanced road safety features.	<p>promoting non-motorized transportation and reducing fossil fuel consumption; and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will reduce GHG emissions by increasing transport efficiency and reducing fossil fuel consumption. Policy actions will also reduce flood risks, increase climate resilience, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. (Note: IEE EMP captures these aspects)</p>	<p>Tranche 2:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal. (Note: IEE EMP captures these aspects)</p>
11	XMG shall have issued the Introduction of Shared Bicycle with docking stations (Including electric bicycle) Operation Implementation Plan to improve shared bicycle schemes with better management and operation.	26	XMG shall have issued Xiangtan Notice on moto-bikes free zones to designate zones to prevent any access to motor-bikes and e-motobikes, develop penalty mechanism, and improve parking facilities nearby the motorbike free zones so to enhance safety of pedestrians and cyclists.	<p>Tranche 1:</p> <p>Positive. Policy actions will reduce GHG emissions by promoting non-motorized transportation and reducing fossil fuel consumption, and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will reduce GHG emissions by</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
				increasing transport efficiency and reducing fossil fuel consumption. Policy actions will also reduce flood risks, increase climate resilience, and will improve the quality-of-life for Xiangtan residents.	
12	XMG shall have issued an addendum to Notice on Strengthening the Management of Electric moto-bikes to control e-motorbike' speed and regulate the use of e-motorbikes in the area with high volume pedestrians and cyclists and school zones.	27	XMG shall have issued Xiangtan Management Rules and design guides on School Zones for Road Safety Enhancement to ensure strict enforcement of 150 meter school zones and enhance safety features.	<p>Tranche 1:</p> <p>Positive. Policy actions will improve public safety from risks posed by quiet e-bikes, and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will improve school safety from risks posed by quiet e-bikes, and will improve the quality-of-life for Xiangtan residents.</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>No mitigation measures are required.</p>
13	XMG shall have issued Interim Measures for Vehicle Parking Management in Xiangtan City to introduce vehicle parking management and parking fee.			Positive. Policy actions will address the current practice of no or low fee parking in the Xiangtan urban area, thereby reducing the use of private cars. This will result in reduced GHG and air pollutant emissions, and will improve the quality-of-life for Xiangtan residents.	No mitigation measures are required.
14	XMG shall have issued an addendum to Implementation Plan of New Energy Vehicle Promotion and Application in Xiangtan City to enhance e-bus charging infrastructure in bus terminals, provide			Positive. Policy actions will reduce GHG and other air pollutants emissions due to the promotion of vehicles using cleaner fuels, and will improve the quality-of-life for Xiangtan residents.	No mitigation measures are required.

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
	incentives for long-distance vehicles with cleaner fuels, and carry out capacity buildings of local authorities on clean vehicles.				
Reform area: Low-Carbon Energy and Building Systems Enhanced					
15	XMG shall have issued Xiangtan 13th Five-Year Plan Comprehensive Work Program for energy conservation and emission reduction, identifying objectives and priority projects which promote clean and renewable energy technologies, energy performance contracts (EPC) and energy service companies (ESCOs), and green buildings.			<p>Positive. Policy actions will reduce GHG emissions as a result of enhanced energy efficiency and reduced fuel consumption, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities.</p>	<p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal.</p>
16	XMG shall have issued Notice on the Establishment of Energy Expert Committee to support in energy efficiency policies and technology improvement to institutionalize the involvement of energy experts in policy design and evaluation, and enhance technical capacity of local authorities.			Positive. Policy actions will enhance XMG energy efficiency capacity and know-how.	No mitigation measures are required.
17	XMG shall have issued Approval of Developing District Energy in Xiangtan (except for industrial zones) for the use of concession contracts, providing clear	28	XMG shall have issued Xiangtan Special Planning for Urban Centralized energy Supply (heating and cooling) Systems, outlining key technical specifications and requirements for low carbon	<p>Tranche 1:</p> <p>Positive. Policy actions will reduce GHG and other air pollutant emissions as a result of enhanced energy efficiency and</p>	<p>Tranche 1:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
	roles and responsibilities and rules on concessions to encourage private investment in energy development and market-based district energy tariff-setting.		technologies (including waste-heat and renewable sources), connection requirements, and consumption-based tariff setting.	<p>reduced consumption of fossil fuels for heating and cooling, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. If energy sources are not from waste heat and renewable sources (except for biomass), it may have emissions from heating and cooling systems, though they will be significantly reduced compared to current systems in use.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will reduce GHG and other air pollutant emissions as a result of enhanced energy efficiency and reduced consumption of fossil fuels for heating and cooling, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. If energy sources are not from waste heat and renewable sources (except for biomass), it may have emissions from heating and</p>	<p>requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal.</p> <p>Heating and cooling systems will have to comply with all relevant PRC regulations including emission controls and limits.</p> <p>Tranche 2:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal.</p> <p>Heating and cooling systems will have to comply with all relevant PRC regulations including emission controls and limits.</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
				cooling systems, though they will be significantly reduced compared to current systems in use.	
18	XMG shall have issued an addendum to Xiangtan Implementation Rules for Green buildings to promote the use of energy performance contracting (EPC) for public institution buildings' energy efficiency, support local banks to develop green financing products for building energy efficiency, green buildings; and pilot building energy management for public buildings.	29	XMG shall have issued Xiangtan green building development plan to enhance incentives for green building developers through various measures, promote awareness raising on green buildings, promote quantifiable green building certification for green financing, and enhance capacity building on green buildings and building materials, passive design, and EDGE certification tools.	<p>Tranche 1:</p> <p>Positive. Policy actions will reduce GHG emissions due to enhanced building energy efficiency and reduced consumption of fossil fuels for building energy systems, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have may temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. Depending on energy sources, there will be a possibility to have emissions from energy systems, though they will be significantly reduced compared to current systems in use.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will reduce GHG emissions due to enhanced building energy efficiency and reduced consumption of fossil fuels for building energy systems, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects</p>	<p>Tranche 1:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal.</p> <p>All independent energy systems installed in buildings will have to comply with all relevant PRC regulations including emission controls and limits.</p> <p>Tranche 2:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day</p>

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
				may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. There will also be emissions from building energy systems, though they will be significantly reduced compared to current systems in use.	time only, and waste collection, recycling and disposal. All independent energy systems installed in buildings will have to comply with all relevant PRC regulations including emission controls and limits.
19	XMG shall have issued Notice on training of energy and resource consumption statistical information management system of public institutions to improve the energy consumption statistics and enhance quality and efficiency of energy statistics works.	30	XMG shall have issued Xiangtan management measures for scaling up energy performance contracting (EPC) for energy renovation to implement building energy management system for efficiency improvement, and enhance building energy accounting and incentive mechanisms for public buildings to apply EPC and ESCO.	<p>Tranche 1:</p> <p>Positive. Policy actions will improve resource and energy information systems, and will improve the quality-of-life for Xiangtan residents.</p> <p>Tranche 2:</p> <p>Positive. Policy actions will reduce GHG emissions due to enhanced building energy efficiency and reduced consumption of fossil fuels for building energy systems, and will improve the quality-of-life for Xiangtan residents.</p> <p>Negative. Policy induced projects may have temporary and localized negative impact for air emission (dust), noise and waste due to construction activities. There will also be emissions from building energy systems, though they will be significantly reduced compared to current systems in use.</p>	<p>Tranche 1:</p> <p>No mitigation measures are required.</p> <p>Tranche 2:</p> <p>Policy induced projects with physical works may need to undergo environmental assessment as per PRC requirements.</p> <p>Standard good practice construction methods, including dust suppression, noise barriers at sensitive receptors, limiting noisy construction activities to day time only, and waste collection, recycling and disposal.</p> <p>All independent energy systems installed in buildings will have to comply with all relevant PRC regulations including emission controls and limits.</p>
		31	XMG shall have issued Xiangtan Notice on expanding energy	Positive. Policy actions will improve resource and energy	No mitigation measures are required.

#	Tranche 1 (before June 2020)	#	Tranche 2 (by June 2022)	Environmental Impact	Mitigation Measures
			consumption statistics to large-scale public and commercial buildings to require energy intensive buildings to report their energy consumption, encourage building energy efficiency works and better building energy management.	information systems, and will improve the quality-of-life for Xiangtan residents.	
		32	XMG shall have issued Xiangtan Notice of implementing energy audit for governmental office buildings and large scale public and commercial buildings to improve quality of energy consumption data and statistics, while promoting building energy efficiency.	Positive. Policy actions will improve information and know how on building energy efficiency, and will improve the quality-of-life for Xiangtan residents.	No mitigation measures are required.

APPENDIX G: Due Diligence Review of Associated Facilities

The Jiuhuabei 220 kV Substation is located in the Jiuhsua Economic and Technological Development Zone, 2 km west of the proposed 110 kV Liwei Substation (Figure 41 and Figure G-1). The substation was constructed by the Hunan Power Transmission and Transformation Engineering Co., Ltd., Xiangtan. It started operation in October 2019, and is operated by the Xiangtan Jiuhua Economic Construction Investment Co., Ltd.

Figure G-1: Jiuhuabei 220 kV Substation



Source: PMO, 2020

An EIT for the substation was prepared by the Hunan Province Xiangdian Experimental Research Institute Co. Ltd., and was approved by the Hunan Provincial Ecology and Environment Department in January 2019 (Table G-1 and Figure G-2). The EIT indicates that the main environmental risks posed by the substation are:

- a. Electromagnetic radiation from the substation, applicable standard: power-frequency-electromagnetic field intensity <4000 V/m, power-frequency-magnetic induction intensity $<100\mu\text{T}$ at any sensitive receptor's location (Electromagnetic Environment Control Limit, GB 8702-2014)

- b. Noise, applicable standard: Class II of “Noise environment quality standard” (GB 3096-2008): 60dB(A) at daytime / 50dB(A) at nighttime at any sensitive receptor’s location.
- c. Ecology
- d. Domestic wastewater: 55t/a.
- e. Domestic solid waste: 0.18t/a.

The required mitigation measure includes:

- a. Substation should locate away from centralized residential areas;
- b. Apply noise absorption roof material and low-noise air fans in substation;
- c. Establish septic tank to treat domestic water, and reuse the treated wastewater in greening actions;
- d. Contract qualified contractors for solid waste and hazardous waste handling.

Modelling of electromagnetic radiation and noise impact was undertaken as part of the EIT, and the results confirmed that the substation complies with relevant requirements.

The total land area of Jiuhuabei Substation is 0.88 ha. The land previously belonged to Maojia village (0.76 ha) and Qingzhu village (0.12 ha) of Xiangshui Township in Yuhu District. Land acquisition was completed in 2018 and land acquisition and compensation payment were implemented in accordance with resettlement policy of Xiangtan City. All compensations have been paid in full and in a timely manner to the affected people, and the compensation was paid based on the AAOV and its multiplier. There are no pending land acquisition and compensation issues.

Table G-1: Associated facility due diligence

Station Name	Associated Road(s)	Status (Year built or planned)	Construction Agency	Operating Agency	EIA Status	EIA Prepared by	EIA Approved by
Jiuhuabei 220 kv substation	West Jinpeng road(under construction), Shimatou road (existing) and Fazhan road (under construction)	Started operation in October 2019	Hunan Power Transmission and Transformation Engineering Co., Ltd.	Xiangtan Jiuhua Economic Construction Investment Co., Ltd.	Approved	Hunan Province Xiangdian Experimental Research Institute Co., Ltd.	Hunan Provincial Ecology and Environment Department

Source: PPTA consultant, PMO, 2020.

Figure G-2: Approval of the Jiuhuabei 220 kV Substation EIT by the Hunan Provincial Ecology and Environment Department

<div><div>湖南省生态环境厅</div><div>湘环评报表(2019)30号</div><div>湖南省生态环境厅</div><div>关于对湖南湘潭白沙洲110kV输变电工程等6个项目环境影响报告表的批复</div><div>国网湖南省电力有限公司: 你公司报送的关于申请开展《湖南湘潭白沙洲110kV输变电工程等6个项目环境影响报告表》审批的申请及相关资料收悉。经研究,批复如下: 一、项目概况 为满足湘潭市部分地区用电负荷发展需要,完善网络结构,提高供电可靠性,国网湖南省电力有限公司拟在湘潭市建设一批输变电工程。本批项目建设内容包括湖南湘潭湘潭110kV输变电工程、湖南湘潭韶山城北110kV输变电工程、湖南湘潭型500kV变电站220kV送出工程、湖南湘潭九华北220kV输变电工程、湖南湘潭九华北220kV变电站110kV送出工程、湖南湘潭白沙洲110kV输变电工程共6个项目,均为新建工程。项目位于湖南省湘潭市湘乡市、湘潭县、韶山市、雨湖区,部分线路经过长沙</div></div> <div><div>市宁乡市。本批项目总投资为45861.5万元,其中环保投资为500.38万元,环保投资占总投资比例约为1.09%。 二、环评审查结论 根据湖南省湘电试验研究院有限公司对本批项目的环境影响分析结论、专家评审意见及湘潭市生态环境局的初审意见,建设单位在落实报告表及专家提出的各项建议和污染防治措施的前提下,从环境保护角度,我厅同意该批项目按环评报告提出的项目规模、性质、站址、路径建设。 三、环保措施要求 在工程设计、建设、运行管理中,必须全面落实环评报告表提出的各项环保措施,并着重做好如下工作: 1、新建的城区变电站均应按照全户内式要求建设,新建变电站在建设前期应做好征地、青苗补偿工作。在新建变电站的初期要注意土石方挖填平衡,做好周边生态恢复工作。 2、对变电站应优先选用低噪声变压器,新增110kV主变本体噪声应控制在65dB(A)以内,新增220kV主变本体噪声应控制在70dB(A)以内,如新建后的噪声不满足厂界达标要求的,须在主变周边采取隔声降噪处理措施,以保证变电站厂界噪声达标排放。 3、新建变电站内的事故油池需按规范要求建设,变电站危险废物应按相关环保法规处置。变电站内生活污水原则上不外排。</div><div>- 2 -</div></div>
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若有外排需达标排放。

4、输电线路建设经过山区林地时，应尽量采取高低腿，尽量加大档距跨越，尽量减少占地和树木砍伐，防止生态破坏和景观的影响。湖南湘潭白沙洲110kV变电站配套110kV线路工程部分线路段位于长株潭城市群生态绿心地区总体规划范围内，根据《湖南省长株潭城市群生态绿心地区保护条例》，项目开工前应办理绿心准入手续。

5、输电线路经过民居敏感区时，应尽量优化，避免跨越常住人的房屋，若无法避让必须跨越房屋时，须告知被跨越房屋户主，并适当抬高对地高度，尽量减小对居民的影响，跨线的民房其居住环境必须满足国家电磁环境限值要求。

6、加强公众沟通和电磁环境的科普宣传，及时调处公众提出的合理环境诉求，及时公开建设项目与环境保护信息，主动接受社会监督。

7、在项目施工期间应按当地政府与环保部门的要求，加强项目的环境管理，做到文明施工。施工期引起的噪声和粉尘对当地的大气环境有一定的影响，应严格按照当地环保部门的相应规定进行施工，切实做到把环境影响降到最低。

四、若工程建设内容发生重大变更时必须重新向我厅申请办理环境保护审批手续，若自批复之日起超过5年方动工建设，必须重新申请办理环境保护审批手续。

五、工程投入运行后，应在规定时间内按相关规定及时办理

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项目的环保竣工自验收手续。

六、你公司在收到批复后15个工作日内将批复及环评文件送至湘潭市生态环境局，本批项目由湘潭市生态环境局负责日常环境监管工作。



抄送：湘潭市生态环境局。

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