Environmental Impact Assessment

August 2013

People's Republic of China: Yunnan Chuxiong Urban Environment Improvement Project

Prepared by the Government of Yunnan Chuxiong Yi Autonomous Prefecture for the Asian Development Bank.

CURRENCY EQUIVALENTS

(Inter-bank average exchange rate as of May 2013)

Currency Unit	-	Yuan (CNY)
CNY 1.00	=	US$ 0.1639
US$ 1.00	=	CNY 6.1

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	affected person
CHCB	–	Chuxiong Housing and Construction Bureau
CNY	–	Chinese Yuan
CCMG	–	Chuxiong City Municipal Government
CSPMO	–	Chuxiong State Project Management Office
CSG	–	Chuxiong Yi Minority Autonomous State Government
CSC	–	construction supervision company
CWRB	–	Chuxiong Water Resource Bureau
DFR	–	draft final report
EA	–	executing agency
EIA	–	environment impact assessment
EMP	–	environmental management plan
EMS	–	environmental monitoring station
EMU		environment management unit
EPB	–	Environment Protection Bureau
FB	–	Financial Bureau
FSR	–	feasibility study report
FYP	-	Five-Year Plan
GDP	–	gross domestic product
GHG	–	greenhouse gas
GRM	--	Grievance Redress Mechanism
IA	–	implementing agency
LAR	–	land acquisition and resettlement
LIEC	--	Loan implementation environmental consultant
MOF	–	Ministry of Finance
NDRC	–	National Development and Reform Commission
O&M	–	operation and maintenance
PFO		project facility operator
PIU	–	project implementation unit
PMO	–	project management office
PPCU		project public complaint unit
PPMS	–	project performance management system
PPTA	–	Project Preparatory Technical Assistance
PRC	–	People’s Republic of China
PSA	–	poverty and social assessment
RP	–	resettlement plan
SPS	–	Safeguard Policy Statement
WWTP	–	wastewater treatment plant

YPDRC	–	Yunnan Provincial Development and Reform Commission
YPFB	–	Yunnan Provincial Financial Bureau
YPEPD	–	Yunnan Provincial Environmental Protection Department
YPG	–	Yunnan Provincial Government

WEIGHTS AND MEASURES

kg	–	kilogram
km	–	kilometer
m^2	–	square meter
m^3	–	cubic meter
mu	–	Chinese land measuring unit (1 hector = 15 mu)
ha	–	hectare (10,000 m^2)
MW	–	megawatt (1 million watts)
t	–	ton (1,000 kg)

NOTES

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

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I. EXECUTIVE SUMMARY

A. Background

1. This Project Environmental Impact Assessment (project EIA) report was prepared for the proposed Chuxiong Urban Environment Improvement Project (the project) in Chuxiong Yi Autonomous Prefecture (the Prefecture) of Yunnan Province, the People's Republic of China (PRC). The project EIA is prepared in accordance with the requirements of Asian Development Bank's (ADB's) Safeguard Policy Statement (SPS 2009) on the basis of four domestic environmental impact assessments (EIAs) prepared by Yunnan Provincial Environmental Science Research Institute[1] (the EIA Institute), the environmental chapter of the Chuxiong Prefecture Master Plan, four Feasibility Study Reports (FSRs) of the project components, four water and soil conservation plans, three workshop reports on plan EIAs for development control plans of the project cities, the social and economic assessments under the Project Preparatory Technical Assistance (PPTA), and project policy dialogue discussions between the ADB missions, PPTA consultants, Yunnan Provincial Government (YPG), Chuxiong Prefecture's Government (CPG) and project city/counties governments.

2. Yunnan has the highest ratio of ethnic minorities among all provinces in the PRC. The total population of the minorities is about 15.3 million, accounting for 33% of the provincial total. Yi Minority is the largest group in the Province, with a population of about 5.1 million. Yunnan has diverse ethnic cultures and is also a global biodiversity hotspot. The province is strategically located for the PRC's cooperation with the Greater Mekong Sub-region. However, the province is relatively under-developed, and still faces urgent sustainable development challenges including poor infrastructures, high incidence of poverty, environmental degradation and over-exploitation of natural resources.

3. The urban center of Chuxiong Prefecture (Chuxiong City) is located in central Yunnan Province, about 160 km west of Kunming City, the Capital of Yunnan Province. Due to rapid and unbalanced urbanization, key cities and towns in the Prefecture (including Chuxiong, Lufeng and Wuding) face serious urban development challenges including lack of infrastructure, poor road networks and poor sanitary facilities. Transport-related problems include poor road conditions, incomplete road networks, sub-standard road structures and road base treatments, no or poor quality sewers and stormwater drainage, and a lack of safe integration of public transport, pedestrians, bicycle lanes, and motorized traffic.

4. Four rivers[2] run through the urban areas of the three project cities and all have a flood history, with property damages and loss of lives. Existing early flood warning systems are not adequate to reduce the flood damages in the events of severe storms. The annual average precipitation in Chuxiong is over 900 mm, and rainfall is concentrated from July to September. Severe storms and heavy rainfall are common during this period and flooding in the urban areas occurs from time to time. Flooding is aggravated as a result of urban development with increased impermeable areas and inadequate stormwater drainage system and river embankments. The water quality of the project rivers is currently Class IV or worse. This situation will continue to block new initiatives to promote sustainable urban development unless the pollution prevention and abatement measures are implemented.

5. The proposed project aims to promote balanced and environmentally sustainable urbanization and social-economic development in the three project cities. The project will support sustainable urban transportation, urban sanitation service facilities, and integrated urban flood control and river enhancement works.

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[1] With the national Grade A EIA certificate.

[2] Longchuan River in Chuxiong City; Wulong River in Wuding City, East River and West River in Lufeng City.

6. The project complies with the two main development agendas of environmentally sustainable growth and inclusive economic growth promoted in ADB's long-term strategic framework 2020. It is also in line with and supports the PRC country partnership strategy (2011-2015), which will support the PRC's over-arching strategic goal of building a "comparatively well-off" society by helping foster inclusive growth and promote environmental sustainability.

7. The project is in line with the Yunnan Provincial Twelfth Five-Year Plan (FYP) and the Prefecture's 2020 Master Plan. The provincial Twelfth FYP calls for economic development, environmental protection, and building environmentally and ecologically friendly urban areas and town settlements. The proposed project components are fully aligned to the 2020 master plans of the three project cities.

B. Project Components

8. The proposed Project consists of four components. Each component includes several subcomponents, which are summarized below.

9. **Component I - Chuxiong urban infrastructure and environment improvement**. Outputs comprise: (a) 9.4 kilometers (km) of Longchuan River flood protection and enhancement with improved 6.2-km river embankments, 202,505 m^2 landscaping, and installation of flood early warning system including a coordination center, 2 water/rainfall monitoring stations, 19 real-time monitoring cameras, and 4 flood warning broadcasting stations; (b) 9.0-km urban roads with non-motorized traffic lanes, pedestrian and bicycle facilities; (c) 19.0-km of water supply pipeline, 18.8-km of sewerage pipeline with 29 sewage interceptor facilities, 19.2-km of storm water pipeline, 9.0-km power supply, telecommunication cable ducts and 2 street light maintenance vehicles; (d) installation of an integrated traffic control and traffic management system comprising traffic signal with traffic control system and monitoring camera; and (e) 8 garbage compressing vehicles, 10 garbage collection vehicles, 2,500 trash bins, 2,900 garbage containers, 1 construction waste recycling machine, 6 street sweeping vehicles, 2 high pressure street cleaning vehicles, 2 water spraying vehicle, 4 sewage collection vehicles and 10 portable toilets.

10. **Component II - Lufeng urban infrastructure and environment improvement**. Outputs comprise: (a) 2.0-km East and 2.1-km West river enhancement and flood protection with 12.2-km of river embankment protection, 290,336 m^2 of landscaping and installation of flood early warning system including a coordination center, 3 water/rainfall monitoring stations, 10 real-time monitoring cameras, and 3 flood warning stations; (b) a stormwater retention pond system with volume capacity of 68,135 m^3; (c) 7.5-km urban roads with non-motorized traffic lanes, pedestrian and bicycle facilities; (d) 15.9-km of water supply pipeline, 15.5-km of sewerage pipeline with 4 sewage interceptor facilities, 18.6 km of storm water pipeline, 7.5-km of power and telecommunication cable ducts; and (e) 4 garbage compactor trucks, 10 garbage collection vehicles, 1 construction waste recycling machine, 12 street sweeping/dust collection vehicles, 1 high pressure street cleaning vehicles, 2 water spraying vehicle, and 2 sewage collection vehicles.

11. **Component III - Wuding urban infrastructure and environment improvement**. Outputs comprise: (a) 2.6-km of Wulong river flood protection and enhancement through 5.2 km of river embankment protection, 54,572 m^2 of landscaping and installation of the flood early warning system including a coordination center, 7 water/rainfall monitoring stations, 10 real-time monitoring cameras, and 3 flood warning broadcasting stations; (b) a stormwater retention pond with volume capacity of 16,884 m^3; (c) 9.4-km urban roads with non-motorized traffic lanes, pedestrian and bicycle facilities and 1 street light maintenance vehicle; (d) 17.9-km of water supply pipeline, 13.4-km of sewerage pipeline with 10 sewage interceptor facilities, 20.3-km of storm water pipeline, 9.4-km of power and telecommunication cables ducts; and (e) 3 garbage compactor trucks, 4 mini garbage collection & transport vehicles, 1 street sweeping/dust collection vehicle, 1 movable toilet, 198 garbage containers.

12. **Component IV - Capacity development and institutional strengthening.** The outputs will be (a) capacity building and institutional strengthening for the project management; (b) experts support and advice on storm water management, municipal solid waste management planning, urban transport management and road safety, (c) public awareness activities on road safety, solid waste recycling and participatory urban design and planning activities; and (d) training on public financial management especially on improve credit-rating and credit worthiness.

C. Environment Safeguards Categorization

13. The project was classified as environmental Category A for environment safeguards in accordance with the criteria set in ADB's Safeguard Policy Statement (2009), requiring the preparation of a project environmental impact assessment report. The environment safeguards categorization of A was mainly triggered by the river rehabilitation and flood control components, which will involve river embankment works. Other major environmental sensitivities identified during the screening process include significant earthwork and related construction spoil disposal; river bridge construction, and community and occupational health and safety risks during construction.

14. Domestically, all components were classified as Category A in accordance with the Guideline on EIA Classification for Construction Projects issued by the PRC's Ministry of Environmental Protection (MEP) in 2008, requiring an environment impact assessment (EIA) for each project component. Four domestic EIAs have been prepared for all the project components by the EIA Institute in accordance with the PRC Law on Environmental Impact Assessment (2003), the Technical Guidelines for Environmental Impact Assessment (HJ/T2-93) and other domestic environmental policies, regulations and standards. The four domestic EIAs have been reviewed and approved by Yunnan Provincial Environmental Protection Department (PEPD) in June 2013.

15. This project EIA, responsive to ADB's Safeguard Policy Statement (2009), has been developed based on the domestic EIAs, FSRs, PPTA's social and economic assessments, and project policy dialogue discussions. The report contains the following chapters: (i) executive summary; (ii) national policy, legal and administrative framework; (iii) description of the project; (iv) description of the environment; (v) anticipated potential environmental impacts and mitigation measures; (vi) analysis of alternatives, (vii) information disclosure, consultation and participation; (viii) grievance redress mechanism; (ix) environmental management plan; and (x) conclusion. A full environmental management plan (EMP) is presented in **Appendix I** of this project EIA. The EMP includes the anticipated impacts and mitigation measures, environmental monitoring program, public consultation program, responsibilities for implementation and supervision, institutional strengthening and training plan, reporting and supervision arrangements, and mechanism for feedback and adjustment.

D. Major Project Benefits

16. **Direct project beneficiaries.** The project will bring significant benefits directly to about 410,000[3] urban residents in Chuxiong, Wuding and Lufeng, by improving urban infrastructures, enhancing urban rivers and flood control, and improving urban sanitation facilities. Of the total direct beneficiary population, approximately 51.2% are women, 9.5% are poor living under the urban poverty line of less than CNY246 per capita per month[4], and 33.1% are ethnic minorities in the project areas.

[3] Source: PPTA social consultant's report.
[4] In 2012 price.

17. **Climate change mitigation and adaptation.** Chuxiong Prefecture is vulnerable to climate change, as evidenced by the continuous severe drought from 2010 to 2013. Project initiatives in both climate change mitigation and adaptation will introduce approaches and activities to enhance the cities' resilience to climatic changes, and to reduce carbon emissions (mainly through promotion of low carbon public transportation systems and energy saving through improved road network conditions, etc.). Adaptation strategies for possible future climatic changes (including greater risk of floods and droughts) have been considered, including (but not limited to) the development of early flood warning flood emergency response planning systems.

18. The project will have some greenhouse gas emission control functions, mainly through the following major interventions: (i) promoting enhanced energy efficiency through higher quality of road surfaces, grades and curve radii, improved road network connectivity, reduced road congestion and travel time; (ii) promoting public transportation and bicycle travel (low carbon transportation modes) following the PRC programs on vehicle emissions, clean fuel regulations, and public transport priority policy to maximize the benefits[5]; and (iv) the application of LED lights, which is expected to save 2.33 million KWh per year of electricity, resulting in a CO_2 emission reduction of 2,260 t/a[6] as compared to conventional street lighting.

19. During the feasibility study and the PPTA phase, the potential impacts due to increase of extreme weather events such as rainstorms or drought were considered, including the design specifications for high-capacity stormwater-sewer separated drainage pipeline (with a flood protection standard of once in 20 years), ecological river restoration with high vegetation cover along the river banks and avoidance of water impoundment structures (such as weirs), to minimize evaporation. In addition, proposed roads in project cities were partly re-aligned to avoid areas with high erosion potential and surface water bodies.

20. **Enhanced flood control.** The three flood control sub-components will significantly increase the cities' resilience to floods. Consequently, damages of flood to houses, facilities and goods, as well as farmlands and crops, will be prevented and/or mitigated. As a result of the project, the area exposed to once-in-fifty year flood risk will be reduced by 4.1 km^2 in Chuxiong, and the area exposed to once-in-twenty year flood risk will be reduced by 4.9 km^2 in Lufeng, and by 2.3 km^2 in Wuding.

21. **Improved urban transport and municipal services.** The infrastructure development components will reduce traffic congestions, and help the project cities establish efficient, safe, and sustainable urban transport systems including public transportation facilities, bicycle lanes, pedestrian crossings, and traffic management facilities and landscaping. The road and bridge constructions will also provide opportunities to complete and expand municipal services through the provision of pipelines and conduits for water supply, sewer collection, and stormwater drainage, which will benefit the local economies and residents' health and safety.

22. The infrastructure development components will expand the stormwater collection coverage in the project areas by 30 km^2. The estimated amount of wastewater to be collected in the project's municipal sewers amounts to 9,000m^3/d. This wastewater will be delivered to the existing municipal wastewater treatment plants (WWTPs), where it will be treated to Class-1B Standard prior to discharge. The sewer system will reduce contamination of ground water, surface water and river ecosystems, and will result in cleaner and healthier living environment for the urban residents.

23. **Improved urban sanitation and public health.** The project will improve the existing urban sanitation condition by enhancement of the city MSW collection and management program to

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[5] As a result of the project, non-motorized traffic lane area will increase by 57,980,100 m^2 in Chuxiong, 61,321,600 m^2 in Lufeng, 17,249,400 m^2 in Wuding.

[6] A KWh electricity saving reduces 0.997 kg of CO_2.

improve the conditions of random dumping and littering in the urban areas. The project includes, in the three project city/counties, placement of 6,222 garbage bins, construction of 11 public lavatories and 668 m^2 rubbish transfer stations, as well as purchase of 41 rubbish transfer trucks, 10 street sweeping vehicles and 4 street water-spraying vehicles.

24. **Increased institutional capacities.** The project will provide the three project cities with an opportunity to establish, build up, and strengthen their institutional capacity for project implementation, environmental protection and river management. The proposed institutional development and capacity-building program under the project will help the project cities achieve this target. The project could also be a model for similar developments in other cities/towns in Yunnan Province and other western provinces in the PRC.

E. Major Environmental Impacts and Risks

25. The potential impacts were scoped during the EIA process in order to (i) identify the relative significance of potential impacts from the activities of the proposed components and subcomponents; and (ii) establish the scope of the assessment which assists in focusing on major, critical, and specific impact. The results of the scoping are shown in **Table I-1** below.

Table I-1: Impact Scoping

Subproject	Assessment Item	Project Phase	Potential for Impact
Road subprojects	Air	Construction and Operation	Construction period: Dust generating by construction activities, and asphalt smoke causing by road pavement; Operation period: Air pollution causing by traffic (vehicle emission).
	Sound environment	Construction and operation	Construction period: Noise impacts by construction activities at noise sensitive locations; Operation period: traffic noise.
	Surface water	Construction and operation	Construction period: Waterways and banks affected by bridge construction; Operation period: Runoff from roads and discharge from drains and sewers..
	Soil stability	Construction	Soil erosion causing by construction activities, in particular at slopes, stockpile areas, borrow pits and spoil disposal sites.
Flood management	Air	Construction	Dust generating from embankment earthworks
	Ecology	Construction	In-stream aquatic ecology and riparian ecology. Downstream sensitive aquatic or riparian areas.
	Surface water	Construction and operation	Construction: Impacts on flow behavior and flooding on downstream beneficial uses; Operation: downstream beneficial uses, minimum ecological flow
	Soil stability	Construction	Soil erosion causing at construction sites, stockpile areas, spoil disposal sites.
	Protected areas	Construction	Physical cultural resources (Fengyu Bridge in Lufeng county).

Source: PPTA consultants

26. **Major safeguards issues during construction** include river embankment works significant permanent and temporary acquisition of land and residents resettlement, earthwork and soil erosion, noise impact, air pollution, surface water pollution, inadequate construction waste management, and occupational and community health and safety. During river embankment construction, contaminants trapped in the river sediments or banks may be released into the water body or soil. The released pollutants may cause a decline in water quality and affect aquatic fauna.

In order to reduce this impact, the site-specific selection of construction methods will be formulated to mitigate the negative effects. Other risks include low institutional capacity for environmental management that the CSPMO, the PIUs, the IAs and CSCs will fail to monitor the environmental impact and implement the EMP during construction; and inadequate construction site management, resulting in occupational and community health and safety concerns. All the impacts and responding mitigation measures are addressed comprehensively in the EMP.

27. The rehabilitation of the West River in Lufeng County will involve a cultural relic protection site (Fengyu Bridge with a history of 600 years). Although the construction will not encroach on the site or its curtilage, special attention shall be paid and strict procedures shall be followed so that no off-site impacts arise from construction which might disturb the relic and any unexpected finds can be identified and protected if they are discovered during construction.

28. The **main potential adverse impacts during operation** of the project facilities include traffic noise and air pollution at some sensitive areas along the constructed roads including schools, hospitals, and residential areas. Air quality predictions indicate that they will have minimal impact on these media, even in the long term. However, noise modeling indicates that noise levels at sensitive receivers will exceed the relevant standard in the short term, requiring noise mitigation measures. These have been defined in the EMP, and included in the project's procurement plan. 166 households will require installation of double-glazed windows. The inadequate management of stormwater, wastewater and solid waste could lead to surface water pollution. The improved rivers may require maintenance dredging from time to time. However, such activities will be short term, infrequent (about once every three years), and will not cause significant impacts.[7] Other negative environmental impacts and risks during operation include traffic safety caused by over speed, and potential accidental spills caused by hazardous goods transportation on the bridges and/or nearby the rivers.

29. The domestic EIAs and this project EIA conclude that all identified impacts can be mitigated to acceptable levels if the mitigation measures defined in the EMP are carefully implemented. Some of the major potential impacts could be significantly reduced through improved project design.

- The components' scope, the project sites, construction methods, road alignments and pipeline routes were adjusted to minimize land acquisition, resettlement and earthwork, and avoid impacts on local water bodies and (highly modified) habitats. Main adjustments to reduce the unbalanced earthwork include the re-alignment of roads away from potentially unstable areas with high erosion potential and environmentally sensitive area, such as a natural pond[8] with an area of 15 ha in Chuxiong City.
- Through policy dialog, the scope of the river rehabilitation works could be significantly reduced. The engineering works on natural river banks as well as river course have been minimized. Vertical retaining walls were avoided and an alternative structure with cascaded precast hollow and vegetated concrete blocks will be used to enhance its ecological value while ensuring high level of flood protection. Section 1 of the project river in Chuxiong will be preserved as it is, with only minor and very localized interventions where excessive bank erosion is observed. River sediment dredging will be avoided altogether.
- The subprojects in Lufeng and Wuding adopt urban stormwater management systems including a detention pond to mitigate the negative impacts of urbanization and its stormwater drainage. The detention pond consists of three small ponds with different

[7] The sediment examination result provided in the domestic EIA shows that all the parameters examined meet the national standard of GB4284-84 "Control Standards for Pollutants in Sediment from Agricultural Applications".

[8] In the original FSR, about 2/3 of the natural pond will be filled in for building the road.

functions that will retain urban stormwater runoff, intercepting pollutants of the first flush. These systems will serve an area of 1.0 km^2 in Lufeng and 0.6 km^2 in Wuding. In addition, a special design stormwater collection and storage system will be introduced and installed along selected project roads. The system consists of granular infiltration strips, underground storage and piping to the urban stormwater network. The system will reduce the direct discharge of runoff to the river system and the flood risk in the downstream, and will allow localized reuse of stormwater for landscaping irrigation.

30. Environmental health and safety considerations combined occupational health and safety of staff/workers at the subcomponent construction sites and facilities, and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities. These considerations include (i) a risk assessment of spillages of transported substances into rivers and emergency response plan; (ii) appropriate alignment of roads away from sensitive areas; (iii) the requirement for contractors to develop and implement environment, health and safety management plans; and (iv) the provision of capacity building support for flood early warning and emergency preparedness and response systems, traffic safety, and others.

31. **Environmental management.** Mitigation measures and a monitoring program were defined for all identified impacts, and are included in the EMP of the project EIA. The EMP sets out the procedures and plans to carry out mitigation measures and monitoring during sequential stages of the project including pre-construction, construction and operation. It consists of two major plans, one for implementing mitigation measures and the other for conduct environmental monitoring. For each impact, appropriate mitigation measures are described. Internal, external and compliance monitoring and supervision will be undertaken to ensure that environmental impacts will be minimized to acceptable levels.

32. **Project risks** were assessed during the PPTA. The majority of environmental risks relate to design features and operational plans, which will avoid or mitigate impacts but rely on the commitment and capacity to implement and consistently follow-up of the Chuxiong State Project Management Office (CSPMO), the city/county governments (implementing agencies, IAs), project implementing units (PIUs) construction supervision companies (CSCs), and contractors. The remaining relate to the likelihood of unexpected negative impacts. More specifically, the main project risks include: (i) low institutional capacity for environmental management and the possibility that the CSPMO, the PIUs, the implementing agencies (IAs) and CSCs will fail to monitor the environmental impact and implement the EMP during the implementation of the project; (ii) proper operation of linked facilities such as the existing WWTPs and landfills in the project cities; (iii) unforeseen land acquisition and resettlement issues, which could constrain the efficient implementation of the project works and restoration of livelihoods of the affected persons (APs); and (iv) inadequate construction site management, resulting in occupational and community health and safety concerns, and negative impacts to the project rivers. Project assurances, addressing the identified risks, have been drafted (presented in the Conclusion section), and, subject to agreements between ADB and the Executing Agency of the project, will be incorporated into the loan documentation as loan covenants.

F. Public Consultation and Grievance Redress Mechanism

33. Information disclosure and public consultation for each component have been conducted during the preparation of the domestic EIAs in accordance with the PRC Guideline on Public Consultation in EIA (2006) and ADB's Safeguard Policy Statement (2009). The information disclosure and public consultation included: two rounds of internet/newspaper disclosure; numerous meetings with the key stakeholders, including the representatives of the APs, local authorities and sector specific organizations; informal visits to the communities and households in the project areas; two questionnaire surveys; and a wider stakeholder meeting attended by the APs

and other concerned stakeholders. Those people affected by land acquisition and resettlement were consulted throughout the process of resettlement planning and social and poverty impact studies. The total number of people consulted in three project cities amounted to approximately 500. The consultation results revealed that the APs and stakeholders were familiar with the project. All consulted people fully support the components, and no one categorically opposed. An overwhelming majority believes that the project will improve living conditions and economic development, and protect the local environment.

34. A grievance redress mechanism (GRM) was established in each project city/town in compliance with ADB's Safeguard Policy Statement (2009) requirement to prevent and address community concerns and assist the project in maximizing environmental and social benefits. The GRM was presented and discussed with the potential APs during the public consultation. The GRM parallels with the GRM established for resettlement and land acquisition, and complies with the existing PRC legislative framework. Each IA will establish a Project Public Complaint Unit (PPCU), coordinated by the environment management units (EMUs) of the LPMO. The PPCUs will instruct contractors and CSCs if people complain about the project. The PPCUs will coordinate with the IAs, LPMOs and EPBs, if necessary, and will be supported by the environmental consultants of the loan implementation consultancy services.

G. Conclusion

35. All project components will support the PRC's Western Development Strategy, Sustainable Development Policy, and the prefecture's and project city/counties' development master plans. The public consultation indicated that the majority of the potential APs supported the project and project components and believed they would benefit the local economy, raise residents' living quality, improve local environmental conditions, and effectively protect the local environment. The overall findings of the domestic EIAs and the project EIA are that some negative impacts on air, water, soil erosion and acoustic environment are expected, especially during construction. Any adverse environmental impacts and risks associated with the project can be prevented, eliminated, or minimized to an acceptable level, if all the mitigation measures and monitoring requirements defined in the EMP are strictly implemented during detailed design, construction and operation, and the environmental management and institutional capacities of CSPMO, the LPMOs and the operators of project facilities (OPFs) are strengthened through implementation of the comprehensive training and capacity building program.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Legal Framework of PRC

36. The environmental protection system in the PRC consists of a defined hierarchy of regulatory, administrative and technical institutions. At the national level, the People's Congress has the authority to proclaim national environmental laws; the State Council promulgates the national environmental regulations; and the Ministry of Environmental Protection (MEP) issues the environmental standards and administrative guidelines. The provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones as well as the local special environmental features and issues. In addition, the local ordinances, national and local environmental standards and national and local five-year environmental protection plans form and become an important part of the legal framework on environmental management.

37. The EIA management procedure has been established in the PRC since early 1990s. A domestic EIA study is undertaken within the PRC national and local legal and institutional framework. The primary national laws and regulations that governed the EIA studies of the proposed project are provided in **Table II-1** and **Table II-2**, respectively. **Table II-3** shows the relevant local laws and regulations.

Table II-1: Relevant National Laws

No.	Law	Year issued
1	Environmental Protection Law	1989
2	Urban and Rural Planning Law	2008
3	Solid Waste Pollution Prevention and Control Law	2005
4	Wild Fauna Protection Law	2004
5	Environmental Impact Assessment Law	2003
6	Water Law	2002
7	Cleaner Production Promotion Law	2002
8	Air Pollution Prevention and Control Law	2000
9	Noise Pollution Prevention and Control Law	1999
10	Land Administration Law	1999
11	Forest Law	1998
12	Water and Soil Conservation Law	1991
13	Water Pollution Prevention and Control Law	2008
14	Highway Law (Second revision)	2004
15	Cultural Relics Protection Law	2002

Table II-2: National Administrative Regulations

No.	Regulation	Year
1	Regulation on EIA of Plans and Programs	2009
2	Regulation on Environmental Protection Management for Construction Projects	2003
3	Directive on Strengthening Wetland Protection and Management	2004
4	Environmental Protection Supervision Rules for Construction Projects	1998
5	Regulation on Culture Heritage Protection	2003
6	Regulation on Protection of Wild Flora	1997
7	Requirements for the EIA Summary of Construction Project	2010

8	Regulation on Classification of Construction Project Environmental Protection Management (MEP)	2001
9	National Biodiversity Strategy and Action Plan (2011-2030)	2010
10	Requirement for Social Risk Assessment of Large Investment Projects	2012
11	The National Biodiversity Strategy and Action Plan (2011-2030)	2010
12	National regulation for public disclosure of EIAs (NDRC)	2012

Table II-3: Local Laws and Regulations

No.	Law and Regulation	Year
1	Environmental Protection Regulations of Yunnan Province	1992
2	Construction Project Management Regulation of Yunnan Province	2007
3	Forest Regulations of Yunnan Province,	2003
4	Regulation on Prime Farmland Protection in Yunnan Province	2000
5	Management Regulations on Scenic Areas in Yunnan Province	1996
6	Regulations on Agricultural Environmental Protection in Yunnan Province	1995
7	Regulations on Terrestrial Wild Animals Protection of Yunnan Province	1997
8	Regulation on Environmental Protection and Management Regulations of Construction Projects in Yunnan Province	2002
9	Provision on Protection and Management of Rare and Endangered Plants in Yunnan Province	1995
10	Surface Water Function Zoning in Yunnan Province,	2001
11	Urban Environmental Noise Functional Zoning in Yunnan Province	2007
12	The Implementation of Measures of Water and Soil Conservation Law of the PRC in Yunnan Province,	1994
13	The Implementation of Measures of Water and Soil Conservation Law of the PRC in Yunnan Province,	1994
14	Regulation on Public Consultation for Constructions in Yunnan Province	2007

38. The implementation of environmental laws and regulations is supported by a series of associated management and technical guidelines, and those applicable to the proposed project are summarized in **Table II-4**.

Table II-4: Applicable Environmental Guidelines

No.	Guideline	Year/Code
1	List of Construction Projects Subject to Environmental Protection Supervision	2008
2	List of Construction Projects Subject to Environmental Protection Supervision	2008
3	Guideline on EIA Classification of Construction Projects	2008
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Interim Guideline on Public Consultation for EIA	2006
6	Circular on Strengthening EIA Management to Prevent Environmental Risks	2005
7	Technical Guideline on EIA: Surface Water Environment	HJ/T 2.3-1993
8	Technical Guideline on Environmental Risk Assessment for Construction Project	HJ/T 169-2004
9	Technical Guideline on EIA: Acoustic Environment	HJ 2.4-2009
10	Technical Guideline on EIA: Atmospheric Environment	HJ 2.2-2008
11	Technical Guideline on EIA: Ecological Assessment	HJ 19-2011

39. The environmental quality standard system that supports/evaluates the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function, i.e. pollutant emission/discharge standards and ambient environmental standards. The relevant main standards applicable to the proposed project are shown in **Table II-5**.

Table II-5: Applicable Environmental Standards

No.	Standard	Code
1	Standard for Flood Control	GB50210-94
2	Urban Ambient Acoustic Quality Standard	GB 3096-2008
3	Noise Limit of Industrial Enterprises	GB 12348-2008
4	Noise Limit for Social Activities	GB 22337-2008
5	Domestic Drinking Water Quality Standard	GB 5749-2006
6	Surface Water Quality Standard	GB 3838-2002
7	Standard on Pollutant Discharges from Municipal Wastewater Treatment Plants	GB 18018-2002
8	Ambient Air Quality Standard	GB 3095-1996
9	Integrated Emission Standard of Air Pollutants	GB 16297-1996
10	Integrated Wastewater Discharge Standard	GB 8978-1996
11	Soil Quality Standard	GB 15618-1995
12	Groundwater Quality Standard	GB/T 14848-1993
13	Noise Limit for Construction Sites	GB 12523-1990
14	Control Standards for Pollutants in Sludge for Agricultural Use	GB 4284-1984
15	Ambient Air Quality Standard	GB 3095-2012[9]

B. International Agreements

40. The PRC is signatory to a number of international agreements, including all major international agreements dealing with biodiversity and wetland protection, Climate Change etc. Those with direct and indirect implications for the project are listed in **Table II-6**.

Table II-6: Applicable International Agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention on Biological Diversity	1993	Conservation and sustainable use of biological diversity
3	United Nations Framework Convention on Climate Change	1994	Achieving stabilization of greenhouse gas concentrations in the atmosphere
4	Kyoto Protocol to the United Nations Framework Convention on Climate Change	2005	Further reduction of greenhouse gas emissions
5	Montreal Protocol on Substances That Deplete the Ozone Layer	1989	Protection of the ozone layer
6	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought

C. Applicable ADB Policies and World Bank's EHS

41. ADB's *Safeguard Policy Statement* (SPS) provides the basis for the project EIAs. All projects funded by ADB must comply with the SPS. The purpose of the SPS is to establish an environmental review process to ensure that projects undertaken as part of programs funded under ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, or safety hazards.

[9] The standard was issued on 29 February 2012, and will be effective on 1st January 2016.

42. The PRC domestic EIAs are prepared initially for the PRC approval processes, which are required to adopt PRC standards for the quality of water, air, and noise, etc. ADB's Safeguard Policy Statement promotes good international practice as reflected in internationally recognized standards such as the World Bank (WB) Group's Environmental, Health and Safety (EHS) Guidelines[10]. The principles and standards of the EHS Guidelines are adopted by the ADB's Safeguard Policy Statement. The general guidelines, in company with the sector guidelines, will provide the context of international best practice, and contribute to establishing appropriate targets for the environmental performance. The sector guidelines referenced include General EHS Guidelines (covering occupational EHS and community EHS), EHS guidelines on Waste Management Facilities, and EHS guidelines on Water and Sanitation. The water, air and noise quality standards in the EHS guidelines will also provide the justification and reference for the use of related PRC standards.

43. This project has been classified "A" for environment in accordance with SPS categorization criteria, requiring the conduct of a full EIA (Report). Compared with PRC EIA requirements, the SPS requires a number of additional considerations, including (i) project level GRM including documentation in the EMP; (ii) definition of the project area of influence; (iii) assessment of direct, indirect, induced and cumulative impacts; (iv) due diligence of project associated facilities; (v) protection of physical cultural resources; (vi) climate change mitigation and adaptation; (vii) occupational and community health and safety requirements (including emergency preparedness and response); (viii) impacts on livelihoods through environmental media; (ix) biodiversity conservation; and (x) ensuring that the EMP includes an implementation schedule and (measurable) performance indicators. These requirements, which are usually weak in PRC EIAs, have been included in domestic EIA reports to the EIA institutes' best knowledge and capacity. This project EIAs complies with SPS requirements.

D. Institutional Framework for Environment Management in the PRC

44. The PRC's Management Guideline of Environmental Protection Categories of Construction Projects (2002) provides detailed classifications of the EIA study, including 23 general categories and 198 subcategories based on the project's nature, scale and environmental sensitivity. In accordance with the guideline, this project was classified into the categories of (i) urban infrastructures; and (ii) water source protection and development. The institutional framework for the EIA approval process in Yunnan Province is summarized in **Table II-7**.

Table II-7: Institutional Frameworks for the EIAs Approval

Responsible Division	Scope of work
Yunnan Provincial EPD	(i) Organizes experts for the EIA evaluation, including compliance with appropriate laws, regulations and standards. (ii) Final EIA approval
Chuxiong Prefecture's and Project City/ counties EPBs	Environmental management and supervision during project implementation, including the management and supervision of the implementation and fulfillment of the environmental mitigation measures and environmental monitoring.

45. In the PRC, the enforcement of environmental laws and regulations rests with the environmental protection authorities within each level of government. At the national level, the Ministry of Environmental Protection (MEP) is the regulatory, enforcement and supervision authority. Each province has an environmental protection department (EPD). The environmental

[10] *"World Bank Group Environmental, Health, and Safety Guidelines"*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

management authorities at the sub-provincial level and county level are the environmental protection bureaus (EPB). These authorities are supported by environmental monitoring stations and environmental protection research institutes.

46. There is an environmental monitoring station (EMS) in each of the three project city/counties, which are responsible for regular monitoring of ambient environmental quality and the compliance monitoring of pollution sources in the project areas. Due to capacity gaps in both instruments and personnel of the city/counties EMSs, Chuxiong prefecture's EMS conducts compliance monitoring for the project city/counties biannually.

E. Impact Areas and Assessment Standards for Proposed Project Components

a. Impact Areas

47. The areas of impact assessment for the project during both construction and operation periods are summarized in **Table II-8** below.

Table II-8: Impact Area of Project Component

Assessment Item	Impact Area	
	River rehabilitation and flood control components	Infrastructure Component
Surface water	Quality: Proposed river section including 200m upper stream from the starting point and 1,000m downstream to the ending point of the river section. Hydrology: Impacts on flow behavior and flooding on downstream beneficial uses.	Surface water bodies including ponds with 200m from the proposed roadsides; areas within 100m upper reach and 1,000m downstream from the cross-river bridges.
Air	Villages, residential communities, schools and hospitals, etc. within areas 200m from the riversides	Area within 200m from the proposed roadsides.
Acoustic environment	Villages, residential communities, schools and hospitals, etc. within areas 100m from the riversides	Area within 200m from the proposed road centerlines.
Ecology	Construction footprint, downstream sensitive aquatic or riparian areas.	Construction footprint.
Soil stability	Sites of embankment construction and landscaping areas along the rivers	Construction sites and spoil disposal sites
Physical cultural resources	Construction footprint.	Construction footprint.
Occupational health & safety	Construction footprint.	Construction footprint.
Community health & safety	Construction footprint. Downstream areas (flood risk).	Within 200m on both sides from the road red line.

Source: Domestic EIAs

b. Ambient Air Quality Standards

48. Assessment of ambient air quality was in accordance with "Ambient Air Quality Standard" (GB3095-1996) Grad II standards. However, the World Bank EHS guidelines[11] (see below) are based on best international practice. Both the PRC standards and EHS guidelines are used in assessment of this project[12], of which the specific standard values are shown in **Table II-9**.

[11] World Bank Group, 2007, *Environmental, Health and Safety Guidelines General EHS Guidelines*, World Bank, Washington.

[12] The project applies PRC standards. The comparison of PRC standards with internationally accepted standards (as defined in the World Bank's Environment Health and Safety Guidelines) described in this chapter confirms that PRC standards are either

Table II-9: Ambient Air Quality Grade II Standard

Pollutant	Time	Standard (mg/m^3)[13]	EHS (mg/m^3)
SO_2	Annual average	0.06	n/a
	Daily average	0.15	0.125-0.05 (0.02 guideline)
	Hourly average	0.50	n/a
PM_{10}	Annual average	0.10	0.07-0.03 (0.02 guideline)
	Daily average	0.15	0.075-0.15 (0.05 guideline)
NO_2	Annual average	0.08	0.04 guideline
	Daily average	0.12	n/a
	Hourly average	0.24	0.20 guideline
CO	Daily average	4.0	n/a
	Hourly average	10.0	n/a

c. Acoustic Environment Quality Standards

49. In accordance with the PRC "Acoustic Environmental Quality Standard" (GB3096-2008), constructed new roads are classified as Class 4a or Class II. Sensitive areas such as schools, hospitals, nursing homes and other noise sensitive spots are evaluated in accordance with "Acoustic Environmental Quality Standard" (GB3096-2008) Grade II standards according to the environmental function zoning identified by the local EPBs. The applicable environmental noise standard values and the applicable areas are shown in **Table II-10**.

Table II-10: Acoustic Quality Standards (dB (A))

Standard Category	Applicable Area	PRC		EHS[14]	
		Day	Night	Day	Night
I	Suburb area along first section of Longchuan River	55	45	n/a	n/a
II	Outdoor of schools, hospitals (nursing homes, homes for the elderly) , and areas beyond 50 m distance from edge of roads	60	50	55	45
4a	Area within 50m distance from edge of roads	70	55	n/a	n/a

d. Noise Limits for Construction Sites

50. Construction activities must be in accordance with "Noise Limits for Construction Site" standard (GB12523-90), see **Table II-11**.

internationally accepted, or have comparable standard limits with internationally accepted standards. A deviation from PRC practices and standards would make the task of compliance monitoring authorities unnecessary complicated, and is deemed not justified.

[13] A new standard has been issued in 2012 (GB 3095-2012), which will only become effective on 1 Jan 2016. Until then, GB3095-1996 remains valid.

[14] The project applies GB3096-2008 as its limits and target values are comparable with the World Bank's Environment Health and Safety Guidelines. GB3096-2008 accounts for regional conditions (including high baseline noise levels), and sets site-specific standard values(following the environmental function zoning identified by the local EPBs). .

Table II-11: Noise Limits for Construction Sites Standard (dB(A))

Noise limits	
Daytime	**Night**
70	55

e. Surface Water Quality Standards

51. Assessment of surface water quality focused mainly on the river rehabilitation and flood control components and the bridges in the infrastructure development components and was in accordance with Grade IV standard values of "Surface Water Environment Quality Standard" (GB3838-2002), which is shown in **Table II-12.** Flood management works will comply with *Flood Protection Standards* (GB50201-94). Because the subproject areas are not related to any special ecologically-sensitive zones, the assessment of ecological environment belongs to Class III according to the "Environmental Impact Assessment Technical Guidelines" (HJ19-2011).

Table II-12: Surface Water Quality Standards (mg/L, pH excluded)

Parameter	pH	COD_{Mn}	BOD_5	COD_{cr}	TP	TN	NH_3-N	Petroleum
Grade IV Standard	6~9	≤10	≤6	≤30	≤0.3	≤1.5	≤1.5	≤0.5

f. Wastewater Discharge Standards

52. The local EPBs confirmed that the proposed sewer networks in the infrastructure components in the three project city/counties should be in accordance with "Integrated Wastewater Discharge Standard" (GB8978-1996) and in accordance with the implementation of domestic sewage, "Integrated Wastewater Discharge Standard" (GB8978-1996) Grade II. Specific standard values are shown in **Table II-13**.

Table II-13: Integrated Wastewater Discharge Standards (mg/L, pH excluded)

Parameter	pH	COD_{Cr}	BOD_5	SS	NH_3-N	Oil
Grade II Standard	6–9	150	30	150	25	10

g. Emission Standard of Air Pollutants

53. Asphalt smoke during road constructions will be in accordance with the Grade II standard of "Integrated Emission Standard of Air Pollutants" (GB16297-1996). The standard values are shown in **Table II-14.**

Table II-14: Integrated Emission Standard for Air Pollutants (mg/Nm3)

Pollutant	Maximum allowable Emission concentration	Fugitive emission concentration limits for monitoring points
Particles	——	1.0
Asphalt Smoke	40-75 mg/Nm^3	No fugitive emission

h. Standard for Urban Area Environmental Vibration

54. Construction activities will cause vibration impact, and should comply with the "Standard for Urban Area Environmental Vibration (GB10070 - 88)". The details are shown in **Table II-15**. The interchange and road works of the project are located near both sides of traffic trunk line, so the project shall comply with the fifth standard listed in the table.

Table II-15: Vertical (Z) Vibration Standard Value for Various Urban Areas (Unit: dB)

Scope of applicable area	Day	Night
Special residential area	65	65
Residential, cultural and educational area	70	67
Mixed area and commercial center	75	72
Industrial centralized area	75	72
Both sides of traffic trunk line	75	72
Both sides of railway main line	80	80

Source: Subproject EIA Reports

i. The PRC Policies for Reduction of Vehicle Emissions

55. The Government of the PRC has a comprehensive program for the control and reduction of vehicle emissions. The current program[15] includes the following main focus areas connected with vehicle emissions: (i) Improvement and stricter enforcement of national emission standards for new vehicles; (ii) Improvement of conventional fuels to make them cleaner with less GHG emissions; (iii) Use of alternatives or cleaner fuels; (iv) Improved maintenance and inspection of vehicles; and (v) Encouragement for the scrapping of older high emission vehicles.

F. Domestic EIA Study and Approval Process

56. Article Sixteen (16) of the PRC EIA Law (2003) stipulates that an Environmental Impact Statement (EIS) [16] is required for any capital construction project producing significant environmental impacts, so as to provide a comprehensive assessment of these potential environmental impacts. On 2 September 2008, the MEP released the Guideline on EIA Classification for Construction Projects, which came into effect on 1 October 2008. According to this guideline, a project is classified into one of the following three categories:

(i) **Category A:** Projects with significant adverse environmental impact, a comprehensive environment impact statement (EIS) is required.

(ii) **Category B:** Projects with adverse environmental impacts which are of lesser degree and/or significance than those of Category A; a tabular (simplified) EIA Report is required.

(iii) **Category C:** Projects unlikely to have adverse environmental impact; an Environmental Impact Registration Form is required.

[15] The PRC's "Air Pollution Control Action Plan (2013)", issued by Ministry of Environment Protection.

[16] Full environmental impact assessment report.

57. The full EIA and tabular EIA under PRC EIA regulations are similar to the EIA and IEE, respectively, under the ADB SPS 2009. Under PRC EIA Law (2003), public consultations are not required for Category B projects.

58. MEP's Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects (2003) provides two prescribed lists of projects for which EIAs must be reviewed and approved. The guideline was amended in 2009 to include a list of construction projects for which EIAs require MEP's review and approval, and a list of projects for which EIAs will be delegated to the provincial EPD. Yunnan Provincial EPD (YEPB) was authorized by the MEP to review and approve the EIAs for all projects financed by IFIs according to the current regulation.

59. The four EIA reports for the project components were prepared by an EIA institute holding a national Grade A certificate in accordance with the Management Guideline on Qualification of EIA Institutes (MEP Ministerial Order No. 26, 2005). The final domestic EIAs have been completed before end of May 2013 and approved in August 2013. The PPTA consultants assisted the finalization of the domestic EIAs, based on which the draft project EIA was completed in June 2013 **(Table II-13).**

Table II-13: Expected Date for EIA Completion and Approval

No.	Component	Date of Final EIA Completion	EIA Approval Date
1	Longchuan River Rehabilitation & Flood Control in Chuxiong city	15 June 2013	15 August 2013
2	Urban Infrastructures Development in Chuxiong City		
3	Wuding Urban Infrastructures Development and Rivers Rehabilitation & Flood Control		
4	Lufeng Urban Infrastructures Development and East and West Rivers Rehabilitation & Flood Control		

Source: EIA Institute

III. DESCRIPTION OF THE PROJECT

A. Rationale and Justification of the Project

60. Yunnan is one of the poorest provinces in the PRC. In 2011, the GDP per capita was CNY18,957 ($3,057) only, ranked second-last amongst all PRC provinces, much below the national average of CNY34,999 ($5,645). In order to narrow the socio-economic development gap between the less-developed western area and the eastern coastal area, the PRC government initiated "the Western Development Strategy" in 2000. The strategy aimed to stimulate regional social-economic development, improve living standards of residents, accelerate infrastructure construction, promote local industry development, enhance environmental protection, and improve ecosystem, etc. The policy covers a total of 12 provinces and autonomous regions in the western part of the PRC, including Yunnan Province.

61. Yunnan has the highest ratio of ethnic minorities among all provinces in the PRC. The total population of the minorities is about 15.3 million, accounting for 33% of the provincial total. Yi Minority is the largest group in the Province, with a population of about 5.1 million. Yunnan has diverse ethnic cultures and is also a global biodiversity hotspot. The province is strategically located for the PRC's cooperation with the Greater Mekong Sub-region. However, the province is relatively under-developed, and still faces urgent sustainable development challenges including poor infrastructures, high incidence of poverty, environmental degradation and over-exploitation of natural resources.

62. The urban center of Chuxiong Prefecture (Chuxiong City) is located in central Yunnan Province, about 160 km west of Kunming City, the Capital of Yunnan Province. Due to rapid and unbalanced urbanization, key cities and towns in the Prefecture (including Chuxiong, Lufeng and Wuding) face serious urban development challenges including lack of infrastructure, poor road networks and poor sanitary facilities. Transport-related problems include poor road conditions, incomplete road networks, sub-standard road structures and road base treatments, no or poor quality sewers and stormwater drainage, and a lack of safe integration of public transport, pedestrians, bicycle lanes, and motorized traffic.

63. Four rivers[17] run through the urban areas of the three project cities and all have a flood history, with property damages and loss of lives. There are no early flood warning systems, which could reduce the flood damages in the events of severe storms. The annual average precipitation in Chuxiong is over 900 mm, and rainfall is concentrated from July to September. Severe storms and heavy rainfall are common during this period and flooding in the urban areas occurs from time to time. Flooding is aggravated as a result of urban development with increased impermeable areas and inadequate stormwater drainage system and river embankments. The water quality of the project rivers is currently Class IV or worse. This situation will continue to block new initiatives to promote sustainable urban development unless the pollution prevention and abatement measures are implemented.

64. The proposed project aims to promote balanced and environmentally sustainable urbanization and social-economic development in the three project cities. The project will support sustainable urban transportation, urban sanitation service facilities, and integrated urban flood control and river enhancement works.

65. The project complies with the two main development agendas of environmentally sustainable

[17] Longchuan River in Chuxiong City; Wulong River in Wuding City, East River and West River in Lufeng City.

growth and inclusive economic growth promoted in ADB's long-term strategic framework 2020. It is also in line with and supports the PRC country partnership strategy (2011-2015), which will support the PRC's over-arching strategic goal of building a "comparatively well-off" society by helping foster inclusive growth and promote environmental sustainability.

66. The project is in line with the Yunnan Provincial Twelfth Five-Year Plan (FYP) and the Prefecture's 2020 Master Plan. The provincial Twelfth FYP calls for economic development, environmental protection, and building environmentally and ecologically friendly urban areas and town settlements. The proposed project components are fully aligned to the 2020 master plans of the three project cities.

B. Project Impact, Outcome and Outputs

67. The project impact will be more competitive, green, and inclusive urbanization in Chuxiong, Lufeng and Wuding to support development of the Kunming city cluster. The outcome will be improved urban infrastructure services and environment in Chuxiong City and Counties of Lufeng and Wuding. The project will generate outputs from three physical construction component and one capacity development and institutional strengthening component, which are summarized below, and specified in **Table III-1**.

(a) Component I - Chuxiong urban infrastructure and environment improvement.

71. The Component comprise (a) 9.4 kilometers (km) of Longchuan River flood protection and enhancement with improved 6.2 km river embankments, 202,505 m^2 landscaping, and installation of flood early warning system including a coordination center, 2 water/rainfall monitoring stations, 19 real-time monitoring cameras, and 4 flood warning broadcasting stations; (b) 9.0-km urban roads with non-motorized traffic lanes, pedestrian and bicycle facilities; (c) 19.0 km of water supply pipeline, 18.8 km of sewerage pipeline with 29 sewage interceptor facilities, 19.2 km of storm water pipeline, 9.0 km power supply and telecommunication cable ducts, and 2 street light maintenance vehicles; (d) installation of an integrated traffic control and traffic management system comprising traffic signal with traffic control system and monitoring camera; and (e) 8 garbage compressing vehicles, 10 garbage collection vehicles, 2,500 trash bins, 2,900 garbage containers, 1 construction waste recycling machine, 6 street sweeping vehicles, 2 high pressure street cleaning vehicles, 2 water spraying vehicle, 4 sewage collection vehicles and 10 portable toilets.

(b) Output II - Lufeng urban infrastructure and environment improvement.

72. The component will contribute to sustainable urban services in Lufeng County by: (a) 2.0 km East and 2.1 km West river enhancement and flood protection with 12.2 km of river embankment protection, 290,336 m^2 of landscaping and installation of flood early warning system including a coordination center, 3 water/rainfall monitoring stations, 10 real-time monitoring cameras, and 3 flood warning stations; (b) a stormwater retention pond system with volume capacity of 68,135 m^3; (c) 7.5 km urban roads with NMT lanes, pedestrian and bicycle facilities; (d) 15.9 km of water supply pipeline, 15.5 km of sewerage pipeline with 4 sewage interceptor facilities, 18.6 km of storm water pipeline, 7.5 km of power and telecommunication cable ducts; and (e) 4 garbage compactor trucks, 10 garbage collection vehicles, 1 construction waste recycling machine, 12 street sweeping/dust collection vehicles, 1 high pressure street cleaning vehicles, 2 water spraying vehicle, and 2 sewage collection vehicles.

(c) Output III - Wuding urban infrastructure and environment improvement.

73. The component will contribute to sustainable urban services in Lufeng County by: (a) 2.6 km of Wulong river flood protection and enhancement through 5.2 km of river embankment protection, 54,572 m^2 of landscaping and installation of the flood early warning system including a coordination center, 7 water/rainfall monitoring stations, 10 real-time monitoring cameras, and 3 flood warning broadcasting stations; (b) a stormwater retention pond with volume capacity of 16,884 m^3; (c) 9.4 km urban roads with NMT lanes, pedestrian and bicycle facilities and 1 street light maintenance vehicle; (d) 17.9 km of water supply pipeline, 13.4 km of sewerage pipeline with 10 sewage interceptor facilities, 20.3 km of storm water pipeline, 9.4-km of power and telecommunication cables ducts; and (e) 3 garbage compactor trucks, 4 mini garbage collection & transport vehicles, 1 street sweeping/dust collection vehicle, 1 movable toilet, 198 garbage containers.

(d) Output IV - Capacity development and institutional strengthening.

74. The outputs will be (a) capacity building and institutional strengthening for the project management; (b) experts support and advice on storm water management, municipal solid waste management planning, urban transport management and road safety, (c) public awareness activities on road safety, solid waste recycling and participatory urban design and planning activities; and (d) training on public financial management especially on improve credit-rating and credit worthiness.

Table III-1: Summary of Project Outputs or

No	Description	Length (km)	Classification	Right-Of-Way (m)	Remark
1	Integrated Municipal and Environmental Services in Chuxiong City				
	A. Chuxiong Longchuan River Rehabilitation				
	a. River rehabilitation	9.38			
	river embankment work	6.20			
	landscaping	202,505			m^2
	b. Flood warning system				Note 1
	B. Chuxiong City Urban Infrastructures				
	No. 17 Road	3.01	Urban Major	60.00	40km/h
	No. 11 Road	2.96	Urban Major	40.00	
	No. 10 Road	1.45	Secondary	36.00	
	No. 49 Road	1.61	Branch	24.00	
	Subtotal =	9.03			
	Water Supply Piping Network	18.98			
	Stormwater Piping Network	19.21			
	Sanitary Sewer Piping Network	18.82			
	Sewerage Intercepter Facilities	29			Note 2
	Power Supply and Communication Ducts	9.03			
	ITS Traffic Management & Control				Note 3
	C. Municipal Solid Waste Management Enhancement				Note 4
2	Integrated Municipal and Environmental Services in Lufeng				
	A. East and West Rivers Rehabilitation	4.10	(ER = 2.0 km, WR = 2.1 km)		
	river embankment work	12.20			
	landscaping	290,336			m^2
	B. Lufeng Urban Infrastructures				
	No. 1 Road	1.55	Urban Major	36.00	
	No. 2 Road	1.39	Secondary	24.00	
	No. 3 Road	1.00	Urban Major	32.00	
	Zhuluoji Avenue Extension	1.00	Urban Major	40.00	
	Shiji Avenue Extension	1.00	Urban Major	36.00	
	Jinshan Nan Road Extension	1.56	Urban Major	36.00	
	Subtotal =	7.51			
	Water Supply Piping Network	15.94			
	Stormwater Piping Network	18.63			
	Sanitary Sewer Piping Network	15.50			
	Sewerage Intercepter Facilities	4			Note 2
	Power Supply and Communication Ducts	7.51			
	C. Municipal Solid Waste Management Enhancement				Note 4
3	Integrated Municipal and Environmental Services in Wuding				
	A. Wuding Wulong River Rehabilitation	2.54			
	river embankment work	5.20			
	landscaping	54,572			m^2
	B. Wuding Urban Infrastructures				
	Beicheng Avenue	1.56	Urban Major	40.00	
	Chengbei Road	1.27	Urban Major	32.00	
	Mudan Road	1.32	Urban Major	30.00	
	Caiyuan Road	0.61	Secondary	24.00	
	Wuzheng Road	0.92	Secondary	20.00	
	Wuji Road	0.85	Secondary	20.00	
	Wuchan Road	1.35	Secondary	20.00	
	Binhe Road	1.19	Secondary	20.00	
	Access Road	0.34	Branch	15.00	
	Subtotal =	9.40			
	Water Supply Piping Network	17.89			
	Stormwater Piping Network	20.34			
	Sanitary Sewer Piping Network	13.35			
	Sewerage Intercepter Facilities	10			Note 2
	Power Supply and Communication Ducts	9.40			
	C. Municipal Solid Waste Management Enhancement				Note 4
4	Capacity Development				
	A. Project implementation support				
	B. Urban transport improvement				
	C. Urban traffic safety improvement				
	D. Improvement of Stormwater Management				
	E. Improved municipal solid waste management				
	F. Financial management improvement				

(Source: PPTA Consultant) (ER = East River, WR = West River)

Notes: 1. Proposed flood early warning system includes: a coordination center, water/rainfall monitoring stations, real-time monitoring cameras, and flood warning stations

2. A facility to intercept the untreated sewer from the adjacent existing residential area.

3. An ITS Traffic Management system includes: a traffic control system and monitoring cameras

4. Municipal solid waste equipment include: garbage compressing vehicles, garbage collection vehicles, trash bins, garbage containers, a construction waste recycling machine, street sweeping vehicles, high pressure street cleaning vehicles, water spraying vehicle, sewage collection vehicles and portable toilets

Components

C. Detailed Description of the Project Components and Subcomponent

(1) Component I – Chuxiong Urban Infrastructure and Environment Improvement

(a) Longchuan River rehabilitation and flood control

75. The proposed section of the Longchuan River starts at the outlet of Qingshanzui Reservoir, passes Shangzhang Village, and ends at the city border of the existing urban area (**Figure III-1**). Within the existing urban area (downstream of section 3), the river banks have been lined with concrete embankment to meet the required flood control standard of 1-in-50 years. The primarily objective of the river rehabilitation and flood control component is to protect farmland and villages along the river from floods, and protect the river from excessive bank erosion. The river enhancement works are based on a flood risk assessment, and accounted for recommendations of the PPTA. The works on the Longchuan River will be divided into three sections as shown in **Figure III-1.**

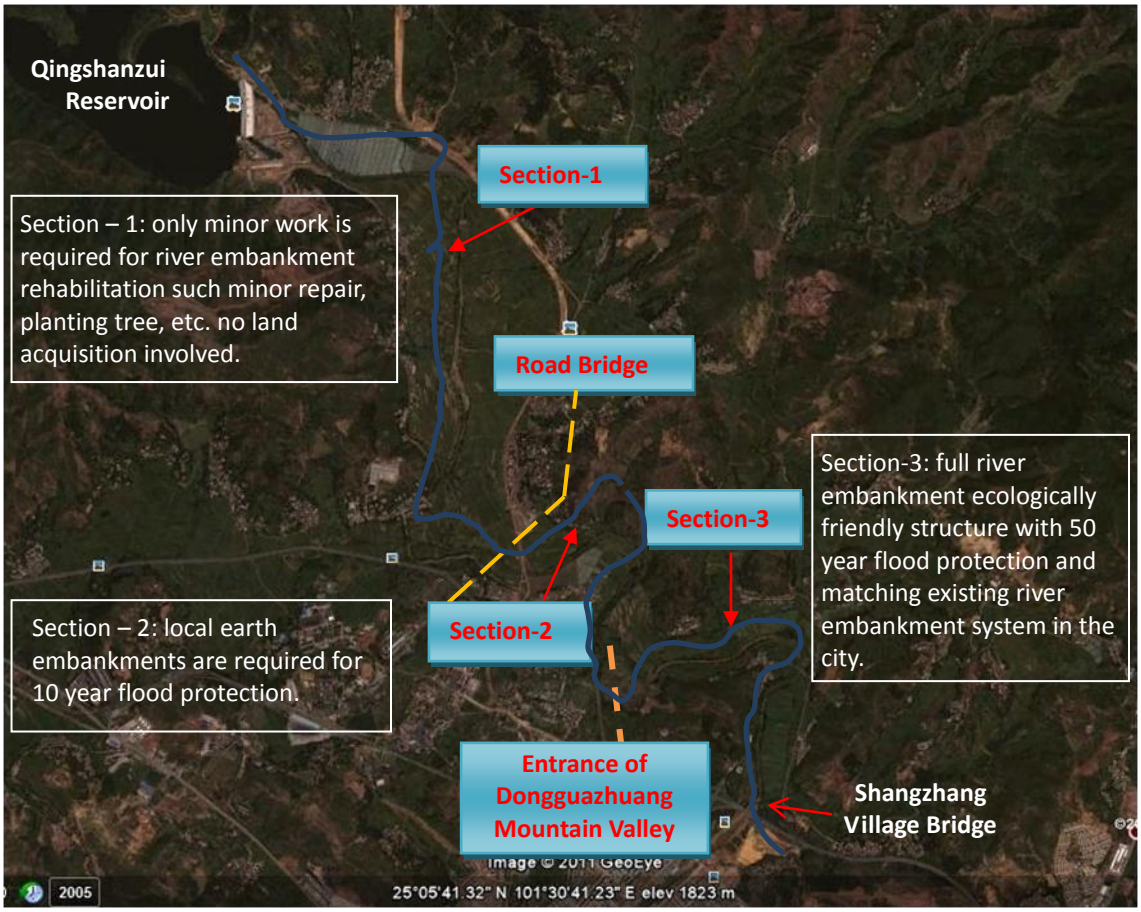


Figure III-1: Longchuan River Rehabilitation Scheme

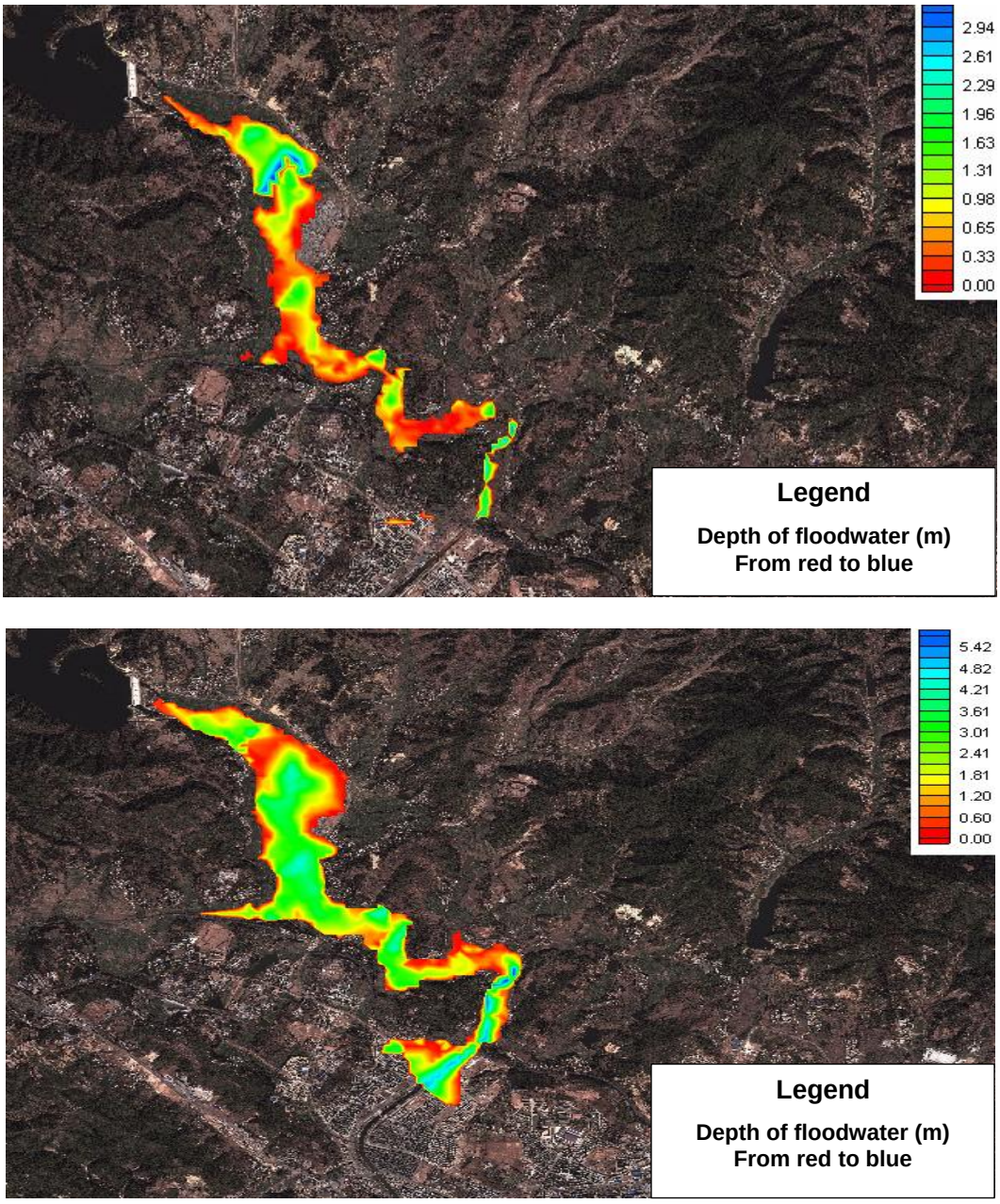


Figure III-2: Inundation Map for 1-in-50 Years Flood (top) and 1-in-100 Years Flood (bottom)

76. **Section 1: Qingshanhu Reservoir to G320 Road Bridge (**0+000 ~ 4+500). The area is primarily farmland and the existing river channel is well vegetated and naturally stable. The flood risk map (**Figure III-2**) shows that for 1-in-10 to 1-in-50 years floods, only the farmland along the river is threatened. The boundary of the flooding is confined by the hills in the left side and the embankment of highway G320 in the right side. The impact from the flooding is limited. In consideration of environmental and ecological protection, and based on policy dialog, it was decided that river rehabilitation will be limited to minor repairs of existing natural riverbanks, including planting of native trees to stabilize the exiting riverbank. The existing waterway channel, natural tree line and vegetation will be preserved.

Figure III-3: Current view of Section 1

77. **Section 2: G320 Road Bridge to Shangzhang Village** – Along the river, the left side is primarily farmland and some small hills and the right side is also mainly farmland but with the village in further right. At some locations, the river touches the residential area of the village. The flood risk map shows that flooding will submerge the farmland along both sides of the river, but also flood part of the residential area of the village. In consideration of protecting resident safety and properties from flooding, the river embankment protection between the hills will be used. The layout of the river embankment is based on the site topography and only the lower areas between the hills will be provided with the earth embankment. In order to maintain the current natural setting with less environmental and ecological impact, a multi-step channel cross section is suggested. The first step channel is the exiting natural water channel with some damaged levees, which will be repaired. The second step river channel will consist of the newly constructed earth berms along the river between hills. The earth berm river embankment will have less impact to the environment and natural settings, is cost effective and has less impact to the farmlands.

78. **Section 3: Shangzhang Village to Chuxiong Urban Area** (6+300 ~ 9+377). The flood risk map shows that part of the exiting urban area will be flooded at the end of this river section. The existing river embankment in the urban area ends at this location. Since there is no river embankment protection further upstream, the urban area in this location will be flooded from the upstream even though there is an existing river embankment. Therefore, a full river embankment to connect to the existing river embankment from Shangzhang Village is required. The design flood for the embankment within the city limit is 1-in-50 years, while the design flood for the channel in north of the city is once in 10-years flood. A transition of the river embankment from 1-in-10 years flood to 1-in-50 years flood is required. In consideration of the proximity of the area to the existing urban area and the pace of urbanization, the area between the village and the existing urban area is likely to become urbanized within the next 10 to 15 years. As a result, flood protection for this section will apply 1-in-50 years standard. Flood control and river embankment design for this section will apply an integrated design, balancing flood control, urban landscaping, recreation and leisure objectives. The embankment cross section consists of sloped stone masonry channel at the bottom, walkway above normal waterline, and earth embankment stabilized with grass, trees and vegetation at the top **(Figure III-4).**

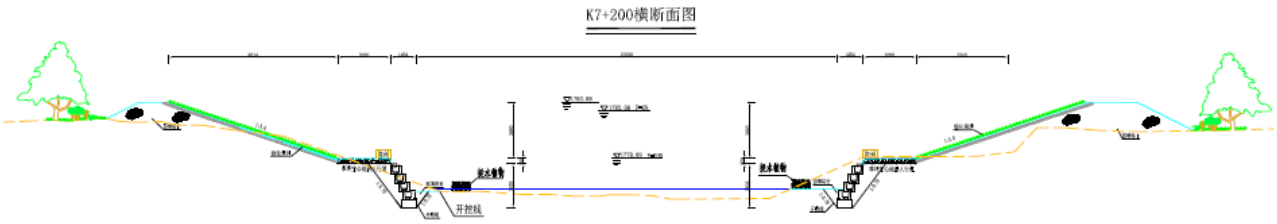


Figure III-4: Proposed river cross-section for Section 3

79. **Longchuan River early flood warning system.** For the river systems in Chuxiong area, there is an existing flood warning system covering all small and medium rivers in the prefecture. The system was developed based on a network of the monitoring stations located along the rivers and major reservoirs and a flood warning projection system developed by Hehai University. The system collects the runoff data and water levels in the reservoirs, performs analysis and provides flood warning based on the recorded rainfall data. Based on the evaluation of the existing flood warning system in Chuxiong, Wuding and Lufeng, it is determined that the current system needs to be enhanced in order to meet the flood warning and flood protection needs for the proposed project areas. The enhancement of the flood warning system will include:

(i) Establishment of Flood Warning Coordination Center – a flood warning coordination center will be established in the office building of Chuxiong WRB as the control center for the flood warning and control.

(ii) Establishment of Additional Water/Rainfall Monitoring Stations – the existing water/rainfall monitoring stations has covered most river and reservoirs. Only two additional automatic stations at Dongfengshan and Donggua locations will be built.

(iii) Establishment of Real-time Video Monitoring System – a real-time video monitoring equipment will be installed along the river at all sensitive and key locations. The camera will have infrared capacity so that they will be functional during both days and nights. A total of 19 cameras will be installed along the river. The video image will be transmitted to the control center vs. fiber optical cables, and the solar power will be used to operate the cameras.

(iv) Establishment of Wireless Flood Warning Broadcasting System – the wireless warning system will broadcast the flood warning information to the public in a wide range of format such as voice, cell phone, FM signals, etc. in the event of flooding. A total of 4 wireless warning broadcasting stations will be established in Chuxiong City **(Figure III-5).**

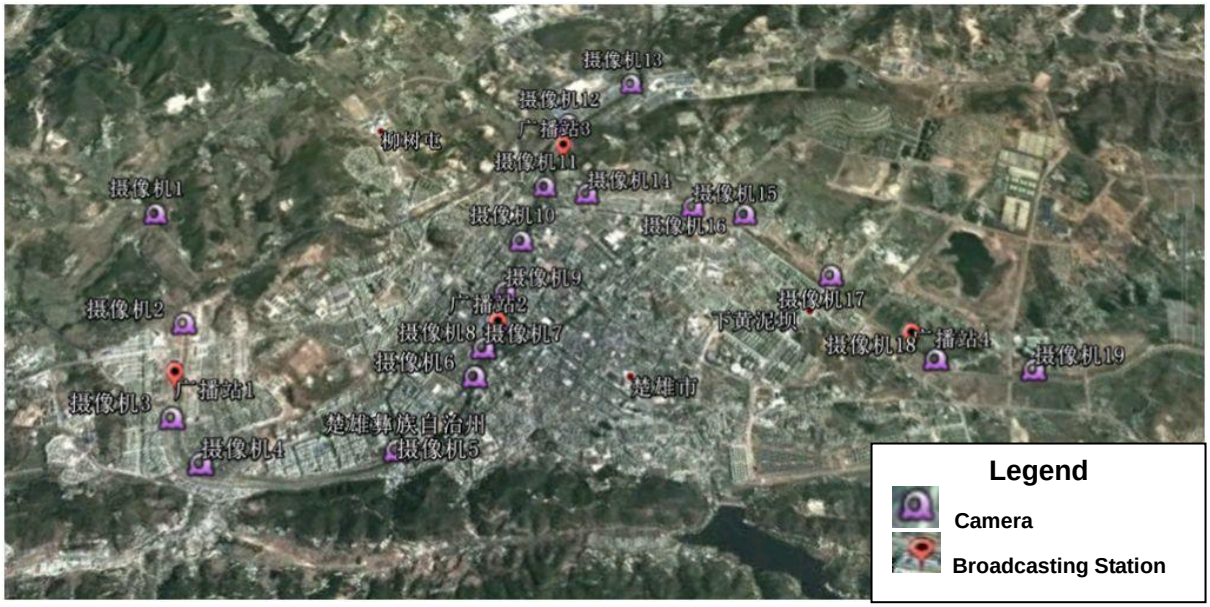


Figure III-5: Layout of monitoring points and wireless broadcast stations in Chuxiong city

(b) Chuxiong Urban Infrastructures Development

80. **Urban roads.** The project will support the construction of four new urban roads. The total road length is 9.0 km. The proposed roads will connect the existing urban area to the southeast area and also to the roads that were already built in the area to form a completed road network in the area. **Table III-2** provides an overview the proposed roads and the design details. Five small bridges will be constructed. The project area is in the southeast of the current urban area. The proposed roads include two urban main roads, an urban secondary road and a branch road. The cross-sections of the road are shown in **Figure III-7 to Figure III-10** below.

Table III-2: Proposed Roads and Bridges in Chuxiong City

No	Road/Bridge	Road Grade/ Bridge Type	Design Speed (km/h)	Design Live Load	Length (m)
1	No. 17 Road	Urban Major	50	BZZ-100	3,014
	Bridge over No. 9 Road	Precast RC Continuous Box Beam			
	Bridge over No. 11 Road	Precast RC Continuous Box Beam			
	Bridge over East Ring Road	Precast RC Continuous Box Beam			
2	No. 11 Road	Urban Major	40	BZZ-100	2,958
	Bridge over Qinglong River	RC Arch (16 m)		Road - II	
3	No. 10 Road	Secondary	30	BZZ-100	1,449
	Bridge over Qinglong River	RC Arch (16 m)		Road - II	
4	No. 49 Road	Branch	20	BZZ-100	1,612
				Total =	**9,034**

Source: Draft FSR

81. **Non-motorized transport.** Lanes will be provided for non-motorized vehicles and pedestrians (see e.g. **Figure III-6Error! Reference source not found.**). These lanes also provide, to some extent, environmental and public health buffer between the road traffic and road side developments. To facilitate safety of non-motorized vehicles and pedestrians in crossing new and

existing road junctions, traffic channelization at junctions will be implemented. Two stage pedestrian crossings will be considered if needed.

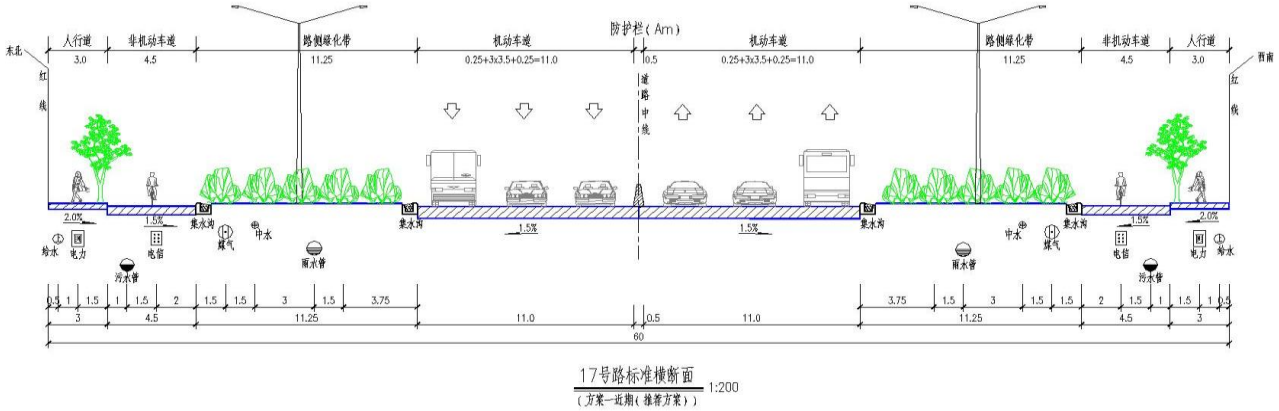


Figure III-6: Cross-sections of No. 17 Roads in Chuxiong 3

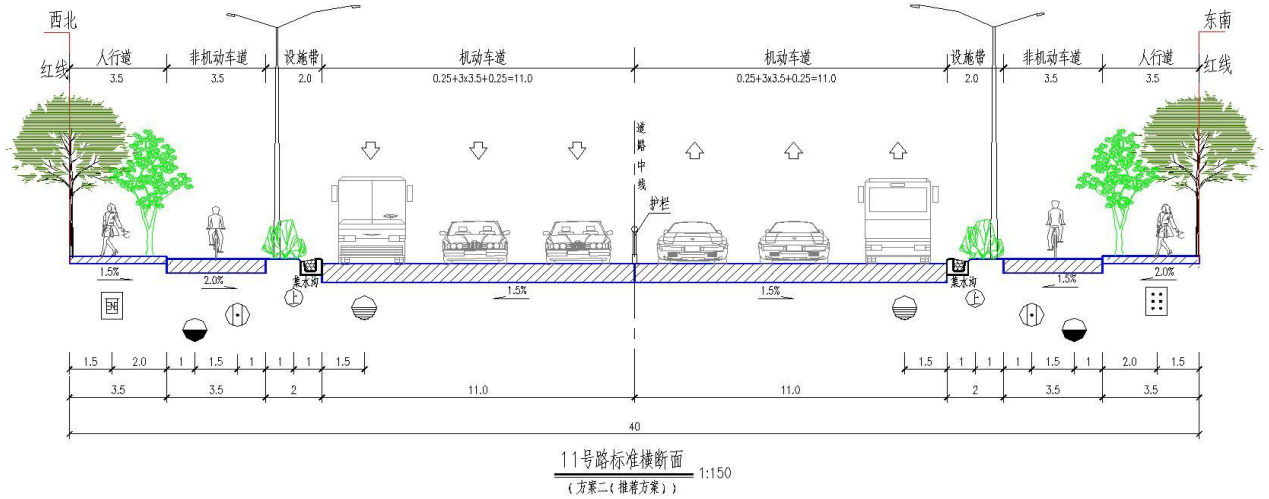


Figure III-7: Cross-sections of No. 11 Road in Chuxiong

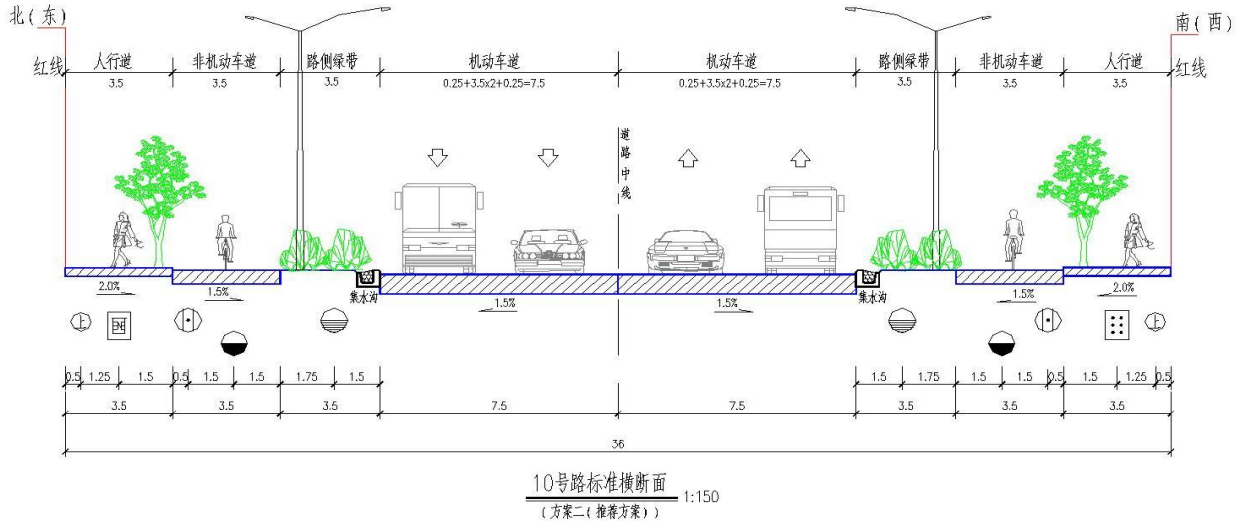


Figure III-8: Cross-sections of No. 10 Road in Chuxiong

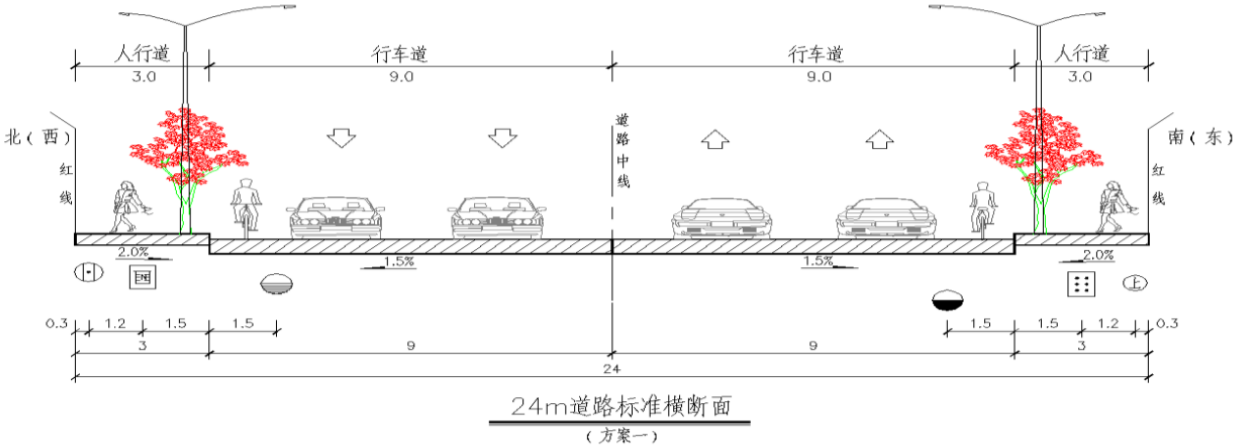


Figure III-9: Cross-sections of No. 49 Road in Chuxiong

82. **Auxiliary piped facilities.** A new water supply piping network of 19.0km will be installed in the new urban area and connect to the existing water supply network (**Table III-3**). Currently, there are two water supply plants (WSPs) of Guanyinshan and Yongan in Chuxiong City, with a total capacity of 72,000 m^3/day. The current water supply capacity is adequate to supply the new urban area. In accordance with the city water supply master plan, by 2020 the total capacity of the two existing WSPs will be expanded to 10,000 m^3/day, and a new Yinjiazui WSP, with a capacity of 10,000 m^3/day, will be built, to cope with future development in the area.

83. The proposed project area is next to the existing residential area (Fumin Village). There is no sewer network in the village, and all domestic sewage is directly discharged into nearby rivers and ponds, resulting in environmental pollution with odor emissions, especially in summer. A separated stormwater and sewer drainage system will be constructed in the project area, which includes 19.2km of stormwater and 18.8km of sewer pipes **(Table III-3)**, which will transport wastewater to the existing WWTP for treatment.

Table III-3: Proposed auxiliary piped facilities in Chuxiong City

No	Road	Diameter (mm)	Length (m)	Material
		Water supply pipes		
1	No. 10 Road	300	3,035	PE[18]
2	No. 11 Road	200	2,175	
3		250	4,030	
4	No 17 Road	250	2,016	
5		350	2,778	
6		450	1,531	
7	No. 49 Road	200	1,434	
8		350	1,980	
		Total =	**18,979**	
		Storm water pipes		
9	No. 10 Road	800	1,888	HDPE[19]
10		900	131	RCP[20]
11		1000	486	
12		1200	496	
13		1500	151	
14		2000	510	
15	No. 11 Road	500	870	HDPE
16		600	426	
17		700	678	
18		800	232	
19		1000	656	RCP
20		1200	530	
21		1500	616	
22		1650	232	
23		1800	334	
24		2000	1,242	
25	No 17 Road	500	3,325	HDPE
26		600	1,120	
27		700	516	
28		800	746	
29		900	895	RCP
30	No. 49 Road	500	2,601	HDPE
31		600	268	
32		700	264	
		Total =	**19,213**	
		Sewer pipes		
33	No. 10 Road	300	1,161	HDPE

[18] Polyethylene
[19] *High density polyethylene*
[20] *Reinforced concrete pipe*

No	Road	Diameter (mm)	Length (m)	Material
34		400	1,548	
35		500	258	
36	No. 11 Road	400	5,539	
37		500	677	
38	No 17 Road	400	6,515	
39	No. 49 Road	300	656	
40		400	2,461	
		Total =	**18,815**	

Note: HDPE = High Density Polyethylene, RCP = Reinforced Concrete Pipe
Source: Draft FSR

(c) Urban environment, health and safety improvements

84. **Municipal solid waste (MSW) management enhancement.** The project will increase Chuxiong's MSW management capacities by procuring waste collection and transportation equipment and city cleaning vehicles, significantly increasing the density of waste collection bins in the city (including the old urban area), and carrying out public awareness program to keep the city clean (**Table III-4**). Collected waste will be transported to an existing sanitary landfill, with a capacity of 250t/d and the remaining service life of more than 10 years, located about 27 km southeast of the city.

Table III-4: Summary of Urban Environmental and Health Improvement Equipment

No	Description	Quantity	Remark
1	High pressure urban street cleaning vehicle	2	
2	Rickshaw rubbish transport vehicle	4	
3	Street Water spraying vehicle	2	
4	Public toilets	10	
5	Garbage compress vehicle (8t)	8	
6	Mini garbage collection vehicle	10	
7	Trash bin	2500	For existing area
8	Garbage container	2900	For existing area
9	Street sweeping vehicle	6	for exiting area
10	Construction wastes recycling machine	1	Construction wastes recycling

Source: Draft FSR

85. **Intelligent Transportation Systems (ITS) Traffic Management and Control.** In comparison to other developed cities in the PRC, there are very limited traffic management and traffic control facilities in the project city/counties. In addition to the regular traffic lights, markings and signals there is no advanced traffic control system such as traffic monitoring system, traffic condition display, red light violation monitoring system, etc. In order to improve the urban traffic safety and traffic congestion condition, the project will include the ITS traffic management and traffic control subcomponent to help improving the traffic condition in the existing urban areas. The subcomponent will include traffic monitoring system, red light and speeding violation monitoring system, real time traffic condition displays by installation GIS system CCTV camera, Infrared radar detectors and Internet Information Server, etc.

(2) Component II – Lufeng Urban and Environment Improvement

(a) Subcomponent of Lufeng Urban Infrastructures Development

86. **Urban roads.** The project will construct six urban roads with a total length of 7.546 km, including five main roads and a secondary road. Two small bridges will be required. The project area is in the north of the existing urban area. The proposed roads will connect to the existing road network to form a completed road network in the town. **Table III-5** shows the summary of the proposed roads and bridges.

87. **Auxiliary piped facilities.** The project will include auxiliary piped facilities including water supply pipes, stormwater drainage and sanitary sewers, street lighting, power supply, communication lines. These facilities will be constructed together with the roads construction (**Table III-6).**

Table III-5: Proposed roads and bridges in Lufeng County

No	Name	Road Grade	Design Speed (km/h)	Design Live Load	Length (m)
1	No. 1 Road	Trunk	40	BZZ-100	1,549
	No. 1 Road Bridge (46 m)	2 span void slab			
2	No. 2 Road	Secondary	30	BZZ-100	1,393
	No. 2 Road Bridge (46 m)	2 span void slab			
3	No. 3 Road	Trunk	30	BZZ-100	1,001
4	Zhuluoji Avenue Extension	Trunk	40	BZZ-100	1,001
5	Shiji Avenue Extension	Trunk	30	BZZ-100	1,001
6	Jinshan Nan Road Extension	Trunk	40	BZZ-100	1,562

Table III-6: Proposed auxiliary piped facilities in Lufeng County

No	Type	Diameter (mm)	Length (m)	Material
1	**Water Supply pipe**	150	15,939	PE
2	**Storm water pipe**	200	1,099	HDPE
3		300		HDPE
4		400		HDPE
5		500	3,591	HDPE
6		600	3,333	HDPE
7		800	3,424	RCP
8		1000	3,539	RCP
9		1200	1,271	RCP
10		1400	837	RCP
11		1800	532	RCP
		2000	1,002	RCP
		Total =	18,628	
12	**Sewer pipe**	300	11,080	HDPE
13		400	4,421	HDPE
		Total	15501	

88. A new water supply piping network will be installed in the project area and connect to the existing water supply network. Currently, there is one water supply plants (WSP) in Lufeng County,

namely Qingyangshan WSP with a capacity of 15,000 m^3/day. The current water demand for the urban area is about 12,000 m^3/day, and the current water supply capacity is adequate for the new urban area. In accordance with the city water supply master plan, a new water supply plant, No. 2 WSP, with a capacity of 40,000 m^3/day will be built within next five years. Currently the preparation of the new WSP is in progress. The planned water supply capacity is compatible with the planned urban development.

89. A separated stormwater and sanitary sewer drainage system will be built in the project area. For the stormwater system, new stormwater drainage pipe will be installed along the new roads and connected to the existing stormwater piping network or discharged into the nearby river. A total of 18.6 km stormwater drainage pipe will be installed as shown in **Table III-6**.

90. The new sanitary sewer pipes will be installed in the new urban area, and connected to the exiting sewer trunk pipes in Shiji Avenue and Zhuluoji Avenue, which are connected to the existing wastewater treatment plants (WWTP). There is a WWTP located in Jinshan Township. The current wastewater treatment capacity is 20,000 m^3/day and it will be expanded to 40,000 m^3/day in according to the wastewater master plan. The existing capacity is adequate to take the sewage discharge from the proposed project area as it is layout in the city sewer master plan. A total of 15.5 km of sanitary sewer pipe will be installed (**Table III-6**)**.**

91. There are three villages of Dabeichang, Xiaobeichang, and Shangying around the project area. The project will improve the living environment of these villages by providing sanitary sewer collections. Currently in the villages, there is no public sewer system. An open ditch system for both sewage and stormwater is present in the villages. The residents discharge the sewage into the ditches along the roads directly and the untreated sewage eventually discharges into the nearby river system. During the rainy days, the open ditch system is also used to discharge the stormwater. The living environment is pretty bad with the untreated sewage flowing in the village, especially during the summers when the odor from the sewage can be felt throughout the village. In order to improve the sewer condition for the existing residential area, **sewer interceptors** will be installed where the new roads intercepting the existing sewer ditches, such as at No.1 Road and Shiji Avenue Extension. The interceptors consist of an overflow chamber to intercept the sewage flow to be discharged into the public sewer system during regular days and will let the stormwater overflow to discharge into the river system during the rainy days. The proposed sewage interception system will reduce the amount of the untreated sewage discharged into the river system and improve the living condition of the villages of Dabeichang, Xiaobechan and Shangying significantly.

92. The road construction and new urban area development will cover the earth with impermeable materials such as concrete, asphalt, etc. which will cause the surface runoff with the pollutants from the streets flows into the river in the downstream at faster speed and bigger volume in comparison to the undeveloped condition where the runoff will take much longer time flowing through the grass or earth surface and infiltration. A **stormwater detention pond** is an effective way to control the runoff discharge rate. The detention pond will collect and store the runoff and discharge it at a controlled low rate that is equivalent to the pre-development condition. A multi-pond system can be included for water quality treatment to remove the pollutants from the first 30 minute rain, in which the urban street pollutants from the vehicle is brought to the pond by the rain water. A multi-pond stormwater detention system is included in the project. The key design parameters are shown in **Table III-7**, the plan and front bay section of the detention pond is shown in **Figure III-10** and **Figure III-11**, respectively.

Table III-7: Design Parameters of Stormwater Detention Pond in Lufeng

Pond Design	Function
Pond volume = 68135 m^3	
Front bay I = 10810 m^3	Pollutants removal
Front bay II = 10810 m3	Pollutants removal
Main pond = 46516 m^3	Discharge rate control

(Source: PPTA Consultants)

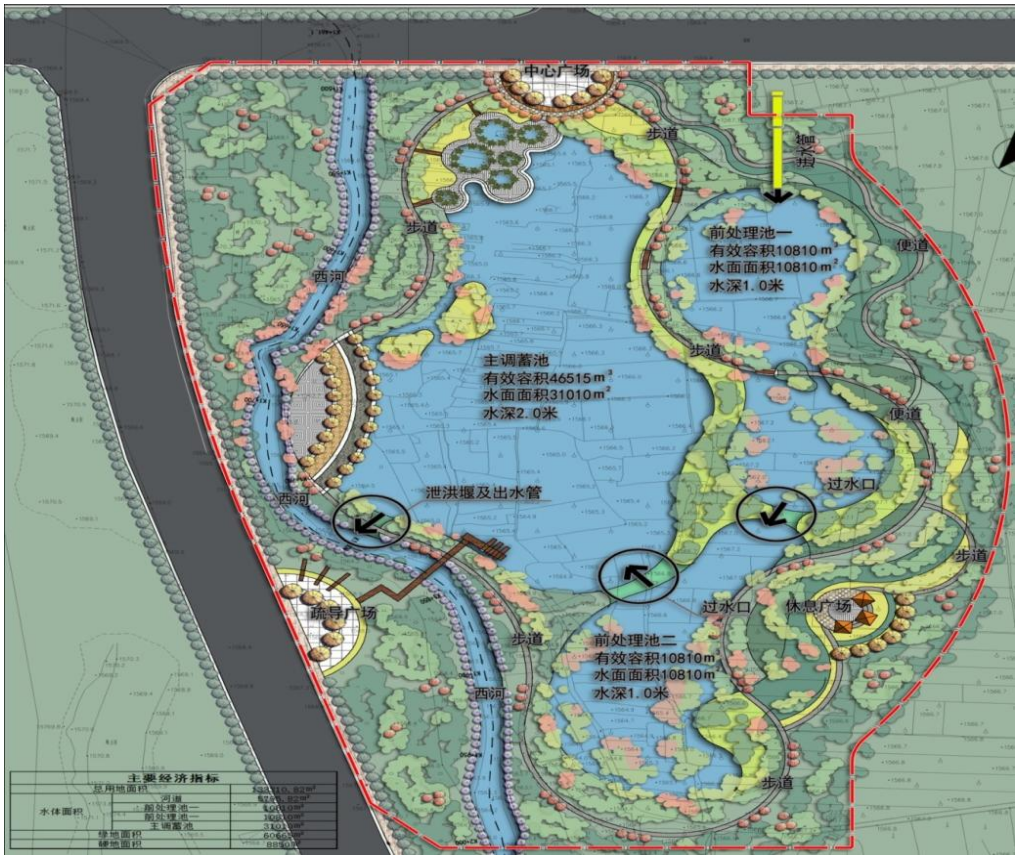


Figure III-10: Stormwater Detention Pond System in Lufeng

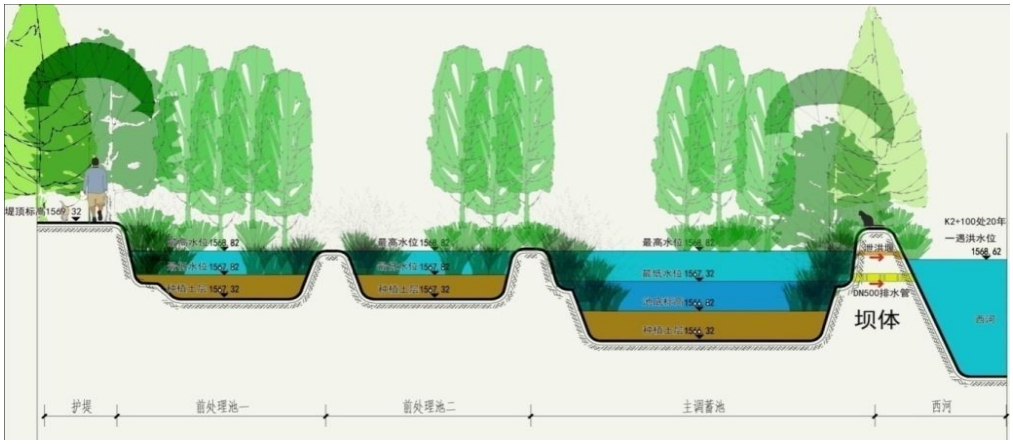
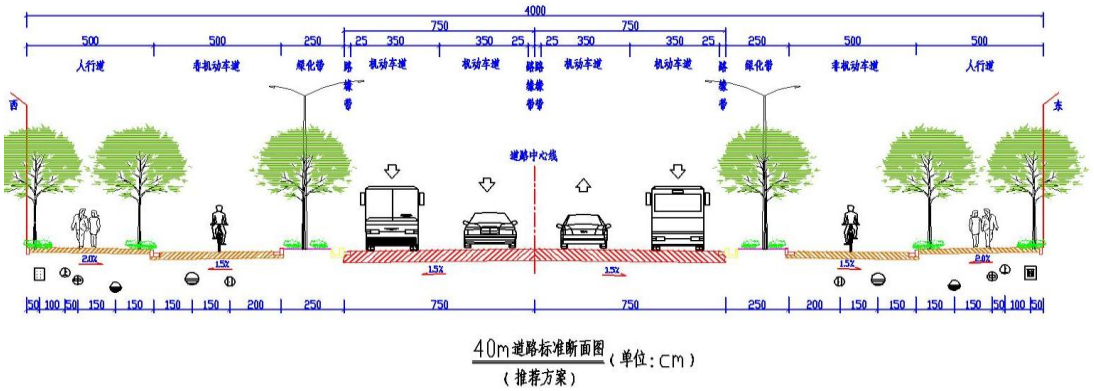


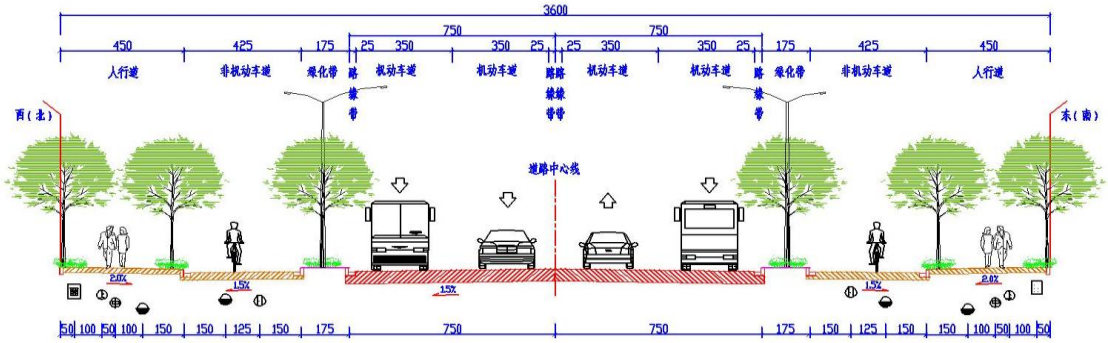
Figure III-11: Cross Section of Stormwater Detention and Front Bays in Lufeng

93. **Non-motorized transport.** Lanes will be provided for non-motorized vehicles and pedestrians (**Figure III-3**). These lanes also provide, to some extent, environmental and public health buffer between the road traffic and road side developments. To facilitate safety of non-motorized vehicles and pedestrians in crossing new and existing road junctions, traffic channelization at junctions will be implemented.



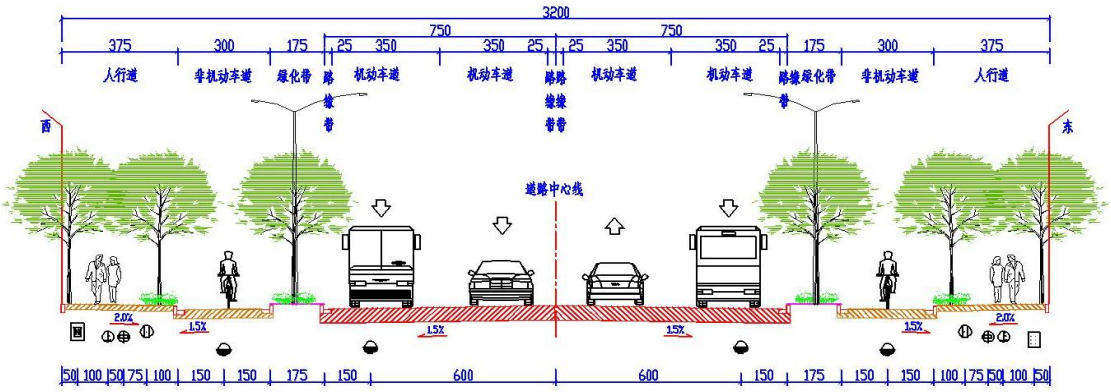
40m道路标准断面图（单位：cm）
（推荐方案）

Figure III-12: Cross-sections of Zhuluji Avenue in Lufeng 3



36m道路标准断面图（单位：cm）
（推荐方案）

Figure III-13: Cross-sections of No. 1 Road, Shiji Avenue and Jinshanna Road in Lufeng



32m道路标准断面图（单位：cm）
（推荐方案）

Figure III-14: Cross-sections of No. 3 Road in Lufeng

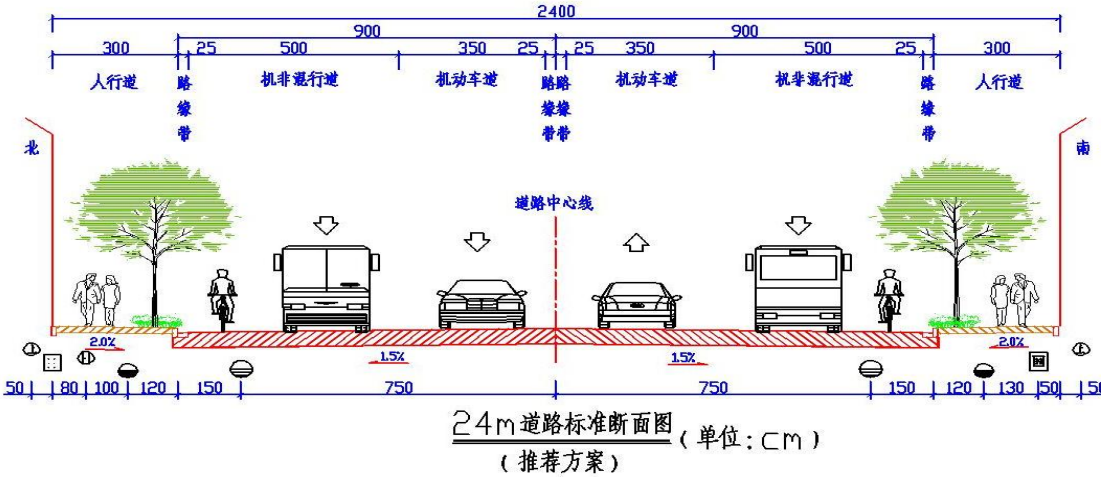


Figure III-15: Cross-sections of No. 2 Road in Lufeng

(b) Municipal Solid Waste Management

94. Currently in Lufeng, the municipal solid waste management is handled by Lufeng Environmental and Health Station, a government agency. The current urban area serviced by the bureau is about 7.96 km^2 with the serviced population of about 80,000. The station is currently handling about 80 tons of rubbish daily. In order to enhance the current MSW management system and improve the urban environment, especially in the aspect of implementing 3R principle, the following project components have been included:

(i) **Introducing MSW Recycling** - In considering the high percentage of the construction waste due to heavy construction activities in most of the urban area, the construction waste recycle machine will be introduced to the municipal SWM unit. The machine can sort the construction waste and produce usable construction materials for backfill, road construction, building construction, etc. The produced material also can be used at the sanitary landfill sites for covering and compacting garbage transported to the site each day. The use of the recycle machine can effectively reduce the MSW to be transported and disposed and reduce the cost for transportation and landfill development and maintenance.

(ii) **Improve Garbage Collecting and Increase Urban Trash Collection Coverage** - adequate numbers of trash bins in conjunction of public education and public awareness for urban cleanness and environment improvement will help to improve the urban environment and health condition, reducing littering and random trash dumping. In addition to increase the numbers of trash bins and garbage barrels, a new type of movable garbage collection container system will be also installed in the selected urban area. The movable container is a closed steel box with openings and lids. The garbage can be dumped in the container and sealed with the lid with minimum impact to the surrounding area. After the container is filled, a special truck will lift and transport the entire container to the landfill site.

(iii) **Street Cleaning and Garbage Transport** - the project will upgrade the fleet with new street cleaning vehicles, water spray vehicles, street sweeping vehicles, garbage transport vehicles, etc. Some of the garbage transport vehicles will have compaction capacity so that the garbage is compressed before transporting to the landfill site. The compaction truck is more efficient and saving fuel cost in hauling the MSW.

(iv) **Movable Public Toilets** - The project will provide the movable public toilets so that they can be used during the public events when more people coming to the town.

95. Based on the evaluation of the needs, a package for improving urban environment and health for Chuxiong has been developed and shown in **Table III-8.**

Table III-8: Municipal Solid Waste Equipment, Lufeng

No	Description	Unit	Quantity	Remark
1	Garbage container (60L)	EA	252	for proposed area
2	Garbage compactor truck (8t)	EA	4	
3	Human waste transport truck	EA	2	
4	Water spay truck	EA	2	
5	Street sweeping vehicle	EA	10	
6	Garbage collection & transport Vel	EA	5	
7	Construction waste recycle machine	Set	1	
8	High pressure street sweeping	EA	1	
9	Mini street sweeping vehicle (3t)	EA	10	
10	Dust vacuum vehicle	EA	2	

(Source: PPTA Consultants)

96. Waste collected with equipment procured by the project will be disposed in a sanitary landfill located in Libentian Valley, 10 km away from Lufeng County Town. The landfill has a total area of 8.67 ha, a total volume of 516,600 m^3, and a daily disposal capacity of 80 tons. The designed service life is 15 years. The landfill was put into operation in May 2012. The facilities include waste transfer stations and leachate treatment facilities. The landfill was approved by Yunnan Provincial DRC, EPD and the Department of Construction and Housing. The landfill meets the requirements of the National Standard for Municipal Solid Waste Landfills (GB16889-2008, replacing GB16889-1997).

(c) West and East Rivers Rehabilitation

97. The river system in Lufeng is well developed with three rivers running through the urban area. The East River is the upper reach of Xingsu River, which is a main tributary to Yuan River. The length of the East River is 74 km and the watershed area is about 733 km^2. The West River is a Class I tributary to Xingsu River. The length of the river is 61.8 km and the watershed area is about 418 km^2. The South River is also a Class I tributary to Xingsu River with a total length of 19.7 km and the watershed area of 193 km^2. At Lufeng urban area, the East River flows from east to west, the West River flows from north to south, the South River flows from south to north, and all three rivers meet at the southwest of the urban area and join the Xingsu River. The river system as well as the proposed river rehabilitation component is shown in **Figure III-16.**

98. The river rehabilitation will be integrated with the urban development. According to the urban development master plan, the area along these rivers will be developed as the urban open space with landscaping, lawn and trees. The open space will prove a place for the urban residents for recreation activities and relax and it will bring in positive impact to the urban development. Therefore, in addition to the flood protection requirements, the area along the rivers will be designed with trails, trees, lawn, and other landscaping features. The project limits for the river rehabilitation are corresponding to the new urban development in the proposed project. The limits of the West River rehabilitation is from the confluence with the South River to the north of No.1 Road with a total length of 4.08 km. The limits for the East River is from the confluence with the West River to the east edge of Lufeng urban area with a total length of 2.0 km. The total river rehabilitation length is 6.08 km. The design criteria and key design parameters are summarized in **Table III-9.**

99. Both East and West Rivers are major river systems with significant flows during the rainy seasons. According to the national flood control standards, the design flood for the river system in the urban area is 20 years. Based on the alternative study results, a precast concrete modular river embankment system will be used for the lower part of the river embankment for normal water level, and the upper part will use earth embankment with grass stabilization. The system is similar to that used in Chuxiong Longchuan River Rehabilitation, Section 3.

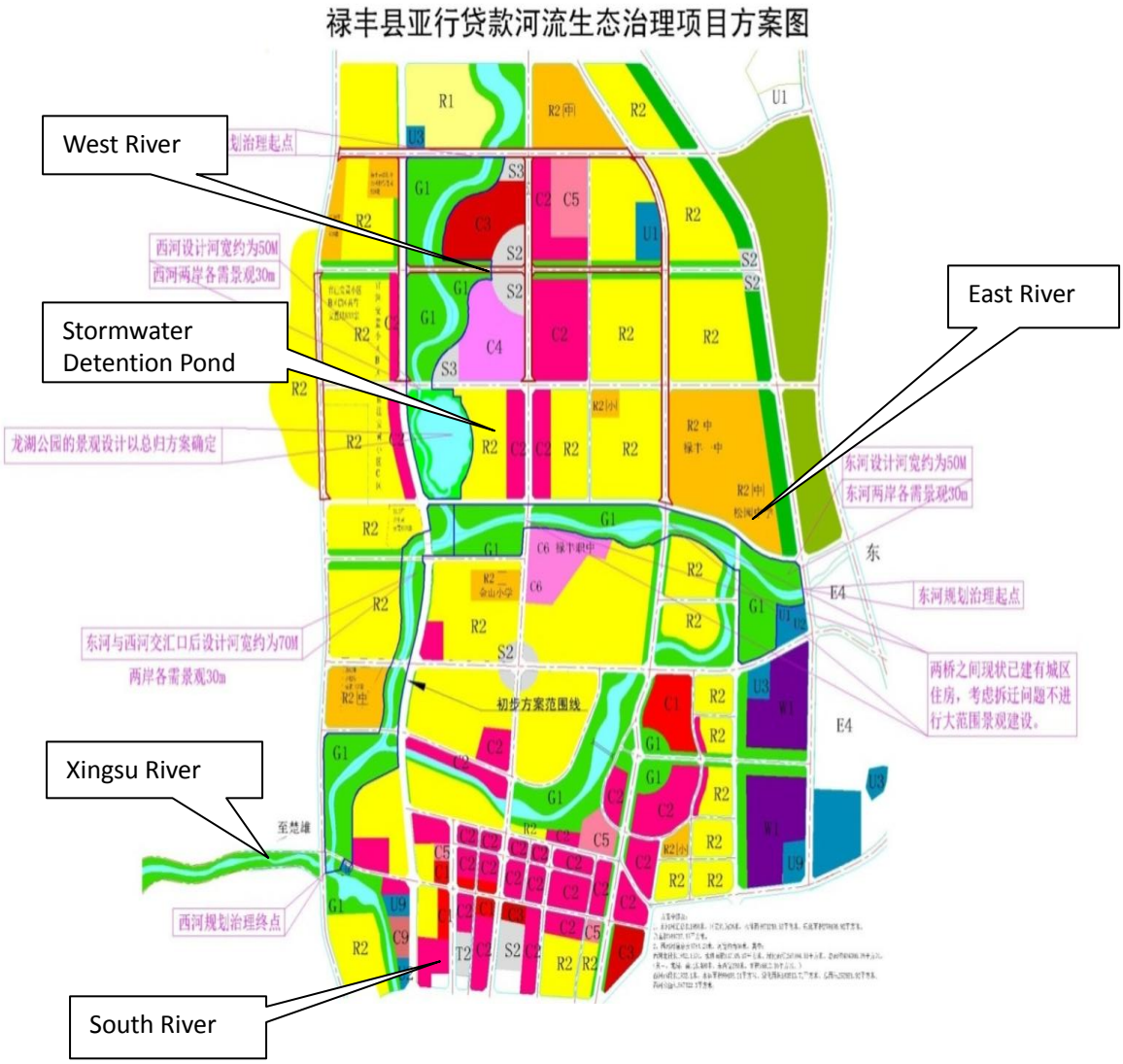


Figure III-16: Lufeng River Rehabilitation

Table III-9: River Rehabilitation Limits and Design Criteria

Rehabilitation Length:	6.08	km
East River:	*2.00*	Km
West River:	*4.08*	Km
Design flood:	20	year
Design service life:	20	year
River channel width:		
East River (before confluence):	50	m
West River (before confluence):	50	m
West River (after confluence):	70	m
Control flow rates:		
East River (2% slope):	566	m^3/s
West River (2% slope):	597	m^3/s
West River after confluence:	1056	m^3/s

(Source: PPTA Consultants)

100. **Associated development.** During project preparation, Lufeng Municipal Government received a special funding from the Ministry of Water Resource (MWR) to upgrade the river embankment for flood control for East River, West River, South River and Xingsu River. The scope of the river rehabilitation is limited only to the river channel embankment without the surrounding urban open space area. This special funding project was mandated to be completed before the rainy season of 2013. The design of the river embankment was reviewed by the PPTA consultant and the gabion river embankment was used, which is consistent with the concept of ecologically friendly structure type and the design is compliance with ADB environmental and ecological protection requirements. The MWR funded project in the West River overlaps with ADB project for about 2.5 km. Based on the design review, it is concluded that the MWR project can be integrated with the project ADB project. The MWR project will rehabilitate the river embankment for the overlapping part, and the ADB project will complete the remaining works for embankment rehabilitation, urban open space development, landscaping and other site works. An EIA for the project financed by MWR has been conducted, which was shared with, and reviewed by, the PPTA consultant. The EIA was approved by the Lufeng County EPB on June 28, 2013.

River Early Flood Warning System

101. The existing flood warning system in Lufeng will be enhanced as follows:

(i) Establishment of Flood Warning Coordination Center – a flood warning coordination center will be established in the office building of Lufeng Water Resource Bureau as the control center for the enhanced flood warning system.

(ii) Establishment of Additional Water/Rainfall Monitoring Stations – additional automatic water/rainfall stations will be added at Shiman Reservoir, East River, and West River to supplement and improve the existing system.

(iii) Establishment of Real-time Video Monitoring System – a real-time video monitoring system will be installed along the river at all sensitive and key locations. The camera will have infrared capacity so that they will be functional during both days and nights. A total of 10 cameras will be installed along East and West Rivers. The video image will be transmitted to the control center vs. fiber optical cables to be constructed along the river, and the solar power system will be used to operate the cameras.

(iv) Establishment of Wireless Flood Warning Broadcasting System – the wireless warning system will broadcast the flood warning information to the public in a wide range of format such as voice, cell phone, FM signals, etc. in the event of flooding. A total of 3 wireless warning broadcasting stations will be established in Lufeng County (**Figure III-17**).

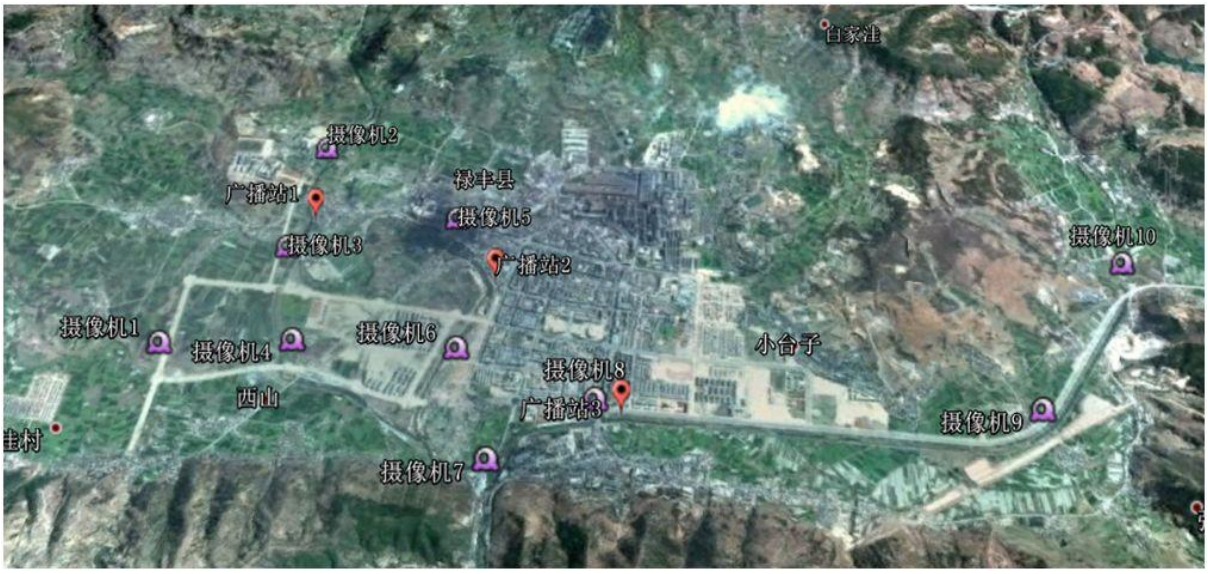


Figure III-17: Layout of monitoring points and wireless broadcast stations in Lufeng County

(3) Component III – Wuding Infrastructure and Environment Improvement

(a) Wulong River Rehabilitation and Flood Control

102. The Wulong River rehabilitation component will strengthen the banks of the river while maintaining the actual water channel, which varies in width from 10 to 20 m. The left river bank, which is a natural earth bank with good vegetation, will be retained with some minor erosion prevention at the edge of the channel and some necessary bank reinforcement. The right bank, which consists of some small hills and some low points, some earth embankment will be built at the low points between the hills. The design criteria for the river rehabilitation are shown in **Table III-10**.

Table III-10: River Rehabilitation Criteria in Wuding County

Item	Design Parameter
Rehabilitation length:	2.59 km
Design flood:	1-in-20 years (46.8 m^3/s)
Design service life:	20 year
River channel width (average):	10-20m (15 m)

Source: the FSR

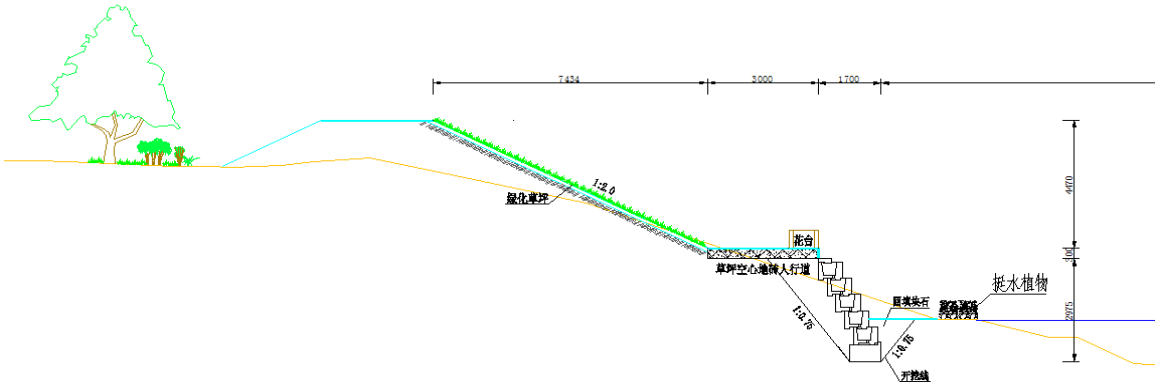


Figure III-18: Proposed river cross-section in Wuding

(b) Flood Warning System

103. The existing flood warning system in Wuding County will be enhanced in order to meet the flood warning and flood protection needs for the proposed project areas. The enhancement of the current flood warning system will include:

(i) Establishment of Flood Warning Coordination Center – a flood warning coordination center will be established in the office building of Wuding Water Resource Bureau as the control center for the enhanced flood warning system.

(ii) Establishment of Additional Water/Rainfall Monitoring Stations – additional automatic water/rainfall stations will be added at 5 reservoirs, namely Huzongcun, Zhongganhe, Tuguadi, Shangxiangshuiqing and Ganbazhuang. And 2 monitor stations will be added at Wulong River with one at the upper stream and another at the confluence with Caiyuan River.

(iii) Establishment of Real-time Video Monitoring System – a real-time video monitoring system will be installed along the river at all sensitive and key locations. The camera will have infrared capacity so that they will be functional during both days and nights. A total of 10 cameras will be installed along Wulong and Caiyuan Rivers. The video image will be transmitted to the control center vs. fiber optical cables to be constructed along the river, and the solar power system will be used to operate the cameras.

(iv) Establishment of Wireless Flood Warning Broadcasting System – the wireless warning system will broadcast the flood warning information to the public in a wide range of format such as voice, cell phone, FM signals, etc. in the event of flooding. A total of 3 wireless warning broadcasting stations will be established in Wuding County **(Figure III-19).**

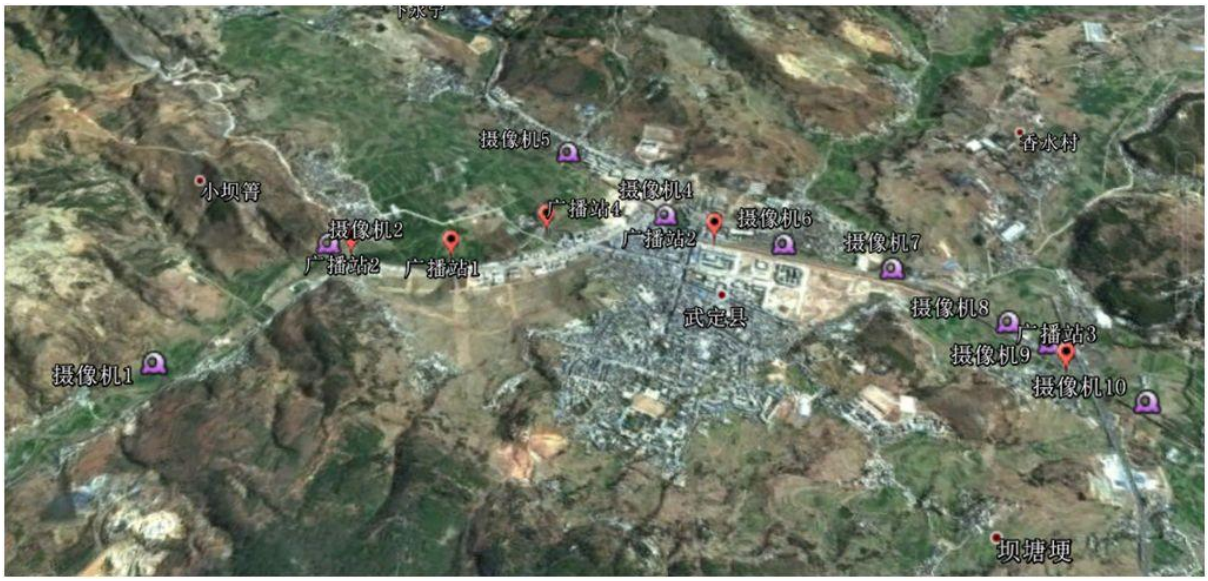


Figure III-19: Layout of monitoring points and wireless broadcast stations in Wuding County

(c) Wuding Urban Infrastructures Development

104. **Urban roads**. The project will construct nine urban roads with a total length of 9.4 km, including 5 small bridges. The proposed roads will be connected to the existing roads to form a completed road network in the county. **Table III-11** shows the proposed roads and bridges, and the cross-sections of the roads are shown in **Figure III-20, Figure III-21, Figure III-22,** and **Figure III-23.**

Table III-11: Summary of roads and bridges in Wuding County

No	Road/bridge	Road Grade	Design Speed (km/h)	Design Live Load	Length (m)
1	Beicheng Avenue	Urban Major	40	BZZ-100	1,559
	Bridge over Wulong River (No.4)	PS Box Beam (20m)		Road – II	
2	Chengbei Road	Urban Major	40	BZZ-100	1,268
	Bridge over Wulong River (No.1)	PS Box Beam (20m)		Road – II	
3	Mudan Road	Urban Major	40	BZZ-100	1,320
	Bridge over Wulong River (No.2)	PS Box Beam (20m)		Road – II	
	Bridge over Caiyuan River	PS Box Beam (66m)		Road – II	
4	Caiyuan Road	Urban Major	40	BZZ-100	607
5	Wuzheng Road	Secondary	30	BZZ-100	924
6	Wuji Road	Secondary	30	BZZ-100	850
	Bridge over Wulong River (No.3)	PS Box Beam (20m)		Road – II	
7	Wuchan Road	Secondary	30	BZZ-100	1,347
8	Binhe Road	Secondary	30	BZZ-100	1,188
	Bridge over Wulong River (No.5)	PS Box Beam (46m)		Road – II	
9	Access Road	Branch	20	BZZ-100	343
				Total =	**9,404**

PS = Pre-stressed; Source: PPTA Consultants

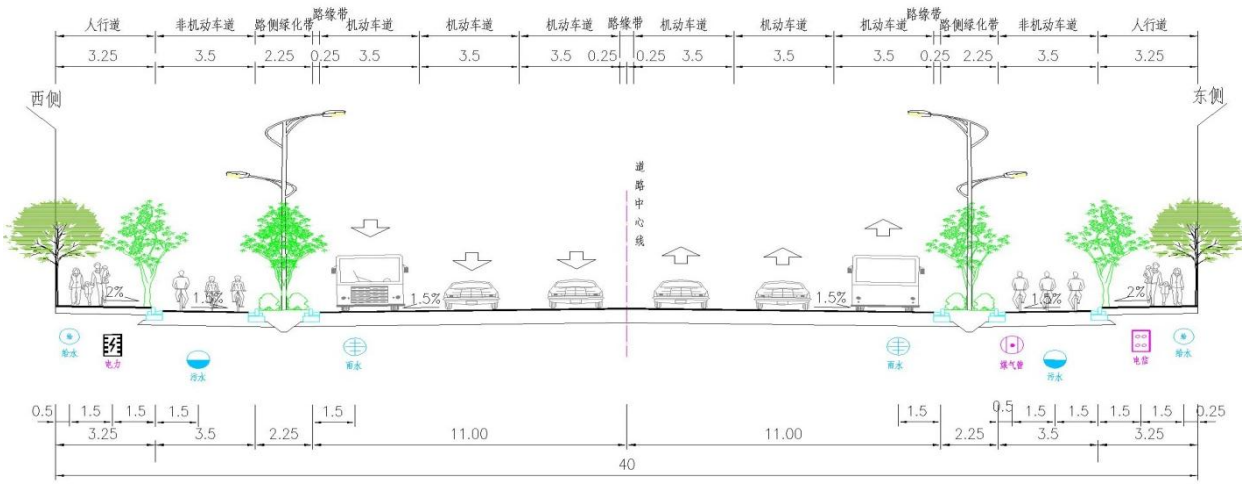


Figure III-20: Cross Section of Beicheng Avenue

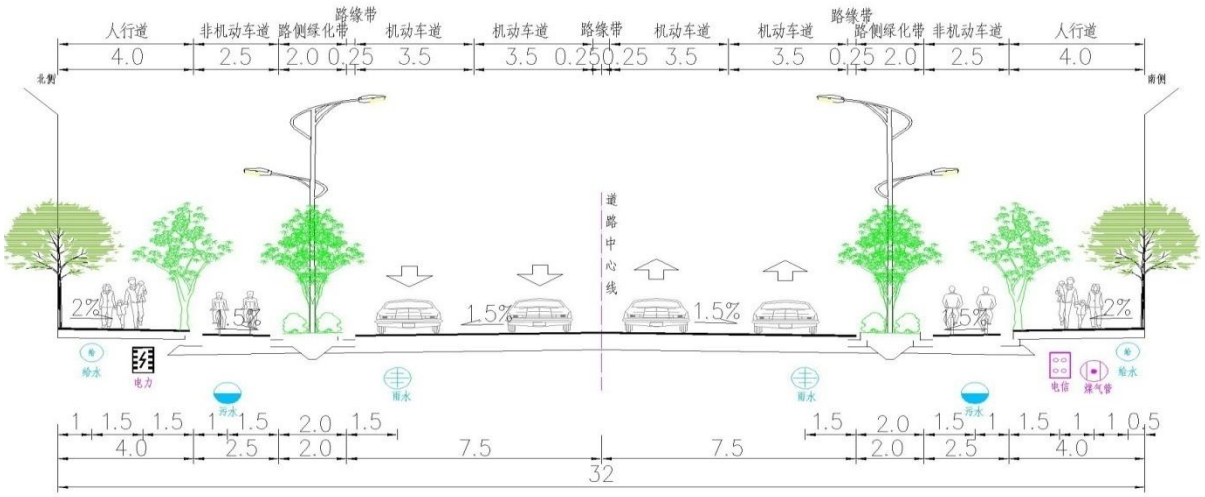


Figure III-21: Cross Section of Chengbei Road

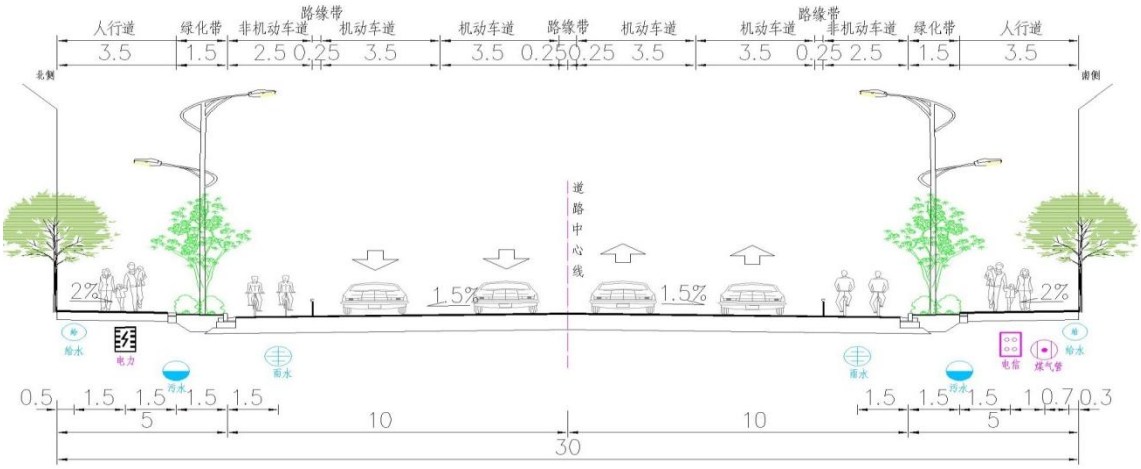


Figure III-22: Cross Section of Mudan Road

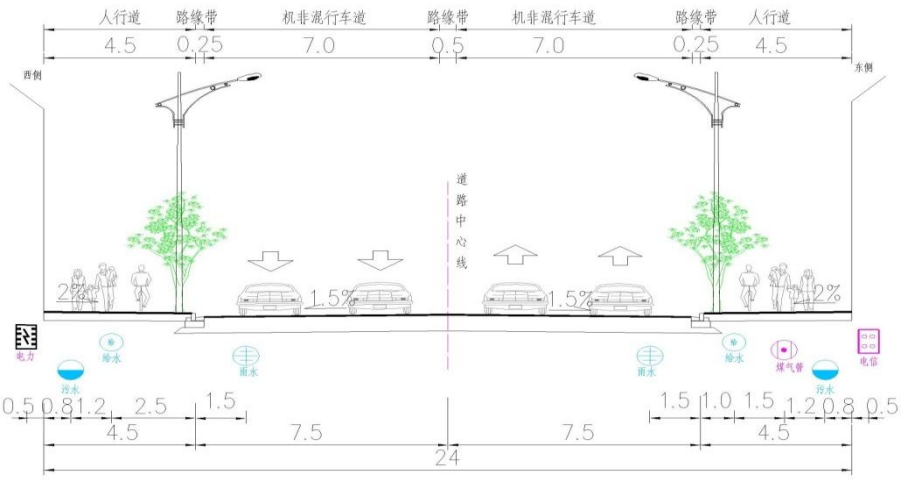


Figure III-23: Cross Section of Caiyuan Road

105. **Auxiliary piped facilities**. The project will also construct municipal facilities including water supply pipeline, stormwater and sewer pipelines, street lighting, and power lines, which will be constructed together with the roads construction. The pipes are summarized in **Table III-12**.

Table III-12: Proposed auxiliary piped facilities in Wuding County

No	Type of pipe	Diameter (mm)	Length (m)	Material
1	Water supply pipe	100	7,502	PN
2		150	9,275	
3		200	635	
4		250	479	
		Total =	17,891	
5	Stormwater pipe	200	774	HDPE
6		300	12,523	HDPE
7		400	2,241	HDPE
8		500	2,190	HDPE
9		800	704	HDPE
10		1000	26	HDPE
11		1200	24	HDPE
		Total	29,339	
12	Sewer pipe	300	11,712	HDPE
13		400	1,641	HDPE
		Total	13,353	

Source: the FSR

(d) Environmental Sustainability Improvements

106. Currently, the municipal solid waste management is handled by Wuding Environmental and Health Station, a government agency. The current urban area serviced by the bureau is about 14.0 km^2 and the serviced urban population is about 30,000. The station is currently handling about 60 tons of MSW daily. In order to enhance the current MSW management system and improve the urban environment, especially in the aspect of implementing 3R principle, the following project components have been included:

(i) Improve Garbage Collecting and Increase Urban Trash Collection Coverage - adequate numbers of trash bins in conjunction of public education and public awareness for urban cleanness and environment improvement will help to improve the urban environment and health condition, reducing littering and random trash dumping.

(ii) Movable Public Toilets - The project will provide the movable public toilets so that they can be used during the public events when more people coming to the town.

107. Based on the evaluation of the needs, a package for improving urban environment and health for Wuding has been developed and shown in **Table III-13.**

Table III-13: Environmental and Health Improvement Package for Wuding

No	Description	Unit	Quantity	Remark
1	Garbage compactor vehicle (8t)	EA	3	
2	Movable toilet	EA	1	
3	Trash bins	EA	624	
4	Garbage barrel	EA	198	

(Source: PPTA Consultants)

108. **Waste disposal.** The project will result in increased amounts of waste collected. The collected waste will be transported to, and discharge in, the municipal landfill. The landfill is located in Yanjiaoqing Area, Yangjiu Village, 23 km northeast of Wuding County Town. The landfill has a total area of 7.5251 ha, a total volume of 648,000 m3, and a daily disposal capacity of 80 tons. The designed service life is 16 years. The main construction of the landfill had been completed in September 2012, but the transfer stations and leachate treatment facility are still under construction. The Wuding County Urban Management Bureau confirmed that the landfill will be put into operation in June 2014. The landfill was approved by Yunnan Provincial DRC, EPD and the Department of Construction and Housing. The landfill is designed to meet the requirements of the National Standard for Municipal Solid Waste Landfills (GB16889-2008, replacing GB16889-1997).

(4) Component IV - Institutional Capacity Strengthening

109. The component will include (a) capacity building and institutional strengthening for the project management; (b) expert support and advice on storm water management, municipal solid waste management planning, urban transport management and road safety, (c) public awareness activities on road safety, solid waste recycling and participatory urban design and planning activities; and (d) training on public financial management especially on improve credit-rating and credit worthiness.

110. The component includes six subcomponents, which are listed in **Table III-14** below.

Table III-14: Summary of Institutional Capacity Building Component

No.	Subcomponent	Scope
1	**Project Implementation Support**	Providing management and technical support to CSPMO and IAs during the project implementation, including (i) bidding document preparation, (ii) contract management, (iii) construction supervision and quality control, (iv) preparation of project progress reports, (v) coordinating environmental and resettlement external monitoring, (vi) project performance management system (PPMS) monitoring and reporting, and (vi) assisting in claim and disbursement.
2	**Urban Transport Improvement**	Conduct (i) assessment of the current urban transport system in terms of road network planning, public transportation, pedestrian and bicycle traffic, parking management and traffic management; (ii) ITS and new technology applications; (iii) urban infrastructure management and maintenance; (iv) improvement of the project city/counties' master plans, infrastructure management and maintenance, and new technology application.
3	**Urban Traffic Safety Improvement**	Help the IAs improve their urban traffic safety by (i) traffic safety audit to identify safety concerns, and completion of traffic safety audit report; (ii) public traffic safety awareness and enforcement; and (iii) provide specific recommendations for improving traffic safety.
4	**Stormwater management**	(i) Provide training on stormwater management, (ii) technical support in stormwater management design; and (iii) introduce international best practices for stormwater management to the project city/counties.
5	**Financial Management Improvement**	Help the financial agencies of the project city/counties improve their financial management capacity by (i) provide training to the financial management staff of the EA and IAs, (ii) help establish and improve the financial management system, and (iii) conduct the EA credit worthiness evaluation and help to improve it.

Source: Draft Project Administration Manual, July 2013

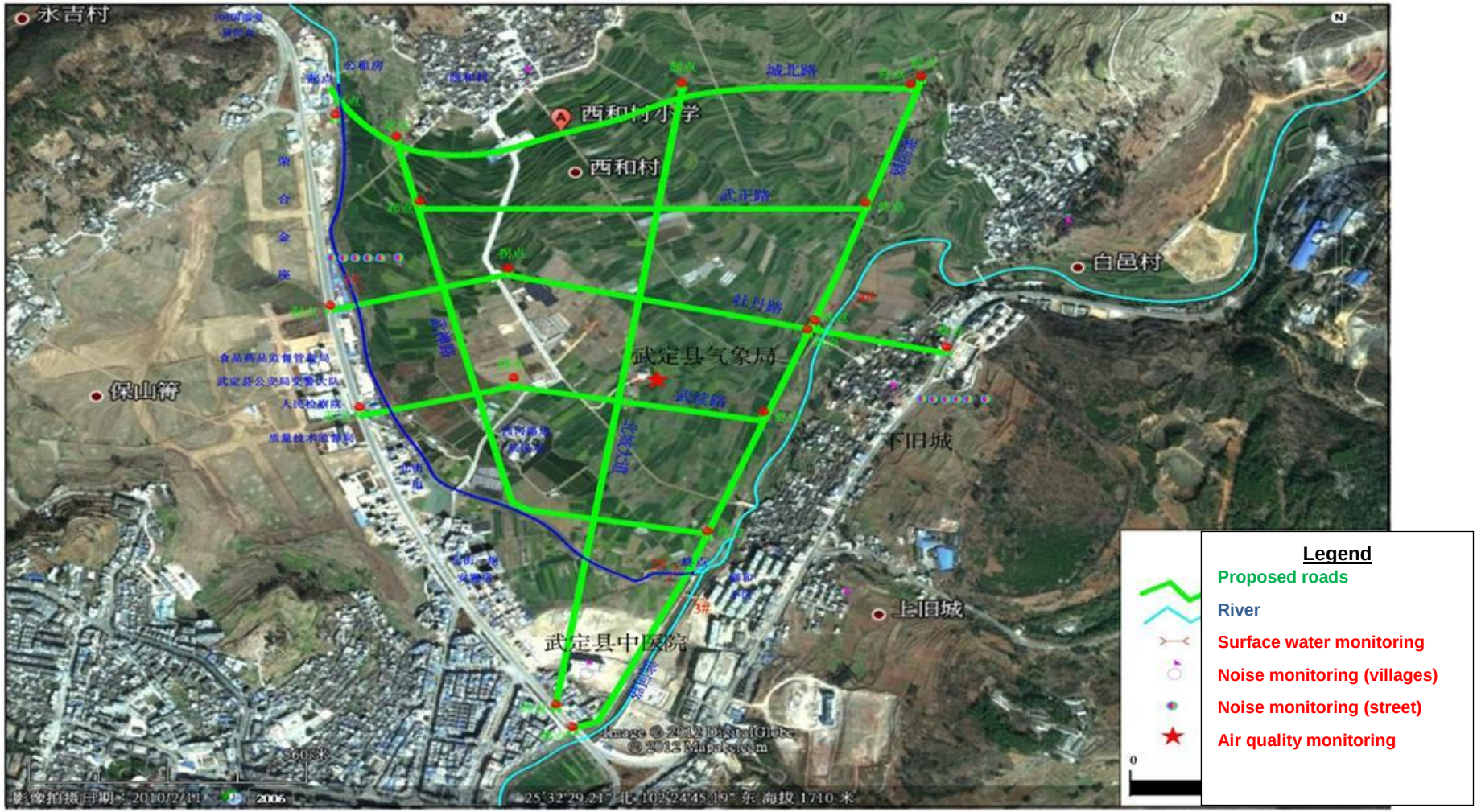


Figure III-24: Proposed roads, rivers; environmental baseline monitoring points, Wuding County

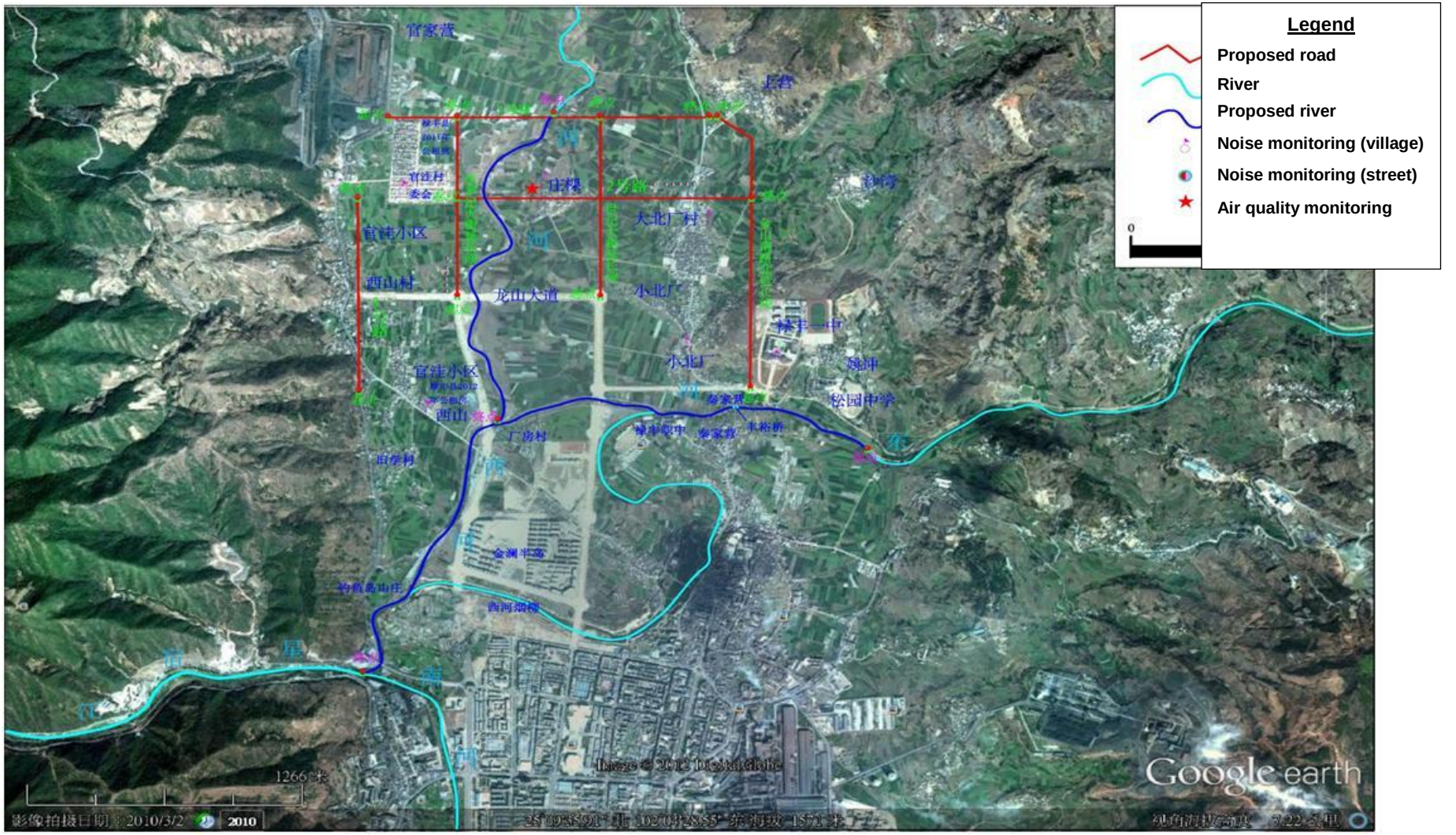
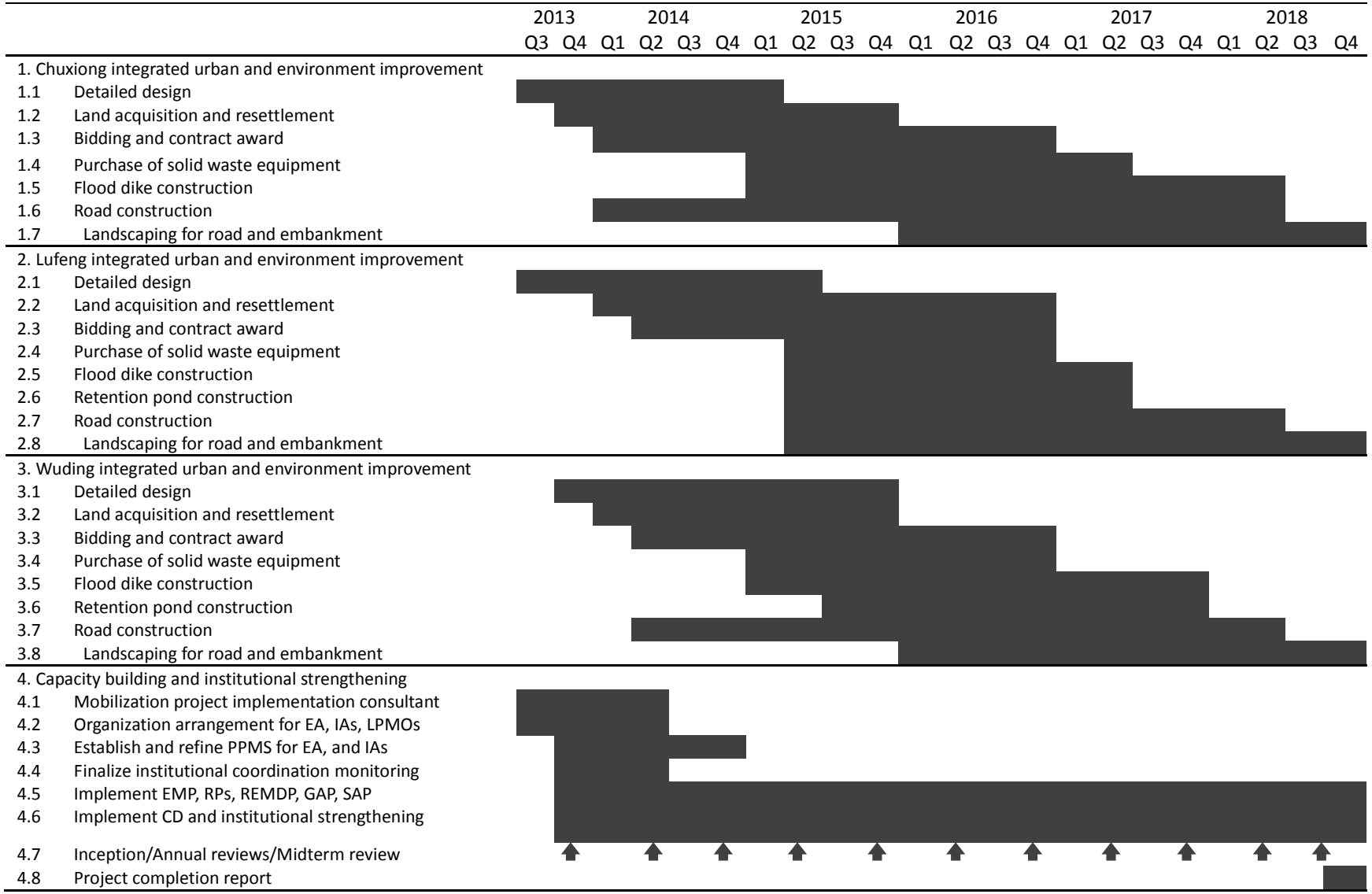


Figure III-25: Proposed roads, rivers; environmental baseline monitoring points, Lufeng County

Figure III-26: Proposed roads; environmental baseline monitoring points, Chuxiong City

Table III-15: Project Implementation Schedule



EA = executing agency, EMP = environmental management plan, EMDP = ethnic minority development plan, GAP = gender action plan, IA = implementing agency, PIU = project implementing unit, PPMS = project performance management system, Q = quarter, SAP = social action plan, RP = resettlement plan.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE)

111. The description of the environment (biophysical and socio-economic) in project areas before the project implementation establishes (i) the environmental setting within which the project will be implemented, and therefore the needs to be designed to suit, and (ii) the environmental values which will be changed (either negatively or positively) by the project. Both these roles are encompassed by the concept of the baseline environment.

A. Yunnan Province

112. Yunnan is the most southwestern province in the PRC. The provincial capital is Kunming, located in the center of the province. The province has an area of 394,100 square kilometers (km2), and the total population is about 46.31 million (2011). The province borders Guangxi and Guizhou provinces in the east, Sichuan Province in the north, and the Tibet Autonomous Region in the northwest. It shares a border of 4,060 km with Myanmar in the west, Laos in the south, and Vietnam in the southeast.

113. The northern part of the province forms part of the Yunnan-Guizhou Plateau. Yunnan is rugged, with mountainous areas covering most part of the province and accounting for about 84% of the entire area. The northwestern part of Yunnan includes Hengduan Mountain, which is extended from the Tibetan Plateau; the southern and eastern parts of Yunnan belong to Yunnan-Guizhou Plateau. The average elevation of the province is about 2,000 m above sea level (ASL). Cultivable land in Yunnan is limited. Most of usable and arable areas are basins of various sizes scattered in the mountainous area. There are about 1,445 basins in the province, with the largest over 700 km2 and the smallest smaller than 1 km2. The total area of the basins together with the water bodies is less than 6% of the total provincial area. Most cities and towns of the province are located in these basins.

114. Yunnan's climate is categorized as tropical or subtropical, with small annual temperature variations. The average temperature in summer is between 19-22℃ and that in winter is between 6-8℃. The area has abundant rainfall, especially during the summer, and the average annual precipitation is over 1,100 millimeters (mm). The province is a major tourism destination with many natural scenery spots and rich ethnic minority culture. The environmental and ecological conditions are good in comparison to many other parts of the PRC. The area has abundant water resources and the average amount per capita is about 10,000 m3, which is about four times the country average. In comparison to other PRC provinces, the favorable natural condition has made Yunnan, including its cities and towns, have comparatively high forest coverage and urban green space. Ecological urban development with adequate green space and landscaping has been one of the special characteristics for the cities and towns in the province.

115. Yunnan Province has the most ethnic minorities among all provinces in the PRC. The total ethnic minority population is about 15.3 million, accounting for 33% of the total population. Yi Minority is the largest group in the province, with a population of about 5.1 million. Other minorities include Hani, Bai, Dai, Zhuang, Miao, Hui, Lisu, and Lagu.

B. Chuxiong Yi Minority Autonomous Prefecture

116. The proposed project is located in Chuxiong Yi Minority Autonomous Prefecture, which is one of the sixteen (16) prefectures in Yunnan Province. It is located in the central part of Yunnan on the western part of the Yunnan-Guizhou Plateau. Its capital, Chuxiong City, is about 160km west of Kunming City. The total area of the Prefecture is 29,258 km^2 and it is bordered by Kunming in the east, Puer and Yuxi Cities in the south, Dali Bai Autonomous Prefecture in

the west, Lijiang City in the northwest, and Panzhihua City in the north. The Prefecture's jurisdiction includes Chuxiong City and nine counties including Lufeng, Wuding, Yuanmou, Muding, Shuangbai, Nanhua, Yongren, Dayao, and Yaoan. The total population was 2.62 million in 2009 with a total minority population of 887,000, accounting for 33.8% of its total population. Yi Minority, with a population of 718,000, is the largest one in the prefecture. The proposed project components will be located in Chuxiong City and the two counties of Lufeng and Wuding. Basic information about the project city and counties are presented in **Table IV-1**.

Table IV-1: Area and Population of Project City/Counties

City/County	Area (km^2)	Population (person)	Remark
Chuxiong City	4,433	588,620	
Lufeng County	3,536	422,770	
Wuding County	3,322	271,963	National Poverty County & ethnic minority autonomous county
Chuxiong Prefecture	29,258	2,542,465	
Yunnan Province	390,000	45,966,000	

Source: Communiqués of Sixth National Census of Chuxiong Prefecture, Chuxiong City, Wuding and Lufeng County, 2010; FRS, Yearbooks of Yunnan Province, Chuxiong Prefecture, Chuxiong City, Wuding and Lufeng County, 2011.

117. **Socioeconomic Profile of Project City/Counties.** Yunnan is one of the least developed provinces in China. As for increase rate, from 2006 to 2011, the income of both urban and rural residents in Chuxiong Prefecture had experienced rapid annual increase by 8% and 10.2%, respectively. However, they were significantly lower than that of the provincial and national average, which indicates that the income gap between the regions have been widened. Detailed income information is presented in **Table IV-2**. The detailed information of urban and rural poor in the project areas is presented in the PPTA Consultant's Report.

Table IV-2: Per Capita Annual Income (2011)

Region	Per Capita Disposable Income of Urban Residents (CNY)			Per Capita Net Income of Rural Residents(CNY)		
	2006	2011	Annual Increase (%)	2006	2011	Annual Increase (%)
Chuxiong City	11,468	19,417	11.1	2,668	5,145	14
Lufeng County	11,275	18,980	11	2,695	5,293	14.5
Wuding County	9,855	15,018	8.8	1,890	3,223	11.3
Chuxiong Prefecture	10,611	15,624	8	2,395	3,896	10.2
Yunnan Province	10,070	18,576	13	2,250	4,722	16
National	11,759	21,810	13.2	3,587	6,977	14.2

Source: Statistical Communiqués of the Nation, Yunnan Province, Chuxiong Prefecture, Chuxiong City, Wuding and Lufeng County, 2006, 2011.

Table IV-3: Urban and Rural Poor in Project Areas (2011)

City/County/ Prefecture/ Province	Urban Poverty Line (CNY/month)	Urban Poor (person)	Urban Poor in Urban Population (%)	Rural Poverty Line (CNY/month)	Rural Poor (person)	Rural Poor in Rural Population (%)
Chuxiong City	246	16,558	5	121	24,110	9.4
Lufeng County	246	15,291	10.25	121	23,693	8.7

Wuding County	246	9,758	16.7	121	18,954	8.9
Chuxiong Prefecture	246	81,705	9.5	121	156,452	8.57
Yunnan Province	248.32	931,455	5.76	122.43	4,034,236	13.54

Source: http://www.mca.gov.cn, the official website of Ministry of Civil Affairs of the PRC. Statistical Communiqués of Chuxiong Prefecture, Chuxiong City, Wuding and Lufeng County, 2011
Note: The urban and rural poor are the people covered by UMLSS and RMLSS.

118. **Ethnic Minorities Profile.** There are 26 ethnic minorities living in Chuxiong Prefecture, including Yi, Lisu, Miao, Dai, Hui, Bai, Hani, Zhuang, etc. As shown in **Table IV-4**, ethnic minority population accounted for 33.1% of the total population in Chuxiong Prefecture in 2010. Yi and Lisu are the largest and second largest ethnic groups in the Prefecture. Yi and Lisu have their own spoken and written languages. However, the written languages are not used widely by the ethnic public general.

Table IV-4: Ethnic Minorities Profile

City/County/Prefecture/ Province	Percentage of Majority (%)	Percentage Of Yi (the Largest Minority) (%)	Percentage Of the Second Largest Minority (%)
Chuxiong City	78.07	18.27	1.55 (Hui)
Lufeng County	76.41	16.93	4.23 (Miao)
Wuding County	47.24	30.05	10.82 (Lisu)
Chuxiong Prefecture	66.9	26.7	2 (Lisu)
Yunnan Province	66.63	10.94	3.55 (Hani)
National	91.5	--	--

Source: Communiqués of Fifth and Sixth National Census of the Nation, Yunnan, Chuxiong Prefecture, Chuxiong City, Wuding and Lufeng County, 2000 and 2010.

C. Chuxiong City

119. Chuxiong City is the capital of Chuxiong Prefecture. It is located at about 160 km west of Kunming with the total area of 4,433 km^2 and the urban area of 35.1 km^2. The city's total population was 588,620 in 2010 and 592,000 in 2011, among which the Yi Minority was 102,726, about 20.1% of the total. Chuxiong City is located in the middle of the Yunnan-Guizhou Plateau, in the Yuanjiang River and Jinsha River watershed area, at the longitude E100°35 ' - 101° 48' and latitude N24°30' - 25°15'. It is next to Lufeng County in the east, Shuangbai County in the south, Nanhua County in the west, and Mouding County in the north. The city sits in a basin with the size of 93 km in east-west direction and 82 km in north-south. The northwestern part of the city is higher than the southeast part, and the elevation of the city is between 1,700 - 2,300 m ASL.

120. The total GDP of the City was CNY19.44 billion in 2011 and the annual growth rate over the previous year was 12.5%. The annual per capita GDP was CNY32,821 ($5,294). The government revenue was CNY1.16 billion ($187.1million). The city's economy is supported by the major sectors of tobacco production, natural herbs, livestock and organic food, trade and tourism, and energy and metallurgy.

121. The national highway of G56 starts at Kunming, passes through Chuxiong, Dali, Baoshan, Longling, and eventually reaches Myanmar. The highway is one of the most important east-west corridors in the PRC and the key connection to western Yunnan, as well as Myanmar

and the GMS region. The city is the gateway to western Yunnan as well as Myanmar and southeast Asia.

122. Based on the 12th Five-Year Plan, the objectives of Chuxiong development are: (i) accelerate economic development by strengthening infrastructure construction and industrial productions of tobacco, metallurgy, biology and pharmaceutical production, organic food, tourism and new energy materials; (ii) improve living conditions; (iii) enhance the environment and nurture ecologically friendly development; and (iv) promote cultural heritage development.

123. **Urban Development Master plan.** The land basin at Chuxiong City is a narrow strip. According to the urban development master plan, the central zone is the old urban area at the middle section, which will continue to serve as the commercial, government, and residential center. The northern zone that has been developed over the last 10 years as the economic development and Yi ethnic minority cultural heritage development zone will serve as the city economic and tourism development center. The southeastern part of the city, referred as southern zone, will be developed into a new urban area for education facilities, commercial and market, organic food productions (**Figure IV-1**).

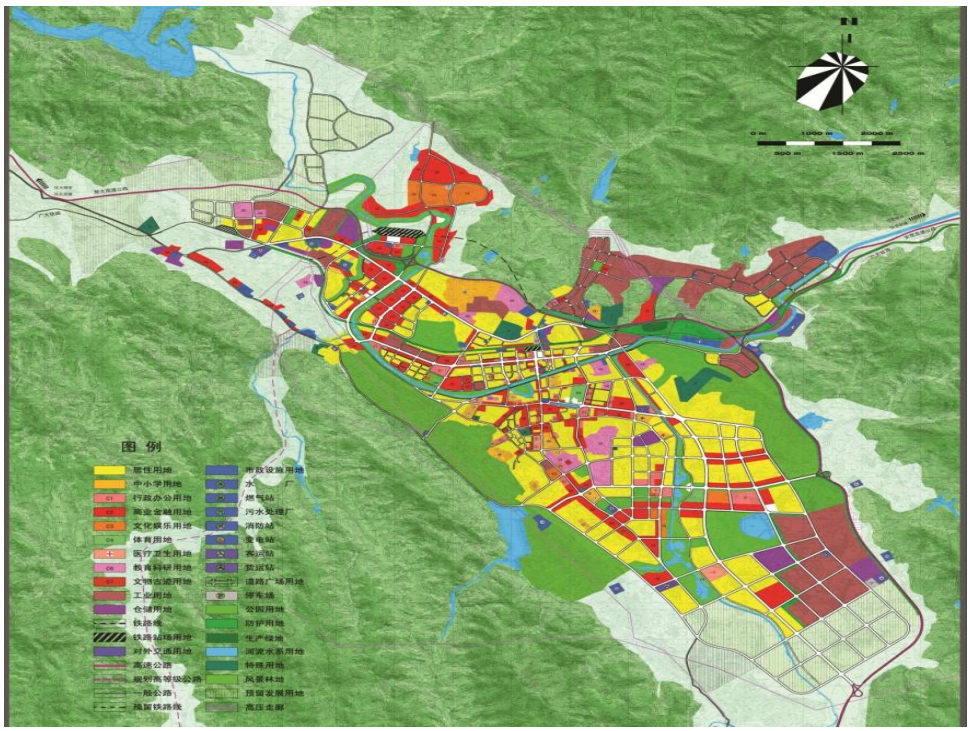


Figure IV-1: Chuxiong Urban Development Master Plan (2004-2020)

(a) Geography, Topography and Geology

124. **Geology.** The terrain in the city is essentially an area of mountains and intermountain basins. The major geological settings include the typical characteristics of sedimentary basins surrounded by hills and mountains. The rock-substrate is fractured and highly variable. The geology and slope stability often change considerably over very short distances. The surface earth consists of highly fractured and shattered rocks, including basalt, limestone, shale, sandstone, granite mixed with unconsolidated aggregates, clay, gravel, and highly unstable glacial/fluvial sediment.

125. **Soil, soil erosion.** The major soil types in the city include red soil, purple soil and paddy soil. May to October is period with highest soil erosion rates. The current annual erosion intensity is 480 tons per km^2 in the project area, which is classified as light to medium erosion according to the PRC's soil erosion classification. Results of hydrogeological survey show that groundwater in the project site is HCO_3^--Ca and HCO_3^--Ca.Mg type with pH = 7.8 to 8.0. Soil

analyses showed the soil has pH=7.0 to 7.3 and Cl^- = 42.3-58.9mg/L. The groundwater and soil will have weak corrosion effects on concrete reinforcement used in construction.

126. **Seismicity.** In the PRC's earthquake intensive zoning map, Chuxiong City is defined as a Grade VII earthquake zone. Determined based on the "Seismic Design of Buildings" of the PRC (GB50011-2001), the basic design earthquake acceleration is 0.15g in the city.

(b) Meteorology and Climate

127. Chuxiong City is located in a low-latitude subtropical monsoon climate zone, with warm and comfortable weather throughout the year. The weather features long sunshine hours, short frost periods, and distinct wet and dry season changes. The average yearly temperature is 15.6°C (**Table IV-5**). January is the coldest month with the extreme lowest temperature at -4.8°C, while July is the hottest month with the extreme highest temperature at 33.4°C. Chuxiong's average annual precipitation is 832mm. The rainy season, with about 80-90% rainfall in a year, lasts from May to October. The climate is very favorable for tree and vegetation growth, which provides an opportunity to develop more environmentally and ecologically friendly green urban areas in the city.

Table IV-5: Climate in Chuxiong City

No.	Parameter	Data
1	Average Temperature	15.6 ^oC
2	Inter-annual Precipitation Variation	370-1,290mm/yr.
3	Highest Temperature	33.4 ^oC
4	Lowest Temperature	-4.8 ^oC
5	Annual non-frost period	342 days
6	Average relative moisture	72%
7	Average wind velocity	1.6 m/s
8	Average wind velocity	1.8 m/s
9	Primary wind direction	South and Southwest

Source: Domestic FSR and EIA

(c) Ecological Resources

128. There are two river systems in Chuxiong, including the Jinsha River and Yuan River **(Figure IV-2).**

129. **Longchuan River** (included in the project scope) is a first grade tributary of the Jinsha River, and has a total length of 245 km with a catchment area of 9,225 km^2. The elevation difference of the river reach is 1725 m, the average gradient of the river bed is 5.1‰. It originates from Miheimen village in Wujie at Nanhua County. The sea elevation of the river origin is at about 2665 m. The Longchuan River has some large branches including the Zidian River, Mouding River, Pudeng River, Jingling River, etc. The river comes from the north of the city and runs through the downtown area before exiting the urban area toward the east. The river embankment in the existing urban area has been upgraded to resist 1-in-50-years floods, but the sections in the northern part of the city (designated as zones for agriculture, and economic and ethnic cultural development, respectively) are still in the natural state with flood protection standards below 1-in-10-years (**Figure IV-3**). The proposed subcomponent will strengthen two sections of the river upstream of the urban area to meet the flood control requirements of the respective zones.

130. There is another smaller river in the urban area, **Qinglong River**, a tributary of Longchuan River. It flows through the southeastern urban area of the city, where the proposed

urban infrastructure component will be located. Currently, the river channel does not have adequate capacity to handle floods of 1-in-10 years (**Figure IV-4**).

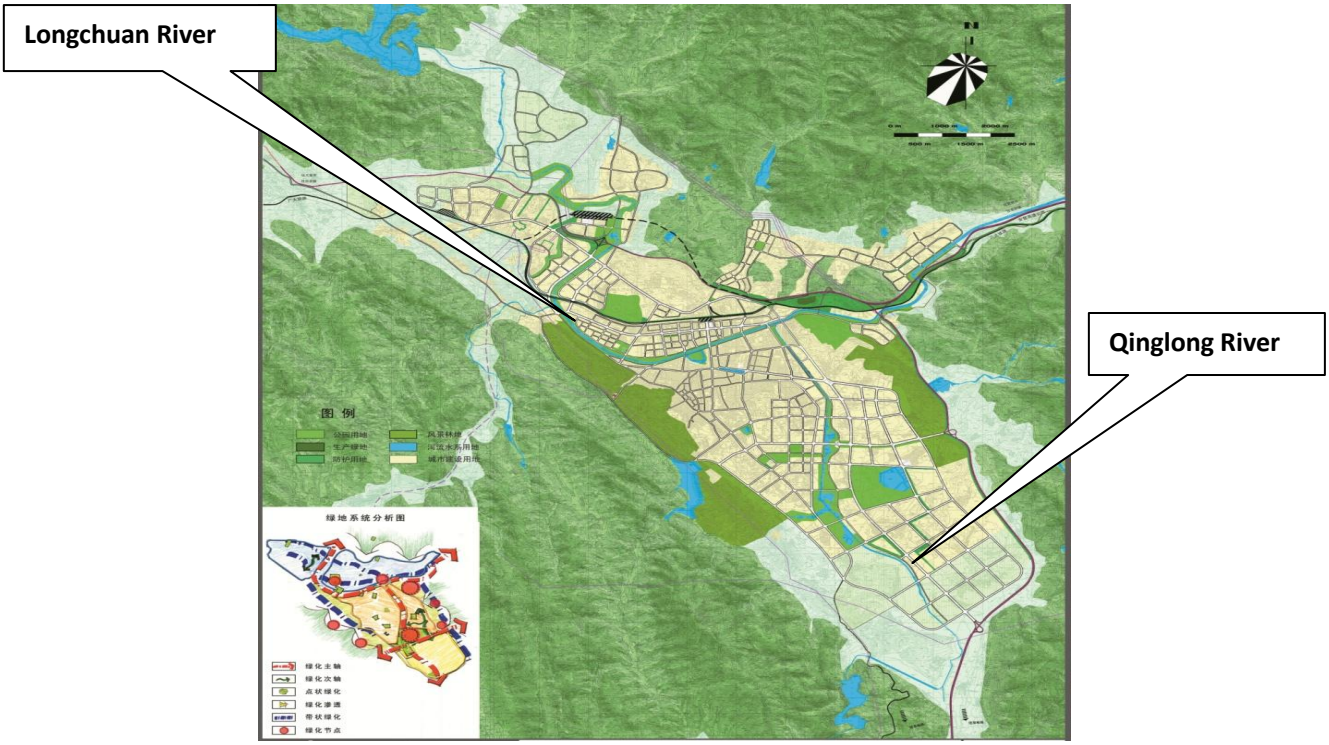


Figure IV-2: River Systems in Chuxiong City (Urban Area)

Figure IV-3: First Section of Longchuan River

Figure IV-4: Qinglong River

131. **Flood history.** The Longchuan River runs across the central part of the urban city. Significant floods occurred in the past. There were 19 large floods during 100 year period from 1890 to 1990, among which five flooded the city area and caused serious damages. Peak flood flows of 1017 m^3/s, 640m^3/s, and 572 m^3/s were recorded in 1908, 1923 and 1939, respectively. The last major flood occurred in 2003 after heavy rains (227.1mm in 12 hours) resulted in peak flood flows of 345 m^3/s. An area of 3 km^2 was affected. The maximum water depth was about 1.6 m. About 60 houses collapsed, 63 houses were submerged, 485 houses were damaged and two persons were killed. Since then, the flood control level for the urban area, not including the project sections of the river, has been raised to protect the urban core from 1-in-50-years flood, which satisfies the national flood control standard. The flood risk was also significantly reduced with the construction of the Qingshanzui reservoir in 2009. However, the flood

protection level of the upstream section (from Qingshanzui QSZ reservoir to the bridge of national route G320 at Shangzhang Village (SZV) is still lower than the required 1-in-10-years.

132. **Qingshanzui Reservoir.** The reservoir, built in 2009, has a drainage area of 1,228 km^2 and an annual inflow of 2.79x10^9 m^3. Dead storage level is 1,800.6 m, normal capacity level is 1,814.0 m and the design flood level is 1,816.89 m. The total capacity is 109 x10^6 m^3 and the effective capacity is 56.23 x10^6 m^3. The major functions of the reservoir are flood control, irrigation and industrial water supply. The reservoir improved the flood protection standard of the 2 000 ha farmland downstream from 5-year to 10-year, and the standard in Chuxiong city from 30-year to 50-year. In addition, it irrigates 5,253 ha of farmland in Chuxiong and Yunmou county, and supplies 730 x10^6 m^3 per year to Chuxiong industry.

133. **Vegetation, protection flora species.** Chuxiong City has a long history (more than 2000 years) with frequent human activities. Vegetation is widely scattered with common shrubs and grasses. Remote sensing images and satellite images show that the vegetation coverage of the area contains mainly rice fields, dryland farm fields, forest, shrub grassland, bare land, and settlements. In general, vegetation coverage is good. Due to intensive human activities, broad-leaved forest is highly fragmented. In the watershed there are rare and endangered species, which is scattered at altitudes 1100 m to 1700 m. Major species include *Cycas panzhihuaonsis*, *Cycas pectinata Griff* and *Cycas siamensis*. There are also some medicinal flora species. The project site is mainly characterized as farmland, and no Cycas Linn species were found within 1 km bands of the Longchuan River. The medicinal flora species are widely present throughout the river basin. The impact of the river rehabilitation project on vegetation and protected species is not of great concern.

134. **Fauna.** Animal resources are limited in the project area due to high population density. Local fauna are mainly made up of grassland and farmland animals. The wild animals include hare, pheasant, wild duck, sparrow, thrash, amphibian, reptilian and small rodents, etc. The domestic EIA concluded that there were no legally protected or endangered species within the project's area of direct influence.

135. **Protected areas, biodiversity value.** The Zixishan Nature Reserve and Sanfengshan Nature Reserve are IUCN category V protected areas. No other protected sites are within the project's wider area of potential influence (**Table IV-6**). Zixishan is upstream and 30 km from the project site; therefore the impact of project the nature reserve is negligible.

136. The native aquatic communities in the Longchuan River have been negatively affected by decades of improper agriculture activities and fast urbanization along the river, siltation, and point discharge of effluent. The ecological functions and biodiversity value in the mid-downstream section of Longchuan River are almost lost due to concrete embankments and wastewater discharge. There are only some native fishes in the upstream of Longchuan River including carps, crucian, loaches, etc., and some emergent plants including water fennel, reeds and *nelumbo nucifera gaertn*, etc.

Table IV-6: Results of Screening of Protection Areas and Nature Reserves near Project Sites

Items	Names	Extra information
Legally protected areas		
■ IUCN category I-II	nil	
■ IUCN category III-IV	nil	
■ IUCN category V-VI	Zixishan, Sanfengshan	IUCN category V
■ IUCN category unknown	nil	
■ International protected areas	nil	
Priority sites for biodiversity		
■ Key biodiversity area	① Zixishan Nature Reserve	① 30km upstream of Chuxiong
■ Alliance for Zero Extinction sites	nil	
Species		
■ Species grid	34-39	

Completeness	
■ China-KBA Completeness	Partial coverage for bird and other major taxa
■ China-WDPA Completeness	Data OK but needs improvement
Region of conservation importance	
■ Endemic bird areas	Yunnan mountains
■ Biodiversity hot spots	nil
■ High biodiversity wilderness area	nil

(d) Physical Cultural Resources

137. The major sites of cultural importance in the city include (i) Ancient Town of the Yi People (**Figure IV-5**), a tourist attraction in the city, with famous dancing and music by people of the Yi Minority; (ii) Solar Calendar Cultural Park of Yi Minority; and (iii) Happiness Tower of Chuxiong (**Figure IV-6**). All the relics and spots are not within or nearby the proposed project areas (more than 5 km away). The Ancient Town is a recent real estate development (2008-2011) with physical cultural heritage value.

Figure IV-5: Ancient Town of the Yi People

Figure IV-6: Happiness Tower of Chuxiong

(e) Environmental Baseline

138. **Surface water quality.** The assigned environmental function of the proposed project section of Longchuan River is class IV of "Environmental Quality Standards for Surface Water of GB3838-2002" set by the local EPB. The EIA Institute conducted surface water quality monitoring in Longchuan River. Water samples were taken once per day for three consecutive days (during 23-25 April 2012). The monitoring results are summarized in **Table IV-7** below.

Table IV-7: Water Quality- Longchuan River (unit: mg/L, except pH)

Parameter	No.1 - Upstream (nearby Qingshanzui Reservoir)		No.2 - Downstream (at Shangzhang Village Bridge)		Grade IV Standard (GB3838-2002)
	Range	Average	Range	Average	
pH	5.70~5.86	5.77	5.84~5.96	5.91	6~9
DO	5.8~6	5.9	6.1~6.4	6.3	≥3
SS	14~17	16	20~24	22	/
COD_{Mn}	4.7~4.9	4.8	5~5.4	5.2	≤10
COD_{Cr}	11~16	14	18~23	21	≤30
BOD_5	4.6~5	4.8	5.4~5.7	5.5	≤6
NH_3-N	0.149~0.171	0.160	0.125~0.149	0.137	≤1.5
TP	0.069~0.079	0.074	0.070~0.077	0.073	≤0.3
TN	1.138~1.148	1.141	2.079~2.207	2.125	≤1.5
Oil	0.01~0.02	0.01	0.01~0.02	0.02	≤0.5
As	0.009~0.012	0.011	<0.007	<0.007	≤0.1
Cd	<0.005	<0.005	<0.005	<0.005	≤0.005

139. According to the above data, only TN value at the downstream sampling point did not satisfy the requirement of the Grade IV standard of GB3838-2002 while all other monitored parameters met the Grade IV Standard. Poor water quality in the project section is caused by upstream pollution sources. According to monitoring data from 2010, the water quality in the upstream reservoir can just satisfy class IV of the national surface water quality standards (GB3838-2002). The main problem parameters are oil, COD and NH_4^+.

140. **Ambient Air Quality.** According to the Yunnan Provincial Environmental Quality Report (2006-2010), the average ambient air quality in Chuxiong City (city-wide) in 2010 met the Ambient Air Quality Standard (GB3095-2012)-Grade II. The major pollutants were SO_2 and PM_{10} according (see **Table IV-8**).

Table IV-8: Air Quality – Chuxiong City (Unit: mg/Nm^3)

Parameter	Range of Concentration	Annual Average Concentration	Grade II Standard Limit (GB3095–1996)
PM_{10}	0.08 ~ 0.10	0.041	0.15
SO_2	0.007 ~ 0.010	0.05	0.15
NO_2	0.018 ~ 0.023	0.014	0.08

Note: The data represent annual average value. Source: EIA Report

141. In addition, local air quality was monitored during 18-24 June 2012 by the Yunnan Provincial Environmental Monitoring Station (EMS) for seven consecutive days. Samples were taken at Fumin Village, where the proposed infrastructures will be constructed. **Table IV-9** summarizes the monitoring results.

Table IV-9: Air Quality – Project Area (Unit: mg/Nm^3)

Monitoring Point	Parameter	Range of Concentration	Grade II Standard Limit (GB3095–1996)	EHS Guideline
Fumin Village	TSP	0.18 ~ 0.21	0.30	n/a
	PM_{10}	0.08 ~ 0.10	0.15	0.02-0.07
	SO_2	0.007 ~ 0.010	0.12	0.05-0.125
	NO_2	0.018 ~ 0.023	0.15	0.04

Note: The data represent daily average values. Source: EIA Report

142. Above data show that all monitoring parameters satisfied the Ambient Air Quality Standard (GB3095-1996) – Grade II, but slightly exceeded the recommended World Bank Group's EHS guideline values for PM10.

143. **Acoustic environment.** Six monitoring points at sensitive sites were set up and monitored by the EIA Institute to identify the acoustic baseline where project roads will be constructed. The baseline monitoring was conducted from 18-21 April 2012 (**Table IV-10**).

Table IV-10: Acoustic Baseline in the Project Area (Unit: dB(A))

No.	Monitoring Point	Monitoring Date	Daytime		Nighttime	
			Monitoring Result	Standard	Monitoring Result	Standard
1	Fumin Village	18 April 2012	54.8	60	45.0	50

No.	Monitoring Point	Monitoring Date	Daytime		Nighttime	
			Monitoring Result	Standard	Monitoring Result	Standard
		19 April 2012	56.0	60	47.0	50
2	Longtanao Village	18 April 2012	56.1	60	45.2	50
		19 April 2012	54.5	60	43.6	50
3	Heiniba Village	18 April 2012	56.7	60	46.3	50
		19 April 2012	54.6	60	45.2	50
4	Qiangqitun Village	18 April 2012	52.4	60	44.4	50
		19 April 2012	54.3	60	46.2	50
5	Haiaiba Village	18 April 2012	49.3	60	43.0	50
		19 April 2012	50.4	60	42.7	50
6	Vocational Education Center	18 April 2012	52.1	60	47.0	50
		19 April 2012	54.6	60	44.1	50

144. Above data show that noise levels at all six monitoring points meet the requirement of Environmental Quality Standard for Noise (GB3096-2008) – Grade II, but partly exceeded the recommended World Bank Group's EHS guideline values of 55dB and 45dB for day and nighttime, respectively, by a slight margin.

145. **Quality of river sediment.** Twenty samples of river sediment along the project section of Longchuan River were taken and monitored by Yunnan Provincial Environmental Monitoring Center on 15 April 2012. The monitoring results (**Table IV-11**) indicate that the sediment quality in the project river complies with the Control Standards for Pollutants in Sludge and Sediment for Agricultural Use (GB4284-84) - for alkaline soil. The quality of sediments is close to Grade I of the PRC Soil Quality Standard (GB15618-95).

Table IV-11: Sediment Quality in Longchuan River (Unit: mg/kg)

Parameter	Range	Average	Standard Value GB4284-84	Standard Value GB15618-95 (Grade I)
As	3.46~19.6	9.61	75	15
Pb	14.3~905	99.24	1000	35
Ni	19.7~86.5	49.32	200	-
Cd	1.21~7.04	3.11	20	-
Zn	41.9~526	163.30	1000	100
Cu	< 0.1~483	51.84	500	35

Source: EIA Report

(f) Potentially affected resources within Project Area of Influence

146. Based on the characteristics of the proposed components, the environmental features of the sites and inspection by the EIA Institute, the sensitive receivers within the projects' area of influence have been identified, which are listed in **Table IV-12 to Table IV-14** below.

Table IV-12: Potentially affected resources by Infrastructures Component in Chuxiong City

Item	Sensitive Receiver	Road	Impact Factor	Applicable Standard
Ecosystem	Vegetation (farmland)	Along roads	Land occupation, and construction activities	
	Soil erosion control	Along roads, borrow pits and spoil disposal sites		
Water	Qinglong River	No. 17 Road (K0+260-K3+200)	Construction of roads and bridges, and	Environmental Quality Standards for Surface
		No. 10 Road (K0+20-K0+60)		

Item	Sensitive Receiver	Road	Impact Factor	Applicable Standard
		No. 11 Road (K0+650-K0+680)	operation of roads and bridges	Water (GB3838-2002) – Grade IV
		No. 12 Road (K0+500-K0+520)		
		No. 41 Road (K0+38)		
		No. 50 Road (K0+0-K1+100)		
Air & Noise	Villages, schools, and residential areas	Xuyang Village; Yanqi Village; Haiziba Village; Xiaobaoshan Village; Zhaoziyuan Village; Fumin Village; Tapu Village; Heiniba Village; Pangjian Village; Longtanao Village; Xiaodong Village; Sunjian Village; Dadong Village; Vocational school	Dust and noise generated by construction activities and traffic, and vehicle emission	Environmental Quality Standard for Noise (GB3096-2008) – Grade II and 4a; Ambient Air Quality Standard (GB3095-1996) – Grade II

Table IV-13: Potentially affected resources by River Rehabilitation and Flood Control Component

Item	Sensitive Receiver	Applicable Standard
Air	Schools, hospitals and residential areas within 200 m from the proposed river construction	Ambient Air Quality Standard (GB3095-1996) – Grade II
Surface Water	Upstream of Longchuan River (first section)	Environmental Quality Standards for Surface Water (GB3838-2002) – Grade IV
Noise	Schools, hospitals and residential areas within 100 m from the proposed river construction	Environmental Quality Standard for Noise (GB3096-2008) – Grade I and II.
Ecosystem	Section 1 of Longchuan River, including (i) ecological condition of river, lands, farmlands and vegetation coverage; (ii) soil erosion during construction; and (iii) vegetation coverage, capacity for soil erosion control and biodiversity, etc.	

Table IV-14: Noise Sensitive Receptors of River Component in Chuxiong City[21]

No.	Item	Sensitive Receiver	Applicable Standard
1	Datun Village	80 m to the upstream of Longchuan River (north side)	Environmental Quality Standard for Noise (GB3096-2008) – Grade I
2	Shayi Village	260 m to the upstream of Longchuan River (south side)	
3	Wutaihe Village	220 m to the upstream of Longchuan River (east side)	
4	Maochaoping Village	220 m to the upstream of Longchuan River (west side)	
5	Shuihe Village	380 m to the upstream of Longchuan River (northeast side)	
6	Wangliu Village	460 m to the upstream of Longchuan River (northeast side)	
7	Donggua Village	80 m to the upstream of Longchuan River (west side); 160 m to the upstream of Longchuan River (southwest side)	
8	Zuo Village	460 m to the upstream of Longchuan River (southwest side)	
9	Shangzhang Village	500 m to the upstream of Longchuan River (south side); 520 m to the upstream of Longchuan River (west side)	
10	Xujiashanzui Village	160 m to the upstream of Longchuan River (north side)	
11	Wangguanshan Village	80 m to the upstream of Longchuan River (south side)	
12	Renjia Village	260 m to the upstream of Longchuan River (east side)	
13	Residential Building of	220 m to the upstream of Longchuan River (south side)	Environmental

[21] Chuxiong EPB classifies all suburban areas as Grade I function zones. All urban areas are grade II function zones (50m from two sides of road are grade 4a).

No.	Item	Sensitive Receiver	Applicable Standard
	Forestry Machinery Factory		Quality Standard for Noise (GB3096-2008) – Grade II
14	Dongguan Cigarette Distribution Station	420 m to the upstream of Longchuan River (southwest side)	
15	Residential and Commercial area of Pickles Factory	580 m to the upstream of Longchuan River (southwest side)	

D. Wuding County

147. Wuding County is located in the northern part of the Yunnan-Guizhou Plateau, about 78 km northwest of Kunming City, with a total area of 3,322 km^2 and a total population of 273,340 in 2011, 54.48% belonging to an ethnic minority. The average elevation is 1,910 m ASL. The eastern, western, and southwestern parts of the county are higher than the north, and about 96% of the area in the county is mountainous.

148. Wuding County has abundant mineral resources including titanium, iron, copper, lead, zinc and sandstone (serpeggiante). The preliminarily proved reserves of iron, titanium and copper are 246 million tons, 28 million tons and 66,800 tons, respectively. In particular, the serpeggiante deposit is about 3.46 billion m^3, which is a famous mineral product in the PRC.

149. **Urban Development Plan.** The objective of Wuding urban development is to build a secondary city center to Kunming with emphasis on developing tourism, mining, organic food processing, and Yi ethnic minority cultural heritage development. According to the urban development master plan (2006-2025), the urban area is divided into four groups. Group 1 is the existing downtown area located in the center, which will continue to serve as the center for government, commercial and residential area. Group 2 is the new urban area in the north of the existing downtown area, which will serve as a secondary center for government, commercial and residential developments. Group 3 includes the new urban areas in the southeast of the downtown area, which will mainly serve as residential areas. Group 4 is at south of the downtown next to the tourism spot of Shizi Mountain, a popular tourism site in Yunnan. The proposed project subcomponent will assist Wuding County Government to develop Phase 2 of the northern part of the city (Group 2). The construction of Phase I, which is the western part of Group 2, has been completed by the municipal government.

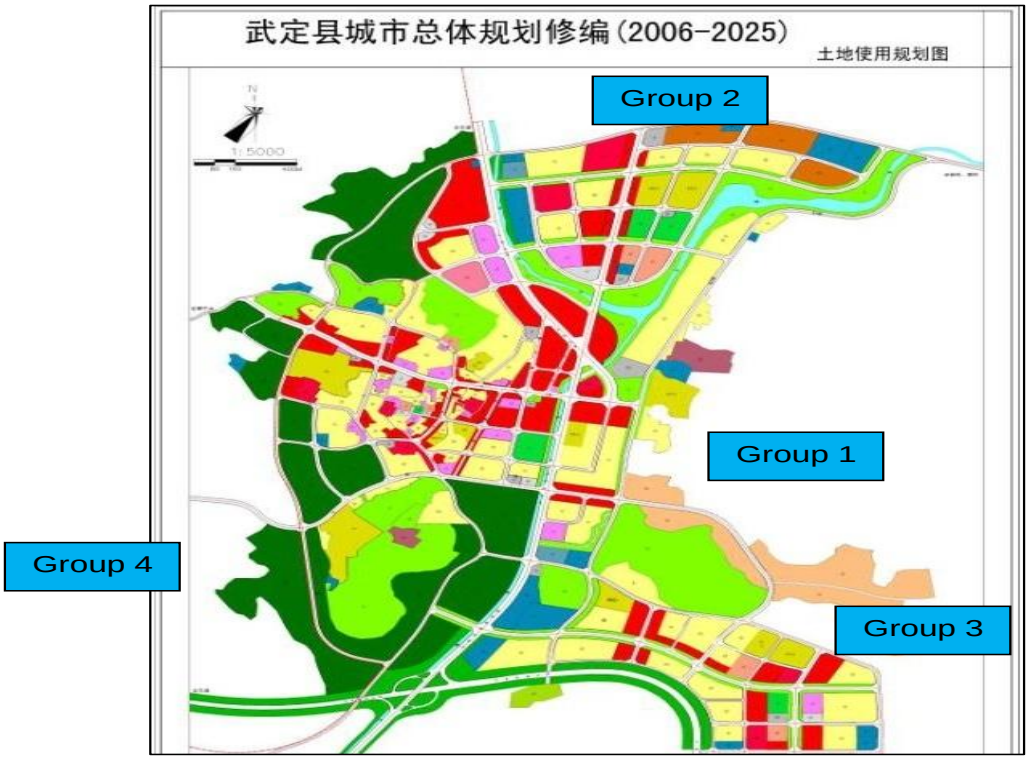


Figure IV-7: Wuding County Urban Development Master Plan (2006-2025)

(a) Geography, Topography and Geology

150. **Topography, Geology.** The terrain of Wuding County is essentially an area of mountains and hills. The major geological settings include the typical small sedimentary basins surrounded by hills and mountains. The total area of the county includes 96% of mountainous area and 4% of basins and water bodies. The average elevation of the county is 1,910 m, with the lowest elevation of 862 m and the highest of 2,956 m. The county is divided into four topographies: eastern mountain area, western mountain area, northern valley area and southern plateau area. Santai Mountain Range, the backbone of the terrain, runs through the county with a big elevation difference. The mountain range direction in the county is northeast-to-southwest, and the highest elevation point in the county is Dahei Mountain with an elevation of 2,906 m.

151. **Soil, soil erosion.** The major soil types in the county include purple soil (42.2%), red soil (20.5%), yellow brown soil (19.6%), brown soil (6.8%), paddy soil (3.4%), limestone soil (0.4%) and alluvium (0.3%). May to October in a year is period with highest soil erosion rates. The current annual erosion intensity is 480 tons per km^2, which is classified as light to medium erosion according to the PRC's soil erosion classification. Results of hydrogeological survey show that groundwater in the project site is HCO_3^--Ca and HCO_3^--Ca. Mg type with pH = 7.8 to 8.2, which will have no corrosion effects on concrete reinforcement used in construction.

152. **Seismicity.** According to the PRC's earthquake intensity zoning map (GB18306-2001), Wuding's seismic intensity is Grade VII.

(b) Meteorology and Climate

153. Wunding has subtropical climate. In general, the climate has the following features: warm winters and cool summers, small annual temperature differences, large daily temperature

differences, abundant precipitation and clear distinction between dry and wet seasons; significant vertical climate change.

154. The annual average temperature of the County is 15.1°C (**Table IV-15**). The coldest month of a year is January with the average temperature of 7.3°C while the hottest month is July with the average temperature of 20.7°C. The annual average frost period is 130 days. Average annual sunshine hours amount to 2,326 hours.

155. Wuding‘s average annual precipitation is 935.6 mm. The precipitation is usually concentrated, with light rainfall during winter and spring and heavy precipitation during summer and fall. The peak of annual rainfall happens in July.

Table IV-15: Climate in Wuding County

No.	Parameter	Data	Remarks
1	Average Temperature	15.1oC	
2	Average High Temperature	20.7oC	
3	Average Low Temperature	7.3oC	
4	Frost Period	130 days	
5	Average Annual Precipitation	936 mm	80-90% during May to October
6	Average Relative Moisture	76%	

(c) Ecological Resources

156. **Surface water.** The rivers within Wuding County belong to two water systems of Jinsha River and Yuanjiang River. Jinsha River covers 97.3% of the total catchment area in the county while Yuanjiang River covers 2.7% of the total. The length of Jinsha River in the County is 34 km with a river drop of 98 m. Other rivers in the County include Wulong River, Caiyuan River, Mengguo River, Heilula River, Tumuda River, Panlong River, Shuicheng River, Puxi River, Xiaojin River and Hedi River. Caiyuan River and Wulong River are the two rivers running through the project area (

157. **Figure IV-9:**).

Figure IV-8: Wulong River in Wuding

158. **Caiyuan River** is a Class 3 tributary of Jinsha River flowing through the County from South to North. Caiyuan River originates from Jiuchang Village and flows into Zhangjiu River (the second tributary of Jinsha River). The total length of Caiyuan River in the county is 25 km, with a catchment area of 301 km^2 and a total annual runoff volume of 105 million m^3. The current river channel only has a 1-in-1-year flood capacity.

159. **Wulong River** is another Class 3 tributary to Jinsha River; it runs through the downtown area from the west and joins the Caiyuan River at the east of the downtown. Similarly, the existing water channel does not have adequate flood capacity. The slope of the river bed of Wulong River is gentle. The current flood control ability of the embankment is weak and eroded.

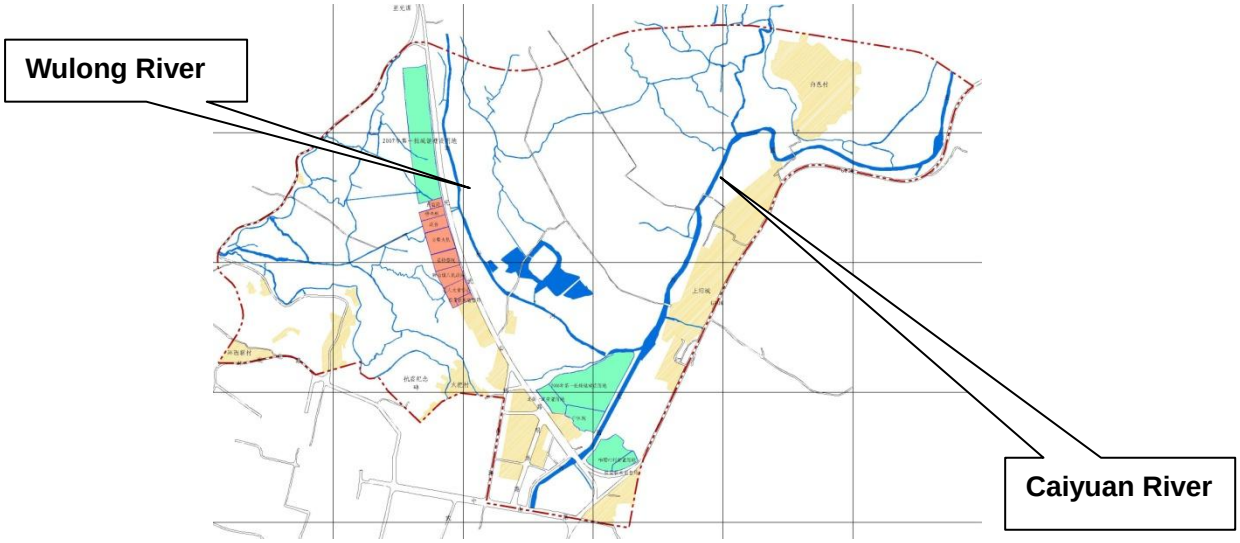


Figure IV-9: Caiyuan River and Wulong River

160. **Flood history.** According to the "Urban Flood Control Plan" of Wuding (1999-2020), the Caiyuan and Wulong rivers flood almost every year, flooding farmland along the rivers. Larger floods were recorder in 1966, 1974, 1989 and 1998. In 1998, more than 18.4 thousand people were affected by the flood disaster, 3 persons were killed, 236 houses were destroyed, and 15 thousand mu of crops were destroyed. The estimated loss reached 9.48 million RMB.

161. **Vegetation, protected species.** The flora in the county include 1,157 spermatophyte species of 538 genera of 137 families including 198 trees (mainly Pinus tabulaeformis, Pinus armandii and fortune keteleeria, etc.), and 700 species of fungi and herbs. Other trees include Eucalyptus globulus, E.robusta, Populus canadensis Moench. Aquatic plants in the project area include Phragmsites australis, Potamogeton pectinatus, Hydrilla verticillata, Potamogeton malaihus, Poa annua, Paspalum thunbergii, Alligator Alternanthera, etc. According to field reconnaissance, there is no rare plant or ancient or famous trees under national protection within the range of project construction.

162. There are many species of wild animals within the territory of Wuding County including golden cat, otter, macaque, pangolin, and Moschus berezovskii, etc. The major species of birds include cormorant, peregrine falcon, and Besra, etc.; and the fishes in the area include Carassius auratus (Lynnaeus), Misgumus anguillicaudatus (Cantor) and Monopterus albus (Zuiew). The wild animals are mainly in the mountainous area. According to the domestic EIA report, none of the above animals are present in the project area of influence.

(d) Physical Cultural Resources

163. The only cultural relic and historic spot in Wuding County is Shizishan Scenic Spot where there is a temple, named Yuanjue Temple, with 600 years of history. The scenic spot is about 7 km away from the proposed project site, which will not be impacted by the construction activities.

(e) Environmental Baseline

164. **Surface water quality.** The surface water quality monitoring of project area was conducted from 23-25 April 2012 by Yunnan Provincial Environmental Monitoring Center. The water quality of the proposed sections of Caiyuan River and Wulong River is Class IV

(GB3838-2002) based on the environmental function zone designated by Wuding County EPB. The monitoring results are summarized in **Table IV-16** below.

Table IV-16: Water Quality - Caiyuan River and Wulong River (unit: mg/L, except pH)

Parameter	No.1 - Upstream at Wulong River		No.2 - Upstream at Caiyuan River		No.3 - Downstream at Caiyuan River		Grade IV Standard (GB383-2002)
	Range	Average	Range	Average	Range	Average	
pH	7.34	7.34	7.66~7.67	7.667	7.55-7.56	7.553	6~9
SS	19~20	19.33	19~24	21.67	20-23	22	/
COD_{Cr}	<10	<10	<10	<10	<10	<10	≤30
BOD_5	2.3~2.5	2.4	1.3~1.4	1.37	1.4-1.5	1.47	≤6
NH_3-N	0.75-0.76	0.753	0.61	0.61	0.63-0.64	0.63	≤1.5
TP	**0.48~0.49**	**0.483**	0.21	0.21	0.29	0.29	≤0.3
TN	1.16~1.17	1.163	0.91~0.93	0.92	0.96-0.98	0.97	≤1.5
Oil	<0.01	<0.01	<0.01	<0.01	0.01-0.02	0.013	≤0.5

Source: EIA Report

165. According to the above data, only TP value at the upstream monitoring point at Wulong River exceeded the Grade IV standard, mainly due to discharge of untreated domestic wastewater and non-point source pollution from farmland. All other monitored parameters met the standard.

166. **Quality of river sediment.** Three samples of river sediment along the project section of Wulong River were taken and monitored by Yunnan Provincial EMS on 17 September 2012. The monitoring results, presented in **Table IV-17** below, show that the sediment quality in the project river complies with the Control Standards for Pollutants in Sludge and Sediment for Agricultural Use (GB4284-84) - for alkaline soil. The quality of sediments is close to Grade III of the PRC Soil Quality Standard (GB15618-95).

Table IV-17: Sediment Quality in Wulong River (Unit: mg/kg)

Parameter	Range	Average	Standard Value GB4284-84	Standard Value GB15618-95 (Class III)
As	<0.5	<0.5	75	Paddy field≤30; dry land ≤40
Pb	<0.2	<0.2	1000	≤500
Ni	<5.0~162.4	101.8	200	≤200
Cd	<0.5	<0.5	20	≤1.0
Zn	26.0~109.0	74.5	1000	≤500
Cu	37.4~207.2	124.5	500	≤400

Source: EIA Report

167. **Ambient air quality**. Local air quality monitoring was conducted from 23-29 April 2012 by the Provincial EMS for seven consecutive days. Samples were taken at the intersection of Beicheng Avenue and Wuxu Road, where the proposed infrastructures will be constructed. The results, presented in **Table IV-18**, show that all monitoring parameters satisfied the Ambient Air Quality Standard (GB3095-1996) – Grade II, but the PM10 did not meet the World Bank Group EHS Guideline. This may be explained by dry weather conditions and low coverage of ground vegetation.

Table IV-18: Air Quality – Project Area (Unit: mg/Nm^3)

Monitoring Point	Parameter	Range of Concentration	Grade II Standard Limit (GB3095–1996)	EHS Guideline
Intersection of Beicheng Ave. and Wuxu Road	TSP	0.097 ~ 0.12	0.30	n/a
	PM_{10}	0.072 ~ 0.10	0.15	0.05-0.15
	NO_2	<0.005 ~ 0.05	0.12	0.04

Note: The data represent daily average values. Source: EIA Report

168. **Acoustic environment.** Five monitoring points at sensitive sites were set up and monitored during 26-27 April 2012 by the provincial EMS to identify the acoustic baseline of the roads to be built under the project component (**Table IV-19**).

Table IV-19: Acoustic Baseline in the Project Area (Unit: dB(A))

No.	Monitoring Point	Monitoring date	Daytime		Nighttime	
			Monitored Data	Standard	Monitored Data	Standard
1	Xihe Village	26 April 2012	57.8	60	47.9	50
		27 April 2012	58.1	60	46.7	50
2	Shangjiu Village	26 April 2012	**67.1**	60	**60.9**	50
		27 April 2012	**68.1**	60	**61.9**	50
3	Xiajiu Village	26 April 2012	**54.6**	60	**47.1**	50
		27 April 2012	**53.4.4**	60	**46.2**	50
4	Baiyi Village	26 April 2012	53.1	60	45.8	50
		27 April 2012	52.5	60	43.9	50
5	Wuding Chinese Medicine Hospital	26 April 2012	59.8	60	**50.2**	50
		27 April 2012	59.9	60	**52.4**	50

169. The results indicate that among all monitoring points, Xiajiu Village, Xihe Village and Baiyi Village met the requirement of Environmental Quality Standard for Noise (GB3096-2008) – Grade II. The nighttime monitoring data at Wuding Chinese Medicine Hospital exceeded the standard due to the three nearby construction sites; while both daytime and nighttime monitoring data at Shangjiu Village exceeded the standard due to traffic noise, in particular heavy vehicles travelling on the nearby highway.

(f) Resources potentially affected by the road component

170. The following sensitive receivers have been identified within the area of influence of the road and river components of the project in Wuding.

Table IV-20: Sensitive Receptors of road component in Wuding Town

Item	Sensitive Road Section	Road Impact Length (m)	Sensitive Receptor
Road section along (or cross) the river	Mudan Road (K0+053.000)	20	Wulong River
	Wuxu Road (0+060.000)	20	
	Beicheng Avenue (K1+214.000)	20	
	Chengbei Road (K0+090.000)	20	
	Beihe Road (K0+720.000)	46	

	Wuchan Road (K0+958.1~K1+62.5)	104.4	
	Mudan Road (K1+071.000)	66	
	Beihe Road (K0+000~K1+180.8)	118	Caiyuan River
	Caiyuan Road (K0+465.3~K0+705.3)	240	
Village with 20m from the roads	Wuchan Road (K0+0 ~ K0+30)	30	Xihe Village
	Chengbei Road (K0+210~0+350)	140	Xihe Village
		Minimum Distance to the Road (m)	
Village and hospital beyond 20m from the road	Binghe Road	80	Shangjiu Village
	Binghe Road/Caiyuan Road	100/160	Xiajiu Village
	Caiyuan Road	110	Baiyi Village
	Beicheng Avenue	21	Wuding Chinese Medicine Hospital

Source: Domestic EIA Report

Table IV-21: Noise Sensitive Receptors of River Component in Wuding

Noise sensitive receptor	Location to River	Minimum Distance to River (m)
Rongji Village	South of Wulong River	109
Xihe Village	East of of Wulong River 63m	63
Residential Community by No. 108 Highway	West of Wulong River	120
Low-rent Apartment in Beijie Village	South of of Wulong River	12
Residental Community by Xihe Road	North of Wulong River	101
Beijie Village	North of Wulong River	65
Shangjiu Village	Northeast of Wulong River	94
Yuanhe Residential Conmunity	South of Wulong River	47
Wuding Chinese Medicine Hospital	South of Wulong River	198

Source: Domestic EIA Report

E. Lufeng County

171. Lufeng County is located about 92 km northwest of Kunming and 83 km northeast of Chuxiong City. The total area of the county is 3,536km^2 and the total population was 440,000 in 2011. About 92% of the county area is mountains and the elevation scope is between 1,309 and 2,754 m. The downtown area of Lufeng County sits in a narrow land basin sloped down from north to south with the average elevation of 1,560 m.

172. Lufeng County has abundant mineral resources. There are 29 mineral deposits, including salt, coal, copper, iron and sodium sulfate, etc., in particular the mines of coal and iron are abundant. The water power resource in the county is 1.2 billion KW.

173. Industries in the county consist mainly of steelmaking, phosphorus chemical industry and cement, etc. In 2010, the total GDP was CNY8.5338 billion, an increase of 12% over the previous year. The production value of primary, secondary and tertiary industries was CNY168.97 million, CNY3.2 billion, and CNY3.644 billion, respectively. Lufeng is also a famous archaeology site for dinosaur fossils and a dinosaur theme park for tourism.

174. **Urban Development Plan.** The urban area is grouped into two axis zones. The first is the urban development axis zone in a north-south direction, including the existing downtown area. The urban development zone will be for government, commercial, residential, and tourism

developments, and the zone will be expanded in a northern direction. The second axis zone will be industrial development zone in the northeast – southwest direction, which will be used for metallurgy and other industrial developments. The proposed project subcomponent in Lufeng is to build the new urban infrastructures in the north of the existing downtown area as the expansion of the existing urban area as defined in the urban development master plan (**Figure IV-10**).

Figure IV-10: Lufeng Urban Development Master Plan (2004-2020)

(a) Geography, Topography and Geology

175. Location, topography. Lufeng County is located in the central part of Yunnan Province, east of Chuxiong prefecture, with the longitude at E101°38' - 102°25' and latitude at N24°51' - 25°30'. The maximum distance from east to west of the county is 76 km, and the maximum distance from south to north is 68 km. The County is located in the southeast of Dianzhong Plateau, the watershed of Jinsha River and Yuanjiang River systems. The terrain of the county is mostly mountains and intermountain basins with an elevation range from 1,309 m to 2,754 m. The mountain area takes 91.9% of the total county area. The terrain of Lufeng is high in north and low in south. The highest point of the county is Laoqing Mountain, with an elevation of 2,754 m, and the lowest point is Xiaojiangkou with an elevation of 1309 m.

176. **Geology, soil and soil erosion.** The major geological settings in the project area include the typical characteristics of sedimentary basins surrounded by hills and mountains. The major soil types in the county include alluvial cohesive soil, sandy clay, gravel, purple calcareous mudstone and argillaceous siltstone. May to October in a year is period with highest soil erosion rates. The current annual erosion intensity is 480 tons per km^2, which is classified as light to medium erosion according to the PRC's soil erosion classification. Results of hydrogeological survey show that groundwater in the project site is HCO_3^--Ca. Mg type with pH = 7.8 to 8.2, which has no corrosion effects on concrete reinforcement used in construction.

177. **Seismicity.** According to the PRC earthquake intensity zoning map (GB18306-2001), Lufeng's seismic fortification intensity is Grade VII.

(b) Meteorology and Climate

178. Lufeng is in the climate zone of sub-tropical low latitude mountain monsoon climate with distinct four seasons.. The general climate features are dry in winter, windy in spring, and rainy and humid in summer and fall, warm winter and mild summer, long sunshine hours, very short frost periods, and over 900 mm of annual precipitation. The county is a low-latitude inland mountain area with the climate controlled by southwest monsoon. The annual average temperature is 16.2°C, the annual sunshine hour is 2,207 hours, the annual precipitation is 930 mm and the non-frost period of a year is 322 days (**Table IV-22**).

Table IV-22: Climate in Lufeng County

No.	Description	Data	Remark
1	Average Temperature	16.2oC	
2	Highest Temperature	36.1oC	
3	Lowest Temperature	-5.5oC	
4	Non-frost Period	322 days	
5	Average Annual Precipitation	915 mm	80-90% during May to October
6	Average Relative Moisture	74%	
7	Average Wind Velocity	1.9 m/s	
8	Primary Wind Direction	Southwest & West	

(c) Physical and ecological resources

179. **Surface water.** The river system in Lufeng is well developed with three rivers running through the urban area. The East River is the upper reach of Xingsu River, which is a main tributary to Yuan River. The length of the East River is 74 km and the watershed area is about 733 km^2. The West River is a Class I tributary to Xingsu River. The length of the river is 61.8 km and the watershed area is about 418 km^2. The South River is also a Class I tributary to Xingsu River with a total length of 19.7 km and the watershed area of 193 km^2. At Lufeng urban area, the East River flows from east to west, the West River flows from north to south, the South River flows from south to north, and all three rivers meet at the southwest of the urban area and join the Xingsu River. The sections of rivers run through the project area (**Figure IV-11** and **Figure IV-12**). Average annual runoff of West River is 361 million m^3.

180. Based on the rainfall data and topographic condition, the hydrological and hydraulic analysis was conducted using the steady model. The water surface elevations for 5 and 20 year floods were calculated for both West and East Rivers, and the results are summarized in **Table IV-23** and **Table IV-24**, respectively.

Table IV-23: Water Surface Elevation for West River

No	Station (km+m)	Riverbed Elevation (m)	P=5%		P=20%		remark
			Water Level (m)	Velocity (m/s)	Water Level (m)	Velocity (m/s)	
1	0+000	1567.3	1571.39	2.99	1570.59	2.87	
2	0+100	1567.06	1571.19	2.66	1570.39	2.54	
3	0+500	1566.62	1570.63	2.53	1569.88	2.31	
4	0+900	1565.43	1570.21	2.45	1569.53	2.21	
5	1+300	1564.57	1569.64	2.14	1568.91	2.01	
6	1+700	1563.14	1569.27	1.48	1568.46	1.28	
7	1+900	1562.03	1569.04	1.28	1568.27	1.08	
8	2+300	1560.87	1568.02	2.51	1567.32	1.41	Conjuction
9	2+500	1560.4	1567.52	3.54	1566.66	2.69	
10	2+700	1560.29	1566.71	4.44	1565.85	3.87	
11	2+900	1560.11	1566.27	3.98	1565.43	3.34	
12	3+100	1560.02	1566.2	2.28	1565.41	2.01	
13	3+300	1559.31	1566.08	2.22	1565.27	1.98	
14	3+500	1558.94	1565.79	3.04	1564.91	2.56	
15	3+700	1558.66	1565.52	2.75	1564.7	2.13	
16	4+082	1557.62	1564.97	3.94	1564.13	3.46	

Source: the FSR

Table IV-24: Water Surface Elevation for East River

No	Station (km+m)	Riverbed Elevation (m)	P=5%		P=20%		remark
			Water Level (m)	Velocity (m/s)	Water Level (m)	Velocity (m/s)	
1	0+000	1563.34	1569.06	1.57	1568.04	1.38	
2	0+400	1562.87	1568.87	1.77	1567.88	1.56	
3	0+800	1562.6	1568.59	2.04	1267.51	1.87	
4	1+200	1562.37	1568.33	1.68	1567.25	1.47	
5	1+400	1562.31	1568.22	1.78	1567.06	1.52	
6	2+000	1563.96	1568.02	0.66	1566.83	0.53	

181. Based on the FSR, the water depth for 20 year flood is about 4-7 m for the west river, and the water depth is about 6 m for the east river. For the West River, the difference of water elevation is about 80cm between 20-year flood and 5-year flood, and the flow velocities of the West River and the East River are 2.4 m/s and about 2.0 m/s, respectively.

Figure IV-11: East River, Lufeng

Figure IV-12: West River, Lufeng

182. **Flood history.** The three rivers do not have adequate flood protection capacity, and they have caused flood damages many times in the history. There was a heavy rain in Lufeng Town on June 20, 1994. Water levels in East, West and South Rivers rose up simultaneously. The East River experienced a 1-in-50-years flood, and the other two rivers experienced a 1-in-10-years flood. The water depth in Lufeng town was about 2-3 m. The flood affected 110 thousand people and one person was killed. During the flood, a total of 1,042 houses and 60 bridges were damaged, and 160 thousand mu of farmland were affected. The economic losses reached CNY133.4 million.

183. **Flora, fauna, protected species.** Lufeng County has high forest coverage of about 70%. The project area is located in a populated area. The long history of human activities in the project area has significantly reduced species richness. Vegetation in the project area includes mainly common species. Common vegetation mainly includes herbaceous plants, of which willow trees and the grass *Setaria viridis* are most widespread. Additionally, there are large amount of grain crops (mainly including maize and wheat) and economic crops (including potatoes, walnuts, citrus, medicinal materials etc.). The major fish species include Schistura callichroma, Schistura laterivittata, Cyprinus carpio rubrofuscus Lacepedeand, and Rhinogobius honghensis. There are no national or municipal level rare or endangered species in the project area.

Figure IV-13: Existing Aquatic Plants in the West and East Rivers (Source: EIA Report)

184. **Physical Cultural Resources.** Lufeng County is rich in physical cultural resources. The Lufeng Dinosaur Valley Museum (**Figure IV-14** and **Figure IV-15**) is located 23km south of the project site, where the world famous Lufengosaurus, a Jurassic prosauropod, was discovered in 1938. Recently, teeth and a skull of a Ramapithecus, a Miocene period primate related to the orangutan, have been found in the area. The minimum distance between the boundaries of the dinosaur protection zone to the site is 7 km, therefore the proposed project component should not have any impact on the dinosaur fossils.

Figure IV-14: Gate of Lufeng Dinosaur

Figure IV-15: Dinosaur Fossils

Museum

185. The only cultural relic and historic spot within the project area in Lufeng is **Fengyu Bridge**, a provincial level cultural and relic protection site (**Figure IV-16**). The bridge was built during the Ming Dynasty in 1621-1627, has a span of 116.55 m and a width of 8.6 m. The proposed river rehabilitation component will pass the bridge. During the PPTA, several dialogues and discussions with the local Cultural Relics Bureaus were conducted, and both the FSR and the domestic EIA confirm that there will be no construction within 200m range of the bridge, with exception of some minor embankment repair works only, and the original status of the bridge will be maintained.

Figure IV-16: Fengyu Bridge

(d) Environmental Baseline

186. **Surface water quality.** The assigned environmental function of East and West Rivers is Class IV of the PRC surface water standard (GB3838-2002), set by Lufeng County EPB. The provincial EMS conducted water quality monitoring in the river in April 2012. Water samples were taken once per day for three consecutive days. The monitoring results are summarized in **Table IV-25** below. TN and BOD_5 values of all three sampling sites, COD_{cr} of the upstream at West River and the intersection of East River and West River exceeded the Grade IV standards, mainly due to discharge of untreated domestic sewage and non-point source pollution from agricultural activities.

Table IV-25: Water Quality – East and West Rivers (unit: mg/L, except pH)

Parameter	No.1 - Upstream at West River		No.2 - Downstream at West River		No.3 - Intersection of East River and West River		Class IV Standard Limit (GB3838-2002)
	Range	Average	Range	Average	Range	Average	
pH	7.77-7.78	7.78	7.87-7.88	7.88	7.79-7.80	7.79	6~9
SS	89~96	93.33	92~94	93.33	100-105	103	/

COD_{Cr}	34-43	37.67	23-30	27	26-32	28.67	≤30
BOD_5	8.7~9.3	9.07	6.1~6.7	6.37	6.2-6.6	6.33	≤6
NH_3-N	0.86-0.87	0.86	0.61	0.61	1.01-1.03	1.02	≤1.5
TP	0.02	0.02	0.02	0.02	0.01-0.02	0.02	≤0.3
TN	3.52~3.54	3.53	3.97~4.01	3.99	3.55-3.58	3.57	≤1.5
Oil	0.01-0.02	0.013	<0.01	0.01	0.01	0.01	≤0.5

Source: Domestic EIA

187. **Quality of river sediment.** Four samples of river sediment along the West River and East River were taken and monitored by Yunnan Provincial EMS on 15 September 2012. The monitoring results are described in **Table IV-26** and **Table IV-27** below.

Table IV-26: Sediment Quality in East River (Unit: mg/kg)

Parameter	Range	Average	Standard Value GB4284-84	Standard Value GB15618-95 (Class III)
As	6.64-9.01	7.82	75	Paddy field≤30; dry land ≤40
Pb	<0.2	<0.2	1000	≤500
Ni	126.5~165.3	145.9	200	≤200
Cd	<0.5	<0.5	20	≤1.0
Zn	106~138	122	1000	≤500
Cu	<0.5~35.2	17.8	500	≤400

Source: EIA Report

Table IV-27: Sediment Quality in West River (Unit: mg/kg)

Parameter	Range	Average	Standard Value GB4284-84	Standard Value GB15618-95 (Class III)
As	<0.5-9.2	5.49	75	Paddy field≤30; dry land ≤40
Pd	<0.2	<0.2	1000	≤500
Ni	127.2~141.6	135.2	200	≤200
Cd	<0.5	<0.5	20	≤1.0
Zn	109~146.8	121.4	1000	≤500
Cu	24.1~380	113.45	500	≤400

Source: EIA Report

188. Based on the above monitoring data, the sediment quality in the project rivers complies with the Control Standards for Pollutants in Sludge and Sediment for Agricultural Use (GB4284-84) - for alkaline soil. The quality of sediments is close to Grade III of the PRC Soil Quality Standard (GB15618-95).

189. **Ambient air quality.** Ambient air quality was monitored from 29 May to 4 June, 2012, by the Provincial EMS for seven consecutive days. Samples were taken at Zhuangke Village. The results are summarized in **Table IV-28**.

Table IV-28: Air Quality – Project Area (Unit: mg/Nm^3)

	Parameter	Range of Concentration	EHS Guideline	Grade II Standard Limit (GB3095–1996)
Zhuangke Village	PM_{10}	0.048 ~ 0.089	0.05-0.15	0.15
	TSP	0.09 ~ 0.13	n.a.	0.15
	NO_2	<0.005 ~ 0.005	0.04	0.08

Note: The data represent daily average values. Source: EIA Report

190. Above data show that all monitoring parameters satisfied the Ambient Air Quality Standard (GB3095-1996) – Grade II, as well as the World Bank Group EHS Guideline.

191. **Acoustic environment.** Six monitoring points at sensitive sites within the project area were set up and monitored by the EIA Institute to identify the acoustic baseline of the roads to be built under the project component. The monitoring was conducted from 30-31 May 2012 Results indicate that the noise level at all six monitoring points met the requirement of Environmental Quality Standard for Noise (GB3096-2008) – Grade II, as well the World Bank Group EHS Guideline of 55/45 dB for day and night noise levels, respectively.

Table IV-29: Acoustic Baseline in the Project Area (Unit: dB(A))

No.	Monitoring Point	Monitoring Date	Daytime		Nighttime	
			Monitored Data	Standard	Monitored Data	Standard
1	Dabeichang Village	30 May 2012	55.2	60	42.6	50
		31 May 2012	52.8	60	45.3	50
2	Zhuangke Village	30 May 2012	51.8	60	45.0	50
		31 May 2012	49.2	60	46.3	50
3	Xiaobeichang Village	30 May 2012	56.3	60	44.8	50
		31 May 2012	52.6	60	45.4	50
4	Guanwa Village	30 May 2012	53.4	60	44.0	50
		31 May 2012	48.1	60	41.6	50
5	Lufeng Middle School	30 May 2012	50.1	60	42.3	50
		31 May 2012	48.7	60	42.2	50
6	Xishan Village	30 May 2012	50.5	60	45.8	50
		31 May 2012	51.4	60	42.6	50

(e) Resources potentially affected by project

192. The sensitive factors and receptors have been identified within the area of influence of the road and river components of the project in Lufeng County, which are listed in the Tables below.

Table IV-30: Environmental Protection Objectives in Lufeng

Item	Sensitive Factor	Location	Impact	Applicable Standard
Ecological environment	Orchard and farmland	All road sections	Land occupation and construction activities	
	Water and soil erosion	All road sections, borrow pits and soil disposal sites		
	Landscaping	All road sections		
Surface water	West River	No. 1 road (K0+800)	Road and bridge construction and operation	Environmental Quality Standards for Surface Water (GB3838-2002)– Grade IV
		No. 2 road (K0+140)		
		Zhuluoji Avenue (K0+0 ~ K0+1000)		
Noise and air	Villages and schools	Guanwai Residential Community, Shangying Village, Dabeichang Village, Xiaobei Village, Zhaungke Village, Xishan Village, Shawan Village, Yaochong Village, and Lufeng No. 2 Middle School	Dust and noise, emission during project operation	Environmental Quality Standard for Noise (GB3096-2008) – Grade II; Ambient Air Quality Standard (GB3095-1996) – Grade II

Source: The EIA Report

Table IV-31: Noise Sensitive Receptors of Road Component in Lufeng

Sensitive Receptor	Road (stake No.)	Location (Scope of Impact)	Applicable Standard
Guangwai Residential Community	No. 1 Road (K0+60)	South (30 ~ 1200 m)	Environmental Quality Standard for Noise (GB3096-2008) – Grade II
	Zhuluoji Avenue (K0+100)	West (35 ~ 370 m)	
	No. 3 Rd (K0+340)	East (20 ~ 470 m)	
Shangying Village	No1Rd (K0+580)	Northeast (50 ~ 280 m)	
	South extension of Jinshannan Rd (K0+500	Northeast (80 ~ 350 m)	
Dabeichang Village	North extension of Jinshannan Rd (K0+720)	West (190 ~ 430m)	
	No. 2 Rd (K0+960)	Two sides (0 ~ 360 m)	Grade 4a of GB3096-2008
Xiaobeichang Village	North extension of Jinshannan Rd (K0+100)	Two sides (0 ~ 120 m)	Grade II of GB3096-2008
Zhaungke Village	No. 2 Rd (K0+360)	Two sides (0 ~ 130 m)	
	Shiji Avenue (K0+340)	West (90 ~ 320 m)	
Xishan Village	No. 3^{Rd} (K0+100)	Two sides (50 ~ 360 m)	
Yaochong Village	North extension of Jinshannan Rd (K0+100)	East (310 ~ 560 m)	
Lufeng No. 1 Middle School	North extension of Jinshannan Rd (K50+300)	East (35m ~ 380 m)	

Table IV-32: Environmental Sensitive Receptors of River Component in Lufeng

Sensitive Receptor	Location (distance)	Applicable Standard
Guanwai Village	165 m west of West River	Environmental Quality Standard for Noise (GB3096-2008) – Grade II
Guangwa Resettlement Community- B Area	70m west of West River	
Guangwa Resettlement Community- C Area	60m west of West River	
Diaoyudao Residential Community	5m west of West River	
Old School	134m west of West River	
Jinlanbandao Residential Comunity	81m east of East River, and 42m North of East River	
Qinjiaying Village	1 m North of East River, and 40 m South of East River	
Lufeng No. 1 Middle School	101m North of East River	
Songyuan Middle School	88m North of East River	
Lufeng Vocational School	1 m south of East River	
Changfang Village	31 m south of the confluent areaof East River and West River, and 5m east of East River	
Fengyu Bridge	On West River	Protected historical sites and cultural relic

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

193. **Direct project beneficiaries.** The project will bring significant benefits directly to about 410,000 urban residents in Chuxiong City and the counties of Wuding and Lufeng in Chuxiong Yi Autonomous Prefecture by improving urban infrastructures and supporting environmentally sustainable rivers rehabilitation and flood control, and increasing urban sanitation facilities. Of the total direct beneficiary populations, approximately 51.2% are women, 9.5% live under the urban poverty line of less than CNY246 per capita per month, and 33.1% are ethnic minorities in the project areas.

194. **Improved urban transport and municipal services.** The infrastructure development components will reduce traffic congestions, and help the project city/counties establish efficient, safe, sustainable and environmentally friendly urban transport systems including public transportation facilities, bicycle lanes, pedestrian crossings, and traffic management facilities. The road and bridge constructions will also provide opportunities to complete and expand municipal services through the provision of pipelines and conduits for water supply, sewer collection, and stormwater drainage, which will benefit the local economies and residents' health and safety.

195. The infrastructure development components in the three project city/counties will construct 47.7 km sewer pipeline, with wastewater the service population of 91,000 and collection coverage of about 30 km^2. The estimated amount of domestic to be collected is about 18,299m^3/d. This wastewater will be delivered to the existing municipal wastewater treatment plants (WWTPs), where it will be treated to Class-1B Standard prior to discharge into the natural rivers. The sewer system will reduce contamination of receiving water bodies, and will result in cleaner and healthier living environment for the urban residents. The estimated pollution abatement is shown in **Table V-1.**

Table V-1: Summary of Pollutants Removal through the Sewer Pipelines

Item	Chuxiong City	Wuding County	Lufeng County	Total
Length of sewer pipe (km)	18.8	13.4	15.5	47.7
Service population (person)	60,000	15,000	16,000	91,000
Wastewater collected (m3/d)	12,000	3,000	3,200	18,200
COD (t/yr.)	1,621	405	432	2,458
BOD (t/yr.)	592	148	158	898
TN (t/yr.)	216	54	58	328
TP (t/yr.)	13	3	4	20
NH3-N (t/yr.)	131	33	35	199

196. **Improved urban sanitation and public health.** The project will improve the existing urban sanitation condition by enhancement of the city garbage collection and management program to improve the conditions of random dumping and littering in the three urban areas. It's estimated that about 45.5 tons of solid waste will be collected and disposed every days in the three project city/counties after implementation of the project.

197. **Poverty and social benefits.** The Project, by its nature of improving environment and public services, is classified as general intervention regarding poverty reduction impact. The Project will not entail disparities and inequalities between the poor and non-poor for their access to the project outputs and the access to the resultant social and economic benefits. However, the Project will benefit the poor in many ways, although indirectly in most cases. There will be many employment opportunities during the Project construction and operation in the subproject areas. The expansion of urban areas and better infrastructures will promote urbanization, further generate more employments. Most of the non-farm employment opportunities will undoubtedly go to locals, including the poor. Certainly, vocational training will be needed for the locals, especially the poor.

198. **Gender benefits.** The project is designed to meet the criteria for effective gender mainstreaming category. Results from the household survey and focus group discussions indicated that women are the primary users of public transport, sidewalks and non-motorized access and consider traffic safety design and awareness and improved public transport access as important benefits of the project. Improved solid waste management and creation of recreational areas adjacent to the rivers are also all indicated by women to be particularly beneficial. The project will significantly improve their access to social services, and provide new employment and income opportunities.

199. **Climate change mitigation and adaptation.** The project will contribute to climate change mitigation and adaptation. The main project features with regard to adaptation and mitigation are extensively discussed in Chapter V Section H (para 296-308).

B. Screening and Scoping of Potential Impacts

200. The potential impacts, both positive and negative, were screened prior to and during the EIA study, through a number of methods such as rapid environment assessment (REA), site visits, technical analysis and consultations with key stakeholders ranging from the government agencies to members of the local communities and APs in the project areas. The purpose of the screening and scoping were to: (i) identify the relative significance of potential impacts from project activities during construction and operation; (ii) establish the scope of the assessment which assists in focusing on major, critical, and specific impacts; and (iii) enable flexibility in regard to consideration of new issues, such as those that reflect the requirements of both the PRC's environmental laws, regulations and standards, and ADB's Safeguard Policy Statement.

201. The major potential impacts of the infrastructures development components during the construction phase include: noise; air pollution (mainly fugitive dust); water pollution; earthwork and soil erosion; solid waste disposal; interference with traffic and municipal services, permanent and temporary acquisition of land, involuntary resettlement; and occupational and community health and safety.

202. The major anticipated impacts of the infrastructures development components during operation phase include traffic noise; vehicle emissions; traffic safety; and possible risk of spills caused by traffic accidents with impacts on rivers, groundwater, farmlands and the local ecosystem.

203. The river rehabilitation and flood control components will improve the local environment and the resilience to floods. But negative impacts may occur during the construction and operation phases if no appropriate measures are defined. Main potential impacts during works on the riverbanks include water pollution from increased river sediment transport, and impact on modified habitats along some sections of project rivers. Potential impacts during the operation phase include: risk and impact of above-standard floods; changes in vegetation communities (**Table V-2**) the need for periodic maintenance; and potential impacts on beneficial users, including downstream users.

Table V-2: Impact scoping

Subproject	Assessment Item	Project Phase	Potential for Impact
Road subprojects	Air	Construction and Operation	Construction period: Dust generating by construction activities, and asphalt smoke causing by road pavement; Operation period: Air pollution causing by traffic (vehicle emission).
	Sound environment	Construction and operation	Construction period: Noise impacts by construction activities at noise sensitive locations; Operation period: traffic noise.
	Surface water	Construction and operation	Construction period: Waterways and banks affected by bridge construction; Operation period: Runoff from roads and discharge from drains and sewers..
	Soil stability	Construction	Soil erosion caused by construction activities, in particular at slopes, stockpile areas, borrow pits and spoil disposal sites.
Flood management	Air	Construction	Dust generating from embankment earthworks
	Ecology	Construction	In-stream aquatic ecology and riparian ecology.
	Surface water	Construction and operation	Construction: Impacts on flow behavior and flooding on downstream beneficial uses; Operation: Downstream beneficial uses; above standard floods
	Soil stability	Construction	Soil erosion causing at construction sites, stockpile areas, spoil disposal sites.
	Protected areas	Construction	Physical cultural resources (Fengyu Bridge in Lufeng county).

Source: PPTA consultants

204. The following sections describe the adverse impacts in detail. Pre-construction, construction and operational phase impacts are considered separately. Potential impacts from the project were considered under the following categories: (i) direct impacts – those directly due to the project itself; (ii) indirect and induced impacts – those resulting from activities arising from the project, but not directly attributable to it; and (iii) cumulative impacts – impacts which in combination would exert a significant additive influence.

C. Environmental management measures during the Pre-Construction Phase

205. **Measures during feasibility study and EIA.** A number of environmental management measures have been proposed during the preparation of the domestic FSRs, EIAs, water and soil conservation plans, this PROJECT EIA and the LAR plans, and will be implemented in the pre-construction phase to ensure that appropriate plans and documentation to determine the environmental performance of construction and operation of project components are in place. These environmental considerations are further discussed below:

(1) Spoil disposal sites have been identified;

(2) All the project sites, road alignments and the pipeline routes in the updated FSRs were carefully selected to avoid or minimize potential adverse impacts on the environment and surrounding communities;

(3) Wide consultations with the stakeholders and APs have been undertaken on the potential environmental and social impacts. Special consultations with the residential community members, villagers, local water management authorities and experts were held with regard to the possible impacts of the river rehabilitation and flood control components. The comments and suggestions from the consultation activities

have been incorporated into the updated FSRs, and will be included in the detailed design;

(4) All components have undergone the EIA process under the PRC laws and regulations including EIA sections in the master plans, as well as ADB SPS. The EIA reports were prepared by the qualified EIA institute, reviewed by expert panels, and approved by Yunnan Provincial EPD;

(5) Project level GRM in the three project city/counties have been established; and

(6) Appropriate environmental mitigation measures and monitoring parameters, locations and frequencies are included in the EMP.

206. **Measures during pre-construction.** The following mitigation measures will be implemented during the pre-construction stage:

(1) ***Updating EMP.*** Mitigation measures defined in this EMP will be updated and incorporated into the detailed design to minimize adverse environmental impacts. This will be the responsibility of the CSPMO and PIUs, using the LDIs.

(2) ***Confirmation of land acquisition and resettlement.*** The LAR Plans will be updated with the final inventory and the results will be incorporated into the detailed design;

(3) ***Bidding document and contract documents.*** The proposed environmental mitigation measures in the EMP will form a section of the detailed design documents for each project component, and be included in the bidding documents and contracts for procurement of civil constructions, goods and services. All contractors and subcontractors will be required to comply with the EMP;

(4) ***Training in environmental management.*** Environmental specialists including Loan Implementation Environmental Consultants (LIECs) and/or experts/officials from provincial EPD will provide training in implementation and supervision of environmental mitigation measures to contractors;

(5) The ***environmental monitoring program*** incorporated in the EMP will be refined during detailed design to ensure that environmental impacts are closely monitored and the construction and operating activities are closely supervised against the EMPs; and

(6) ***Flood monitoring and early warning systems and emergency response plans*** including the downstream areas will be established.

D. Impacts and Mitigation Measures during Construction

(1) Contractor Performance and Environmental Management on Construction sites

207. To ensure that contractors are able to implement the mitigation measures within their construction sites during construction, the three IAs will put in place the following arrangements: (i) environmental mitigation measures and management requirements will be included in all contracts with contractors; and (ii) approved spoil disposal sites, material haulage routes and waste disposal arrangements will be defined in the contracts as appropriate. Following the award of contracts of construction and construction supervision, the contractor and the CSC will prepare a Construction Site Environmental Management Plan (CS-EMP) and an Environmental Supervision Plan (ESP) respectively, including an emergency preparedness and response plan for construction emergencies and a site environmental health and safety plan, for clearance by the LPMOs of the IAs.

208. During construction, the environmental management unit (EMU) of the LPMOs, together with environmental supervision engineers from the PIUs and CSCs, should be responsible for

enhancing site supervision, management and appraisal, so as to identify problems and solve the problems in time. Environmental training, especially related to environmental management included in the EMP should be conducted. The contractor will take reasonable measures to minimize the impact of construction on the environment.

(2) Impacts on Geology and Soil

209. **Impact on geology.** Potential impacts on geology and topography are most likely to occur in the project as a result of: (i) cutting and filling activities, which will occur along some roads, and (ii) spoil disposal and earth borrowing, which will cause topographic changes and visual problems unless properly controlled.

210. **Impacts on soil.** During construction, the project components could affect the soil in the project areas through erosion, contamination, and differential compaction. Soil erosion may be caused by roadbed construction; excavation of pipe trenches; stockpiles and spoils from earthwork during constructions of roads, bridges, pipelines and river rehabilitation. Bridge and river bank constructions may contribute to bank erosion and excessive amounts of sediment may enter into the surface water bodies if proper design and construction methods are not strictly followed. Soil contamination may result from the inappropriate transfer, storage, and disposal of polluted earth, petroleum products, chemicals, hazardous materials, liquids and solid waste.

211. **Soil erosion.** According to the soil erosion protection plans (SEPPs), the natural soil erosion intensity in the three project areas is 500 tons per square kilometer and year. Higher soil erosion rates are expected during construction when surface vegetation and soil are damaged or disturbed. Soil erosion can also occur after completion of construction in areas if site restoration is inadequate. The most vulnerable soil erosion areas in the construction sites of influence include deep cuts, high fills, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. The estimation of the soil erosion amounts for each component is shown in **Table V-3** below.

Table V-3: Estimated Soil Erosion Amount for each Component during Construction (ton)

Component	Impacted soil erosion area (ha)	Original soil erosion amount	Increased soil erosion amount	Estimated total soil erosion amount
Chuxiong infrastructures	43.56	238	4,788	5,026
Chuxiong River	46.73	221	1,315	1,536
Wuding Infrastructures & river	46.86	397	8,664	9,055
Lufeng infrastructures	102.26	1,157	14,941	16,098
Total	239.41	2,013	29,708	31,715

Source: SEPP for each component

212. **Earthwork.** At the beginning of the PPTA, significant imbalance between earth excavation and fill was proposed in the original FSRs. Through policy dialog, surplus earth in the four project components was reduced from 1.5 million m^3 in the original FSR to almost balance in the updated ones. The measures for achieving a cut-and-fill balance included: (i) re-design of Jinshan Nan Road in Lufeng by maximizing the longitudinal slope to 8% to avoid cutting the hill; (ii) the surplus earth of 11,618 m^3 from Chuxiong infrastructures component will be used for filling the planned landscaping area between Qinglong River bank and the roads of No.15 and 16, where about 0.9 million m^3 filling earth will be needed; (iii) the surplus earth of 250,824 m^3 from Wuding component will be transported to the northwest part of the county town for filling a new construction site, where about 1.5 million m3 of earth are needed; (iv) the surplus earth of 40,500m^3 from Lufeng infrastructure construction will be used for filling the landscaping area on the river banks (domestic funding section), where about 0.5million m^3 filling soil will be used; and (v) the top soil (humus soil) of 45,591m^3 will be used for planting trees, bushes and grass in the landscaping areas in Chuxiong and Wuding, respectively. As a result,

only 12,232 m^3 of inert construction wastes will be transported to the approved spoil disposal sites **(Table V-5).**

213. **River dredging.** The project will not require sediment dredging in the project rivers, as the project will not involve works on the river bed. This was confirmed by the design institutes at several occasions. In Chuxiong City, the Qingshanzui Reservoir upstream of the proposed Longchuan River section was built and put into operation in October 2009, since then suspended solids in the upstream of the river are deposited in the reservoir. Sediment transport in the river downstream of the reservoir has significantly reduced as a result. Therefore, according to the FSR, there will be no sediment dredging work during the river rehabilitation.

Table V-4: Earth Balance for Each Project Component (m^3)

Component	Chuxiong Infra.	Chuxiong River	Wuding Infra & River	Lufeng Infra. & River	Total
Excavation	803,704	327,400	738,423	1,776,500	3,646,027
Filling	966,425	310,200	1,064,141	1,745,100	4,085,866
Stone & gravel to be purchased	280,339	-	604,933	259,300	1,144,572
Landscaping used	0	17,200	28,391	0	45,591
Surplus earth	11,618[22]	0	250,824	290,700	553,142
Construction wastes	486	0	4,946	6,800	12,232

214. **Identification of spoil disposal sites.** Approved spoil disposal sites in the three project city/counties have been identified during the PPTA, which are summarized in **Table V-5.** Soil erosion protection plans of the spoil sites have been approved by local EPB, and environmental management performance of the sites including soil erosion protection and vegetation coverage restoration are being periodically monitored for compliance.

Table V-5: Spoil Disposal Sites

Item	Chuxiong City	Wuding County	Lufeng County
Available capacity (m^3)	400,000	250,000	500,000
Distance from construction site (km)	3.12	2.0	9.2
Transport route	No.9 Rd or West Ring Rd	Yuanwu Rd or No. 108 highway	No. 331 highway
Approval Year (and authority)	2008 (EPB)	2008 (EPB)	2008 (EPB)
Soil erosion protection plan	Available	Available	Available

Source: CSPMO, 2013

215. **Measures for soil erosion control.** Before construction, the contractor will be required to prepare a Site Drainage and Soil Erosion Management Plan (as part of the CS-EMP) to prevent soil erosion. The plan will include the following soil erosion control measures:

(1) During road and bridge constructions, maintain slope stability at cut faces by implementing erosion protection measures such as terraces and silt barriers;

(2) Stabilize all cut slopes, embankments, and other erosion-prone working areas while constructions are going on;

(3) All earthwork disturbance areas must be stabilized within 30 days after earthworks have ceased at the sites;

[22] The surplus earth will be used for filling the landscaping areas between Qinglong River Bank and the roads of No.15 and 16 according to the EIA Report.

(4) Minimize active open excavation areas during trenching activities and use appropriate compaction techniques for pipe trenches construction;

(5) Provide temporary detention ponds or containment to control silt runoff;

(6) Construct intercepting ditches and drains to prevent runoff entering construction sites, and divert runoff from sites to existing drainage;

(7) Strip and stockpile topsoil, and cover or seed temporary soil stockpiles;

(8) Limit construction and material handling during periods of rains and high winds;

(9) Properly slope or re-vegetate disturbed surfaces, such as compacted pipeline trenches and cut banks;

(10) Protect slopes on both sides of bridges and culverts; and

(11) Appropriately set up temporary construction camps and storage areas to minimize the land area required and impact on soil erosion.

216. **Strengthen inspection and monitoring of soil erosion.** A soil erosion inspection and monitoring program has been proposed in the EMP. Internal inspection and monitoring will be conducted by contractors and CSCs while compliance inspection and monitoring shall be conducted by the external environment monitor (EEM). The inspection and monitoring results will be submitted to the LPMOs, PIUs, CSPMO, local EPBs and Water Resources Bureaus to serve as basis for project implementation progress reports and acceptance of construction.

217. Mitigation measures for **soil contamination control** include the following:

(1) Properly store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas, and use the best management practice to avoid soil contamination;

(2) Remove all construction wastes from the site to approved waste disposal sites;

(3) Establish emergency preparedness and response plan (Spill Management Plan); and

(4) Provide spill cleanup measures and equipment at each construction site and require contractors to conduct training in emergency spill response procedures.

(3) Impacts on Hydrology and Water Quality

218. The following section assesses impacts on hydrology and water quality during construction, with a focus on the roads (including bridges and pipelines) in the project city/counties. The proposed infrastructure components are not expected to cause significant impacts on hydrology and water quality, but the measures for construction site management described below were proposed in the domestic EIAs, which also apply to the river rehabilitation and flood control components.

219. **Impact on river hydrology from bridge construction.** Thirteen bridges with a span of 10-50 m will be constructed in the project city/counties over rivers and channels. These channels and rivers are in urban areas, with no to little ecological value (**Figure V-1** and **Figure V-2**). All bridges have been designed based on the PRC flood control standard of 1-in-50 years.

Figure V-1: Qinglong River in Chuxiong City

Figure V-2: Wulong River in Wuding City

220. Bridge construction may disrupt the river hydrology through obstruction of flood flow and cause back water effect in the upstream during the rainy season. In order to minimize these impacts, the following mitigation measures will be implemented (to be defined in contract specifications):

(1) River bridge pier constructions shall be conducted during the dry season, construction during the rainy season will be prohibited;

(2) Foundation treatment and pier grouting come first in pier construction; and

(3) Provide adequate opening for flood flow before the rainy season.

221. **Obstruction in river hydrology during riverbank works:** River embankment works may disrupt the river hydrology through obstruction of flood flow and cause backwater effect in the upstream, but according to domestic EIAs and the FSRs, river embankment works are 2-3 m above the average water levels. The mitigation measures include:

(1) Cofferdam diversion will be set along the proposed rivers; and

(2) River bank constructions shall be conducted during the dry season (from November to March).

222. **Surface water pollution.** Inappropriate storage and handling of petroleum products and hazardous materials, or accidental spills, disposal of domestic wastewater from construction camps, and wash-down water from construction equipment and vehicles may contaminate adjacent surface water or groundwater resources. Infrastructure and river rehabilitation constructions, as well as pipeline works, will disturb surface soils and could affect surface water in the project areas through increased sedimentation in rivers, resulting from cutting and filling operations, excavation of pipeline trenches, and bridge constructions across the rivers. According to the FSRs for the infrastructure components, piles will be drilled during construction of the bridge foundation, which could disturb the river sediment and further increase suspended solid (SS) concentration in the water bodies. This impact is believed to be negligible, since rivers in the project area are seasonal rivers with minimal to no flow during the dry period, and construction of river bridge piers will be conducted during the dry season.

223. **Construction wastewater.** Wastewater produced during construction will come from washing aggregates, pouring and curing concrete, wastewater from maintenance and cleaning of mechanical equipment and vehicles. Based on the domestic EIA reports, during construction period, there will be six (6), three (3) and three (3) construction sites during same period in Chuxiong, Wuding and Lufeng, respectively, each construction site will generate about 6 m^3 construction wastewater based on the estimation in the EIA reports. The peak work force is estimated at 540, 210 and 240 workers in Chuxiong, Wuding and Lufeng, respectively. The daily domestic wastewater discharge from each worker is 0.048 m^3 according to the domestic

EIA reports. The construction and domestic wastewaters generated during construction are summarized in **Table V-6**.

Table V-6: Summary of Wastewater Generated during construction

Item	Chuxiong	Wuding	Lufeng	total
Construction wastewater (m3/d)	36	18	18	72
Domestic wastewater (m3/d)	25.92	10.08	11.52	47.52

224. **Impacts on groundwater from road construction.** As groundwater in the project's areas of influence is generally relatively deep (average 10 m in Chuxiong and Wuding, and 8 m in Lufeng), no major impacts on groundwater resources are anticipated in either the construction or operation phases of the roads and auxiliary facilities. No wells/hand pumps are located in the area of potential impact. However, fuels and chemicals used for road construction could contaminate groundwater if they are not properly stored and disposed. Spills of toxic substances resulting from traffic accidents during construction may also contaminate groundwater if no proper emergency response is undertaken.

225. **Measures to avoid surface water and groundwater pollution** include the following:

(1) During bridge and river bank constructions, contractors will be required to pump slurry to shore and properly dispose cutting materials. This will reduce the disturbance of sediments and the impact to water quality;

(2) Contractors will be required to develop contingency plans for control of oil and other dangerous substances (Spill Management Plan) as part of the CS-EMP;

(3) Wastewater from construction activities will be collected in sedimentation tanks, retention ponds, and filter tanks to remove silts and oil;

(4) All areas where construction equipment is being washed will be equipped with water collection basins and sediment traps;

(5) Fuel storage, maintenance shop and vehicle cleaning areas must be stationed at least 500 m away from the nearest water body;

(6) Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces, and provided with bunds and cleanup installations;

(7) Contractors' fuel suppliers must be properly licensed. They shall follow proper protocol for transferring fuel and the PRC standard of JT3145-88 (Transportation, Loading and Unloading of Dangerous or Harmful Goods);

(8) Labor camps will be located at least 500 m from rivers and ponds;

(9) Eco-toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols; and

(10) Water quality (for pollutants such as SS, CODcr, oil, and grease) in rivers and ponds will be monitored during construction in accordance with the EMP monitoring program to identify and confirm results of the impact assessment and effectiveness of adopted mitigation measures.

226. **Additional mitigation measures for the river rehabilitation components.** In addition to the above, the following measures will be implemented to protect the surface water quality and avoid negative alteration of the local hydrology systems:

(1) A water monitoring program will be developed and implemented to assess the impact of construction activities on the water qualities of rivers compare with baseline conditions;

(2) All earthworks along the rivers will be accompanied by measures to minimize sediment runoff into the rivers. This will include the use of sediment traps to protect runoffs from construction activities; and

(3) The discharge of construction wastewater to the rivers will be prohibited; and fuel storage, maintenance shop and vehicle cleaning areas will be stationed at least 500 m away from the rivers.

(4) Impact on Air Quality

227. **Pollution sources.** Anticipated sources of air pollution from construction activities include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially in windy days; (iii) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (iv) dust from aggregate preparation and concrete-mixing; (v) vehicle emission from construction vehicles (gaseous CO, CH and NO_2) and heavy diesel machineries and equipment; and (vi) asphalt flue gas during road pavement. The dust and gaseous air emissions could affect nearby sensitive receivers, including villages, residential areas, hospitals and schools, etc.

228. The quantity of dust generated by the construction activities depends on the force of the wind, the humidity of the material, the level of construction and the state of site. It is estimated that under the general condition (with an average wind speed of 2.5 m/s) in the area of 150 m downwind from the construction, the dust becomes less apparent and disturbing. For dust generated by transporting earth and other construction powdery materials, the impact exceeds 60 m on both sides of the transport route.

229. A particular emission from road construction is asphalt flue gas. During the asphalt heating and mixing process, the fuel burning will produce smoke, and the asphalt will produce flue gases emissions. Currently, modern asphalt mixing equipment used in the PRC releases typical emission concentrations of asphalt flue gases of about 30 mg/m^3, which complies with asphalt flue gas discharge requirements of 80-150 mg/m^3 of Atmospheric Pollutant Emission Standard (GB16297-1996). It also complies with the Ambient Air Quality Standard (GB3095-1996), which limits the concentration of benzopyrene at 0.01 $\mu g/m^3$ (at 100 m downwind from the asphalt mixing station).

230. A series of **mitigation measures** are defined in the EMP for reducing the impact of air emission on sensitive receivers (to be included in technical specifications):

(1) Spraying water on construction sites and earth/material handling routes where fugitive dust is being generated;

(2) Locating asphalt plants and mixers as far away as possible (at least 500 m downwind) from the nearest residential areas and other sensitive receptors;

(3) Paying particular attention to dust suppression near sensitive receptors such as schools, hospitals and residential areas;

(4) Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission;

(5) Covering materials during truck transportation, in particular, the fine material, to avoid spillage or dust generation; and

(6) Ensure emissions from vehicle and construction machineries are in compliance with the PRC standards of GB18352-2005, GB17691-2005, GB11340-2005, GB2847-2005, and GB18285-2005.

231. With the above mitigation measures, the impact of construction on air quality is anticipated to be acceptable.

(5) Noise

a. Noise Intensity

232. A significant increase in noise is expected during construction, due to various construction and transport activities. Construction activities will involve excavators, bulldozers, graders, stabilizers, dredgers, concrete-mixing plants, drills, stone-crushing and screening plants, rollers, and other heavy machinery. Noise during pipeline construction will be generated by trench excavators, rollers and other compaction machine. Though noise levels may be severe, the noise will be temporary and localized. The major construction machinery noise testing values are shown in **Table V-7**.

Table V-7: Testing Values of Construction Machinery Noise

No.	Machine Type	Model	Distance between Measuring Site and Machinery (m)	Maximum Sound Level Lmax (B)
1	Wheel loader	Model XL40	5	90
2	Wheel loader	Model XL50	5	90
3	Grader	Model PY160A	5	90
4	Vibrating roller	Model YZJ10B	5	86
5	Two-wheeled two-vibrating roller	Model CC21	5	81
6	Three-wheeled roller		5	81
7	Tire roller	Model ZL16	5	76
8	Bulldozer	Model T140	5	86
9	Tire hydraulic excavator	Model W4-60C	5	84
10	Paver (UK)	Fifond311ABGCO	5	82
11	Paver (Germany)	VOGELE	5	87
12	Generating set (two sets)	FKV-75	1	98

Source: EIA Reports (Ministry of Transportation, 2006. “Specifications for Environmental Impact Assessment of Road Construction)

b. Methodology for Prediction of Noise Value during Construction

233. Construction equipment noise source is considered as a point sound source, and the predictive mode is as follows:

$$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

Where, L_i and L_0 are equipment noise sound levels at R_i and R_0 respectively. ΔL is additional diffusion attenuation produced by barriers, vegetation and air.

234. As for the impact of multiple construction machineries on a certain future position, sound level superposition is needed:

$$L = 10\lg\Sigma 10^{0.1\times L_i}$$

c. Prediction Results

235. Noise levels at different distances are gained after calculating the impact scope of equipment noise during construction as defined in **Table V-8**. The PRC “Standard of Noise Limits for Construction Sites” (GB12523 - 90) specifies the noise limit Class II area as 70 dB (A) during daytime and 55 dB (A) during nighttime. The standard compliance noise impact scope (m) of different machineries is listed in **Table V-9.**

Table V-8: Noise Values of Construction Machineries at Different Distances dB (A)

Machinery Name	Distance to Machinery									
	5 m	10 m	20 m	40 m	50 m	60 m	80 m	100 m	150 m	300 m
Excavator	84	78	72	66	64	63	60	58	55	47
Bulldozer	86	80	74	68	66	65	62	60	57	49
Land scraper	90	84	78	72	70	69	66	64	62	54
Loader	90	84	78	72	70	69	66	64	62	54
Roller	86	80	74	68	66	65	62	60	57	49
Concrete-mixer	87	81	75	69	67	66	63	61	58	50
Asphalt concrete paver	85	79	73	67	65	64	61	59	56	48

Source: Domestic EIA Reports.

Table V-9: Road and Bridge Construction Equipment Noise Impact Scope

Construction Stage	Construction Machinery	Limit Standard (dB)[23]		Impact Scope (m)	
		Daytime	Nighttime	Daytime	Nighttime
Earth and Stone Work	Excavator	75	55	15	150
	Bulldozer	75	55	18	180
	Land scraper	75	55	29	290
	Scraper loader	75	55	29	290
Piling	Pile driver	85	Prohibited	126	/
Structure	Road roller	70	55	32	180
	Truck	70	55	67	266
	Vibrator	70	55	53	224
	Dump truck	70	55	20	112
	Mixing machine	70	55	29	200
	Asphalt concrete paver	70	55	29	160

Source: Domestic EIA Reports.

236. The noise impact distances during construction of infrastructures for compliance with the PRC Standard of Noise Limits for Construction Sites (GB12524-90) are up to about 130 m away from the source during the day and 300 m at night (**Table V-9**). In addition, construction materials, surplus spoil and construction wastes will be transported to and from the construction sites during the average 10 hour workday for the construction season of about 290 days per year in the project area for about 4 years. As a result, urban residential areas and villages through which haul roads pass and which are adjacent to construction sites will frequently experience noise levels at 70–80 decibels in the audible scale. Activities with intensive noise levels not only will have an impact on the residents, but also may cause injury to construction workers operating the equipment.

d. Mitigation Measures for Noise Impact

237. A step-wise approach towards mitigation of construction noise will be followed to reduce noise levels to acceptable levels. The noise control strategy includes two major methods of source control and path control. Source control is most highly prioritized because it is, in general, the most effective form of noise control by eliminating a noise source before it is allowed to emit offensive noise levels. Source control, which limits noise emissions or restricts allowable types or operating times of heavy equipment, is also the easiest to oversee. Source control measures will be combined with path control measures: intervening pathways over which construction noise propagates to the sensitive receptors can be effectively interrupted

[23] Standard of Noise limits for Construction Sites (GB 12523-90).

with noise barriers and/or curtains, providing care is taken to completely block the line-of-sight between the noise source and the affected receptors.

238. The following **mitigation measures** will be implemented to meet the PRC construction site noise limits and to protect sensitive receptors (see **Table IV-14, Table IV-21 and Table IV-31**):

(1) Ensure that noise levels from equipment and machinery conform to the PRC standard of GB12523-90, and properly maintain construction vehicles and machineries to minimize noise;

(2) Apply noise reduction devices or methods where piling equipment is operating within 300 m of sensitive sites such as schools, hospitals and residential areas (see **Table IV-14, 20 and 24**);

(3) Locate sites for rock crushing, concrete-mixing, and similar activities at least 1 km away from sensitive areas;

(4) To reduce noise at night, restrict the operation of machinery generating high levels of noise, such as piling, and movement of heavy vehicles along urban and village roads between 20:00 and 06:00 the next day in accordance with the PRC regulations;

(5) Take special caution at construction sites that are close to such sensitive sites as schools, hospitals and office buildings. When construction activities are unavoidable during the school seasons, the use of heavy equipment will be restricted to weekends and non-class hours.

(6) Place temporary hoardings or noise barriers around noise sources during construction, if necessary;

(7) Monitor noise at sensitive areas at regular intervals (refer to the monitoring plan in the EMP). If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; and

(8) Conduct monthly interviews with residents living adjacent to construction sites to identify community complaints about noise, and seek suggestions from community members to reduce noise annoyance. Community suggestions will be used to adjust work hours of noise-generating machinery.

239. **Additional mitigation measures for the Chuxiong river rehabilitation component** (for the first section of Longchuan River in Chuxiong City only[24])**.** To protect birds and ducks potentially present during construction activities in Section 1 of the river, the following measures have been defined in the EMP to minimize the noise impacts:

(1) Erect temporary noise barriers around noise sources during construction to comply with Class I[25] (55 dB(A) during day-time; 45 dB(A) during night-time) of the PRC Ambient Noise Standard (GB3096-2008);

(2) Prohibit construction activities during the night;

(6) Vibration Impact

240. Vibration impacts are expected during infrastructure and river rehabilitation works, including vibrations from bridge pilling, pipeline trench compaction, river bank stone crashing, and roadbed compacting and rolling, etc. On the proposed construction sites, different degrees of mechanical vibration will occur. Such vibration is sudden and discontinuous, which can annoy

[24] The section from Qingshanzui Reservoir to G320 Road Bridge (stake 0+000-4+500)

[25] For the first section of Longchuan River in Chuxiong City.

people nearby the sites and construction workers. Main construction machineries include vibrating road rollers, land scrapers, loaders, stone crashers and spreading machines, among which the impacts of bridge pile drivers and vibrating road rollers are the highest. Mitigation measures defined in the EMP include prohibition of pilling and compaction operations at night, which will effectively reduce the vibration impact to acceptable levels.

(7) Solid Waste

241. **Solid waste from workers' camps**. While most workers will live in rented apartments, some work camps might be needed. An average of 0.5 kg/day per worker of garbage will be produced in construction camps according to the domestic EIA reports. A covered garbage basin will be installed at each construction camp. It will be the responsibility of the construction contractors to provide sufficient garbage bins at proper locations and ensure that they are protected from birds and vermin, and emptied regularly (using the local municipal solid waste collection systems). The contractors' responsibility is included in the EMP and will be included in bidding documents and construction contracts. Because the construction sites are within and nearby the existing urban areas, according to the EIA reports, most of the construction workers will live in rent-apartments, so that they can use the existing municipal service system.

242. **Construction wastes.** Construction wastes could have adverse impacts on the surroundings if not properly managed. Construction wastes that cannot be used will be collected on site and not be discarded in a way that will damage farmland or the immediate environment. Construction wastes will be regularly transported off-site by the contractor for disposal at disposal sites approved by the local EPBs in compliance with the Law on the Prevention and Control of Environmental Pollution by Solid Waste of the PRC (issued on 29 December 2004) and scrap material and demolition waste disposal standards promulgated by the Ministry of Housing and Urban-Rural Construction.

E. Impacts to Biological Resources

243. **Loss of habitats, impact on biodiversity.** As established during environmental baseline assessment, none of the project sites is within a legally protected site or a site proposed for protection. The project sites do not include critical habitats with recognized critically endangered or endangered species. Project sites largely support degraded and modified habitats with low conservation values. No rare and endangered species were identified and recorded in the project areas during the domestic EIA process. The three project rivers are unlikely to sustain aquatic life of ecological significance or high biodiversity due to their polluted state. Flora to be affected along project rivers include mostly shrubs, common seasonal crops, and weeds. The impact on flora and fauna are mainly land use changes, a reduction in cultivated land (142 ha), and reduced vegetation coverage (20.9 ha). In Chuxiong, section 1 of the river rehabilitation subcomponent supports the highest ecological value in the project area. In this section, project embankment activities will only be implemented for eroded banks, avoiding removal of native vegetation and reducing the possibility that feeding or breeding sites will be affected. No activity involves works within the actual water bodies of the rivers. Tree cutting and river bed dredging works will be avoided. The project will increase vegetation coverage by 57.18 ha along the proposed roads and rivers for urban environment improvement and landscaping purposes (**Table V-10**).

Table V-10: Vegetation affected by the Project (ha)

Component	Affected grassland (ha)	Affected forest land (ha)	Area vegetated by the project (ha)	Surplus vegetation (ha)
Chuxiong infrastructure.	0.53	2.61	10.24	+7.1
Chuxiong River	0	2.78	19.41	+16.63
Wuding Infrastructure	0.12	1.19	4.18	+8.93
Wuding river			6.06[26]	
Lufeng Infrastructure	0.63	14.32	6.37	+24.52
Lufeng river landscaping			33.1[27]	
Total	1.28	20.90	79.36	+57.18

Source: Domestic EIA Reports

244. **Protection and mitigation measures** for the impact on flora will include the following activities:

(1) Protect existing vegetation nearby construction sites;

(2) Properly backfill, compact and re-vegetate pipeline trenches after pipeline installation;

(3) Protect existing trees and grassland during road, bridge, river rehabilitation and pipeline constructions; where a tree has to be removed or an area of grassland disturbed, replant trees and re-vegetate the area immediately after construction;

(4) In compliance with the PRC's forestry law, undertake compensatory planting of an equivalent or larger area of affected trees and vegetation;

(5) Only native plant species of local provenance will be used for re-vegetation; and

(6) Identify, demarcate and protect sites where small animals, reptiles, and birds of common species live such as vegetated roadside areas, trees, inner areas of bridges and river beaches, etc.

245. **Mitigation measures for protection of flora and fauna on the first section of the Longchuan River**[28]**.** According to the FSR and the EIA, as well as the site inspection conducted by the PPTA Consultants and CSPMO, there are some wild fishes and birds (such as wild ducks) in the first section (with a length of 4,500 m) of the Longchuan River in Chuxiong City, and there are many wild willows on the riverbanks along the section, which are valuable for maintaining the bank stability and ecological function of the river. Particular attention shall be paid to protect the wild species. The following measures should be taken during the river rehabilitation:

[26] Includes the green space surrounding the stormwater retention pond
[27] Includes the green space surrounding the stormwater retention pond

[28] Other sections of the Longchuan River and other two rivers in the counties of Lufeng and Wuding lost almost all ecological functions, and became seasonal streams.

(1) The river rehabilitation for the first section of the Longchuan River will be limited to existing riverbank repairs, replanting native trees with roots flourishing to stabilize the exiting riverbank;

(2) The existing waterway channel, natural tree line and vegetation will be preserved.

F. Impacts on Socio-Economic Resources

246. **Loss of land.** The total permanent land acquisition area is 2,261.42 mu (150.16ha)[29], of which farmland, house plot and other land account for 94.52%, 3.35% and 2.13%, respectively. The total house/building demolition area is 40,814 m^2 including residential houses of 36,170 m^2, rural shanties of 325 m^2 and small shops/institution buildings of 2,625 m^2. The breakdown of these losses by subcomponent and land category is shown in **Table V-11**.

247. The IAs must obtain approval from the local land administration departments to alienate farmland. Under the relevant legislation and principles that apply in the PRC in such cases, farmers or residents who lose land permanently will be compensated by replacement with land of equivalent quality and quantity, or through a lump sum payment. This process is detailed in the Land acquisition and resettlement plans (LAR plans).

[29] Chinese unit of area, equal to 1/15 hectare.

Table V-11: Land Acquisition and Resettlement Impact

Item		Unit	Chuxiong River Rehabilitation	Chuxiong Road Network	Wuding Road & River	Lufeng Road & River	Total
Affected township/urban sub-district		No.	1	1	1	1	**4**
Affected village/community		No.	5	3	5	5	**18**
Affected village groups		No.	27	14	22	33	**96**
Permanent land acquisition	Collective land	mu	190.24	584.76	388.67	1,096.01	**2,259.68**
	Farmland	*mu*	190.24	477.3	386.09	1,082.43	2,136.06
	House plot	*mu*	0	60.44	1.58	13.58	75.60
	Construction land	*mu*	0	0	0	0	0.00
	Enterprise land	*mu*	0	0	0	0	0.00
	Other land	*mu*	0	47.02	1	0	48.02
	State land	mu	0	0	1.74	0	**1.74**
Demolition of residential houses and structures	Total structure area	M^2	0	29,972	3,789	7,053	**40,814.00**
	Rural house	M^2	0	28,622	670	6,878.00	**36,170.00**
	Rural Shanty	M^2	0	0	150	175	**325.00**
	Rural Enterprise/shop	M^2	0	0	0	0	**0.00**
	Urban house	M^2	0	0	1,694	0	**1,694.00**
	Urban Shanty	M^2	0	0	0	0	**0.00**
	Urban Enterprise/shop	M^2	0	1,350	1,275	0	**2,625.00**
Affected rural households and persons	Acquisition of farmland	HH	273	359	540	673	**1,845**
		Person	1,225	1,559	2,392	2,874	**8,050**
	Demolition of residential houses	HH	0	37	2	49	**88**
		Person	0	156	7	196	**359**
	Both land and house acquisition	HH	0	50	5	12	**67**
		Person	0	234	21	53	**308**
Affected urban households and persons	Demolition of residential houses	HH	0	0	11	0	**11**
		Person	0	0	38	0	**38**
Total of affected households and persons		HH	273	446	558	734	**2,011**
		Person	1,225	1,949	2,458	3,123	**8,755**
Total of enterprises/shops and persons		No.	0	4	13	0	**17**
		Person	0	140	44	0	**184**

Source: the PPTA social and resettlement consultants' report

248. **Resettlement.** A total of 8,755 persons from 2,028 households will be affected, including 1,845 households affected by land acquisition, 105 households by house demolition, and 67 households by both.

249. Four full LAR Plans have been prepared in compliance with the *Land Administration Law of the People's Republic of China* (2004), *Law of the People's Republic of China on Administration of the Urban Real Estate* (2007 Revised); *Regulations regarding the Administration of Urban Housing Removal* (2001); *Guidelines Regarding Urban Housing Removal Estimation*, and other applicable guidelines. They were also based on local policies regarding LAR in Yunnan Province, Chuxiong Prefecture, and the project city/counties, and ADB's Safeguard Policy Statement. The LAR Plans will be updated based on the census of APs and detailed measurement survey, and submitted to ADB for review and approval prior to award of civil works contracts. The LAR Plans provide a socioeconomic profile of the APs and scope of impacts, and address issues related to compensation entitlement, legal framework, public consultations, grievance procedures, environmental protection, rehabilitation measures, and budget and implementation milestones. Resettlement requirements have been carefully considered and incorporated into design of each project component.

250. **Risks to public utilities and community health and safety**. Traffic congestion may worsen as construction traffic in urban areas increases, causing temporary inconvenience to traffic, residents, commercial operations, and institutions. Some construction sites will be located close to residential communities and schools, presenting a threat to public health and safety. The constructions may also contribute to road accidents through the use of heavy machinery on existing roads. Construction may cause unexpected interruptions in municipal services and utilities because of damage to pipelines for water supply, drainage, and gas supply, as well as to underground power cables and communication cables (including optical fiber cables).

251. **Mitigation of impacts on community health and safety.** The potential impacts on community health and safety will be mitigated through a number of activities defined in the EMP. The contractors will implement the following measures:

(1) **Traffic management.** A traffic control and operation plan will be prepared, to be approved by the local traffic management administrations before construction. The plan will include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings, selecting transport routes to reduce disturbance to regular traffic, reinstating roads, and opening them to traffic as soon as the construction is completed;

(2) **Underground facilities survey and protection.** Construction activities will be planned so as to minimize disturbances to utility services. Three-dimensional detection of underground facilities will be conducted before construction where appropriate;

(3) **Information disclosure.** Residents and businesses will be informed in advance through media of the construction activities, given the dates and duration of expected disruption; and

(4) **Construction sites protection.** Clear signs will be placed at construction sites in view of the public, warning people against potential dangers such as moving vehicles, hazardous materials, excavations etc., and raising awareness on safety issues. Heavy machinery will not be used at night. All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.

252. **Risks to occupational health and safety.** Construction industry is considered to be one of the most hazardous industries. Intensive use of heavy construction machinery, tools, and materials present physical hazards including noise and vibration, dust, handling heavy

materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, etc.

253. **Measures to ensure adequate occupational health and safety.** Contractors will implement adequate precautions to protect the health and safety of their construction workers. The occupational health and safety risks will be managed by applying measures in the following order of preference: avoiding, controlling, minimizing hazards, and providing adequate protective equipment. The contractors will undertake the following activities:

(1) **Environmental, health and safety officer.** An environmental, health and safety officer will be appointed by each contractor to implement and supervise the environmental, health, and safety management plan (see below).

(2) **Environmental, health and safety management plan.** Each contractor will prepare such a plan for the construction works on the basis of the EMP. The plan will include the following provisions:

(a) **Clean water.** Provide a clean and sufficient supply of fresh water for construction sites and for all camps, offices and workshops;

(b) **Sewage and wastewater.** Provide an adequate number of latrines and other sanitary arrangements at construction sites and work camps, and ensure that they are cleaned and maintained in a hygienic state;

(c) **Solid waste.** Garbage receptacles at construction sites and camps will be set up, which will be periodically cleared to prevent outbreak of diseases;

(d) **Personal protection.** Provide personal protection equipment, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations for workers;

(e) **Emergency preparedness and response.** An emergency response plan to take actions on accidents and emergencies will be prepared, including environmental and public health emergencies associated with hazardous material spills and similar events, and submitted to the local EPBs for review and appraisal. Emergency phone link with hospitals in the three project towns will be established. A fully equipped first-aid base in each construction camp will be organized;

(f) **Records management**. A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits;

(g) **Safety communication.** Ensure that occupational health and safety matters are given a high degree of publicity to all persons regularly or occasionally on each construction site. Posters will be displayed prominently in relevant areas of the site; and

(h) **Training, awareness and competence.** Train all construction workers in basic sanitation, general health and safety matters, and on the specific hazards of their work. Implement site HIV/AIDS and other communicable diseases awareness and prevention program to target the local community and construction workers.

254. **Other Social Issues.** No other social risks and/or vulnerability are anticipated as a result of the project. The project construction workers will be engaged locally. Prevention and control of transmissible diseases and HIV/AIDS, and community disturbance training and sensitization will be provided to the contractors, as well as drug and human trafficking education will be provided to the local communities, ensured in the loan assurances and monitored in the social action plans. Core labor standards will be implemented. Civil works contracts will stipulate priorities to (i) employ local people for works, (ii) ensure equal opportunities for women and men, (iii) pay equal wages for work of equal value, and pay women’s wages directly to them;

and (iv) not employ child or forced labor. Specific targets for employment have been included in the gender action plan (GAP).

255. **Impact on physical cultural resources.** With exception of Fengyu Bridge in Lufeng County, no cultural heritage or archaeological sites are recorded within the project areas. However, construction activities have the potential to disturb unknown underground cultural relics. The mitigation measures will include immediate suspension of construction activities if any archaeological or other cultural relics are encountered. The municipal relic management authorities and the LPMOs and CSPMO will be promptly notified, and construction will resume only after thorough investigation and with the permission of the appropriate authority. The clause for protection of unknown underground cultural relics will be included in construction contracts.

256. The Lufeng river rehabilitation component will pass **Fengyu Bridge** (river embankment works are ongoing, financed through domestic funding; the ADB loan will only include landscaping works along the river). During the PPTA, several rounds of dialogues and discussions with the local Cultural Relics Bureaus were conducted, and both the FSR and the EIA confirm that there will be no construction within 200m range of the bridge except some very minor embankment repairing works under the domestically funded project, and the original status will be preserved.

F. Environmental Impact and Mitigation Measures during Operation

(1) Operation of Proposed Infrastructures (roads and auxiliary facilities)

257. Main environmental issues during operation of the urban roads, bridges and auxiliary piped facilities in the three project city/counties relate to vehicle emissions, traffic noise, water pollution from storm-water runoff and inappropriate wastewater treatment, traffic safety and the related risk of hazardous spills.

a. Air Pollution

258. In this project, NO_2 and CO are the parameters designated by the Yunnan EPD for assessing traffic emission impact on air quality. The baseline monitoring indicates that the average concentrations of NO_2 in the three project city/counties met Grade II of the PRC Ambient Air Quality Standard of GB3096-1996 (see baseline data in Chapter IV of this project EIA).

259. By using traffic volume projections provided in the FSRs, air qualities were modeled during the domestic EIA studies based on the AERMOD methodology (software), which is recommended in the PRC “Technical Guideline on Environmental Impact Assessment – Atmospheric Environment” (HJ2.2-2008). Vehicle emission concentrations at average traffic volumes (both daily average and rush hours) during the operation period at sensitive locations were estimated. **Table V-12** to **Table V-14** show that the predicted incremental concentrations of NO_2 and CO for 2016 (short-term), 2022 (medium-term), and 2030 (long-term) on ground level along both sides of the project roads at the sensitive locations in the three project city/counties all meet the national Grade II Standards of GB3095-1996.

Table V-12: NO_2 & CO Concentrations at Sensitive Locations in Chuxiong City during Operation (mg/m^3)

Wind Speed: 2.25m/s

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[30]	Standard	Predicted Concentration	Predicted Concentration	Standard	Standard
Hehua Village	30 ~ 475m northeast of No.17 Road (K2+860)	2016	Rush hours	1.378975	10	meet	0.035053	0.24	meet
			Daily average	0.253392	4	meet	0.006441	0.12	meet
		2022	Rush hours	4.198102	10	meet	0.121848	0.24	meet
			Daily average	0.771433	4	meet	0.018536	0.12	meet
		2030	Rush hours	8.170275	10	meet	0.20932	0.24	meet
			Daily average	1.50125	4	meet	0.031026	0.12	meet
Heiniba Village	0 ~ 230 m two sides of No. 10 Road (K0+660)	2016	Rush hours	0.968668	10	meet	0.012654	0.24	meet
			Daily average	0.178007	4	meet	0.002325	0.12	meet
		2022	Rush hours	2.144929	10	meet	0.027282	0.24	meet
			Daily average	0.394173	4	meet	0.004787	0.12	meet
		2030	Rush hours	4.189742	10	meet	0.04616	0.24	meet
			Daily average	0.769831	4	meet	0.008043	0.12	meet
Yinqi Village	400 ~ 870 m north of No. 10 Road	2016	Rush hours	1.164093	10	meet	0.01561	0.24	meet
			Daily average	0.214016	4	meet	0.00287	0.12	meet
		2022	Rush hours	4.588046	10	meet	0.056539	0.24	meet
			Daily average	0.843368	4	meet	0.010393	0.12	meet
		2030	Rush hours	8.929062	10	meet	0.094677	0.24	meet
			Daily average	1.640623	4	meet	0.017396	0.12	meet
Xiaodong Village	220 ~ 440 m northeast of No. 11 Road (K2+940)	2016	Rush hours	0.873503	10	meet	0.015873	0.24	meet
			Daily average	0.160488	4	meet	0.002916	0.12	meet
		2022	Rush hours	1.997968	10	meet	0.034697	0.24	meet
			Daily average	0.367107	4	meet	0.006234	0.12	meet
		2030	Rush hours	3.904832	10	meet	0.058532	0.24	meet
			Daily average	0.717478	4	meet	0.010483	0.12	meet
Sunjia Village	265 ~ 335 m east of No. 11	2016	Rush hours	0.69986	10	meet	0.011838	0.24	meet
			Daily average	0.128599	4	meet	0.002175	0.12	meet

[30] These predictions do not account for CO baseline, but only model the projects contribution to CO concentrations. Baseline CO ambient concentrations are low in the Chuxiong prefecture and usually not monitored. Maximum daily concentrations are below 1.0 mg/m^3 (national standard is 4.0 mg/m^3) and the maximum hourly concentration monitored by the provincial EPD was 2.88 mg/m^3 (national standard is10 mg/m^3).

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[30]	Standard	Predicted Concentration	Predicted Concentration	Standard	Standard
	Road (K2+940)	2022	Rush hours	1.684166	10	meet	0.028213	0.24	meet
			Daily average	0.309478	4	meet	0.004943	0.12	meet
		2030	Rush hours	3.288341	10	meet	0.047713	0.24	meet
			Daily average	0.604205	4	meet	0.008302	0.12	meet
Dadong Village	415 ~ 590 m east of No. 49 Road (K0+160)	2016	Rush hours	0.507395	10	meet	0.008799	0.24	meet
			Daily average	0.093235	4	meet	0.001617	0.12	meet
		2022	Rush hours	1.311361	10	meet	0.022018	0.24	meet
			Daily average	0.241032	4	meet	0.003806	0.12	meet
		2030	Rush hours	2.554789	10	meet	0.037291	0.24	meet
			Daily average	0.469417	4	meet	0.006389	0.12	meet
Longtanao Village	10 ~ 400m west of No. 49Road (K0+780)	2016	Rush hours	0.524774	10	meet	0.0085	0.24	meet
			Daily average	0.096486	4	meet	0.001562	0.12	meet
		2022	Rush hours	2.190387	10	meet	0.026599	0.24	meet
			Daily average	0.402645	4	meet	0.00489	0.12	meet
		2030	Rush hours	4.261524	10	meet	0.044525	0.24	meet
			Daily average	0.783011	4	meet	0.008181	0.12	meet
Fumina Village	0-360 m two sides of No. 11 Road (K1+870); 0 ~ 1060 m two sides of No. 17 Road (K0+620)	2016	Rush hours	1.716585	10	meet	0.044201	0.24	meet
			Daily average	0.31543	4	meet	0.008122	0.12	meet
		2022	Rush hours	5.273925	10	meet	0.15483	0.24	meet
			Daily average	0.969124	4	meet	0.023502	0.12	meet
		2030	Rush hours	9.26305	10	meet	0.206039	0.24	meet
			Daily average	1.885789	4	meet	0.039337	0.12	meet
Panjia Village	50 ~ 600 m southwest of No. 49Road	2016	Rush hours	0.480095	10	meet	0.007676	0.24	meet
			Daily average	0.088222	4	meet	0.00141	0.12	meet
		2022	Rush hours	1.578138	10	meet	0.019709	0.24	meet
			Daily average	0.290088	4	meet	0.003623	0.12	meet
		2030	Rush hours	3.071583	10	meet	0.033009	0.24	meet
			Daily average	0.564372	4	meet	0.006065	0.12	meet
Tapu Village	900 ~ 1000 m south of No.49 Road	2016	Rush hours	0.390176	10	meet	0.008581	0.24	meet
			Daily average	0.071695	4	meet	0.001577	0.12	meet
		2022	Rush hours	1.071181	10	meet	0.02681	0.24	meet
			Daily average	0.196886	4	meet	0.00421	0.12	meet
		2030	Rush hours	2.086916	10	meet	0.045907	0.24	meet

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[30]	Standard	Predicted Concentration	Predicted Concentration	Standard	Standard
			Daily average	0.38345	4	meet	0.007053	0.12	meet
Zaoziyuan Village	400 ~ 800 m east of No. 17 Road	2016	Rush hours	0.53945	10	meet	0.012592	0.24	meet
			Daily average	0.099125	4	meet	0.002314	0.12	meet
		2022	Rush hours	1.542899	10	meet	0.041224	0.24	meet
			Daily average	0.283517	4	meet	0.006382	0.12	meet
		2030	Rush hours	3.004856	10	meet	0.070692	0.24	meet
			Daily average	0.552126	4	meet	0.010688	0.12	meet
Xiaobaoshan Village	650 ~ 1200 m southeast of No. 17	2016	Rush hours	0.800334	10	meet	0.019602	0.24	meet
			Daily average	0.147064	4	meet	0.003602	0.12	meet
		2022	Rush hours	2.369234	10	meet	0.066383	0.24	meet
			Daily average	0.435363	4	meet	0.010175	0.12	meet
		2030	Rush hours	4.612403	10	meet	0.113952	0.24	meet
			Daily average	0.847506	4	meet	0.017036	0.12	meet
Haiziba Village	250 ~ 1200 m south of No.11Road	2016	Rush hours	0.8332	10	meet	0.014562	0.24	meet
			Daily average	0.153094	4	meet	0.002676	0.12	meet
		2022	Rush hours	1.984782	10	meet	0.03408	0.24	meet
			Daily average	0.364708	4	meet	0.005999	0.12	meet
		2030	Rush hours	3.87622	10	meet	0.057613	0.24	meet
			Daily average	0.712222	4	meet	0.010078	0.12	meet
Yangqi Village	0 ~ 570 m north of No.11Road (K0+0)	2016	Rush hours	0.777761	10	meet	0.013853	0.24	meet
			Daily average	0.142894	4	meet	0.002545	0.12	meet
		2022	Rush hours	1.726852	10	meet	0.031148	0.24	meet
			Daily average	0.317304	4	meet	0.005483	0.12	meet
		2030	Rush hours	3.372727	10	meet	0.05266	0.24	meet
			Daily average	0.619709	4	meet	0.009213	0.12	meet
Vocational school	190 m west of No.11Road (K0+0)	2016	Rush hours	0.569815	10	meet	0.010586	0.24	meet
			Daily average	0.104697	4	meet	0.001945	0.12	meet
		2022	Rush hours	1.397164	10	meet	0.025443	0.24	meet
			Daily average	0.256728	4	meet	0.004455	0.12	meet
		2030	Rush hours	2.728285	10	meet	0.043038	0.24	meet
			Daily average	0.501299	4	meet	0.007484	0.12	meet

Source: EIA Report of Chuxiong Component

Table V-13: NO_2 & CO Concentrations at Sensitive Locations in Wuding County during Operation (mg/m^3)

Wind speed: 2.23m/s

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[31]	Standard	Predicted Concentration	Standard	Predicted Concentration	Standard
Xihe Village	20-840m Northeast of Wuchan Road (k0+0); 10-150m Northside of Chengbei Road (k0+210)	2016	Rush hours	0.26546	10	meet	0.007316	0.24	meet
			Daily average	0.049488	4	meet	0.001515	0.12	meet
		2022	Rush hours	1.140767	10	meet	0.02923	0.24	meet
			Daily average	0.215472	4	meet	0.006134	0.12	meet
		2030	Rush hours	2.039233	10	meet	0.050969	0.24	meet
			Daily average	0.41634	4	meet	0.010481	0.12	meet
Baiyi Village	110 ~ 450meast of Caiyuan Road (K0+0)	2016	Rush hours	0.513336	10	meet	0.014147	0.24	meet
			Daily average	0.095269	4	meet	0.002917	0.12	meet
		2022	Rush hours	2.133084	10	meet	0.054656	0.24	meet
			Daily average	0.415022	4	meet	0.011816	0.12	meet
		2030	Rush hours	4.017008	10	meet	0.098064	0.24	meet
			Daily average	0.801507	4	meet	0.020178	0.12	meet
Shangjiucheng Village	80 ~ 480m east of Binhe Road (K0+240)	2016	Rush hours	1.05121	10	meet	0.02897	0.24	meet
			Daily average	0.194471	4	meet	0.005955	0.12	meet
		2022	Rush hours	3.98444	10	meet	0.102094	0.24	meet
			Daily average	0.84752	4	meet	0.024129	0.12	meet
		2030	Rush hours	7.288321	10	meet	0.200361	0.24	meet
			Daily average	1.637426	4	meet	0.041222	0.12	meet
Xiaojiucheng Village	100 ~ 270meast of Binhe Road (K0+0); 160 ~ 460meast of Caiyuan Road (K0+500)	2016	Rush hours	0.6696	10	meet	0.018453	0.24	meet
			Daily average	0.123866	4	meet	0.003793	0.12	meet
		2022	Rush hours	2.560481	10	meet	0.065607	0.24	meet
			Daily average	0.539685	4	meet	0.015365	0.12	meet
		2030	Rush hours	4.508193	10	meet	0.127589	0.24	meet
			Daily average	1.042755	4	meet	0.026251	0.12	meet

[31] Ibid.

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[31]	Standard	Predicted Concentration	Standard	Predicted Concentration	Standard
Luwujiiayuan Hotel	40m east of Mudan Road (K1+320)	2016	Rush hours	0.51532	10	meet	0.014202	0.24	meet
			Daily average	0.095454	4	meet	0.002923	0.12	meet
		2022	Rush hours	1.693685	10	meet	0.043397	0.24	meet
			Daily average	0.416355	4	meet	0.011854	0.12	meet
		2030	Rush hours	4.326619	10	meet	0.098305	0.24	meet
			Daily average	0.80371	4	meet	0.020233	0.12	meet
Low-rent Houses	65 ~ 180m east of Binhe Road (K0+660)	2016	Rush hours	0.897589	10	meet	0.024737	0.24	meet
			Daily average	0.166011	4	meet	0.005083	0.12	meet
		2022	Rush hours	3.557047	10	meet	0.091142	0.24	meet
			Daily average	0.723228	4	meet	0.02059	0.12	meet
		2030	Rush hours	5.82375	10	meet	0.171039	0.24	meet
			Daily average	1.397639	4	meet	0.035186	0.12	meet
Yuanhe Garden Residential Community	70 ~ 210m east of Binhe Road (K0+780)	2016	Rush hours	0.969699	10	meet	0.026724	0.24	meet
			Daily average	0.179646	4	meet	0.005501	0.12	meet
		2022	Rush hours	3.950189	10	meet	0.101216	0.24	meet
			Daily average	0.782393	4	meet	0.022275	0.12	meet
		2030	Rush hours	6.156323	10	meet	0.185007	0.24	meet
			Daily average	1.512012	4	meet	0.038065	0.12	meet
Heshengshijia Residential Community	60 ~ 170m east of Binhe Road (K0+940)	2016	Rush hours	0.973233	10	meet	0.026821	0.24	meet
			Daily average	0.180232	4	meet	0.005519	0.12	meet
		2022	Rush hours	3.938911	10	meet	0.100927	0.24	meet
			Daily average	0.785009	4	meet	0.022349	0.12	meet
		2030	Rush hours	6.207381	10	meet	0.185635	0.24	meet
			Daily average	1.517075	4	meet	0.038192	0.12	meet
Wuding County Chinese Medicine Hospital	30m east of Beicheng Avenue (K1+500)	2016	Rush hours	0.806784	10	meet	0.022234	0.24	meet
			Daily average	0.149249	4	meet	0.00457	0.12	meet
		2022	Rush hours	3.51097	10	meet	0.089962	0.24	meet
			Daily average	0.649656	4	meet	0.018496	0.12	meet
		2030	Rush hours	4.428864	10	meet	0.153772	0.24	meet
			Daily average	1.256236	4	meet	0.031626	0.12	meet

Source: EIA Report of Wuding Component

Table V-14: NO_2 & CO Concentrations at Sensitive Locations in Lufeng County during Operation (mg/m^3)

Wind speed: 2.4m/s

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[32]	Standard	Predicted Concentration	Standard	Predicted Concentration	Standard
Shangying Village	0-280m northeast of No.1 Road (K0+580); 0 ~ 350mnortheast of Jinshannan Road (K0+500)	2016	Rush hours	0.4046	10	meet	0.015531	0.24	meet
			Daily average	0.075935	4	meet	0.003239	0.12	meet
		2022	Rush hours	1.742673	10	meet	0.063396	0.24	meet
			Daily average	0.326794	4	meet	0.013208	0.12	meet
		2030	Rush hours	3.1811	10	meet	0.116308	0.24	meet
			Daily average	0.596421	4	meet	0.024227	0.12	meet
Yaochong Village	310 ~ 560mnorth of Jinshannan Road (K0+0)	2016	Rush hours	0.761562	10	meet	0.026926	0.24	meet
			Daily average	0.142716	4	meet	0.005599	0.12	meet
		2022	Rush hours	3.274657	10	meet	0.10975	0.24	meet
			Daily average	0.61412	4	meet	0.022834	0.12	meet
		2030	Rush hours	5.976724	10	meet	0.201325	0.24	meet
			Daily average	1.120753	4	meet	0.041881	0.12	meet
Dabeichang Village	190 ~ 430m west of Jinshannan Road (K0+720); 0 ~ 360m two sides of No. 2 Road (K0+960)	2016	Rush hours	0.485845	10	meet	0.018746	0.24	meet
			Daily average	0.091189	4	meet	0.003909	0.12	meet
		2022	Rush hours	2.092818	10	meet	0.076523	0.24	meet
			Daily average	0.392463	4	meet	0.015945	0.12	meet
		2030	Rush hours	3.820308	10	meet	0.14039	0.24	meet
			Daily average	0.716291	4	meet	0.029247	0.12	meet
Xiaobeichang Village	0 ~ 120m west ofJinshannan Road (K0+0)	2016	Rush hours	0.534404	10	meet	0.02057	0.24	meet
			Daily average	0.100306	4	meet	0.00429	0.12	meet
		2022	Rush hours	2.302294	10	meet	0.083982	0.24	meet
			Daily average	0.431709	4	meet	0.017497	0.12	meet
		2030	Rush hours	4.202482	10	meet	0.154067	0.24	meet

[32] Ibid.

Sensitive Locations	Location & Distance from Roadside (m)	Year	Time	CO (mg/m^3)			NO_2 (mg/m^3)		
				Predicted Concentration[32]	Standard	Predicted Concentration	Standard	Predicted Concentration	Standard
			Daily average	0.78793	4	meet	0.032094	0.12	meet
Zhuangke Village	0 ~ 130m two sides of No.2 Road (K0+360); 90 ~ 320m west of Shiji Avenue (K0+340)	2016	Rush hours	0.328565	10	meet	0.012681	0.24	meet
			Daily average	0.061658	4	meet	0.002644	0.12	meet
		2022	Rush hours	1.415612	10	meet	0.051776	0.24	meet
			Daily average	0.265354	4	meet	0.010784	0.12	meet
		2030	Rush hours	2.583437	10	meet	0.094964	0.24	meet
			Daily average	0.484306	4	meet	0.019781	0.12	meet
Guanwa Residential Community	30 ~ 1200m south of No.1 Road (K0+60); 35 ~ 370m west of Zhuluoji Avenue (K0+0); 20 ~ 470m east of No.3 Road (K0+340)	2016	Rush hours	0.323902	10	meet	0.011179	0.24	meet
			Daily average	0.060677	4	meet	0.002323	0.12	meet
		2022	Rush hours	1.391777	10	meet	0.04554	0.24	meet
			Daily average	0.261051	4	meet	0.009472	0.12	meet
		2030	Rush hours	2.540431	10	meet	0.083548	0.24	meet
			Daily average	0.476361	4	meet	0.017372	0.12	meet
Xishan Village	10 ~ 360m two sides of No.3 Road (K0+0)	2016	Rush hours	0.34353	10	meet	0.013257	0.24	meet
			Daily average	0.06453	4	meet	0.002767	0.12	meet
		2022	Rush hours	1.481909	10	meet	0.054197	0.24	meet
			Daily average	0.277751	4	meet	0.011287	0.12	meet
		2030	Rush hours	2.704505	10	meet	0.099408	0.24	meet
			Daily average	0.50697	4	meet	0.020705	0.12	meet
Lufeng No. 1 Middle School	0 ~ 380m east of Jinshannan Road (K0+0)	2016	Rush hours	0.299674	10	meet	0.010956	0.24	meet
			Daily average	0.056202	4	meet	0.002281	0.12	meet
		2022	Rush hours	1.289881	10	meet	0.044696	0.24	meet
			Daily average	0.241866	4	meet	0.009303	0.12	meet
		2030	Rush hours	2.354219	10	meet	0.08199	0.24	meet
			Daily average	0.441424	4	meet	0.017065	0.12	meet

Source: EIA Report of Lufeng Component

260. **Mitigating air pollution.** The control of vehicle emissions on the project roads is closely related with the policies and measures for emission control of Yunnan Province and the PRC. Therefore, the vehicle emission control measures under the infrastructure components of the project city/counties should be considered in the context of provincial and national policies and measures for vehicle emission control.

261. In 2005, the PRC promulgated the “Limits and Measurement Methods for Emissions of Pollutants from Light-duty Vehicles (grade III, grade IV)” (GB18352.3-2005), which became effective on 1st July 2007. At present, the three project city/counties are conducting on-road inspection and annual examination of vehicle exhaust pollutants for each vehicle. As a result of these inspections, substandard vehicles, both private and public, are refused registration for road use, until they meet the standard. The local EPBs and the local Traffic Management Bureaus are in charge of implementing all the policies and measures for vehicle emission control formulated by the state and provincial authorities, and take the corresponding measures to control the exhaust pollutants emission of vehicles running on the proposed roads.

262. The capacity development component under this ADB project includes urban traffic management technical assistance, which will also support and cooperate with the project city/counties to improve the control of vehicle exhaust pollution and manage traffic flows along the proposed road networks.

b. Traffic Noise

263. **Prediction model for traffic noise.** The noise prediction during operation from new roads has adopted the road noise prediction model as recommended in Appendix A.2 of the *PRC Technical Guidelines for Assessment of Environmental Impact - Acoustical Environment (HJ2.4-2009).* It has also used the horizontal noise generation of vehicles at speed from Annex C of *Assessment Criterion on Environmental Impact in Road Construction Project (JTG B03-2006*) and the attenuation effects of building groups in GB/T17247.2.

264. Using average running velocity of various vehicles type and predicted traffic flows and the calculation of noise at source, the distance at which compliance with PRC ambient noise standards are reached have been calculated in each component EIA. The analyses then used these noise/distance calculations to predict the future noise levels at sensitive receptors along the roads.

265. **The noise impact assessment criteria** for the proposed road network in the project city/counties are: (i) for areas within 35 m from the edges of road red-lines, the applicable standard is Grade 4a (70 dB for daytime and 55 dB for nighttime) of the Acoustic Environmental Quality Standard (GB3096-2008); (ii) for areas beyond 35 m from the red-lines of roads, Grade II standard is applicable (60 dB for daytime and 50 dB for nighttime) according to the Classification of Acoustic Environmentally Functional Zones issued by the Chuxiong Prefecture EPB.

266. **Traffic noise prediction for the Chuxiong component.** Traffic noise prediction values for the selected sensitive sites in short, medium and long terms, are showed in **Table V-15** for Chuxiong City. The predicted noise level at daytime at all sensitive receivers meet the standard in the predicted years of 2015, 2022 and 2030. Predicted nighttime noise levels in Xiaodong Village, Sunjia Village, Dadong Village and the Vocational School meet the standard, but the predicted noise data in nighttime Xiaodong Village and the Vocational School exceed the Grade II standard in 2022 and 2030.

267. The reasons for exceeding standard are the predicted increased traffic flows and the short distance from the receivers to the proposed roads. According to the domestic EIA Report, noise-attenuation measures will include planting of trees with big canopies along the roadside and installing noise insulation windows on the first row buildings until the noise monitoring data is compliance with relevant standards.

Table V-15: Traffic Noise Prediction Leq [dBA] in Chuxiong City

Sensitive Location	Distance from the First Row of Building to Road Edge	Predicted Year					
		2015		2022		2030	
		Day	Night	Day	Night	Day	Night
Xuyang Village	30 m (No. 17 Rd)	58.04	*55.6*	60.83	*59.82*	62.46	*60.51*
Yangqi Village	30 m (No. 11 Rd)	56.89	*55.81*	58.96	*58.09*	60.65	*58.79*
Fumin Village	30 m (No. 11 Rd)	57.96	*55.86*	59.65	*58.12*	61.13	*58.81*
Fumin Village	30 m (No. 17 Rd)	59.47	*58.58*	62.91	*62.47*	64.76	*63.16*
Heiniba Village	30 m (No. 10 Rd)	56.67	*52.51*	57.63	*54.42*	58.63	54.98
Longtanao Village	10 m (No. 49 Rd)	55.65	48.16	56.6	*51.68*	57.34	52.34
	4a Standard	**70**	**55**	**70**	**55**	**70**	**55**
Xiaodong Village	220 m (No. 11 Rd)	56.17	48.6	56.54	*50.21*	56.96	*50.76*
Sunjia Village	265 m (No. 11 Rd)	55.64	48.01	55.99	49.55	56.39	49.86
Dadong Village	415 m (No. 49 Rd)	55.32	44.67	55.37	45.24	55.43	45.39
Vocational School	190 m (No. 11 Rd)	53.85	49.3	54.56	*50.89*	55.31	*51.42*
	Grade II standard	**60**	**50**	**60**	**50**	**60**	**50**

Note: The data exceeding the standard are underlined.
Source: EIA Report.

268. **Traffic noise prediction for Wuding road component**. Traffic noise prediction values for the selected sensitive sites in short, medium and long term, are showed in **Table V-16** for Wuding County. The noise levels at Shangjiucheng and Xiajiucheng villages are expected to exceed the Grade II standard in 2015, 2022 and 2030 due to impact from traffic flow from nearby No. 108 National Highway. Other sites are slightly exceeding the standard.

269. It was noted in **Table IV-19** of Chapter IV that baseline noise levels at some sensitive receptors already exceed the PRC standard for residential areas (60 dBA (day) and 50 dBA (night)). The predicted operational noise levels, on top of baseline levels, will therefore also exceed the standard and guidelines.

Table V-16: Traffic Noise Prediction in Wuding County Leq [dBA]

Sensitive Location	Distance from the First Row of Building to Roadsides	Predicted Year					
		2015		2022		2030	
		Day	Night	Day	Night	Day	Night
Xihe Village	20m (Wushan Rd)	57.99	47.73	58.14	48.81	58.26	49.47
	10m (Chengbei Rd)	59.66	**55.12**	62.09	**59.54**	63.51	**61.29**
Wuding Chinese Medicine Hospital	30m (Beicheng Avenue)	54.72	51	57.34	**55.18**	58.84	**56.9**
	4a Standard	**70**	**55**	**70**	**55**	**70**	**55**
Xihe Village	180m (Wuding Rd)	57.96	47.37	57.98	47.56	58	47.69
Baiyi Village	110m (Caiyuan Rd)	53.08	46.21	53.86	48.76	54.43	49.97
Shangjiu Village	80m (Binhe Rd)	**62.01**	**56.02**	**62.02**	**56.08**	**62.04**	**56.12**
Xiajiu Village	100m (Binhe Rd)	**62**	**56.02**	**62.02**	**56.06**	**62.03**	**56.1**
	160m (Caiyuan Rd)	**62.02**	**56.09**	**62.1**	**56.34**	**62.13**	**56.51**
Luowujiayuan Hotel	40m (Mudan Rd)	54.27	49.99	57.09	**54.84**	58.55	56.54
Wuding Low-rent Residential Community	65m (Binhe Rd)	52.85	45.15	53.03	45.9	53.19	46.41
Yuanhe Garden Residential Community	70m (Binhe Rd)	52.85	45.12	53.02	45.83	53.16	46.32
Heshengshijia Residential Community	60m (Binhe Rd)	52.86	45.17	53.04	45.98	53.22	46.52
	Grade II standard	**60**	**50**	**60**	**50**	**60**	**50**

Note: The data exceeding the standard are underlined.
Source: EIA Report.

270. **Traffic noise prediction for Lufeng road component**. Traffic noise prediction values for sensitive sites in Lufeng road network in short, medium and long terms, are showed in **Table V-17**.

Table V-17: Traffic Noise Prediction in Lufeng County Leq [dBA]

Sensitive Location	Distance from the First Row of Building to Roadsides	Predicted Year					
		2015		2022		2030	
		Day	Night	Day	Night	Day	Night
Guangwai Village	30m (No.1 Rd)	54.14	52.37	57.58	**57.32**	59.86	**60.3**
	35m (Zhuluji Avenue)	53.66	51.46	56.89	**56.43**	59.07	**59.39**
	20m (No. 3 Rd)	53.9	51.94	57.26	**56.9**	59.49	**59.88**
Shangying Village	10m (No.1 Rd)	56.84	55.28	60.51	**60.35**	62.85	**63.37**
	12m (Jinshannan Rd)	55	51.27	57.43	**56.12**	59.31	**59.08**
Dabeichang Village	15m (No.2 Rd)	54.75	50.66	57.06	**55.55**	58.71	**58.3**
Xiaobeichang Village	20m (Jinshannan Rd)	54.93	51.54	57.39	**56.21**	59.29	**59.13**
Zhuangke Village	25m (No.2 Rd)	52.72	51.02	55.98	**55.76**	58.37	**58.37**
Xishan Village	10m (No.3 Rd)	54.48	53.41	58.3	**58.33**	60.69	**61.3**
Lufeng No.1 Middle School	35m (Jinshannan Rd)	51.6	48.5	54.2	53.1	56.08	**56**
	4a Standard	**70**	**55**	**70**	**55**	**70**	**55**
Dabeichang Village	190m (Jinshannan Rd)	53.73	46.14	54.28	48.92	54.89	**51.21**
Zhuangke Village	90 m (Shiji Avenue)	52.19	**50.04**	54.79	**54.14**	56.72	**56.88**
Yaochong Village	310 m (Jinshannan Rd)	49.86	44.11	50.66	46.87	51.5	49.13
	Grade II standard	**60**	**50**	**60**	**50**	**60**	**50**

Note: The data exceeding the standard are underlined.
Source: EIA Report.

271. According to the noise predictions presented in the domestic EIA reports, noise levels are predicted to exceed the standard in the medium and long term, in particular in nighttime. The following **noise attenuation and protection measures** will be implemented during the operation stage:

(1) Low-noise pavement materials shall be used for road maintenance when possible, particularly on the road section nearby the environmentally sensitive sites;

(2) Noise monitoring will be undertaken at the locations and frequencies indicated in the EMP by the three local EMSs;

(3) Ambient noise monitoring will be mandated to determine whether mitigation measures will be required for sites where noise levels are expected to exceed by more than 3 dB(A);

(4) Trees and shrubs will be planted as soon as possible along the proposed roadsides after construction; as far as possible, native species of local provenance (i.e. seedlings from the local area, not imported from elsewhere) will be used; and

(5) Noise barriers or noise insulation windows will be installed at sites where noise levels are predicted to exceed the PRC standards by more than 3 dB in 2020 (see **Table V-18**). The costs for these windows are included in the contract packages of the road concerned. The importance of noise attenuation measures is flagged as loan assurance.

Table V-18: Noise mitigating measures (sound insulated windows)

Noise sensitive receptor	Road receptor close to	Noise Standard non-compliance	No. of affected household	Proposed sound insulated windows (No./m^2)	Budget (CNY)
A. Chuxiong					
Hehua Village	No. 17 Rd.	6.92dB(A) exceeded standard at night	15	150/75m^2	150,000
Yangqi Village	No.11 Rd.	5.81dB(A) exceeded standard at night	22	210/105m^2	210,000
Fumin Village	No. 11 Rd.	8.58dB(A) exceeded standard at night	24	220/110m^2	220,000
Subtotal			**71**	**580/290m^2**	**580,000**
B. Wuding					
Xihe Village	Chengbei Rd.	4.37dB(A) exceeded standard at night	14	120/60m^2	90,000
Wuding Chinese Medicine Hospital	Beicheng Avenue	2.77dB(A) exceeded standard at night	10 rooms	40/20m^2	30,000
Subtotal			**24**	**160/80m^2**	**120,000**
C. Lufeng					
Guanwa Residential Community	No. 1 Rd	3.96dB(A) exceeded standard at night	25	250/125m^2	125,000
Shangying Village	No.1 Rd	5.28dB(A) exceeded standard at night	11	100/50m^2	100,000
Xishan Village	No. 3 Rd	3.41dB(A) exceeded standard at night	35	320/160m^2	320,000
Subtotal			**71**	**670/335m^2**	**545,000**
Total			**166**	**1,410/705m^2**	**1,245,000**

Source: Domestic EIA Report

c. Water Pollution

272. **Stormwater runoff.** Stormwater that flows over the ground can entrain debris, rubbish, petroleum, chemicals, sediments and other pollutants. If prevented by impervious surfaces like asphalt pavements and sidewalks from naturally permeating into the ground, it can transport these pollutants into drainage systems, tributaries, and even directly into rivers, contributing to water pollution. Stormwater runoff will discharge into a roadside drainage system and then flow into channels and rivers. The average annual precipitation in the project areas is about 900 mm, but 70% of rainfalls are concentrated during June to September. The dry season lasts about 8-9 months every year, during which the roadside greenbelts have to be watered by using scarce water resource. In the recent past, rapid urbanization in the project cities has significantly increased asphalt and (or) concrete paved roads, impermeable plazas, sidewalks and parking areas. Consequent to this, the rainwater run-off has increased and natural ground water recharge has declined.

273. Roadside stormwater collection and local infiltration systems will be designed and constructed on some of the proposed roads in the three project city/counties. As the roads slope towards the roadsides, rainwater falling on the road is guided to the side curbs (**Figure V-3**). Holes on the curbs with a diameter of 100 mm will be opened on the side towards the

carriageway while 50 mm diameter holes are opened on other side. During rainfall, partial rainwater collected from paved carriageway and non-motor vehicle (NMV) lanes will flow into blind drains and rainwater collecting wells (**Figure V-4**) and remaining water will flow into the greenbelt on other side of the curbs to increase groundwater recharge. The water stored in the collecting wells (underground tanks filled with aggregates and covered by top soil and vegetation) will be used for watering the greenbelts (about 1,200 m^3 rainwater per year).

Figure V-3: Curbs with Holes[33]

Figure V-4: Rain Water Collecting Wells on Greenbelt

274. In addition to local stormwater retention and infiltration, the following measures will be implemented:

(1) Routinely collecting and properly disposing litter and debris from sidewalks, driveways, and parking lots, especially near rivers;

(2) Installing litter traps along waterways (small floating mesh traps attached to one bank) and regularly emptying them;

(3) Cleaning the roadside catch basins before the rainy season to avoid surface water pollution by storm water runoff flushing debris and silt;

(4) Placing garbage bins and containers along the road networks, which have been included in the components of this ADB financed project;

(5) Prohibiting the construction of car washing near rivers and drainage networks and channels; and

(6) Constructing stormwater collection and retention ponds in Wuding and Lufeng (see **Figure III-10**, **Figure III-11**).

275. **Municipal wastewater.** The project will construct 47.7 km sewer pipelines along the project roads in the three project city/counties with the directly served population of 91,000, and domestic sewer collection amount of 18,200m^3/d (**Table V-19**). The collected wastewater will be delivered to the existing WWTPs, which are summarized in **Table V-20** to **Table V-22** below.

Table V-19: Summary of Proposed Sewer Pipeline

Item	Chuxiong	Wuding	Lufeng	Total
Sewer length (km)	18.8	13.4	15.5	47.7
Population served	60,000	15,000	16,000	91,000
Wastewater (m^3/d)	12,000	3,000	3,200	18,200

[33] Source: the FSRs

d. Due Diligence for Associated WWTPs

276. **The existing WWTPs in Chuxiong City**. There are two existing WWTPs in Chuxiong City with a total treatment capacity of 80,000 m^3/d, which will be expanded to 100,000 m^3/d by 2015. The No. 1 WWTP (in operation on 15 September 2005) with a designed capacity of 400,000 m^3/d adopts the Carrousel Oxidation Ditch treatment process, and complies with Class II of the PRC WWTP's effluent quality standard (**Table V-20**).

277. Chuxiong No. 2 WWTP (in operation on 1 October 2010), with a design capacity of 400,000 m^3/d, adopts the A2/O Oxidation Ditch Treatment process, and the current effluent complies with the PRC Class 1B quality standard.

Table V-20: Performance of Chuxiong City

Parameter	Quality of Current Effluent (average concentration)		Class II Standard of GB18918-2002[34]
	No.1 WWTP	No.2 WWTP	
COD_{cr}	28 mg/l	≤27 mg/l	100 mg/l
BOD_5	4 mg/l	4 mg/l	30 mg/l
SS	3.6 mg/l	≤7 mg/l	30 mg/l
TN	23 mg/l	18 mg/l	---
NH_3-N	14.1 mg/l	3.23 mg/l	30 mg/l
TP	0.43 mg/l	0.79 mg/l	3 mg/l
pH	---	---	6-9

278. **The existing WWTP in Lufeng County.** The WWTP began normal operation in October 2012. The current treatment capacity of the WWTP is 20,000 m^3/d (the current influent is 10,000 m^3/d), which will be expanded to 40,000 m^3/d before 2025 according to Lufeng County Master Plan. The WWTP adopts Cyclic Activated Sludge System, and it complies with the PRC effluent quality standard Class 1B (**Table V-21**).

Table V-21: Performance of Lufeng WWTP

Parameter	Quality of Current Influent (average concentration)	Quality of Current Effluent (average concentration)	Class I-B Standard GB18918-2002[35]
COD_{cr}	420 mg/l	≤60 mg/l	60
BOD_5	220 mg/l	≤20 mg/l	20
SS	220 mg/l	≤20 mg/l	20
TN	50 mg/l	≤20 mg/l	20
NH_3-N	40 mg/l	≤8 mg/l	8/15[36]
TP	4 mg/l	≤1 mg/l	1
pH	7.6	---	6-9

Source: the EIA Report of Lufeng Component

279. **The existing WWTP in Wuding County.** The WWTP in Wuding adopts the Cyclic Activated Sludge System process with a current treatment capacity of 10,000 m^3/d (the current influent is 4,500 m^3/d only), and will be expanded to 20,000 m^3/d before 2025. The WWTP was

[34] The PRC "Pollutants Discharge Standard for Municipal Wastewater Plants".

[35] The PRC "Pollutants Discharge Standard for Municipal Wastewater Plants".

[36] 8 mg/l -water temperature >12℃; and 15 mg/l- water temperature ≤12℃

put in normal operation in October 2012. The effluent of the WWTP complies with the standard of Class 1B of GB18918-2002 (**Table V-22**).

Table V-22: Performance of Wuding WWTP

Parameter	Quality of Current Influent (average concentration)	Quality of Current Effluent (average concentration)	Class I-B Standard GB18918-2002
COD_{cr}	450 mg/l	≤60 mg/l	60
BOD_5	180 mg/l	≤20 mg/l	20
SS	220 mg/l	≤20 mg/l	20
TN	---	≤20 mg/l	20
NH_3-N	35 mg/l	≤8 mg/l	8/15
TP	3 mg/l	≤1 mg/l	1
pH	----	----	6-9

Source: the EIA Report of Wuding Component

280. According to the FSRs and the EIAs, as well as the due diligence conducted jointly by the CSPMO and the PPTA Consultants, the existing WWTPs in the three project city/counties have enough spare treatment capacities to treat wastewater to be collected in the proposed sewer pipeline networks. The effluent from the WWTPs meets the PRC Standard of GB18918-2002. Overall, the impact of the proposed sewer networks on the surface water quality is anticipated to be positive if the WWTPs keep normal operation, and all mitigation measures are implemented. Regular compliance monitoring by the local EPBs during operation will assess possible unanticipated impacts of the project on water quality, and additional mitigation measures and corrective actions will be defined if necessary.

f. Health and Safety

281. **Traffic safety.** The concerns over community safety of the proposed roads have been thoroughly examined during the PPTA. All roads have separate pedestrian sidewalks. All major roads have separate lanes for non-motorized traffic. Pedestrian-priority traffic lights, safety islands, crosswalks (zebra lines), and boarding bays/islands will be established at all intersections. Road maintenance vehicles will be equipped with warning lights, and staff will wear safety hats and reflective garments and undergo safety training.

282. The project will also include an ITS traffic management and traffic control subcomponent to help improving the traffic condition in the existing urban areas. The subcomponent will include traffic monitoring system, red light and speeding violation monitoring system, real time traffic condition displays, etc. The project's capacity building component will bring in urban traffic safety expertise to help the local government to improve urban road safety. The urban traffic safety experts will conduct traffic safety audits for the project city/towns to identify safety concerns in engineering design, traffic safety feature implementation, traffic safety education and enforcement needs, and help to develop a program for public safety education and safety awareness. Based on the results of the assessment, the recommendation for improving urban traffic safety as outlined in the traffic safety audit report will be provided to the local government for their taking action to improve the urban traffic safety.

283. **Accidental spills.** The haulage of hazardous goods on the proposed roads represents a risk for pollution to rivers, groundwater, soil, villages and residential areas. According to the domestic EIA Reports, hazardous and dangerous goods expected to be transported on the proposed roads include petrol, titanium pigment, chemical fertilizers and farm chemicals based on the local industrial nature and market demands. By combining estimated risk occurrence frequencies at predicted traffic volume at sensitive road sections, the probabilities of pollution on the proposed roads in the three project city/towns were predicted as extremely low (see Tables below). The domestic EIAs conclude that the risk of spills on the project roads and bridges is minor, and that adequate response procedures are in place to deal with the risk. The

project city/counties have emergency preparedness and response mechanisms in place and have environment emergency response command offices within their EPBs. Environmental emergency response drills are carried out regularly in the city/counties.

284. The applicable PRC standards and regulations related to hazardous goods transportation on roads include the Standard for Hazardous Substances and Major Hazard Installations Discrimination (GBl8218-2000), Classification of Health Hazard Levels from Occupational Exposure to Toxic Substances (GB50844-85), and Rules of Transportation of Dangerous Goods by Automobile (JT3130-88). These include hazardous goods transport vehicles and equipment, packaging and logos, consignment and documentation, consignment acceptance and hand-over, transport, loading and unloading, storage and fire control, labor protection and medical emergency treatment, as well as supervision and management, etc. The CPG provided assurance to ADB that above national standards will be strictly complied with.

Table V-23: Predicted Spillage Accident Probability for Carriage of Dangerous Goods - Chuxiong City

Spot of Protection	Sensitive Road Section	Length of Predicted Rd (m)	Spillage Accident Probability in Predicted Year		
			2016	2016	2016
Qinglong River	No.10 Rd (K0+038)	36	0.0000031	0.0000064	0.0000117
	No.11Rd (K0+668)	36	0.0000038	0.0000081	0.0000149
Ynagqi Village	No. 11 Rd (K0+0 - K0+350)	350	0.0000369	0.0000787	0.0001448
Fumin Village	No.11Rd (K1+870-K2+0)	130	0.0000137	0.0000292	0.0000538
	No.17 Rd (K0+620-K1+20)	400	0.0000610	0.0001876	0.0003433
Heiniba Village	No.10 Rd (K0+660-K1+40)	380	0.0000327	0.0000674	0.0001240
Longtanao Village	No.49 Rd (K0+780-K0+840)	60	0.0000028	0.0000113	0.0000206

Table V-24: Predicted Spillage Accident Probability for Carriage of Dangerous Goods – Wuding County

Spot of Protection	Sensitive Road Section	Length of Predicted Rd (m)	Spillage Accident Probability in Predicted Year		
			2015	2015	2015
Wulong River	Mudan Rd (K0+053)	20	0.0000009	0.0000042	0.0000080
	Wuxu Rd (K0+060)	20	0.0000003	0.0000015	0.0000028
	Beicheng Avenue	20	0.0000014	0.0000050	0.0000092
	Binhe Rd	46	0.0000008	0.0000035	0.0000066
	Chengbei Rd	20	0.0000017	0.0000061	0.0000112
	Wuchan Rd	104.4	0.0000019	0.0000085	0.0000156
Caiyuan River	Mudan Rd (K1+071)	66	0.0000031	0.0000138	0.0000264
	Binhe Rd	1,180.8	0.0000208	0.0000905	0.0001694
	Caiyuan Rd	240	0.0000118	0.0000523	0.0000217
Xihe Village	Wuchan Rd	30	0.0000005	0.0000024	0.0000045
	Chengbei Rd	140	0.0000122	0.0000428	0.0000785

Table V-25: Predicted Spillage Accident Probability for Carriage of Dangerous Goods – Lufeng County

Spot of Protection	Sensitive Road Section	Length of Predicted Rd (m)	Spillage Accident Probability in Predicted Year		
			2015	2015	2015
West River	No.1 Rd (K0+800)	46	0.0000038	0.0000129	0.0000237
	No.2 Rd (K0+140)	46	0.0000019	0.0000068	0.0000120

Spot of Protection	Sensitive Road Section	Length of Predicted Rd (m)	Spillage Accident Probability in Predicted Year		
			2015	2015	2015
	Zhuluoji Avenue (K0+0 – K0+1000)	1000	0.0000802	0.0002777	0.0005100
Guanwa Residential Community	No.3 Rd (K0+340 – K0+810)	470	0.0000220	0.0000752	0.0001383
Shangying Village	No.1 Rd (K1+580 ~K1+588.8)	8.8	0.0000007	0.0000025	0.0000045
	Jinshannan Rd (K1+500~ K1+561.8)	61.8	0.0000042	0.0000143	0.0000264
Dabeichang Village	No.2 Rd (K0+960 ~ K1+200	240	0.0000097	0.0000355	0.0000626
Xiaobeichang Village	Jinshnnan Rd (K0+0 ~ K0+120)	120	0.0000000	0.0000278	0.0000512
Zhuangke Village	No.2 Rd (K0+360 ~ K0+580)	220	0.0000089	0.0000325	0.0000574
Xishan Village	No.3 Rd(K0+0 ~ K0+860)	860	0.0000402	0.0001376	0.0002530
Lufeng No.1 Middle School	Jinshannan Rd(K0+0 ~ K0+320)	320	0.0000215	0.0000742	0.0001365

(2) River Rehabilitation and Flood Control Components during Operation

285. The operation of the river components is not expected to generate major impacts. The mitigation measures for environmental impact during operation includes (i) properly maintaining all river embankment vegetation, emergent aquatic plants and other vegetation; (ii) inspecting all river embankment for stability issues. If signs of failure are discovered, a repair program will be implemented immediately. The rivers will also require periodic maintenance to remove garbage or excessive plant growth. Non-structural measures will be implemented to complete the flood risk management system of the cities. An important requirement to ensure success of the project component in Chuxiong is the release of sufficient water to sustain healthy ecological and environmental conditions (minimum ecological flow). These operational aspects are discussed below. The flood control works will have no significant impacts on downstream areas (see discussion on induced impacts at the end of this chapter).

286. **Periodic river channel maintenance.** The flood flow capacity of the project rivers may be severely impaired as a result of accumulations of garbage, uncontrolled plant growth and the construction of weirs built to provide either irrigation water, or create artificial water bodies for beautification purposes. The CPG confirmed (through loan covenant) that no artificial structures will be constructed to impound water restricting free flow of flood waters. This will also avoid increased evaporation of water from increased water surfaces. The local WRBs will be responsible for the maintenance of the rehabilitated rivers. They will appoint sufficient personnel to regularly maintain the river, including removal of garbage and vegetation which may impair flood flow capacity.

287. **Maintaining minimum ecological flow in Longchuan River.** The operating rules of the Qingshanzui Reservoir should be reviewed to ensure that the Longchuan River receives a minimum flow at all times. Current reservoir operating rules include a minimum flow provision [37], but during drought periods the minimum flow release is discontinued. There may be some argument for reducing the minimum flow provision during periods of more severe drought if the

[37] The minimum flow provision is 10% of the average annual flow, or 1.26 m^3/s. However, much lower flows are released in practice during the dry season. Releases of 0.2 m^3/s to 0.3 m^3/s have been observed, and these are subject to discontinuance in drought conditions (annual operations plans are based on storage conditions and meteorological forecasts).

reservoir storage is low, but it should not simply be discontinued. Minimum flows are required for maintaining water in the low flow channel downstream, not only for aesthetic reasons but for environmental and water quality purposes and to provide water for any riparian users downstream.

288. **Flood monitoring and early warning.** The flood monitoring and early warning systems of all three cities will be reviewed and upgraded in the framework of the capacity building component of the project to cover the existing and proposed urban development areas so that, when an over-standard flood is forecast, people at risk or with property at risk could be warned, take appropriate precautions to limit flood damage and be evacuated from the areas at risk of inundation if necessary. The plans will consider safety of evacuation routes and locations of safe temporary refuge, among other matters. Even for floods below the design flood protection standard, the flood monitoring and forecasting systems should be used to warn the community of approximate flood peak levels expected so that activities undertaken near the river banks can be suspended.

289. In Chuxiong City, a system for flood monitoring, forecasting and warning has been prepared in 2010 (Chuxiong Municipal FCDRHQ, 2010). The system requires upgrading and updating for the project. It requires updating because it does not take into account the commissioning of Qingshanzui Dam a short distance upstream, and this has greatly changed flood hydrology of the Longchuan River. It requires upgrading because it relies on a pre-existing network of meteorological stations in the river basin upstream. This network will be expanded to improve monitoring and forecast capability, and key stations in the network must be equipped to transmit real-time data to the 'integrated operations center' in the prefecture HQ office.

290. Details on the scope of the flood monitoring and early warning system subcomponents are presented in Chapter III (Project Description). Essentially, the project will establish the following in the three project cities: (i) flood warning coordination centers; (ii) additional water/rainfall monitoring stations; (iii) establishment of real-time video monitoring systems; and (iv) establishment of wireless flood warning broadcasting system (voice, cell phone, FM signals, etc).

291. **Dam safety of the Qingshanzui reservoir.** Within the context of the PPTA a review of dam safety related to Qingshanzui reservoir has been carried out. The review confirmed that an EIA study has been performed and approved. At the end of the construction of the dam, MEP has issued an environmental completion certificate, confirming that measures proposed in the EIA and related to construction have been implemented. Visits of the reservoir confirmed that among the measures, extensive re-vegetation works have been successfully carried out. Regarding dam safety, the compulsory works completion safety review was conducted in 2009. The review concluded that the dam does not present any major structural or management weakness which could jeopardize its safety. Routine inspections are carried out covering safety aspects as structural integrity, and visual signs of landslides leakage or seepage. The reservoir has monitoring instrumentation related to rainfall, reservoir level, and ground movement. It also has an emergency preparedness plan including description of responsibilities, description of areas at risk, flood warning system, evacuation procedures and plan of mobilization of forces. A dam break analysis was conducted for different dam break scenarios. The discharge flow was calculated based on different water levels inside the reservoir, the dam burst size and elevation of the dam burst basement. The flood gradual progress was calculated adopting non-hydrostatic supercritical flow model (nearby the dam) and the one-dimensional and two-dimensional coupled flow model (for downstream areas). The results of the dam break analysis (available on request, in Chinese only), will be incorporated into the design of flood monitoring and early warning system.

G. Indirect and Induced Impacts

292. **Induced development through roads and bridges**. The expanded road networks in Chuxiong, Wuding and Lufeng will facilitate urban development with significant population increases. This will induce increases in traffic flows, pollution generation and demand for public services. The induced traffic was considered in the traffic forecast, which in turn affected road design. All project roads and bridges as well as future traffic volumes on these roads and bridges and their induced impacts have been examined in the context of relevant development plans. The project roads are in line with approved urban master plans and development control plans of the cities/counties, and will thus not induce uncontrolled development. The proposed roads and bridges will address the inadequacy of the existing road networks. Their individual contributions to, and influence on the district and neighborhood traffic flows have been assessed within the context of the relevant plans and are considered appropriate. Air quality and noise impacts due to increased traffic flow have been assessed in this report and mitigation measures have been identified where necessary. Significant indirect or induced negative impacts from road components are not anticipated.

293. **Auxiliary facilities.** The installation of auxiliary utilities concurrent with road construction would induce potential impacts on the water supply system and the wastewater treatment system by increasing the demand on their services. Again, such increase has been fully considered in the urban master plans of the three cities, with the capacities of water and wastewater treatment timely expanded to meet such demand. Significant induced negative impacts are not expected.

294. **Solid waste management**. Improved solid waste collection will result in increased solid waste volumes to be disposed of properly, which could induce impact on the capacity of the landfills. Existing landfills have enough capacities to cope with increased waste collection rates (see Chapter III of the project EIA). With better solid waste collection, transfer and disposal in the three cities, illegal dumping of garbage onto rivers will be reduced, thus improving environmental and public health conditions. The induced impact is therefore positive.

295. **Induced downstream effects of river works .** The river rehabilitation and flood control components will improve flood control capacities. In Chuxiong City, the natural inundation area reduced by the subproject is approximately 410ha. In Lufeng and Wuding, the natural inundation areas reduced by the subprojects are approximately 490ha and 230ha, respectively. The loss of this area to floodwaters passing down the river channel will have minor incremental effect on downstream flooding. In Chuxiong, the section of the Longchuan River downstream of the project sections has been enhanced to comply with the 1-in-50 years flood protection standard. In Wuding, the Wulong River (to be rehabilitated under the project) is a tributary of the Caiyuan River, which has much higher average and peak flows, thus attenuating any potential changes in flood flows in the Wulong River. In Lufeng, the East and West Rivers are tributaries of the much bigger Xingsu River, which is currently being strengthened to comply with 1-in-50 years standard. Thus, the induced flooding risks downstream of project subcomponents are not significant. Before the components commencement, flood vulnerable areas immediately downstream of the project sites will be identified and communities in or bordering these areas will be included in the proposed flood monitoring and early warning systems, to be developed under the project's capacity building component.

H. Climate Change and Greenhouse Gas Emissions

296. **Climate change mitigation and adaptation.** Chuxiong Prefecture is vulnerable to climate change. Project initiatives in both climate change mitigation and adaptation will introduce approaches and activities for enhancing climate resilience and reducing carbon emissions (see below).

297. **Estimated GHG emissions:** According to the ADB Environment Safeguards - a Good Practice Sourcebook (2012), an EIA for a road project should determine if the project has the

potential to emit GHGs listed in the Kyoto Protocol at the rate of 100,000 t of CO_2e per year. If the traffic expressed as passenger car units per day (PCU/day) is below the numbers indicated in **Table V-26** in a representative year, the emissions in that year are unlikely to exceed the 100,000 tons CO_2e threshold.

Table V-26: Maximum Number of PCU per Km to Trigger 100,000CO_2e/a

Length of Rd. (km)	PCU/day	Length of Rd. (km)	PCU/day
5	85,500[38]	50	23,000
9	77,900	60	19,000
10	76,000	70	16,000
20	57,000	80	14,000
30	38,000	90	13,000
40	28,000	100	11,000

Source: ADB Environment Safeguards - a Good Practice Sourcebook (2012)

298. The total length of the proposed roads in Chuxiong City is 9.03km, the projected traffic flows in the representative years of 2016, 2022 and 2030 are 9,364, 27,653 and 51,024 PCU/day respectively, those are below 76,000PCU/d traffic for emitting 100,000 tons/a of GHGs (**Table V-27**).

299. Similarly, the total length of the roads in Wuding is 9.06km, the projected traffic flows in the representative years of 2016, 2022 and 2030 are 7,792, 31,023 and 57,071 PCU/day respectively; while the roads in Lufeng is 7.55km with the projected traffic flows in the representative years of 2016, 2022 and 2030 are 9,635, 33,296 and 60,967 PCU/day respectively, those of both counties are below 77,900PCU/d traffic for emitting 100,000 tons/a of GHGs (**Table V-27**).

Table V-27: Average Daily Traffic Flow on Each of the Roads (No/d)

City/ County	Road	Length of Rd. (km)	Year	Car	Mid-Size Vehicle (No./d)	Oversize Vehicle (No./d)	PCU/d
Chuxiong City	No. 17 Rd	3.01	2016	2,523	439	238	3,658
			2022	8,210	1,200	619	11,248
			2030	16,465	1,921	617	20,581
	No. 11 Rd	2.96	2016	1,746	304	165	2,532
			2022	4,852	709	366	6,648
			2030	10,048	1,172	377	12,560
	No. 10 Rd	1.45	2016	1,424	248	134	2,064
			2022	3,837	561	289	5,257
			2030	7,720	901	290	9,652
	No. 49 Rd	1.61	2016	767	133	72	1,111
			2022	3,285	480	248	4,501
			2030	6,586	768	247	8,232
	Total	**9.03**	**2016**	**6,460**	**1,124**	**609**	**9,364**
			2022	**20,184**	**2,950**	**1,522**	**27,653**
			2030	**40,819**	**4,762**	**1,531**	**51,024**
Wuding County	Chengbei Rd	1.27	2016	1,156	204	119	1,700
			2022	4,316	639	360	5,995

[38] The numbers for 5km and 9km are calculated based on the table in ADB Environment Safeguards - a Good Practice Sourcebook by mathematical extrapolation

City/ County	Road	Length of Rd. (km)	Year	Car	Mid-Size Vehicle (No./d)	Oversize Vehicle (No./d)	PCU/d
			2030	8,712	882	496	11,027
	Caiyuan Rd	0.61	2016	770	136	79	1,132
			2022	3,619	536	302	5,027
			2030	7,300	739	416	9,241
	Mudan Rd	1.32	2016	800	141	82	1,176
			2022	3,762	557	314	5,226
			2030	7,590	769	432	9,608
	Wuzheng Rd	0.92	2016	277	49	29	409
			2022	1,304	193	109	1,812
			2030	2,631	266	150	3,330
	Wuji Rd	0.85	2016	282	50	29	415
			2022	1,327	197	111	1,845
			2030	2,676	271	152	3,387
	Wuchan Rd	1.35	2016	299	53	31	441
			2022	1,404	208	117	1,950
			2030	2,834	287	161	3,587
	Binhe Rd	1.19	2016	287	51	30	424
			2022	1,323	196	110	1,837
			2030	2,718	275	155	3,441
	Beicheng Avenue	1.56	2016	1,425	252	147	2,097
			2022	5,280	782	440	7,333
			2030	10,628	1,076	605	13,452
	Total	9.06	2016	**5,296**	**936**	**546**	**7,792**
			2022	**22,335**	**3,308**	**1,863**	**31,023**
			2030	**45,089**	**4,565**	**2,567**	**57,071**
Lufeng County	No.1 Rd	1.59	2016	1,230	331	129	1,985
			2022	4,629	715	504	6,710
			2030	8,891	824	1,111	12,349
	No.2 Rd	1.39	2016	602	162	63	971
			2022	2,447	378	266	3,546
			2030	4,505	417	563	6,257
	No.3 Rd	1.00	2016	694	187	73	1,121
			2022	2,647	410	288	3,838
			2030	5,080	470	635	7,055
	Zhuluoji Avenue	1.00	2016	1,192	320	125	1,922
			2022	4,595	710	500	6,660
			2030	8,806	815	1,100	12,229
	Jinshannan Rd	1.00	2016	1,000	269	105	1,614
			2022	3,835	592	417	5,557
			2030	7,365	682	920	10,228
	Shiji Avenue	1.56	2016	1,254	337	132	2,024
			2022	4,820	745	524	6,986
			2030	9,252	856	1,157	12,850
	Total	7.55	2016	**5,972**	**1,606**	**627**	**9,635**
			2022	**22,973**	**3,550**	**2,499**	**33,296**

City/ County	Road	Length of Rd. (km)	Year	Car	Mid-Size Vehicle (No./d)	Oversize Vehicle (No./d)	PCU/d
			2030	**43,899**	**4,064**	**5,486**	**60,967**

Source: the FSR and domestic EIA;
Note: 1car=1PCU, 1mid-size vehicle=1.5PCU, and 1 oversize vehicle=2PCU

300. **GHG emission reduction.** The GHG emission reduction benefits of the project are derived primarily from the following major interventions: (i) promoting public transportation and non-motorized transport (low carbon transportation modes) following the PRC programs on vehicle emissions, clean fuel regulations, and public transport priority policy to maximize the benefits; and (ii) the application of LED street lights, which is expected to save 2.33 million KWh per year of electricity, resulting in a CO_2 emission reduction of 2,260 t/a[39] as compared to conventional street lighting.

301. The project will also promote enhanced energy efficiency through higher quality of road surfaces, grades and curve radii, improved road network connectivity, reduced road congestion and travel time. While an exact estimation of energy savings is difficult, an independent study[40] conducted from 2007-2010 indicates that energy savings of up to 45% can be achieved in road construction (mainly by using recycled material), and energy savings of up to 20% could be achieved in the operation of the road over 20 years if road design is optimized in terms of alignment, material and maintenance. The study also showed that average energy savings of 25% to 30% can be achieved just by using new 'low energy' materials (recycling products). These savings are significant and indicate that substantial reductions in energy use are possible if consideration is given to the materials being used. Other studies have identified road smoothness as a major impact on fuel economy: driving on a smooth road, as opposed to a rough road surface, can mean a 2-5% improvement in fuel economy

302. **Anticipated climatic changes.** There is general agreement among leading global climate models that rainfall in south-west PRC will increase because of global warming (Chen & Sun, 2009). Using information from Chuxiong City and data from the hydro-meteorological data from the Xiaohuangguayuan station during 1960-2010, recent climate change trends have been estimated (**Table V-28**). Data indicates that annual precipitation, flood season precipitation and dry season precipitation all have an increasing trend. In particular, increases of annual precipitation and dry season precipitation are statistically significant.

303. Longchuan River flow also has an increasing trend (**Table V-29**). During the flood season (June –August), the discharge has an increasing trend, while during the dry season (December – February), the discharge has a decreasing trend. In spring (March – May) and autumn (September – November), the discharge has an increasing trend. But none of these trends are statistically significant.

Table V-28: Changes of Temperature and Precipitation in Longchuan River

Item	Data	*T*	Critical vales	*U*	Critical value	Trend	significant
Annual Temperature	1960-2010	1.34	2.01	1.42	1.96	Increase	Y
Maximum temperature	1960-2010	0.14	2.01	0.02	1.96	Increase	N
Minimum temperature	1960-2010	0.37	2.01	0.45	1.96	Increase	N
Annual precipitation	1960-2010	2.09	2.01	2.07	1.96	Increase	Y
Flood season precipitation	1960-2010	1.68	2.01	1.57	1.96	Increase	N
Dry season precipitation	1960-2010	2.41	2.01	2.37	1.96	Increase	Y

T: Spearman statistical parameter; U: Mann-Kendall statistical parameter

[39] A KWh electricity saving reduces 0.997 kg of CO_2.
[40] Intelligent Energy Europe. 2010. Energy Conservation in Road Pavement Design, Maintenance and Utilisation.

Table V-29: Changes in Discharge in the Longchuan River

Item	Data	*T*	Critical vales	*U*	Critical value	Trend	significant
Annual discharge	1954-2010	0.51	2.01	0.39	1.96	Increase	N
Flood season discharge	1954-2010	0.21	2.01	0.08	1.96	Increase	N
Dry season discharge	1954-2010	-1.19	2.01	-1.48	1.96	Decrease	N
Normal discharge in spring	1954-2010	0.28	2.01	0.24	1.96	Increase	N
Normal discharge in fall	1954-2010	20.60	2.01	0.55	1.96	Increase	N

T: Spearman statistical parameter; U: Mann-Kendall statistical parameter

304. **Climate change adaptation.** The project generally conforms to the principles of the Bellagio Declaration on sustainable transportation and climate change, which recommends that adaptation strategies, at a minimum, contain the following aspects: (i) a long-term perspective (building climate resilient infrastructure); (ii) requirements for fixing and adapting what already exists (such as road rehabilitation and maintenance), (iii) recognition of the need to respond to climate emergencies[41] (an emergency preparedness approach, such as flood and drought control), and ecological river rehabilitation and restoration method to be conducted to achieve local environmental and ecological improvement.

305. During the feasibility study and the PPTA phase, the potential impacts due to increase of extreme weather events such as rainstorms or drought were considered, including the design specifications for high-capacity stormwater-sewer separated drainage pipelines, ecological river restoration with vegetation along the river banks to prevent high evaporation, which strengthen climate change adaption. In addition, proposed roads in project city/counties were partly re-aligned to avoid areas with high erosion potential and natural surface water bodies.

306. The infrastructure components with improved road connectivity will be beneficial in coping with any increase in the incidence of natural disasters and extreme weather events that might result from future climate change. They will provide efficient and alternative routes for both emergency vehicles and escape.

307. **Flood control.** The three river rehabilitation and flood control components will construct and strengthen unstable embankments along the rivers (with a flood protection standard of once in 10 to 50 years[42]), thus the city/counties' ability for flood control and protection will be significantly improved. Consequently, damages of flood to houses, facilities and goods, as well as farm lands and crops, will be prevented and/or mitigated, and therefore increasing the land values. However, the trend incurred by climate change will affect the flood protection for a specific flood protection standard. The standard of flood protection provided by structural flood defenses will decline over time, and the challenge is to prepare a strategy to adapt to that change. Based on a comprehensive analysis of alternatives (see Chapter VI), the Project promotes a strategy that combines periodic assessment and review of the hydrology and the state of knowledge about climate change every 10 years and incremental upgrade of flood control facilities to restore the desired standard, with strong reliance on non-structural measures (such as the review and strengthening of measures flood monitoring and early warning systems, emergency preparedness and response plans, etc).

308. **Roadside stormwater harvesting and reuse facility.** The average annual precipitation in the project areas is about 900 mm, where about 70% of precipitation is concentrated during July to September. The dry season lasts for about nine months every year, during which roadside greenbelts have to be watered by using scarce water resources. In the recent past, rapid urbanization in the project cities has significantly increase asphalt paved roads,

[41] A flood warning system will be established in all project cities.

[42] Standard of once in 10 years for the first and second sections of Chuxiong Longchun River (suburb) while once in 50 years for the third section of Longchuan River (urban area); the standard of once in 20 years for the rivers in Wuding and Lufeng counties.

impermeable plazas, sidewalks and parking areas. Consequent to this, the rainwater run-off has increased and the natural groundwater recharge potential has declined. According to the updated FSRs of the infrastructure components, roadside stormwater harvesting and reuse facilities will be designed and constructed on selected roads in the project city/counties (see para. 271).

I. Cumulative Impacts during both Construction and Operation

309. The significant cumulative impacts identified in the domestic EIAs are potential contamination of surface water, soil and groundwater as a combined result of construction activities and uncontrolled waste and wastewater disposal. The significance of these potential cumulative impacts will depend on whether each of the project components is designed, constructed and operated in line with environmental best practices and the EMP. This project includes environmentally friendly orientation and training to ensure that CSPMO, the PIUs, IAs and contractors are aware of their environmental responsibilities and are provided guidance on implementation to help ensure that the project's adverse cumulative impacts on local environment and residents' daily life are minimized and acceptable.

310. The changes in land use and population density by the proposed project will contribute to cumulative effects on ambient environment as a result of increased emissions, noise, GHG emissions, water and energy consumptions and increased solid waste and wastewater generation and management requirements, contributing to local, national and global pressures on resources and services.

311. The simultaneous construction of several constructions close to each other in the project city/counties will cause a magnification of environmental and social impacts in terms of traffic on the existing road network, noise, air-borne dust, waste generation, community disturbance and safety, etc. These construction related cumulative impacts will be mitigated by adopting proper mitigation measures, including: i) ensuring coordination between all project subcomponents and other projects in the area of influence in terms of construction schedule, possible access roads and disposal sites sharing; ii) contractors will be required to develop material transport plans in consultation with local road management authorities and local community; iii) enforcement of impact mitigation measures to minimize dust, noise and waste generation; iv) education of construction workers to avoid social conflicts; v) provision of temporary access for local traffic; and vi) proper maintenance of access roads and timely restoration upon completion. With effective implementation of good construction management measures, these construction-related cumulative impacts can be adequately mitigated to an acceptable level. The GRM will enable potential APs to report any excessive disturbances during construction.

VI. ALTERNATIVE ANALYSIS

312. During the PPTA stage, various alternatives for each component were proposed, screened, and compared against the technical, economic, social, and environmental criteria. The primary objective with respect to environmental criteria was to identify and adopt options with the least adverse environmental impacts and maximum environmental benefits. The alternative analysis also included the no-project alternative.

A. No-Project Alternatives

313. **Urban infrastructure components – road and bridge constructions.** The without-project scenario would result in continued shortages of reliable urban infrastructures including quality roads and bridges, and lack of public transportation, bicycle and pedestrian facilities in the project city/counties. The without-project alternative would weaken the city/counties' attractiveness to outside investors and tourists, impede their development and economic growth, as well as slow down the improvement of living standards of their residents.

314. **Sewer and stormwater networks subcomponents.** Without the sewer network subcomponents, large volume of wastewater would be continuously discharged into adjacent surface water bodies, resulting in continued pollution of groundwater, surface water and soil, and deterioration of the river ecosystem; without the stormwater pipeline subcomponents, the stormwater runoffs collected on the impermeable road surface would continuously cause waterlogging in the urban areas, resulting urban flood risk in the project areas.

315. **Water supply pipeline subcomponent.** The provision of safe drinking water to residents in the project areas is a basic infrastructure for their social and economic development. The project areas are currently not connected to the water supply network of the project city/counties. The no-project alternative is thus not an option.

316. **River flood control and rehabilitation components.** The river rehabilitation and flood control components will improve the flow, water quality, and flood storage of these rivers. Without the components, water quality deterioration and flooding would continue, living environments of local residents would deteriorate, and decline of the recreational area and tourism industry would result in negative socioeconomic impacts.

317. **The solid waste management component.** The component is important not only in improving the sanitary conditions of local residents but also improving the environmental conditions of rivers and local environment. Prolific littering and illegal dumping of garbage onto river banks and roadsides was observed in the project city/counties. This component provides facilities/equipment for the collection, transport and disposal of domestic solid waste in the areas. Without the components, the river banks and the roadsides will continue to be unsightly and unsanitary, creating public health threats to the nearby residents and causing pollution to the rivers and local environment.

318. The no-project alternative is also discussed in detail in the section of Project Justification and Rationale in Chapter III of this project EIA, where the current situation is described. The poor environmental performance of existing infrastructure (such as lack of sewer and stormwater collection networks), the poor road network and the lack of connectivity are the main justifications for the project components.

B. Alternatives for Urban Infrastructure Components

319. Alternatives for road pavement, cross-section, bridges structure, as well as pipe material of stormwater and sewer pipelines have been considered in the FSRs and EIAs.

320. **Road pavement alternatives.** Two kinds of pavement materials for motor vehicle lanes and non-motor vehicle lanes were considered: asphalt concrete pavement and cement concrete pavement. Based on the traffic forecasts and the requirements of urban roads, in addition to other requirements like skid resistance, tire/road noise, durability, rutting and crack resistance, local material supplies, and hydro-geological conditions, asphalt concrete pavement was selected. This pavement is cheaper and will make the maintenance of underground utilities easier than that of cement concrete pavement. Asphalt concrete pavement is commonly used in the PRC. The correct grade of asphalt pavement will be specified during the detailed design to take into account the specific conditions in the project city/counties.

Table VI-1: Comparison of Asphalt Concrete and Cement Concrete Pavement

Item	Asphalt Concrete	Cement Concrete
Pavement performance	Low noise, low vibration, low dazzle	High noise, high vibration, high dazzle
Driving comfort	High	Low
Traffic disturbance during maintenance	Short time road closure	Long time road closure
Design life	15 years	30 years
Maintenance	Easy to maintain	Difficult to maintain
Load capacity	Average	High
Investment	Average	High
Thermal stability	Low	High

321. **Sidewalk pavement alternatives.** Two types of pavements were considered for the pedestrian sidewalks, including non-permeable sidewalk bricks and permeable sidewalk bricks. Water permeable sidewalk paving is a relatively recent development trend in the PRC, supporting sustainable urban drainage systems as it enables the control of stormwater and reduces stormwater runoff. The permeable blocks have a permeability index up to 0.032~0.044 mm/s while the average maximum rainfall for the project city/counties is less than 0.04 mm/s. This will effectively keep stormwater on site, mitigate localized flooding, protect drainage systems and contribute to groundwater recharge. The permeable sidewalk blocks are estimated to also remove CODcr by 30%, SS by 60%, total nitrogen (TN) by 25% and total phosphorus (TP) by 25%.[43] Permeable sidewalk bricks will be adopted for the proposed roads.

322. **Road alignment.** The alignments of urban roads are based on connecting existing roads and local topographic condition, and conform to the project city/counties' master plans and the 12th FYPs. No alternative alignments were considered, except some slight adjustment for avoiding deep cut and high fill (Lufeng), and re-alignment of No. 10 Road away from a natural pond[44] with an area of 15 ha in Chuxiong City.

323. **River-crossing Bridges.** The project will finance two bridges in Chuxiong City, i.e. No.10 Road Qinglong River Bridge, and No.11 Road Qinglong River Bridge. Two structures were compared in the FSR for the bridges, i.e. rigid framed arch bridge (Option 1) and pre-stressed concrete hollow slab bridge (Option 2). **Table VI-2** shows the comparison. For aesthetic reasons and more stable structure performance, Option 1 was selected for the two bridges.

Table VI-2: Comparison of Bridge Structures in Chuxiong City

Analysis Criteria	Option 1- rigid framed arch bridge	Option 2 – Hollow slab bridge
Construction difficulty and feasibility	Slightly more difficult construction with reliable design and construction	Easy construction with reliable design and construction technology

[43] "Current Status and Development Outlook of Water Permeable Pavement", South China Institute of Technology, 2007

[44] In the original FSR, about 2/3 of the natural pond were to be filled in for building the road.

Analysis Criteria	Option 1- rigid framed arch bridge	Option 2 – Hollow slab bridge
	technology	
Feature of structure	Good combination of arch and girder with stable structure performance	Less structure stable performance
Landscape coordination and aesthetic effect	Beautiful style with nice landscape coordination and aesthetic effect	Medium landscape coordination
Maintenance complexity	Less and easy maintenance with low cost	Easy maintenance with low cost
Cost	higher	lower

324. **Cross-section of Roads.** Four types of road cross sections were considered (**Table VI-3**). Based on the city's master plan, the characteristics of traffic flow and the road function, the appropriate type of cross section was selected for each road in the FSR.

Table VI-3: Comparison of Cross Section Alternatives

Cross Section	Characteristics	Application
One section	(i) There is no specific lane for non-motor vehicle (NMV) traffic which uses partial lane or sidewalk; (ii) There is no separation for the lanes going the opposite direction which causes interference and low traffic speed.	Secondary or branch road with low motor vehicle (MV) and NMV traffic
Two sections	(i) There is no specific lane for NMV traffic which uses partial lane or sidewalk; (ii) The lanes going in the opposite direction are separated without interference, and the traffic speed of the inside lane is relatively high.	Secondary or main road with heavy MV and NMV traffic
Three Sections	(i) There is the dedicated lane for NMV which avoids interference between the MV and NMV traffic and pedestrian, and guarantees NMV traffic safety; however, there is a weakness for pedestrian crossing; (ii) There is no separation for the lanes going in opposite direction; however, the speed of MV traffic is high because of no interference between MV and NMV traffic.	Main road with continuous heavy NMV traffic flow; or main road with rapid growth of pedestrian and NMV traffic
Four Sections	(i) There is the specific lane for NMV traffic which avoids interference between the MV and NMV traffic flow and pedestrian, and the safety of NMV traffic is guaranteed; however, there are significant difficulties for the crossing; (ii) The lanes going in opposite direction are separated without interference, and the traffic speed is relatively high.	Main road with heavy MV and NMV traffics

Source: FSR for Chuxiong Infrastructure Component

325. Taking the roads under Chuxiong Infrastructure Component as an example, a three section cross-section was selected for the urban main roads No.11 and No. 17, and the urban secondary road No.10, while one section was selected for the urban branch road No.49. The same principle was adopted for the design of Wuding and Lufeng road cross-sections.

326. **Alternatives for street lighting**. Two alternatives for street lighting, including high-pressure sodium lamps and light-emitting diode (LED) lighting were compared. Both can meet street lighting requirements, but LED light consumes significantly less power than high-pressure sodium lamps. LED lamps will be used on the proposed roads to satisfy ADB's and the PRC's energy conservation and emission reduction policies. This has been flagged as loan assurance. The comparison of the alternatives for the street lighting is shown in **Table VI-4**.

Table VI-4: Comparison of High-pressure Sodium and LED Lamps

Items	High Pressure Sodium Light	LED Street Light
Photometric performance	Low	Excellent
Radiator performance	Low	Excellent
Electric performance	Electric Shock Easy (High voltage)	Safe (Low voltage)
Working life	Short (5,000 hours)	Long (>50,000 hours)
Working voltage range	Narrow (±7%)	Wide (±20%)

Items	High Pressure Sodium Light	LED Street Light
Daily power consumption	6kWh	3KWh
CO2 emission (12 hours)	6kg	3kg
SO2 emission (12 hours)	0.2kg	0.1kg
Price	CNY 1000/lamp	CNY5800/lamp
Startup speed	Quite Slow (Over 10 minutes)	Rapid (2 seconds)
Strobe	Yes (Alternating current drive)	No (Direct current drive)
Optical efficiency	Low	High
Color index / distinguish feature	Bad, Ra <50 (The color of object is faith, boring, hypnosis)	Good, Ra >75 (The color of object is fresh, veritable and comfortable)
Color temperature	Quite Low (Yellow or amber , uncomfortable)	Ideal Color Temperature (Comfortable)
Bad glare	Strong Glare (Dazzle)	No Harmful Glare
Light pollution	Strong	No
Heating	Serious (>300°C)	Cold Light (<60°C)
Lampshade turn dark	Easy (Absorb dust)	No (Static proof)
Lamp aging turn yellow	In A Short Time	No
Shockproof performance	Bad (Fragile)	Good (No filament nor glass)
Environment pollution	Contains Lead Element Etc.	No
Maintenance cost	CNY200/lamp/year	CNY 30/lamp/year
Product cubage	Big	Small (Slim appearance)
Product weight	Heavy	Light
Annual power saving		**1,095 kWh**

Source: DMX Technologies, 2010 and FSR

327. **Alternatives for drainage and sewer pipe material.** Two types of pipe materials were compared in the FSRs (**Table VI-5**), including high-density polyethylene (HDPE) double-wall corrugated pipe, and reinforced concrete pipe. The reinforced concrete pipe was adopted for the stormwater pipe with a diameter of >800mm due to lower cost. For the sewage pipe works and the stormwater pipes with a diameter < 800mm, the HDPE double wall corrugated pipe was selected because of easy construction, less scale formation, better corrosion resistance, high rigidity and flexibility, and high resistance to shock and pressure.

Table VI-5: Comparison of Pipe Material Alternatives

Item	HDPE Double Wall Corrugated Pipe	Reinforced Concrete Pipe
Roughness Coefficient	0.009	0.013
Corrosion Resistance	Good	Medium
Quality of Pipe Works and Maintenance Cost	The hot melt is used for pipe connection, which quality is good and is not subject to damage. The quality of pipe installation is guaranteed. The maintenance cost is relatively low.	The joint is subject to damage. Due to the fact that the unit pipe is short, the impermeability is poor. The quality of whole works cannot be guaranteed. Maintenance cost is relatively high.
Length of Unit Pipe	> 6 m	3-5m
Unit Price	High	Low
Weight	5% of reinforced concrete pipe	Very heavy
Environmental Impact	Good for groundwater due to less seepage	Leakages more likely, resulting in groundwater pollution
Service Life	60 years	60 years

C. Alternatives for Flood Control and River Embankment Design

328. **Alternative Climate Change Adaptation Strategies.** The trend incurred by climate change will affect the flood protection for a specific flood protection standard. The standard of flood protection provided by structural flood defenses will decline over time, and the challenge is to identify suitable strategies to adapt to that change. The following adaptation strategies were compared:

(1) ***Build for the future now***. Estimate the change in flood frequency based on the best science available, and design structures for future conditions. This would require raising the investment required for capital expenditure on flood defenses now. Given the competition for available funding by numerous other worthy proposals and given the uncertainty attached to predictions of climate change – with even greater uncertainty attached to predictions of hydrological change – this is unlikely to be a sensible strategy.

(2) ***Periodic review and incremental upgrade*.** An alternative would be to review the hydrology and the state of knowledge about climate change every 10 to 20 years after project implementation. As data accumulates it may become clearer if the hydrology is changing, and with improving scientific models for predicting climate responses too, the predictions of future changes to precipitation, runoff and flood frequency may become more accurate. If the analysis shows that it is likely that the standard of flood protection has declined the structures could then be incrementally upgraded to restore the desired standard. Problems with this strategy are that hydrological response is a highly variable process both temporally and spatially, and it would be very difficult to verify hydrological regime change over a period as short as 10 to 20 years; and even if predictions of future climate change do improve it is likely that they will still retain significant, albeit lesser, uncertainty.

(3) ***Adaptation through non-structural measures*.** Another adaptation strategy, and one consistent with integrated flood risk management, is to rely on non-structural measures to manage the residual risk that remains after implementation of structural flood defense measures. According to flood risk management theory, the exposure of people and assets and their vulnerability to danger or damage from flood hazard in over-standard floods can be treated satisfactorily by implementation of non-structural measures (such as flood forecasting and warning, emergency response planning, community awareness and preparedness, post-flood recovery actions, flood insurance). If the standard of protection provided by structural defenses declines due to the impacts of climate change, the non-structural measures will continue to be effective in managing flood risk. This strategy alone is not perfect either because, if the standard of flood protection did decline there would be a progressive increase in losses and damages, and some increased risk to personal safety. There would come a point in time when further expenditure to upgrade structural works would become economically beneficial.

329. Based on the analysis of alternatives, the Project decided to adopt a strategy that combines the approach of periodic assessment and review with strong reliance on non-structural measures (mainly through the establishment of flood monitoring and early warning systems). The review of hydrological data (including rainfall patterns, rainfall runoff, flood flows) and the validity of the design flood flow assumptions will be conducted every 10 years. Corrective actions such as reinforcement of flood protection facilities or adjustment of land use plans will be triggered if statistically significant design assumption variations are observed (let’s say, 10%). The exact mechanism for assessment, review and corrective actions will be defined in the framework of the establishment of the flood monitoring and early warning systems.

330. **Longchuan River rehabilitation: Original vs. final design** The Longchuan river rehabilitation component as originally proposed by the DI and IA was critically reviewed by pre-PPTA consultants, the PPTA consultants and ADB at PPTA inception and interim stage. The original design concept proposed by the design institute for the river rehabilitation and flood management adopted dikes to a 50-year standard throughout the project reach. While there were four variations on the basic design, with the preferred option the spacing between dike crests would be about 40 m. The original dike design included steep side slopes and a minimum crest width. A narrow strip between the dike walls and the river channel was included with a footpath. The channel proposed between the dikes would be of rectangular cross-section of constant width, with a paved bed and uniform longitudinal gradient over considerable lengths. The original design had some realignment of channel bends, with the result that the length of the design channel would have been reduced from over 9 km to 8.8 km.

331. On 31 August 2011 a Yunnan Provincial Government decree was formalized to protect valuable agricultural land from urban development (Strengthening Farmland Protection and Promotion of Scientific Approach to Urbanization (Yunzhengfa [2011]185)). As a consequence land use planning zones underwent major revision, including land use along the Longchuan River upstream of Chuxiong City. Through policy dialog with the IA and DI, the design was significantly revised to balance environmental, social and economic needs of an urban river:

(1) In section 1, the fertile farmland in the floodplain will be retained for its agricultural and scenic values. The lush green farmland is an attractive landscape feature. Retention of the floodplain farmland would also be consistent with national policy to protect limited fertile and productive agriculture from urban development (State Council Decree no.257 of 1998: Basic Farmland Protection Rule). As a result, interventions in that section will be limited to river bank stabilization where erosion is evident (such as outer banks of river bends) and some planting of indigenous species (trees, plants and water grasses) along the river through this zone.

(2) In Section 2, minor river embankment works between the hills are proposed. The layout of the river embankment is based on the site topography and only the lower areas between the hills will be strengthened. A multi-step channel cross-section is proposed.

(3) In Section 3, full river embankment to connect to the existing river embankment is required. Flood control and river embankment design for this section will apply an integrated design, balancing flood control, urban landscaping, recreation and leisure objectives. The embankment cross section consists of sloped stone masonry channel at the bottom, walkway above normal waterline, and earth embankment stabilized with grass, trees and vegetation at the top.

332. **River embankment design.** Section 3 of Longchuan River, some sections of East and West River in Lufeng, and Wulong River will require river embankment works to ensure compliance with the flood control standard. An alternative study was conducted for five types of river embankments including: (i) stone masonry embankment; (ii) three dimensional geo-mat embankment; (iii) combined stone masonry and vegetation protection embankment; (iv) gabion revetment; and (v) ecological concrete precast block embankment. Considering the needs for flood control, urban landscaping and water environment, Option (v) was selected. It provides balanced structural stability for flood control and ecological river rehabilitation and restoration, is commercially available in Yunnan Province, is in harmony with the adjacent landscape and has beautiful aesthetic effect.

Table VI-6: Alternative river embankment designs

Embankment Alternative	Advantage	Disadvantage
Option (i) stone masonry revetment	Stable structure for flood control	(i) Without function for river water purification; (ii) high construction cost; (iii) difficult for construction and long construction period

Embankment Alternative	Advantage	Disadvantage
Option (ii) three-dimensional geo-mat slope	(i) Low land occupation; (ii) with river restoration function	(i) Weak structural stability and anti-scouring capacity,(ii) short service life; and (iii) high construction cost
Option (iii) combined stone masonry and vegetation revetment	(i) Low construction cost; (ii) good landscape effect; (iii) with river restoration function	(i) weak structural stability and scouring resistance, and (ii) short service life.
Option (iv) gabion revetment	(i) Good river restoration function; (ii) good aesthetic effect;(iii) easy for construction	(i) high construction and maintenance costs;(ii) short service life; (iii) weak anti-scouring capacity
Option (v) ecological concrete precast block embankment	(i) balanced flood control and river restoration; (ii) with function of water purification; (iii) good landscape coordination and aesthetic effect; and (iv) commercially available in Yunnan province	(i) weak anti-scouring capacity in case of high water level in comparison with stone masonry revetment.

Source: the FSRs and EIA Reports

333. Together with the embankment construction, native trees (such as willows and bamboos), as well as native emergent aquatic plants (reeds and cattail) will be planted along the river banks to increase the river's self-purification capacity and speed up the river restoration process.

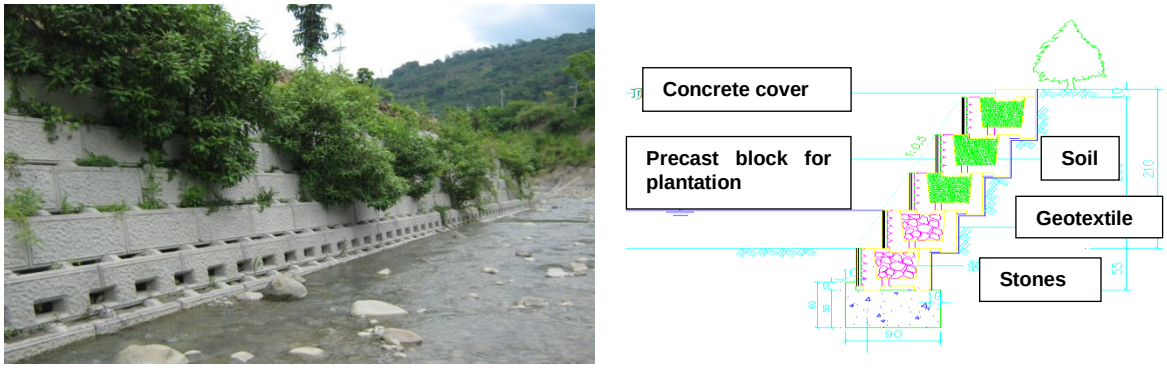


Figure VI-1: Ecological concrete precast block embankment (selected option for Section 3 of Longchuan River, Wuding River)

Source: the FSRs

VII. CONSULTATION, PARTICIPATION AND INFORMATION DISCLOSURE

A. Legislative Framework for Public Consultation and Information Disclosure

334. Meaningful participation and consultation during the evaluation of project planning, feasibility study, design and implementation are an important environment safeguards requirement. Relevant provisions in the Environmental Protection Law of the PRC and the Regulations on the Administration of Construction Project Environmental Protection (Order of the State Council, No. 253) require that an EIA report prepared by a certified EIA Institute shall be in accordance with relevant laws to solicit the opinions of organizations concerned and residents within and nearby the project sites. The PRC National Development and Reform Commission (NDRC) issued a new requirement for "Social Risk Assessment of Large Investment Projects" in August 2012, which emphasizes the importance of public consultation in an effective manner, and requires that the results of public consultation are clearly summarized in the EIA report, including the dates of consultations, number of stakeholders, who the stakeholders are, and the comments received, etc.

335. ADB's Safeguard Policy Statement (2009) also requires meaningful public participation, consultation and information disclosure. The consultation process for this project therefore followed both the PRC laws and regulations and ADB's Safeguard Policy Statement (2009). Key activities and results are presented in the following sections.

B. Information Disclosure

336. Two rounds of information disclosure for each project component were conducted by the EIA Institute, which are summarized in **Table VII-1** and illustrated in **Figure VII-1**.

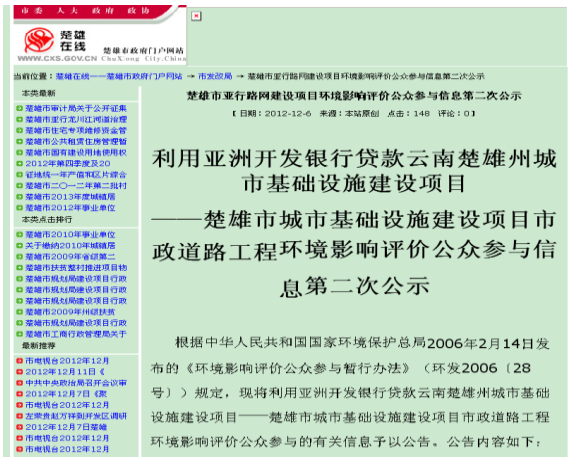
337. The first round of information disclosure was carried out during the early stage of EIA preparation, of which the content mainly included a detailed description of project scope, contact details of the CSPMO, the LPMOs and PIUs, the EIA Institute and local EPBs, major procedures and scope of the EIA, and main aspects and approaches for public consultation.

338. The second round of information disclosure was undertaken after the preparation of draft FSRs and EIA reports to solicit public comments and suggestions on the preliminary findings of the EIAs, including the potential impacts identified, proposed mitigation measures, as well as the arrangement of environmental management during both project construction and operation. During information disclosure, the EIA Institute also communicated with local APs and villages, companies/organizations within or nearby project sites to collect preliminary public opinions for the project.

Table VII-1: Information disclosure during project preparation

City/ County	1st Information Disclosure		2nd Information Disclosure	
	Date	Media Posted	Date	Media Posted
Chuxiong	20 Mar. 2012	Posted on Chuxiong Prefecture construction information website: http://gcjsxxgk.yn.gov.cn	6 Dec. 2012	Posted on Chuxiong Municipal Government website: http://www.cxs.gov.cn
Wuding	20 Mar. 2012	Posted on Wuding County Government's website: http://gs.yn.gov.cn	12 Dec. 2012	Posted on Wuding County Government's website: http://gs.yn.gov.cn
Lufeng	19 Mar. 2012	Posted on Lufeng County Government's website: http://www.ynlf.gov.cn	17 Dec. 2012	Posted on Lufeng County Government's website: http://www.ynlf.gov.cn

Webpage of 1st Information Disclosure for Chuxiong Component



Webpage of 2nd Information Disclosure for Chuxiong Component

Webpage of 1st Information Disclosure for Wuding Component

Webpage of 2nd Information Disclosure for Wuding Component

Webpage of 1st Information Disclosure for Lufeng Component

Webpage of 2nd Information Disclosure for Lufeng Component

Figure VII-1: Information disclosure during project preparation

339. **Future information disclosure.** The project's environmental information will be further disclosed by the Prefecture's EPB, local EPBs and ADB as follows:

(i) Summaries of the domestic EIA reports in Chinese were disclosed on the local governments' websites for more than fifteen (15) days before the EIA reports were approved by the provincial EPD.

(ii) Copies of the domestic EIAs (in Chinese) are available on request in both the Prefecture's

EPB and the EPBs of project city/counties;

(iii) This project EIA is available for review at www.adb.org for 120 days before ADB Board consideration of the loan; and

(iv) Environment progress and monitoring reports will be prepared on a semi-annual basis and will be disclosed on ADB's project website (www.adb.org).

C. First Round of Consultation

(a) Chuxiong Infrastructure Development Component

340. On 13 May 2012, eighty (80) questionnaires were distributed by the EIA Institute to twenty (20) project-affected organizations/units, including village committees, community residential committees, shops, companies and government departments, and sixty (60) APs and beneficiaries from different age groups, gender, educational backgrounds and occupation (**Table VII-2**). All questionnaires were completed and returned. The survey result is summarized in **Table VII-3**.

Table VII-2: Respondents of 1st Round of Questionnaire Survey (Chuxiong Infrastructure Subcomponent)

Basic Information of the Consulted APs			No. of Respondents	Percentage (%)
60 APs consulted	Gender Distribution	Male	47	78.3
		Female	13	21.7
	Age Group	<25	2	3.3
		26-44	36	60.0
		≥45	50	36.7
	Occupation	Civil servant and cadre	1	1.67
		Worker	0	0
		Farmer	58	96.66
		Teacher and engineer	0	0
		Self-employed individual and others	1	1.67
20 organizations consulted	1) Dadong Village Committee, 2) Fumin Community Residential Committee, 3) Jinlong Community Residential Committee, 4) Fumin Jiahong Water Heater Store, 5) Fumin Sales Department of China Telecom, 6) the Township Public Health Center, 7) the Town Credit Bank, 8) Chujia Store of Construction Materials, and 9) the representatives from 12 organizations and government departments, including the Municipal Bureau of Land and Resource, the Municipal DRC, the EPB, the local Political Consultative Conference, and the local People's Congress, etc.			

Source: EIA Report of Chuxiong Infrastructure Development Component

Table VII-3: Results of 1st Round of Questionnaire Survey (Chuxiong Infrastructure Development Component)

No.	Question	Option	No. of Respondents (60 APs in Total)	Percentage (%)	No. of Respondents (20 Organizations in Total)	Percentage (%)
1	Do you know the project component?	Yes	55	91.7	15	75.0
		No	5	8.3	5	25.0
2	Whether the project is beneficial to local social and economic development?	Very favorable	58	96.7	19	95.0
		Favorable	0	0	0	0
		Not conducive	0	0	0	0
		Do not know	2	3.3	1	5.0
3	What do you think about	Significant impact	11	18.3	3	15.0

No.	Question	Option	No. of Respondents (60 APs in Total)	Percentage (%)	No. of Respondents (20 Organizations in Total)	Percentage (%)
	the noise impact level during construction?	Moderate impact	28	46..7	9	45.0
		Limited impact	16	26.7	7	35.0
		Do not know	5	8.3	1	5.0
4	What do you think about the air pollution impact level during construction?	Significant impact	14	23.3	4	20.0
		Moderate impact	24	40.0	9	45.0
		Limited impact	16	26.7	6	30.0
		Do not know	6	10.0	1	5.0
5	What do you think about the air pollution impact level during construction?	Significant impact	5	8.3	1	5.0
		Moderate impact	15	25.0	5	25.0
		Limited impact	31	51.7	13	65.0
		Do not know	9	15.0	1	5.0
6	What do you think about the motor vehicle emission impact level during project operation?	Significant impact	4	6.7	2	10.0
		Moderate impact	22	36.7	8	40.0
		Limited impact	29	48.3	8	40.0
		Do not know	5	8.3	2	10.0
7	What do you think about the water pollution impact level during project operation?	Significant impact	1	1.7	2	10.0
		Moderate impact	19	31.7	4	20.0
		Limited impact	33	55.0	12	60.0
		Do not know	7	11.7	2	10.0
8	What do you think about the impact on the surrounding ecological environment during project operation?	Significant impact	2	3.3	1	5.0
		Moderate impact	18	30.0	5	25.0
		Limited impact	36	60.0	12	60.0
		Do not know	4	6.7	2	10.0
9	What do you think about the noise impact during project operation?	Significant impact	7	11.7	2	10.0
		Moderate impact	17	28.3	7	35.0
		Limited impact	29	48.3	9	45.0
		Do not know	7	11.7	2	10.0
10	What's the most effective mitigation measure for mitigating traffic noise impact during project operation?	Sound insulated window	18	30.0	6	30.0
		Sound barrier	22	36.7	4	75.0
		Green belt	54	90.0	12	25.0
		Financial compensation	22	36.7	2	95.0
		Move out	4	6.7	0	0
		Change the use function of the first row buildings	24	40.0	0	0
		No action required	2	3.3	1	5.0
11	What is your attitude towards the project?	Support	53	88.3	20	100.0
		Indifference	7	11.7	0	0
		Not support	0	0	0	0

Source: EIA Report of Chuxiong Infrastructure Development Component

341. **Consultation result.** 88.3% of the consulted APs and 100% of the consulted organizations support the project, and believe that the project will improve the local social and economic development, promote sustainable urbanization and enhance residents' living conditions. The main issues raised by the respondents include: (i) resettlement and related compensation; (ii) the need for noise and dust control, pedestrian safety and traffic management during construction and operation; (iii) quality control of the project construction; and (iv) landscaping maintenance during operation.

342. Suggestions provided by the respondents included: (i) avoiding the construction activities at nighttime to minimize the noise and during rush hour of students to guarantee their health and safety; (ii) proper planning should be conducted to avoid repeated excavation of underground pipelines; (iii) undertake water spraying to minimize dust; (iv) timely disposal of construction wastes with necessary covering; and (v) improve vegetation along roads to reduce the noise during road operation. All these considerations have been included as mitigation and management measures in the updated FSR, EIA and EMP.

(b) Chuxiong Longchuan River Rehabilitation and Flood Control Component

343. One hundred and eight (108) questionnaires were distributed at two symposiums conducted by the EIA Institute on 13 May 2012. The questionnaires were distributed to seventy-two (72) APs from different age groups, gender and occupations; and to thirty-six (36) project-affected organizations, including village committees, community residential committees, shops, companies and government departments. All questionnaires were completed and returned (**Table VII-4**). The consultation results are shown in **Table VII-5**.

Table VII-4: Respondents of 1st Round of Questionnaire Survey for Chuxiong Longchuan River Rehabilitation and Flood Control Component

Basic Information of APs Surveyed			No. of Respondents	Percentage (%)
72 consulted APs	Gender Distribution	Male	60	83.33
		Female	12	16.67
	Age Group	<25	6	8.33
		26-44	43	59.72
		≥45	23	31.94
	Occupation	Civil servant and cadre	0	0
		Employee	4	5.56
		Farmer	61	84.72
		Teacher and engineer	2	2.78
		Self-employed individual and others	5	6.94
	Ethnicity	Han (majority)	61	84.72
		Yi (Minority)	2	2.78
		Miao (Minority)	1	1.39
		Hui (Minority)	1	1.39
		Bai (Minority)	1	1.39
		Unknown	6	8.33
36 consulted organizations	1) Donggua Village Committee, 2) Donggua Cheping Community Residential Committee, 3) Xinglong Village Committee, 4) Donggua Township Community Residential Committee, 5) Liujia Village Committee, 6) Township Public Health Center, 7) Qingshanzui Reservoir Administration, 8) Donggua Town Labor Union, and 9) the representatives from 28 organizations and government departments including the Water Conservation Bureau, the Municipal Bureau of Land and Resource, the Municipal DRC, the EPB, the Political Consultative Conference, and the local People's Congress, etc.			

Source: The EIA Report of Chuxiong River Rehabilitation and Flood Control Component

Table VII-5: Results for Questionnaire Survey on APs for Chuxiong Longchuan River Rehabilitation and Flood Control Components

No.	Question	Option	No. of Respondents (72 APs in Total)	Percentage (%)	No. of Respondents (36 Organizations in Total)	Percentage (%)

No.	Question	Option	No. of Respondents (72 APs in Total)	Percentage (%)	No. of Respondents (36 Organizations in Total)	Percentage (%)
1	Do you know the project component?	Yes	65	90.3	34	94.4
		No	7	9.7	2	5.6
2	Whether the project is beneficial to local environment?	Very favorable	60	83.3	33	91.7
		Favorable	7	9.7	3	8.3
		Not conducive	1	1.4	0	0.0
		Do not know	4	5.6	0	0.0
3	What's the most positive effect/ benefit after the project completion?	Water environment	18	25.0	15	38.5
		Ambient air	6	8.3	3	7.7
		Vegetation	4	5.6	2	5.1
		Groundwater	3	4.2	1	2.6
		Landscape	28	38.9	13	33.3
		Residents' living condition	16	22.2	5	12.8
4	Whether the project is beneficial to local social and economic development?	Very favorable	48	66.7	32	88.9
		Favorable	17	23.6	4	11.1
		Not conducive	0	0.0	0	0.0
		Do not know	7	9.7	0	0.0
5	What is the major environmental concern during the project construction?	Ambient air	5	6.9	1	2.5
		Surface water	23	31.9	14	35
		Solid wastes	8	11.1	13	32.5
		Noise	32	44.4	11	27.5
		Others	4	5.6	1	2.5
6	What do you think about the noise and vibration impact levels during construction?	Significant impact	13	18.1	2	5.6
		Moderate impact	27	37.5	22	61.1
		Limited impact	19	26.4	8	22.2
		Do not know	13	18.1	4	11.1
7	What do you think about the air pollution impact level during construction?	Significant impact	8	11.1	1	2.8
		Moderate impact	24	33.3	22	61.1
		Limited impact	29	40.3	8	22.2
		Do not know	11	15.3	5	13.9
8	What do you think about the surface water pollution impact level during construction?	Significant impact	0	0.0	2	5.5
		Moderate impact	12	16.7	11	30.6
		Limited impact	38	52.8	13	36.1
		Do not know	22	30.6	10	27.8
9	What do you think about the impact on the surrounding ecological environment during project operation?	Significant impact	1	1.4	3	8.3
		Moderate impact	14	19.4	11	30.6
		Limited impact	41	56.9	20	55.6
		Do not know	16	22.2	2	5.5
10	After the project completion, the local water environment will be:	Improved	44	61.1	32	88.9
		No Change	15	20.8	3	8.3
		Degraded	0	0.0	0	0.0
		Do not know	13	18.1	1	2.8
11	After the project completion, the river bank landscape and river environment will be:	Improved	54	75.0	35	97.2
		No Change	5	6.9	0	0.0
		Degraded	0	0.0	1	2.8
		Do not know	13	18.1	0	0.0
12	What is your attitude towards the project?	Support	69	95.8	36	100.0
		Not support	3	4.2	0	0

No.	Question	Option	No. of Respondents (72 APs in Total)	Percentage (%)	No. of Respondents (36 Organizations in Total)	Percentage (%)
		Indifference	0	0	0	0

Source: The EIA Report of Chuxiong Longchuan River Rehabilitation and Flood Control

344. 95.8%[45] of the consulted persons and 100% of consulted organizations support the project, and 100% of the respondents believe that the project will improve the residents' living condition and the local ecological environment, in particular the surface water quality, and promote local socio-economic development. The main concerns raised by the respondents include: (i) environmentally friendly river rehabilitation; (ii) flood control and safety of residents' life and property; (iii) resettlement and related compensation; (iv) riverside landscaping and aesthetic effect; (v) noise and dust control during construction; (vi) disposal of construction wastes and rubbish from workers' camps during construction; (vii) QA/QC of the river bank construction; and (viii) river maintenance, including embankment structure and bank vegetation, after project completion.

345. The suggestions provided by the respondents included: (i) avoiding construction activities at nighttime to minimize noise and to guarantee residents' safety; (ii) proper measures should be conducted to avoid pollution and impact on the reservoir, which is a major drinking water source for the city; (iii) undertaking water spraying to minimize dust; (iv) timely disposal of construction waste with necessary covering; and (v) protecting existing trees and vegetation and fauna along the river. All these comments have been included as mitigation and management measures in the updated FSR and in the EMP.

(c) Component of Municipal and Environmental Services in Wuding County

346. **Road Subcomponent:** On May 2012, eighty-three (83) questionnaires were distributed in two separate symposiums organized by the EIA Institute. Questionnaires were distributed to sixty (60) Aps from different age groups, gender, and ethnicity. Most people consulted were farmers. Twenty-three (23) project-related local organizations/units, including village committees, community residential committees, NGOs, companies and government departments. All questionnaires were completed and returned (**Table VII-6**). The consultation results are shown in **Table VII-7**.

Table VII-6: Respondents of 1st Road of Questionnaire Survey for Infrastructure Development Component in Wuding County

Basic Information of APs Surveyed			No. of Respondents	Percentage (%)
60 consulted APs	Gender Distribution	Male	39	65
		Female	21	35
	Age Group	<25	3	5.0
		26-44	33	55.0
		≥45	24	40.0
	Occupation	Civil servant and cadre	0	0
		Employee	0	0
		Farmer	59	98.3
		Teacher and engineer	0	0
		Self-employed individual and others	1	1.7

[45] 4.2% consulted APs expressed indifference towards the project, and nobody is against the project.

23 consulted organizations	1) Xihe Village Committee, 2) Rongning Village Committee, 3) Beijie Community Residential Committee, 4) Zhongma Community Residential Committee, 5) Jiucheng Community Residential Committee, 6) Wuding Women's Federation, 7) Wuding Soil and Water Conservation Station, 8) Wuding Youth League Committee; and 9) the representatives from 15 organizations and government departments including the local Religious Affairs Bureau, the Water Conservation Bureau, the Bureau of Land and Resource, the county DRC, the Bureau of Housing and Construction, the EPB, the Political Consultative Conference, and the county People's Congress, etc.

Source: The EIA Report of Wuding Component

347. **Wuding River Rehabilitation and Flood Control Component:** Eighty-five (85) questionnaires were distributed in two separated symposiums (100% of the questionnaires were completed and returned) by the EIA Institute to sixty-five (65) APs, from different age groups, gender, ethnicity and occupation; and twenty (20) project-related local organizations/units, including village committees, community residential committees, companies and government departments (**Table VII-7**). The consultation results are shown in **Table VII-8**.

Table VII-7: Respondents of 1st Round of Questionnaire Survey (River Rehabilitation and Flood Control Subcomponent in Wuding County)

Basic Information of APs Surveyed			No. of Interviewees	Percentage (%)
65 consulted Aps	Gender Distribution	Male	42	64.61
		Female	23	35.39
	Age Group	<25	1	1.54
		26-44	42	64.61
		≥45	22	33.85
	Occupation	Civil servant and cadre	0	0
		Employee	0	0
		Farmer	55	84.61
		Teacher and engineer	0	0
		Self-employed individual and others	10	35.39
	Nationality	Han (majority)	55	84.62
		Yi (Minority)	4	6.15
		Hui (Minority)	6	9.23
20 consulted organizations	1) Rongning Village Committee, 2) Xihe Village Committee, 3) Beijie Community Residential Committee, 4) Zhongma Community Residential Committee, 5) Jiucheng Community Residential Committee, 6) Wuding Women's Federation, 7) Wuding Youth League Committee, and 8) the representatives from 13 organizations and government departments including the Wuding Religious Affairs Administration, the Water Conservation Bureau, the Wuding Forestry Bureau, the Bureau of Land and Resource, the county DRC, the bureau of Housing and Construction, the EPB, the Political Consultative Conference, and the county People's Congress, etc.			

Source: The EIA Report

Table VII-8: Results for 1st Round of Questionnaire Survey (Wuding Road Component)

No.	Question	Option	No. of Consulted APs (60 in Total)	Percentage (%)	No. of Consulted Organizations (23 in Total)	Percentage (%)
1	Do you know the project component?	Yes	57	95.0	22	95.7
		No	3	5.0	1	4.3
2	Whether the project is beneficial to local social and economic	Very favorable	58	96.7	23	100.0
		Favorable	2	3.3	0	0
		Not conducive	0	0	0	0

No.	Question	Option	No. of Consulted APs (60 in Total)	Percentage (%)	No. of Consulted Organizations (23 in Total)	Percentage (%)
	development?	Do not know	0	0	0	0
3	What do you think about the noise and vibration impact levels during construction?	Significant impact	1	1.7	0	0
		Moderate impact	20	33.3	5	21.7
		Limited impact	39	65.0	17	74.0
		Do not know	0	0	1	4.3
4	What do you think about the air pollution impact level during construction?	Significant impact	2	3.3	1	4.3
		Moderate impact	11	18.3	4	17.4
		Limited impact	47	78.4	18	78.3
		Do not know	0	0	0	0
5	What do you think about the air pollution impact level during operation?	Significant impact	1	1.7	0	0
		Moderate impact	16	26.7	5	21.7
		Limited impact	43	71.6	17	74.0
		Do not know	0	0	1	4.3
6	What do you think about the motor vehicle emission impact level during project operation?	Significant impact	1	1.7	0	0
		Moderate impact	16	26.7	5	21.7
		Limited impact	42	70.0	17	74.0
		Do not know	1	1.6	1	4.3
7	What do you think about the water pollution impact level during project operation?	Significant impact	1	1.7	0	0
		Moderate impact	14	23.3	3	13.0
		Limited impact	45	75.0	19	82.7
		Do not know	0	0	1	4.3
8	What do you think about the impact on the surrounding ecological environment during project operation?	Significant impact	1	1.7	0	0
		Moderate impact	16	26.7	4	17.4
		Limited impact	43	71.6	18	78.3
		Do not know	0	0	1	4.3
9	What do you think about the traffic noise impact during project operation?	Significant impact	1	1.7	0	0
		Moderate impact	11	18.3	5	21.7
		Limited impact	48	80.0	17	74.0
		Do not know	0	0	1	4.3
10	What are the most effective mitigation measures for mitigating traffic noise?	Sound insulated window	36	60.0	8	34.8
		Sound barrier	34	56.7	5	21.7
		Green belt	48	80.0	19	82.7
		Financial compensation	28	46.7	3	13.0
		Move out	1	1.7	0	0
		Change the use function of the first row buildings	2	3.3	4	17.4
		No action required	0	0	0	0
11	What is your attitude towards the project?	Support	60	100.0	23	100.0
		Indifference	0	0	0	0
		Not support	0	0	0	0

Source: the EIA report of Wuding Component

Table VII-9: Results of 1st Road of Questionnaire Survey for Wulong River Rehabilitation and Flood Control Components in Wuding County

No.	Question	Option	No. of Respondents (65 APs in total)	Percentage (%)	No. of Respondents (20 Organizations in total)	Percentage (%)
1	Do you know the project component?	Yes	62	95.38	19	95.00
		No	3	4.62	1	5.00
2	Whether the project is beneficial to local environment?	Very favorable	56	86.15	17	85.00
		Favorable	9	13.85	2	10.00
		Not conducive	0	0.00	0	0.00
		Do not know	0	0.00	1	5.00
3	What's the most positive effect/benefit after the project completion?	Water environment	46	70.77	17	85.00
		Ambient air	20	30.77	3	15.00
		Vegetation	9	13.85	3	15.00
		Groundwater	11	16.92	0	0.00
		Landscape	19	29.23	9	45.00
		Residents' living condition	18	27.69	6	30.00
4	Whether the project is beneficial to local social and economic development?	Very favorable	52	80.00	19	95.00
		Favorable	10	15.38	1	5.00
		Not conducive	0	0.00	0	0.00
		Do not know	3	4.62	0	0.00
5	What is the major environmental concern during the project construction?	Ambient air	14	21.54	8	40.00
		Water	32	49.23	9	45.00
		Solid wastes	21	32.31	9	45.00
		Noise	29	44.62	10	50.00
		Others	2	3.08	2	10.00
6	What do you think about the noise and vibration impact levels during construction?	Significant impact	17	26.15	2	10.00
		Moderate impact	25	38.46	8	40.00
		Limited impact	23	35.38	8	40.00
		Do not know	0	0.00	2	10.00
7	What do you think about the air pollution impact level during construction?	Significant impact	18	27.69	1	5.00
		Moderate impact	27	41.54	8	40.00
		Limited impact	20	30.77	11	55.00
		Do not know	0	0.00	0	0.00
8	What do you think about the surface water pollution level during construction?	Significant impact	11	16.92	0	0.00
		Moderate impact	28	43.08	7	35.00
		Limited impact	23	35.38	11	55.00
		Do not know	3	4.62	2	10.00
9	What do you think about the impact on the surrounding ecological environment during project operation?	Significant impact	10	15.38	0	0.00
		Moderate impact	28	43.08	8	40.00
		Limited impact	24	36.92	11	55.00
		Do not know	3	4.62	1	5.00
10	After the project completion, the local water environment will be:	Improved	58	89.23	19	95.00
		No Change	7	10.77	0	0.00
		Degraded	0	0.00	0	0.00
		Do not know	0	0.00	1	5.00
11	After the project	Improved	60	92.31	19	95.00

No.	Question	Option	No. of Respondents (65 APs in total)	Percentage (%)	No. of Respondents (20 Organizations in total)	Percentage (%)
	completion, the river bank landscape and river environment will be:	No Change	5	7.69	0	0.00
		Degraded	0	0.00	0	0.00
		Do not know	0	0.00	1	5.00
12	What is your attitude towards the project?	Support	65	100.00	20	100.00
		Not support	0	0.00	0	0.00
		Indifference	0	0.00	0	0.00

Source: The EIA Report of Wuding Component

348. **Consultation result of the Wuding infrastructure component:** Based on **Table VII-8**, 100% of the respondents support the project, and 100% of the respondents believe that the project will bring convenience to the residents, improve their living standard significantly, promote local social and economic development, and speed up Wuding's sustainable urbanization. The main issues raised, and wishes expressed, by the respondents include: (i) increase green landscaping area along with the proposed roads; (ii) resettlement and related compensation; (iii) timely removal and disposal of construction wastes; (iv) pedestrian and bicycle travel safety during both construction and operation; (v) noise and dust control, traffic congestion during construction; (vi) QA/QC of the project construction; and (vii) noise control during operation.

349. The suggestions provided by the respondents include: (i) avoiding the construction activities at nighttime to minimize noise; (ii) sound construction planning should be conducted to avoid repeated excavation of underground pipelines; (iii) undertaking water spraying to minimize dust generated by construction activities; (iv) timely disposal of construction waste with necessary covering; and (v) protecting and improving vegetation along roads to reduce noise during road operation, and (vi) taking measures to avoid river pollution during bridge construction. All these considerations and comments have been included as mitigation and management measures in the updated FSR and the EIA.

350. **Consultation result of the Wuding river rehabilitation and flood control component:** As indicated in **Table VII-9**, 100% of the consulted APs and organizations support the project, and 100% of the consulted APs and organizations believe that local social-economic development, local environment, in particular the surface water quality, and residents' living standard will be improved. The main issues raised by the public include: (i) environmentally friendly river rehabilitation; (ii) flood control and safety of residents' life and property; (iii) resettlement and related compensation; (iv) riverside landscaping and aesthetic effect; (v) noise and dust control during construction; (vi) waste disposal during construction; (vii) quality control of the river banking construction; and (viii) river maintenance after project completion.

351. The suggestions provided by the consulted APs and organizations included: (i) avoiding construction activities at nighttime to minimize noise and to guarantee residents' safety; (ii) proper measures should be conducted to avoid pollution and impact on the upstream reservoir, which is a major drinking water source for the city; (iii) undertaking water spraying to minimize dust; (iv) timely disposal of construction waste with necessary covering; and (v) protecting existing trees and vegetation along the river and aquatic fauna. All these comments have been included as mitigation and management measures in the updated FSR and in the EMP.

(d) Municipal and Environmental Services Component in Lufeng County

352. On 15 May 2013, a total of eighty (80) questionnaires were distributed in two separated symposiums by the EIA Institute to sixty (60) APs and twenty (20) project-related local organizations/units, and 100% of the questionnaires were completed and returned. The

consulted local organizations included village committees, community residential committees, companies and government departments; and the consulted APs included people from different age groups, gender, ethnicity and occupation (**Table VII-10**). The consultation results are shown in **Table VII-11**.

Table VII-10: Respondents of 1st Round of Questionnaire Survey in Lufeng

Basic Information of APs Surveyed			No. of Respondents	Percentage (%)
60 consulted APs	Gender Distribution	Male	42	70.0
		Female	18	30.0
	Age Group	<25	4	6.7
		26-44	31	51.7
		≥45	25	41.7
	Occupation	Civil servant and cadre	1	1.7
		Worker	3	5.0
		Farmer	54	90.0
		Teacher and engineer	0	0
		Self-employed individual and others	2	3.3
20 consulted organizations	1) Lufeng Women's Federation, 2) Local Chronicles Compilation Committee, 3) Lufeng Youth League Committee; and 4) representatives from 17 organizations and government departments including the Social Security Administration, the Lufeng Water Conservation Bureau, the Bureau of Land and Resource, the County DRC, the County Bureau of Housing and Construction, the EPB, the local Political Consultative Conference, and the County People's Congress, etc.			

Source: The EIA Report of Lufeng Component

353. Based on the results shown in the **Table VII-11**, 100% of the respondents support the project, and they believe that the project will bring convenience to the local residents, improve their living condition significantly, and the project will promote the local social-economic development, and speed up Lufeng's sustainable urbanization. The main issues raised by the respondents include: (i) increasing green landscaping area along both the proposed roads and river; (ii) trying best to reduce land occupation and resettlement and providing reasonable compensation; (iii) timely removal and disposal of construction wastes and rubbish from construction worker's camps; (iv) noise and dust control during construction; (v) pedestrian safety and traffic congestion during both construction and operation; (vi) QA/QC of the project construction; and (vii) traffic noise and motor vehicle emission control during operation.

354. The suggestions provided by the consulted APs and organizations included: (i) balancing the road and river construction and environmental protection and landscaping; (ii) avoiding construction activities at nighttime to minimize noise; (ii) guaranteeing middle school and primary school students' health and safety during construction; (iii) proper planning to avoid repeated excavation of underground pipelines; (iv) undertaking water spraying to minimize dust; (v) timely disposal of construction waste with necessary covering; (vi) protecting existing vegetation along the roads to reduce the noise during operation, and (vii) take measures to avoid river pollution during bridge construction. All these considerations have been included as mitigation and management measures in the updated FSR and the EIA.

Table VII-11: Results for 1st Round of Questionnaire Survey (Lufeng Component)

No.	Question	Option	No. of Consulted Aps	Percentage (%)	No. of Consulted Organizations	Percentage (%)
1	Do you know the project component?	Yes	53	88.3	20	100.0
		No	7	11.7	0	0
2	Whether the project is beneficial to local social and	Very favorable	47	78.3	20.0	100.0
		Favorable	12	20.0	0	0

No.	Question	Option	No. of Consulted Aps	Percentage (%)	No. of Consulted Organizations	Percentage (%)
	economic development?	Not conducive	0	0	0	0
		Do not know	1	1.7	0	0
3	What do you think about the noise and vibration impact levels during construction?	Significant impact	2	3.3	12	60.0
		Moderate impact	37	61.7	8	40.0
		Limited impact	19	31.7	0	0
		Do not know	2	3.3	0	0
4	What do you think about the air pollution impact level during construction?	Significant impact	9	15.0	0	0
		Moderate impact	27	45.0	11	55.0
		Limited impact	12	20.0	9	45.0
		Do not know	2	3.3	0	0
5	What do you think about the surface water pollution impact during construction?	Significant impact	4	6.7	0	0
		Moderate impact	36	60.0	2	10.0
		Limited impact	18	30.0	16	80.0
		Do not know	2	3.3	2	10.0
6	What do you think about the motor vehicle emission impact level during project operation?	Significant impact	2	3.3	0	0
		Moderate impact	25	41.7	5	25.0
		Limited impact	30	50.0	15	75.0
		Do not know	3	5.0	0	0
7	What do you think about the water pollution impact level during project operation?	Significant impact	0	0	0	0
		Moderate impact	28	46.7	3	15.0
		Limited impact	30	50.0	15	75.0
		Do not know	2	3.3	2	10.0
8	What do you think about the impact on the surrounding ecological environment during project operation?	Significant impact	0	0	0	0
		Moderate impact	25	41.7	5	25.0
		Limited impact	34	56.7	15	75.0
		Do not know	1	1.7	0	0
9	What do you think about the traffic noise impact during project operation?	Significant impact	1	1.7	0	0
		Moderate impact	27	45.0	6	30.0
		Limited impact	31	51.7	14	70.0
		Do not know	1	1.7	0	0
10	What's the most effective mitigation measure for mitigating traffic noise during project operation?	Sound insulation window	1	1.7	4	20.0
		Sound barrier	1	1.7	10	50.0
		Green belt	53	88.3	18	90.0
		Financial compensation	6	10.0	2	10.0
		Move out	2	3.3	1	5.0
		Change the use function of the first row buildings	3	5.0	4	20.0
		No action required	0	0	0	0
11	What is your attitude towards the project?	Support	60	100.0	20	100
		Indifference	0	0	0	0
		Not support	0	0	0	0

Source: the EIA report of Lufeng Component

D. Second Round of Consultation

355. The second round of public consultation activities were mainly consultation meetings and questionnaires surveys in the meetings. The consultation meetings were undertaken by the

EIA Institute together with the project team in the three project city/counties from 25-27 July 2012, to communicate on the preliminary findings from the draft FSRs and domestic EIAs and the additional findings of the PPTA consultant, and to receive additional public feedback. The results of the consultation were also used in the design of the GRM, which aimed at ensuring that the APs are aware of the existence of the GRM process for the implementation of the project components and agree with its structure. The meetings were also used to present the main anticipated impacts and the proposed mitigation measures as defined in the draft FSRs and the EIAs. The second round of consultation in the three project sites are summarized in **Table VII-12** and shown in **Figure VII-2** and **Figure VII-3** below.

Figure VII-2: 2nd Consultation Meeting in Chuxiong City

Figure VII-3: 2nd Consultation Meeting in Wuding County

356. **Results of the second round of public consultation:** 100% of the APs and stakeholders support the project. They believe the project will significantly improve the local social, economic and ecological environment, and improve the residents' living condition. Moreover, with more available detailed information of the project scale and locations, the APs and stakeholders were able to comment on specific issues, which are listed below:

i) Most of the APs are concerned about the proper LAR plans and reasonable compensation rates, and the plans should be made available to the public and the compensation rates should be transparent;

ii) Some APs expressed their concern about the possibility of surface water (both rivers and ponds) pollution caused by construction activities of river rehabilitation and flood control, bridges and roads nearby the rivers;

iii) People support the concept of reusing stormwater runoff for roadside green belt irrigation;

iv) Most of the APs who will benefit from the solid waste collection and disposal component were concerned about the tariff for waste collection and treatment (APs agree to pay for waste collection and disposal, but hope the tariff will remain affordable); and

Figure VII-4: Consultation Meeting in Lufeng County

v) Most of the residents who will be affected by road construction expressed their concern regarding resettlement and hoped that their future living condition would be improved (these concerns have been considered in the LAR plans).

Table VII-12: Summary of 2nd Round of Public Consultation

Project City/County	No. of Participants	Gender	Nationality	Education	Occupation	Support the Project	Indifference	Not Support the Project
Chuxiong City	26	• Male (21) • Female (5)	• Han (14) • Yi (8) • Hui (2) • Dai (2)	• College and above (10) • Vocational school and senior high school (9) • Junior High school (7) • Primary school (0)	• Civil servant and cadre (15) • Worker (1) • Farmer (9) • Teacher and engineer (0) • Self-employed individual (0) • Student (0) • Others (1)	26 (100%)	0	0
Wuding County	32	• Male (28) • Female (4)	• Han (25) • Yi (3) • Lisu (2) • Hui (1) • Dai (1)	• College and above (10) • Vocational school and senior high school (12) • Junior High school (9) • Primary school (1)	• Civil servant and cadre (17) • Worker (0) • Farmer (12) • Teacher and engineer (0) • Self-employed individual (2) • Student (0) • Others (1)	32 (100%)	0	0
Lufeng County	43	• Male (27) • Female (16)	• Han (33) • Yi (7) • Hui (2) • Dai (1)	• College and above (13) • Vocational school and senior high school (29) • Junior High school (1) • Primary school (0)	• Civil servant and cadre (33) • Worker (0) • Farmer (6) • Teacher and engineer (0) • Self-employed individual (0) • Student (0) • Others (4)	43 (100%)	0	0

Source: the EIA Reports

357. During the public consultations, the majority of the participants indicated that if all the mitigation measures proposed in EMP are strictly carried out and supervised by qualified personnel and institutes during the construction and operation phases, they would be satisfied.

358. After the public consultations, all the concerns and suggestions were summarized and provided to the design institute and the EIA institute. In turn, these concerns and suggestions, as well as corresponding mitigation measures, have been fully taken into account and incorporated in the latest FSR, the EIAs and this project EIA.

E. Future Consultation

359. Dialog will be maintained with the APs and stakeholders throughout project implementation by continued meaningful public consultation. Such dialog will ensure that public concerns are understood and dealt with in a timely manner. A consultation and participation plan during construction and operation has been developed, which is presented in the attached EMP. Future consultation will be undertaken via questionnaire surveys, household visits, workshops, and public consultation meetings.

360. Future consultation and participation will also include involvement of APs during inspection of EMP implementation during the construction and operation phases (through informal interviews by LIEC and EEM).

VIII. GRIEVANCE REDRESS MECHANISM (GRM)

A. Introduction

361. In consultation with the CSPMO, the IAs and the PIUs, it was agreed that each IA (through their LPMO) will establish a grievance redress mechanism (GRM) to address community concerns and complaints. Grievances will most likely include disturbance of traffic; dust emissions; construction noise; soil erosion; inappropriate disposal of waste materials; damage to private houses; safety measures for the protection of the general public and construction workers; or water quality deterioration during riverbank works. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project components; (ii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations; (iii) improve mutual trust and respect and promote productive relationships with local communities and other stakeholders; and (iv) build community acceptance for the project.

362. The GRM will be accessible to diverse members of the community and stakeholders. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available.

363. Each LPMO will establish a Project Public Complaint Unit (PPCU), which will be coordinated by the environment management unit (EMU) of the LPMO. The PPCUs will instruct contractors and CSCs if people complain about the project. The PPCUs will coordinate with the local EPBs and other government divisions, if necessary, and will be supported by the Loan Implementation Environmental Consultant (LIEC), hired under the Project Implementation Consultant Support (PIC). The PPCU will establish a GRM tracking and documentation system, including procedures to retrieve data for reporting purposes to the CSPMO and ADB.

364. The contact persons for different GRM entry points, such as contractor, operators of project facilities (OPFs), local EPB, PPCU, etc., will be identified prior to construction. The contact details for the entry points (phone numbers, addresses, e-mail addresses) will be publicly disclosed on information boards at construction sites and on the website of the local EPBs. The chart of proposed GRM is shown in **Figure VIII-1.**

365. Once a complaint is received and filed, the PPCU will identify if complaints are eligible. Eligible complaints include those where (i) the complaint pertains to the project; and (ii) the issues arising in the complaint fall within the scope of environmental issues that the GRM is authorized to address. Ineligible complaints include those where: (i) the complaint is clearly not project-related; (ii) the nature of the issue is outside the mandate of the environmental GRM (such as issues related to resettlement, allegations of fraud or corruption); and (iii) other procedures are more appropriate to address the issue. Complaints illegible to the project or the environmental GRM will be recorded and passed onto relevant authorities. If an eligible complaint is rejected, the complainant will be informed of the decision and the reasons for rejection.

B. Step-by-Step GRM Procured

366. The **procedure and timeframe** for the grievance redress mechanism are described as follows (see **Figure VIII-1**):

- **Stage 1**: If a concern arises during construction, the affected person will submit a written or oral complaint to the contractor directly. Whenever possible, the contractor will

resolve the issue directly with the AP. The contractor shall give a clear reply within five (5) days. If successful, the contractor will inform the PPCU accordingly.

- **Stage 2**: If no appropriate solution can be found after the Stage 1 process applied (i.e., after 5 days), the contractor has the obligation to forward the complaint to the PPCU. The AP may also decide to submit a written or oral complaint to the PPCU, either directly or via one of the GRM entry points (local EPB, PIU, community leaders). For an oral complaint, proper written records must be made. The PPCU will assess the eligibility of the complaint, identify the solution and provide a clear reply for the complainant within five (5) working days. The LIEC will assist the PPCU in replying to the affected person, if needed. The PPCU will also inform the ADB project manager and submit all relevant documents. Meanwhile, the PPCU will timely convey the complaint/grievance and suggested solution to the contractors or OPFs. The contractors during construction and the OPFs during operation will implement the agreed upon redress solution and report the outcome to the PPCU within seven (7) working days.
- **Stage 3**: In case no solution can be identified by the PPCU, or the complainant is not satisfied with the proposed solution, the PPCU will organize, within two (2) weeks, a multi-stakeholder hearing (meeting) involving all relevant stakeholders (including the complainant, contractor, OPFs, local EPB, PIU, LPMO, CSPMO). The hearing shall identify a solution acceptable to all, and formulate an action plan. The contractors during construction and the OPFs during operation will implement the agreed-upon redress solution and report the outcome to the PPCU within the agreed upon timeframe.

367. The PPCU shall accept the complaints/grievances lodged by the AP free of charge. Any cost incurred should be covered by the contingency of the project. The grievance procedures will remain valid throughout the duration of project construction and until project closure.

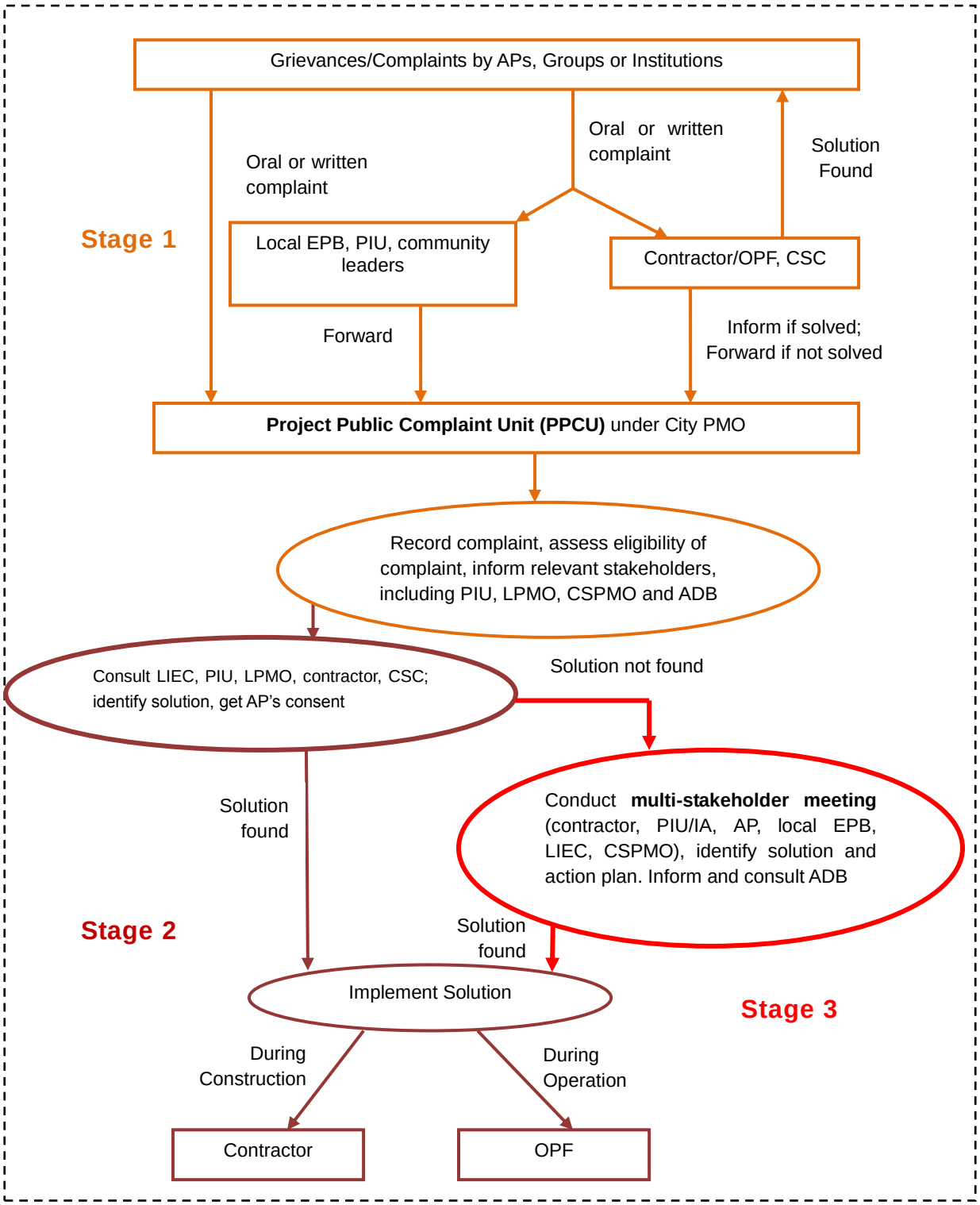


Figure VIII-1: Proposed GRM

Note: AP = affected person, EPB = environmental protection bureau, OPF = operator of project facilities, LIEC = loan implementation environmental consultant; CSPMO = Chuxiong Prefecture project management office; PIU=project implementation unit; CSC=construction supervision company.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

368. An environmental management plan (EMP) has been prepared for the project, which is presented in **Appendix I** of this project EIA. The development of the EMP drew on the four domestic EIA reports prepared by the EIA Institute, discussions with the CSPMO, the LPMOs and IAs of the project city/counties, and consultations with the Yunnan Provincial EPD and the local EPBs, as well as other relevant government divisions and local communities.

369. The EMP defines appropriate mitigation measures for the anticipated environmental impacts, and defines the institutional responsibilities and mechanisms to monitor and ensure the compliance with PRC's environmental laws, standards and regulations, and ADB's Safeguard Policy Statement (SPS 2009). The EMP specifies (i) objectives; (ii) mitigation measures; (iii) implementing organization and responsibilities; (iv) inspection, monitoring, and reporting arrangements; (v) training and institutional strengthening; (v) a feedback and adjustment mechanism; and (vi) the grievance redress mechanism. The EMP will be reviewed and updated at the end of the detailed designs, as needed.

B. Organizations and Their Responsibilities for EMP Implementation

370. The Chuxiong Yi Minority Autonomous State Government (CSG) is the executive agency (EA) of the project. The EA is responsible for communication with ADB, loan on-lending and repayment, as well as supervision and guidance of the CSPMO, LPMOs and the Project Implementation Units (PIUs) in three project city/counties during the project implementation.

371. At the state-level, CSG has established the Chuxiong State Project Leading Group (CSPLG) to provide policy guidance and coordination, and (ii) Chuxiong State Project Management Office (CSPMO) to supervise and coordinate overall project implementation. The three participating city/county governments will be the implementing agencies (IAs), and they have already established local project management offices (LPMOs) to supervise and coordinate overall implementation of subprojects in their respective cities. Three project implementing units (PIUs) will physically implement the subprojects on behalf of respective IAs. The EMP implementation arrangements and responsibilities of governmental organizations are summarized in **Table IX-1**.

Table IX-1: Institutional responsibilities for EMP implementation

Project implementation organizations	Environmental Management Roles and Responsibilities
Executing Agency (EA) – Chuxiong Yi Minority Autonomous State Government (CSG)	*Overall policy and direction control. Responsible for project coordination with three project city/town's government, liaison with ADB, financial management and administration.*
Chuxiong State Project Leading Group (CSPLG)	*Responsible for implementation of the entire project. Headed by the Vice Mayor and consists of DRC, FB, EPB, HURDB, TB, LRB, and PB:* • Coordinate and overlook project preparation and implementation; • Provide policy guidance during implementation; • Facilitate interagency coordination and coordination.

Project implementation organizations	Environmental Management Roles and Responsibilities
ADB Chuxiong State Project Management Office (CSPMO)	*Supervision and overall management to ensure smooth implementation of the Project:* • Responsible for all day-to-day management work during the project preparation and implementation period; • Assign one environment specialist as EMP coordinator; • Communicate and coordinate with ADB for project management and implementation; report the project implementation progress and compliance monitoring to ADB; • Submit bidding documents, bid evaluation reports and other necessary documentations to ADB for necessary approval • Engage project management consulting service • Procurement of project implementation consultant services (PIC), including loan implementation environmental consultant (LIEC) to assist in supervision, tracking and reporting on EMP implementation of all subprojects; • Procurement of external environment monitor (EEM); • Packaging of environmental monitoring reports prepared by the LPMOs and submission of them to ADB;
Implementing Agencies (IAs) - Governments of Chuxiong Municipality, Lufeng County, and Wuding County	*Primarily responsible for project implementation for project components in their jurisdiction, including finance and administration, technical and procurement matters, monitoring and evaluation, and safeguard compliance. Day-to-day activities delegated to LPMOs (see below)*
Local Project Leading Groups (LPLGs)	• *Coordinate and overlook project preparation and implementation:* • *Provide policy guidance during implementation:* • *Facilitate interagency coordination and coordination.*
Local Project Management Offices (LPMOs), established under IAs	*Responsible for all day-to-day management work during the project preparation and implementation period.* • Communicate and coordinate with CSPMO for project management and implementation; • Establish environment management unit (EMU); • In conjunction with PIUs, incorporation of EMP into bidding documents; • Establishment of a Grievance Redress Mechanism (GRM) with a dedicated Project Complaints Coordinating Unit (PCCU). • Supervision and monitoring of the EMP implementation and semi-annual reporting to the CSPMO (with support of LIEC); • Participation in capacity building and training programs;
Project Implementing Units (PIU) - Chuxiong Development and Investment Company Limited (CDIC) - Lufeng Urban Construction and Investment Company (LUCIC) - Wuding Urban Construction and Investment Company (WUCIC)	*Ensuring successful implementation of the relevant subproject components* • Appoint one environment specialist as EMP coordinator; • Tendering contractors and equipment with assistance of the international tendering agency; • Administer and monitor contractors and suppliers; • Construction supervision and quality control • Contracting of local environment monitoring stations (EMS) to conduct environment impact monitoring; • Procurement and management of construction supervision companies (CSC) required for subproject implementation in accordance with People's Republic of China (PRC) and ADB procedures and regulations; • Participation in capacity building and training programs; • Commissioning of the constructed facilities.

Project implementation organizations	Environmental Management Roles and Responsibilities
Facility Operators - Water Resource Bureaus; - Urban Management Bureaus; - Transport Management Bureaus; - Traffic Police.	*Ensuring successful ongoing operation and maintenance of the relevant subproject components:* • In conjunction with PIUs, commissioning of the constructed facilities • O&M of completed facilities, including environmental management, monitoring and reporting responsibilities.

372. The LPMOs will have main EMP coordination responsibility. Therefore, each LPMO will establish an environmental management unit (EMU) and designate a leader and an appropriate number of staff to coordinate environmental issues associated with each component, subcomponent and contract package. The EMUs will be technically supported by the loan implementation environment consultants (LIECs), hired under the project implementation consultant services (PIC). The LIEC will advise the CSPMO, LPMOs, PIUs, contractors and CSCs on all aspects of environmental management and monitoring for the project. The CSPMO and the PIUs will nominate one staff to act as environmental coordinator to check the overall implementation of environmental management provisions of the EMP.

373. The successful bidders for the individual contracts will be required to submit site-specific environmental management plans to further detail and commit contractors to the stipulations of the EMP. To meet this end, contractors are requested to employ an Environmental Specialist to prepare the site-specific EMPs and to submit that expertise to the overseeing authorities. This specialist will also prepare, on behalf of the Contractor, regular environmental monitoring and EMP compliance reports to be submitted to the city PMOs and PIUs. The contractors may contract local environmental monitoring stations (EMS) to conduct internal environment impact monitoring during construction.

374. The IAs will appoint the local environment monitoring stations (EMS) of each project city/county to conduct periodic environmental impact monitoring during construction and operation in accordance with the environmental impact monitoring plan (**Table EMP-7** and **Table EMP-8**). In addition, the EA will engage an independent, external environment monitor EEM) to examine and verify the project's environmental performance, to comply with ADB's SPS 2009 requirement for category A projects.

375. The full EMP is presented in **Appendix I**.

X. CONCLUSION

A. Project benefits

376. **Poverty reduction and gender benefits.** The project will bring significant benefits directly to about 410,000[46] urban residents in Chuxiong, Wuding and Lufeng, by improving urban infrastructures, enhancing urban rivers and flood control, and improving urban sanitation facilities. Of the total direct beneficiary population, approximately 51.2% are women, 9.5% are poor living under the urban poverty line of less than CNY 246 per capita per month[47], and 33.1% are ethnic minorities in the project areas. It is anticipated that the project will create 3,558 jobs during construction (365 skilled management, 755 skilled labor and 2,447 unskilled) and 306 positions during operation. Targets for employment of women, ethnic minorities and the poor are included in the social action plan (SAP), gender action plan (GAP) and design and monitoring framework. Improved access to wastewater connection and sanitation, solid waste management, public transport and traffic safety will have positive benefits for public health. The project is designed to meet the criteria for effective gender mainstreaming category. Results from the household survey and focus group discussions indicated that women are the primary users of public transport, sidewalks and non-motorized access and consider traffic safety design and awareness and improved public transport access as important benefits of the project. Improved solid waste management, and creation of recreational areas adjacent to the rivers are also all indicated by women to be particularly beneficial. The project will significantly improve their access to social services, and provide new employment and income opportunities.

377. **Technical feasibility.** The project technical designs are based on locally proven reliable designs as well as relevant PRC engineering guidelines and local regulations. Technical feasibility was found to be adequate after detailed examination of the project's compatibility with local conditions including required level of flood protection, protection of ecological features, projections of traffic demand and solid waste generation, and function of roads. Alternative technical options identified the preferred river embankment design; cross-section, alignment and surface material of roads. The project will provide training under its capacity development component to ensure sustainable O&M of project facilities.

378. **Environmentally sound flood management and river enhancement**. For three flood management subprojects, ecologically-friendly design has been incorporated where possible. The engineering works on natural river bank as well as river course have been minimized. Vertical retaining walls were avoided and an alternative structure with cascaded precast concrete blocks will be used to enhance its ecological value while ensuring high level flood protection. Public paths beside the river course ensure people's access to the water front. Based on the detailed assessment on existing and planned flood early warning system in three cities, additional investments were agreed to further strengthen the non-structural measures for flood management.

379. **Innovative stormwater management.** The subprojects in Lufeng and Wuding adopt urban stormwater management systems including detention ponds consisting of three small ponds with different functions to detain urban stormwater, thus reducing peak flows downstream, and intercepting pollutants typically present in the first flush. In Chuxiong, a more decentralized stormwater collection and storage system will be introduced for selected roads. The kerbside stormwater collection and storage system will reduce the direct discharge of runoff to the surface water bodies, and will be reused as irrigation water for roadside landscaping.

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[46] Source: PPTA social consultant's report.

[47] In 2012 price.

380. **Sewage interception from existing residential areas**. In three cities, the public sewer service coverage is still limited and a number of existing residential areas surrounding the project area remain without access to proper sanitation. The proposed new sewer piping network in the new urban areas will be extended to reach the existing residential areas in three cities so that a portion of the domestic sewage in the areas can be collected and sent to the wastewater treatment plant.

381. **Stormwater reuse for road components**. All three project city/towns are located in the subtropical climate zone with concentrated rainfalls during summers. Currently, the urban runoff is collected through the scuppers and stormwater piping network and discharged into the nearby rivers directly.

382. **Transport safety and public transport**. The project will include an ITS traffic management and traffic control subcomponent to help improving the traffic condition and safety in the existing urban areas. The subcomponent will include a traffic monitoring system, a red light and speeding violation monitoring system and real time traffic condition displays. Meanwhile, the road components include the provision of bus stops and non-motorized lanes to provide different modes of transport to the local people.

383. **Climate change mitigation and adaptation.** Chuxiong Prefecture is vulnerable to climate change, as evidenced by the continuous severe drought from 2010 to 2013. Project initiatives in both climate change mitigation and adaptation will introduce approaches and activities to enhance the cities' resilience to climatic changes, and to reduce carbon emissions (mainly through promotion of low carbon public transportation systems and energy saving through improved road network conditions, etc.). Adaptation strategies for possible future climatic changes (including greater risk of floods and droughts) have been considered, including (but not limited to) the development of early flood warning flood emergency response planning systems.

384. The project will have some greenhouse gas emission control functions, mainly through the following major interventions: (i) promoting public transportation and bicycle travel (low carbon transportation modes) following the PRC programs on vehicle emissions, clean fuel regulations, and public transport priority policy to maximize the benefits; and (ii) the application of LED lights, which is expected to save 2.33 million KWh per year of electricity, resulting in a CO_2 emission reduction of 2,260 t/a[48] as compared to conventional street lighting.

385. During the feasibility study and the PPTA phase, the potential impacts due to increase of extreme weather events such as rainstorms or drought were considered, including the design specifications for high-capacity stormwater-sewer separated drainage pipeline (with a flood protection standard of once in 20 years), ecological river restoration with high vegetation cover along the river banks and avoidance of water impoundment structures (such as weirs), to minimize evaporation. In addition, proposed roads in project cities were partly re-aligned to avoid areas with high erosion potential and surface water bodies. The three flood control sub-components will significantly increase the cities' resilience to floods. Consequently, damages of flood to houses, facilities and goods, as well as farmlands and crops, will be prevented and/or mitigated.

B. Environmental Impacts and Mitigation Measures

386. During the preparation of the domestic FSRs, the EIAs and this project EIA, potential environmental impacts were carefully assessed and addressed. All components have undergone the EIA process under the PRC laws and regulations. The four EIA Reports were prepared by the EIA Institute, reviewed by the expert panels, and approved by Yunnan Provincial EPD.

[48] A KWh electricity saving reduces 0.997 kg of CO_2.

387. Major safeguards issues during construction include river embankment works with significant earthwork and soil erosion; permanent and temporary acquisition of land and residents resettlement, noise pollution, air pollution, surface water pollution, inadequate construction waste management, and occupational and community health and safety. During river embankment works, soil may be released into the water body that may cause a decline in water quality and affect aquatic fauna. In order to reduce this impact, the site-specific selection of construction methods will be formulated to mitigate the negative effects.

388. The main potential adverse impacts during operation of the project facilities include traffic noise and air pollution at some sensitive areas along the constructed roads including schools, hospitals, and residential areas. Noise and air quality predictions indicate that they will have minimal impact on these media, even in the long term. The inadequate management of stormwater, wastewater and solid waste could lead to surface water pollution. The improved rivers will require maintenance dredging from time to time. However, such activities will be short term, infrequent (about once every three years), and will not cause significant impacts. Other negative environmental impacts and risks during operation include traffic safety caused by over speed, and potential accidental spills caused by hazardous goods transportation on the bridges and/or nearby the rivers.

389. Some of the major potential impacts could be avoided through improved project design. The components' scope, the project sites, construction methods, road alignments and pipeline routes were adjusted to minimize land acquisition, resettlement and earthwork, and avoid impacts on local water bodies. Main adjustments to reduce the unbalanced earthwork included the re-alignment of roads away from potentially unstable areas with high erosion potential and environmentally sensitive area, such as a natural pond with an area of 15 ha in Chuxiong City. Through policy dialog, the scope of the river rehabilitation works in Chuxiong City could be significantly reduced. Section 1 of the project river will be preserved as it is, with only minor and very localized interventions where excessive bank erosion is observed. The local community will be contracted to support river enhancement works in this section. Land acquisition, tree cutting and river bed dredging works will be avoided.

390. Environmental health and safety considerations combined occupational health and safety of staff/workers at the subcomponent construction sites and facilities, and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities. These considerations include (i) a risk assessment of spillages of transported substances into rivers and emergency response plan; (ii) appropriate alignment of roads away from geologically hazardous areas; (iii) the requirement for contractors to develop and implement environment, health and safety management plans; and (iv) the provision of capacity building support to develop and implement flood early warning and emergency preparedness and response systems for the cities.

391. Mitigation measures and a monitoring program were defined for all identified impacts, and are included in the EMP of the project EIA. The EMP sets out the procedures and plans to carry out mitigation measures and monitoring during sequential stages of the project including pre-construction, construction and operation. It consists of two major plans, one for implementing mitigation measures and the other for conduct environmental monitoring. For each impact, appropriate mitigation measures are described. Internal, external and compliance monitoring and supervision will be undertaken to ensure that environmental impacts will be minimized to acceptable levels.

C. Project Risks and Assurances

392. Project risks were assessed during the PPTA. The majority of environmental risks relate to design features and operational plans, which will avoid or mitigate impacts but rely on the commitment and capacity to implement and consistently follow-up of the CSPMO, the LPMOs, PIUs, construction supervision companies (CSCs), and contractors. The remaining relate to the

likelihood of unexpected negative impacts. More specifically, the main project risks include: (i) low institutional capacity for environmental management and the possibility that the CSPMO, the PIUs, the LPMOs and contractors will fail to monitor the environmental impact and implement the EMP during the implementation of the project; (ii) unforeseen land acquisition and resettlement issues, which could constrain the efficient implementation of the project works and restoration of livelihoods of the APs; and (iii) inadequate construction site management, resulting in occupational and community health and safety concerns.

393. Measures have been identified to address the project risks: (i) appointment of project implementation consultancy services including LIEC and other experts in environmental management and monitoring, river rehabilitation, restoration and maintenance, stormwater pollution control, transport safety, and training/awareness raising; (ii) clear definition of roles and responsibilities for EMP implementation, performance indicators, and mechanisms for feedback and adjustment; (iii) a comprehensive capacity building and training component with strong focus on soil erosion, river system management and monitoring, EMP implementation and supervision, and urban transport and stormwater pollution control; and (iv) specific assurances from CSG.

394. **Tentative Project Assurances.** The following (tentative) assurances were agreed upon at LFF stage and will be acted upon by the respective levels of governments to ensure sound project design and effective implementation of the EMP:

- Prior to the commencement of construction of any subprojects, CSG shall ensure that the IAs and PIUs shall have (i) ensured that all the Project facilities are designed and constructed in accordance with the national engineering norm and technical standards of the Borrower and the specifications defined in the EMP; and (ii) ensured that construction supervision, quality control, and contract management shall be carried out in compliance with the laws and regulations of the Borrower.
- CSG will cause the IAs to cooperate with all relevant agencies to promote public transport and non-motorized transport (NMT) and traffic safety provisions for all roads and bridges constructed under the Project. CSG will cause the IAs to consider in detailed engineering design to include appropriately the provision of public transport and NMT, adequate traffic and safety signage, median separators, energy efficient street lights, drainage for storm water reuse, traffic control and other necessary facilities.
- CSG shall cause the IAs to ensure new sewage pipeline network will include sewage interception facilities and ensure untreated wastewater and storm water from surrounding Fumin village in Chuxiong, Dabeichang, Xiaobeichang and Shangying villages in Lufeng and Daxi and Xiaoxi villages in Wuding will be discharged into the sewage network and treated in the respective municipal wastewater facilities.
- CSG will cause the Lufeng and Wuding County Governments to ensure that an operation guideline and plans of the storm water retention pond management will be formulated and appropriate human and financial resources will be allocated to ensure that the storm water retention ponds will be fully functional. The storm water retention ponds will have adequate safety measures including warning signs and barriers to be provided in appropriate locations.
- CSG will cause the Chuxiong Municipal Government to ensure that the first section of the Chuxiong river rehabilitation component will be implemented by local people's participation to the community-level reforestation with special attention paid to women, the poor and ethnic minority.
- CSG will cause the Lufeng County Government to ensure: (i) the concept of river ecological rehabilitation and public access to water front adopted for ADB project will be applied to the domestic financed project for the West river; (ii) the intersections between the domestic financed project for the West river and the Project will be carefully designed so that two projects will be consistent in terms of engineering standard as well

as their appearance and (iii) design of public paths beside the river course is added under the river channel project financed by the Water Resources Bureau to ensure the continuity of the design.

- CSG shall through the IAs and PIUs ensure that the preparation, design, construction, implementation, operation and decommissioning of the Project, Subprojects and all Project facilities comply with (i) all applicable laws and regulations of the Borrower relating to environment, health and safety; (ii) the Environmental Safeguards; and (iii) all measures and requirements set forth in the EIA, the EMP, and any corrective or preventative actions (a) set forth in a Safeguards Monitoring Report, or (b) subsequently agreed between ADB and CSG. CSG shall cause the IAs and PIUs to incorporate such respective mitigation and monitoring measures into the design and bidding documents and construction contracts.
- CSG shall ensure, and cause the IAs to ensure, that (a) no artificial structures will be constructed to impound water restricting free flow of flood waters in the project rivers, and (b) no river sediment dredging is carried out unless a sediment management plan is developed, defining at a minimum sediment treatment, transport, disposal and reuse and shared with ADB, and disclosed to affected people by environmental safeguards. Furthermore, CSG will cause the IAs to ensure that spoil and dredged material generated in the course of implementation of the project is tested and disposed of in accordance with national and local laws and regulations, and that such disposal creates no significant risk of secondary pollution.
- CSG shall cause Chuxiong Water Resource Bureau to review and adjust the operating procedures of the Qingshanzui Reservoir to ensure that the Longchuan River receives a minimum flow at all times in accordance with the reservoir operating rule on minimum flow provision as defined in the reservoir EIA approved by the Ministry of Environmental Protection in 2005.
- CSG shall cause the IA's to implement the necessary noise mitigation measures along the project roads in according to the requirements specified in the EMP and applicable national environmental protection regulations.

D. Overall Conclusion

395. The EIA concludes that anticipated environmental impacts and risks can be mitigated to acceptable levels through the implementation of the environmental management plan (EMP). During construction, the focus will be on proper earthwork management, soil erosion and water resources protection, and sound construction site management. During operation, special attention will be paid to mitigating traffic noise at sensitive sites, and strengthening flood early warning, traffic safety, and solid waste management in Chuxiong, Lufeng and Wuding. CSG and the IAs are committed to manage identified environmental risks and agreed on a comprehensive set of environment-related loan covenants and a training program with a strong focus on environment safeguards. Environment safeguard documents were disclosed to the affected people. The project is feasible from an environment safeguards point of view.

Attachment 1 - Environmental Management Plan (DRAFT)

TABLE OF CONTENTS

A. Objectives

1. This Environmental Management Plan (EMP) was prepared by the environmental consultants of Asian Development Bank (ADB) Project Preparatory Technical Assistance (PPTA) 7891-PRC for the proposed **Yunnan Chuxiong Urban Environment Improvement Project** in conjunction with the domestic Environmental Impact Assessment (EIA) Institutes[1], the design institute[2] and Chuxiong Project Management Office (CSPMO) based on the domestic EIA reports, soil erosion protection plans (SEPP), the feasibility study reports (FSRs), as well as the master plans of Chuxiong, Lufeng and Wuding, and other project documents. The EMP covers all project implementation phases, including design, pre-construction, construction, and operation.

2. The EMP defines appropriate mitigation measures for the anticipated environmental impacts, and defines the institutional responsibilities and mechanisms to monitor and ensure the compliance with PRC's environmental laws, standards and regulations, and ADB's Safeguard Policy Statement (SPS 2009). The EMP specifies (i) objectives; (ii) mitigation measures; (iii) implementing organization and responsibilities; (iv) inspection, monitoring, and reporting arrangements; (v) training and institutional strengthening; (v) a feedback and adjustment mechanism; and (vi) the grievance redress mechanism. The EMP will be reviewed and updated at the end of the detailed designs, as needed.

B. Organizations and Their Responsibilities for EMP Implementation

3. The Chuxiong Yi Minority Autonomous State Government (CSG) is the **executive agency (EA)** of the project. The EA is responsible for communication with ADB, loan on-lending and repayment, as well as supervision and guidance of the CSPMO, LPMOs and the Project Implementation Units (PIUs) in three project city/counties during the project implementation.

4. At the state-level, CSG has established the **Chuxiong State Project Leading Group (CSPLG)** to provide policy guidance and coordination, and (ii) **Chuxiong State Project Management Office (CSPMO)** to supervise and coordinate overall project implementation.

5. The three participating city/county governments will be the **implementing agencies (IAs)**, and they have already established **local project management offices** (LPMOs) to supervise and coordinate overall implementation of subprojects in their respective cities.

6. Three **project implementing units (PIUs)** will physically implement the subprojects on behalf of respective IAs. The EMP implementation arrangements and responsibilities of governmental organizations are summarized in **Table EMP-1**.

[1] Yunnan Provincial Environmental Science and Research Institute;
[2] Yunnan Institute of Architectural Design

Table EMP-1: Institutional responsibilities for EMP implementation

Project implementation organizations	Environmental Management Roles and Responsibilities
Executing Agency (EA) – Chuxiong Yi Minority Autonomous State Government (CSG)	*Overall policy and direction control. Responsible for project coordination with three project city/town's government, liaison with ADB, financial management and administration.*
Chuxiong State Project Leading Group (CSPLG)	*Responsible for implementation of the entire project. Headed by the Vice Mayor and consists of DRC, FB, EPB, HURDB, TB, LRB, and PB:* • Coordinate and overlook project preparation and implementation; • Provide policy guidance during implementation; • Facilitate interagency coordination and coordination.
ADB Chuxiong State Project Management Office (CSPMO)	*Supervision and overall management to ensure smooth implementation of the Project:* • Responsible for all day-to-day management work during the project preparation and implementation period; • Assign one environment specialist as EMP coordinator; • Communicate and coordinate with ADB for project management and implementation; report the project implementation progress and compliance monitoring to ADB; • Submit bidding documents, bid evaluation reports and other necessary documentations to ADB for necessary approval • Engage project management consulting service • Procurement of project implementation consultant services (PIC), including loan implementation environmental consultant (LIEC) to assist in supervision, tracking and reporting on EMP implementation of all subprojects; • Procurement of external environment monitor (EEM); • Packaging of environmental monitoring reports prepared by the LPMOs and submission of them to ADB;
Implementing Agencies (IAs) - Governments of Chuxiong Municipality, Lufeng County, and Wuding County	*Primarily responsible for project implementation for project components in their jurisdiction, including finance and administration, technical and procurement matters, monitoring and evaluation, and safeguard compliance. Day-to-day activities delegated to LPMOs (see below)*
Local Project Leading Groups (LPLGs)	• *Coordinate and overlook project preparation and implementation:* • *Provide policy guidance during implementation:* • *Facilitate interagency coordination and coordination.*
Local Project Management Offices (LPMOs), established under IAs	*Responsible for all day-to-day management work during the project preparation and implementation period.* • Communicate and coordinate with CSPMO for project management and implementation; • Establish environment management unit (EMU); • In conjunction with PIUs, incorporation of EMP into bidding documents; • Establishment of a Grievance Redress Mechanism (GRM) with a dedicated Project Complaints Coordinating Unit (PCCU). • Supervision and monitoring of the EMP implementation and semi-annual reporting to the CSPMO (with support of LIEC); • Participation in capacity building and training programs;

Project implementation organizations	Environmental Management Roles and Responsibilities
Project Implementing Units (PIU) - Chuxiong Development and Investment Company Limited (CDIC) - Lufeng Urban Construction and Investment Company (LUCIC) - Wuding Urban Construction and Investment Company (WUCIC)	*Ensuring successful implementation of the relevant subproject components* • Appoint one environment specialist as EMP coordinator; • Tendering contractors and equipment with assistance of the international tendering agency; • Administer and monitor contractors and suppliers; • Construction supervision and quality control • Contracting of local environment monitoring stations (EMS) to conduct environment impact monitoring; • Procurement and management of construction supervision companies (CSC) required for subproject implementation in accordance with People's Republic of China (PRC) and ADB procedures and regulations; • Participation in capacity building and training programs; • Commissioning of the constructed facilities.
Facility Operators - Water Resource Bureaus; - Urban Management Bureaus; - Transport Management Bureaus; - Traffic Police.	*Ensuring successful ongoing operation and maintenance of the relevant subproject components:* • In conjunction with PIUs, commissioning of the constructed facilities • O&M of completed facilities, including environmental management, monitoring and reporting responsibilities.

7. **Environment staff within LPMOs, CSPMO and PIUs.** The LPMOs will have main EMP coordination responsibility. Therefore, each LPMO will establish an environmental management unit (EMU) and designate a leader and an appropriate number of staff to coordinate environmental issues associated with each component, subcomponent and contract package. The EMUs will take charge of (i) coordinating the implementation of the EMP and developing implementation details; (ii) supervising the implementation of mitigation measures during project construction and operation; (iii) ensuring that environmental management, monitoring, and mitigation measures are incorporated into bidding documents, construction contracts and operation management plans; (iv) submitting semi-annual EMP monitoring and progress reports to the CSPMO; (v) coordinating the local grievance redress mechanism (GRM); and (vi) responding to any unforeseen adverse impact beyond those mentioned in the domestic EIAs, the project EIA and the EMP. The EMUs will be technically supported by the loan implementation environment consultants (LIECs). The CSPMO and the PIUs will nominate one staff to act as environmental coordinator to check the overall implementation of environmental management provisions of the EMP.

8. **Loan Implementation Environment Consultant.** A LIEC will be hired under the project implementation consultant services (PIC). The LIEC will advise the CSPMO, LPMOs, PIUs, contractors and CSCs on all aspects of environmental management and monitoring for the project. The LIEC will (i) assist in updating the EMP and environmental monitoring program, as needed; (ii) supervise the implementation of the mitigation measures specified in the EMP; (iii) on behalf of the LPMOs and CSPMO, prepare the semi-annual EMP monitoring and progress reports in English; (iv) provide training to the CSPMO, LPMOs, PIUs, CSCs, on the PRC's environmental laws,

regulations and policies, ADB SPS 2009, EMP implementation, and GRM, etc in accordance with the tentative training plan defined in **Table EMP-9**; (v) identify any environment-related implementation issues, and propose necessary corrective actions; (vi) undertake site visits as required.

9. **Construction Contractors.** Construction contractors will be responsible for implementing relevant mitigation measures and internal monitoring during construction under the supervision of the CSCs and PIUs. Construction contractors will also be responsible for conducting internal environmental monitoring. The contractors may contract local environmental monitoring stations (EMS) to conduct internal environment impact monitoring during construction.

10. **Construction Supervision Companies (CSCs).** CSCs will be selected through the PRC bidding procedure by the PIUs. The CSCs will be responsible for supervising construction progress and quality, and EMP implementation on construction sites. Each CSC shall have at least one environmental engineer on each construction site to: (i) supervise the contractor's EMP implementation performance; and (ii) prepare the contractor's environmental management performance section in monthly project progress reports submitted to the PIUs and LPMOs.

11. **Environmental Monitoring Stations (EMS)**. The IAs will appoint the EMS of each project city/county to conduct periodic environmental impact monitoring during construction and operation in accordance with the environmental impact monitoring plan (**Table EMP-7** and **Table EMP-8**).

12. **External environment monitor (EEM).** The EA will engage an independent, external environment monitor to examine and verify the project's environmental performance by: (i) conducting independent verification of the project's environmental management performance, including identification of any environment-related implementation issues and environment management plan (EMP) compliance issues; (ii) reviewing environmental impact monitoring results of the local environmental monitoring stations, and EMP monitoring and progress reports prepared by LPMOs and CSPMO, comparing predicted with actual environmental impacts, assessing the effectiveness of the mitigation measures, and suggesting enhancement measures, as required; (iii) providing advice to CSPMO, LPMOs and PIUs on required corrective actions; and (iv) submitting EMP implementation compliance verification reports to CSPMO, LPMOs, PIUs (in Chinese) and ADB (in English) on annual basis during project implementation period.

C. Potential Impacts and Mitigation Measures

13. **Table EMP-2 to EMP-5** list the anticipated impacts of the project components in the three project cities/counties during project preparation, implementation and operation as identified by the domestic EIAs and the project EIA, as well as corresponding mitigation measures defined to minimize those impacts. The mitigation measures will be incorporated into detailed design, bidding documents, construction contracts and operational management manuals, which will mainly be implemented by the design institutes (during detailed design) and contractors (during construction), under the supervision of CSCs, LPMOs and PIUs, with technical support from the LIECs. The effectiveness of these measures will be evaluated based on environmental inspections and monitoring to determine whether they should be continued, improved or adjusted.

Table EMP-2: Potential Impacts and Mitigation Measures during Preconstruction and Construction Phases

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
A. Design & Preconstruction Phases									
Detail design stage	Establishment of env. units at different levels of supervision	● Establish an EMU in each of the LPMOs, including at least one environment specialist ● Appoint environmnental coordinators for EMP coordination within CSPMO and PIUs	LPMOs, CSPMO, PIUs	EA, ADB	-		-	-	Counterpart funds (EA, IAs, PIUs)
	Updating EMP	● Update mitigation measures defined in this EMP based on final detailed design, as needed, submit to ADB for disclosure. ● In case of major change of project location (or additional physical component) that may cause substantial environmental impacts or involve additional affected people, IAs and PMOs should form an EIA team to conduct additional environmental assessment and also public consultation. The revised EIA reports should be submitted to relevant EPB and ADB for approval and disclosure. To determine whether the change is minor or major, City PMOs should consult with ADB.	LPMOs, EMU, TA consultant	EEM, EPBs, ADB	-	-	-	-	Included in LPMOs' operation budget
	Confirmation of land acquisition and resettlement	● Update LARP after detail design	DIs	BCA[3]; BLM[4]	-	-	-	-	Included in resettlement budget
Construction Preparation	Environmental monitoring stations	● Prior to construction, engage EMS[5]. ● Prepare a detailed environmental monitoring plan in accordance to monitoring plan defined in this EMP.	PIUs, EMSs	LPMOs, CSPMO, ADB	25	15	35	30	Counterpart funds (IAs)
	Project Implementation Consultant Services (PIC)	● Engage loan implementation environmental consultant (LIEC)	CPMO, City/county PIUs	ADB	-	-	-	-	Included in PIC budget (CSPMO)

[3] Bureau of Civil Affairs
[4] Project City/counties' Bureau of Land Management
[5] Environmental Monitoring Station of each project city/county, which is the only licensed environmental monitoring units

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
	External environment monitor (EEM)	● Engage external environment monitor (EEM) to verify the project environmental performance and compliance with the EMP	EA, CSPMO	ADB	9.0	8.0	17.0	17.0	Counterpart funds (EA)
	Bidding and contract documents	● Prepare environment section in the terms of reference for bidders; ● Prepare environmental contract clauses for contractors, namely the special conditions (e.g., reference to EMP and monitoring table).	LDIs, LPMOs, PIUs	Start-up Project Management Support, CSPMO,	-	-	-	-	Included in Detail design stage
	EMP training [6]	● PIC, LIEC, or invited environment specialists and/or officials from the provincial EPB and the Prefecture EPB provide training on construction environmental management and implementation and supervision of environmental mitigation measures to contractors and CSCs, in accordance with tentative training plan defined in this EMP.	PIC&LIEC[7],	CSPMO, LPMOs, ADB	5.0	3.0	5.0	5.0	Included in the PIC budget
	Establish operational GRM	● Establish a Project Public Complaints Unit (PPCU) in each LPMO; provide training for PPCU members and GRM access points; ● Disclose the PPCU's phone number, fax, address, and email to the public on City EPB's website and on information boards at each construction site.	LPMOs, PIUs	CSPMO, LIEC, ADB	-	-	-	-	Included in LPMO's operation budget
	Land acquisition and resettlement	● Establish a resettlement office comprising local government officials to manage the land acquisition and resettlement process; ● Conduct information dissemination and community consultation programs in accordance with the PRC Land Administration Law (1999) and ADB SPS (2009); ● Ensure that all resettlement activities are reasonably completed before construction	PIUs, City/county LAROs[8],	EA, City/county LBs, BCAs	-	-	-	-	Included in the cities' Land Acquisition and Resettlement

[6] Environmental management
[7] Loan Implementation Environmental Consultant
[8] City/county Land Acquisition and Resettlement Office

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		starts on any component.							
Contr. Obligation prior to construction	Construction site EMP	● Each civil works contractor shall prepare a Construction-site EMP (CS-EMP), based on this EMP, which shall include the following plans: - Site drainage and soil erosion protection; - Spill control and management; - Environmental, health and safety management plan (EHSMP); - Surface water protection; - Temporary traffic management; - Construction site access control; These plans are further elaborated below (construction phase)	Civil works contractors	LPMOs, PIUs, LIEC, EEM	-	-	-	-	Included in civil works contracts
TOTAL					**39.0**	**26.0**	**57.0**	**52.0**	
B. Construction Phase									
Soil & Geology	Soil erosion, soil contamination	● Develop and implement a **Site Drainage and Soil Erosion Management Plan** that responds to the SEPP approved by local Water Resources Bureau, and the project EIA. Measures shall include the following: - During road and bridge constructions, maintain slope stability at cut faces by implementing erosion protection measures such as terraces and silt barriers; - Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are going on; - All earthwork disturbance areas must be stabilized within 30 days after earthworks have ceased at the sites; - Minimize active open excavation areas during trenching activities and use appropriate compaction techniques for pipe	Contractors, CSCs	PIUs, EPBs, WRBs, LIEC, EEM	145.81[9]	180.86	240.03	236.88	Included in construction contract

[9] Source of the budget: domestic EIA Report

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		trenches construction; - Provide temporary detention ponds or containment to control silt runoff; - Construct intercepting ditches and drains to prevent runoff entering construction sites, and divert runoff from sites to existing drainage; - Strip and stockpile topsoil, cover or seed temporary soil stockpiles; - Limit construction and material handling during periods of rains and high winds; - Properly slope or re-vegetate disturbed surfaces, such as compacted pipeline trenches and cut banks; - Protect slopes on both sides of bridges and culverts; - Plant grass to protect slopes, especially on sandy soil and terraced slopes; - Appropriately set up temporary construction camps and storage areas to minimize the land area required and impact on soil erosion; ● Implement the following measures to avoid **soil contamination**: - Properly store petroleum products, hazardous materials and wastes on impermeable surfaces in secured and covered areas, and use the best management practice to avoid soil contamination; - Remove all construction wastes from the site to approved waste disposal sites; - Establish emergency preparedness and response plan (Spill Management Plan); and - Provide spill cleanup measures and equipment at each construction site and require contractors to conduct training in emergency spill response procedures.						

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
	Earthwork, spoil disposal site management and rehabilitation	● For Chuxiong, the surplus earth of 79,857m^3 shall be used for filling the planned landscaping area between Qinglong River bank and the roads of No.15 and 16, where about 0.9million m^3 filling earth will be needed; ● For Wuding, the surplus earth of 250,824m^3 shall be transported to the northwest part of the county town for filling the real estate construction site, where about 0.15million m3 of earth will be used; ● For Lufeng, the surplus earth of 40,500m^3 shall be used for filling the landscaping area on the river banks, where about 0.5million m^3 filling soil will be used; ● Topsoil of 45,591m^3 will be used for planting trees, bushes and grass in the landscaping areas in Chuxiong and Wuding, respectively. ● Transport remaining construction spoil to approved spoil disposal sites defined in Table V.4 of this EIA.	Contractors, CSCs	LPMOs, PIUs, EPBs, LIEC, EEM	6.0	6.0	5.0	8.5	Included in construction contract
Surface water quality, hydrology	Impact on river hydrology by bridge construction	● River bridge pier constructions (13 bridges) shall be conducted during the dry season; construction during the rainy season will be prohibited; ● Foundation treatment and pier grouting come first in pier construction; and ● Provide adequate opening for flood flow before the rainy season.	Contractors, CSCs	City/county PIUs, LIEC, EPBs, WRB ,	14.0	17.0	18.0	19.0	Included in construction contract
	Impact on river hydrology by river rehabilitation works	● Cofferdam diversion will be set along the proposed rivers; and ● River bank constructions shall be conducted during the dry season (from November to next March), and construction during the rainy season shall be prohibited.							
	Surface and groundwater pollution	● Contractors will be requested to implement the following measures to protect surface and groundwater resources (to be defined in their CS-EMPs):							

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		- During bridge and river bank constructions, pump slurry to shore and properly dispose cutting materials; - Install sediment traps along the rivers to minimize sediment runoff into the rivers during earthworks; - Works on the river bed, including sediment dredging, shall not be conducted without prior assessment of environmental impacts, and dredged material management planning; - Develop contingency plans for control of oil and other dangerous substances (Spill Management Plan); - Collect wastewater from construction activities in sedimentation tanks, retention ponds, and filter tanks to remove silts and oil; - Equip all areas where construction equipment is being washed with water collection basins and sediment traps; - Station fuel storage, maintenance shop and vehicle cleaning areas at least 500m away from the nearest water body; - Locate storage facilities for fuels, oil, and other hazardous materials within secured areas on impermeable surfaces, and provided with bunds and cleanup installations; - Ensure that fuel suppliers are properly licensed. They shall follow proper protocol for transferring fuel and the PRC standard of JT3145-88 (Transportation, Loading and Unloading of Dangerous or Harmful Goods); - Locate labor camps at least 500m from ecologically sensitive receivers, such as rivers, residential areas and natural ponds, etc.; - Install eco-toilets and septic treatment and disposal systems at construction camps along with proper maintenance protocols;							

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		- The discharge of construction wastewater to the rivers will be prohibited; - Conduct water quality monitoring in the rivers and the natural ponds during construction in accordance with the EMP monitoring program to identify and confirm results of the impact assessment and effectiveness of adopted mitigation measures.							
Ambient Air	Dust generated by construction activities	● Spray water daily on construction sites and earth/material handling routes where fugitive dust is being generated; ● Pay particular attention to dust suppression near sensitive receptors such as schools, hospitals and residential areas; and ● Cover materials during truck transportation, in particular, the fine material, to avoid spillage or dust generation.	Contractors, CSCs	LPMOs, PIUs, LIEC, EEM	7.0	7.0	12.0	10.0	Included in construction contract
	Air emission from asphalt pavement, and vehicles and machinery	● Locate asphalt plants and mixers as far away as possible (at least 500 m downwind) from the nearest residential areas, and other sensitive receptors; ● Store petroleum or other harmful materials in appropriate places and covering to minimize emission; ● Maintain vehicles and construction machinery regularly to a high standard of efficient running and fuel-burning to ensure emissions from vehicle and construction machineries are in compliance with the PRC standards of GB18352-2005, GB17691-2005, GB11340-2005, GB2847-2005, and GB18285 -2005; and ● Initiate a regular inspection and certification system for vehicle and equipment emission.							
Noise	Noise generated from	● Ensure that noise levels from equipment and machinery conform to the PRC standard of GB12523-90, and properly maintain	Contractors, CSCs	LPMOs, PIUs, LIEC, EEM	21.7	1.5	36.04	13.9	Included in construction contract

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
	construction activities	construction vehicles and machineries to minimize noise; ● Apply noise reduction devices or methods where piling equipment is operating within 300m of sensitive sites such as schools, hospitals and residential areas; ● Locate sites for rock crushing, concrete-mixing, and similar activities at least 1 km away from sensitive areas; ● To reduce noise at night, restrict the operation of machinery generating high levels of noise, such as piling, and movement of heavy vehicles along urban and village roads between 20:00 and 06:00 the next day in accordance with PRC regulations; ● Take special caution at construction sites that are close to such sensitive sites as schools, hospitals and office buildings. When construction activities are unavoidable during the school seasons, the use of heavy equipment will be restricted to weekends and non-class hours. ● Place temporary hoardings or noise barriers around noise sources during construction, if necessary; ● Monitor noise at sensitive areas at regular intervals (refer to the monitoring plan in the EMP). If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; and ● Conduct monthly interviews with residents living adjacent to construction sites to identify community complaints about noise, and seek suggestions from community members to reduce noise annoyance. Community suggestions will be used to adjust work hours of noise-generating machinery.							
	Noise impacts on the first	● Erect temporary noise barriers around noise sources during construction to comply with	Contractor, CSC,	LPMO, PIU and EPB,	--				Included in construction

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
	section [10] of Longchuan River in Chuxiong City	Class I [11] (55 dB(A) day-time; 45 dB(A) night-time) of the PRC Ambient Noise Standard (GB 3096-2008); ● Prohibit construction activities during the night;	nearby villages	LIEC, EEM					contract
Vibration	Vibration generated by piling	● Piling and compaction operations at night are prohibited.	Contractors, CSCs	LPMOs, PIUs, LIEC, EEM	-	-	-	-	-
Solid Waste	Solid waste generated by construction activities and from workers' camps	● Provide appropriate waste collection and storage containers at locations away from surface water or sensitive receivers; ● Reach agreement with municipal waste collection services for regular collection of waste prior to construction; ● Properly remove and dispose of any significant residual materials, wastes and contaminated soils that remain on the ground timely during and after construction to designated sites. Any planned paving or vegetating of the area shall be done as soon as the materials are removed to protect and stabilize the soil; ● Burning of waste is strictly prohibited. ● Provide sufficient garbage bins at strategic locations and ensure that they are protected from birds and vermin, and emptied regularly (using the municipal solid waste collection systems).	Contractors, CSCs	PIUs, LIEC, EEM	56.0	56.0	56.0	56.0	Included in construction contract
Flora and Fauna	Protection of vegetation, and fauna	● Protect existing vegetation nearby construction sites; ● Properly backfill, compact and re-vegetate pipeline trenches after pipeline installation; ● Protect existing trees and grassland during road, bridge, river rehabilitation and pipeline constructions; where a tree has to be removed or an area of grassland disturbed,	Contractor, CSCs	PIUs, LIEC, EEM	36.45	45.21	53.18	29.04	Included in construction contract

[10] The section (4500m in length) has some ecological value (vegetation, fish, ducks); other downstream section lost ecological value (seasonal stream)
[11] For the first section of Longchuan River in Chuxiong City

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		replant trees and re-vegetate the area immediately after construction; ● Remove trees or shrubs only as a last resort if they impinge directly on permanent works or approved necessary temporary works; ● In compliance with the PRC's forestry law, undertake compensatory planting of an equivalent or larger area of affected trees and vegetation; and ● Use native plant species of local provenance will for replanting; ● Take special precautions during and after construction for the protection of small animals, reptiles, and birds of common species that live in the vegetated roadside and riverside areas, medians, inner areas of bridges, and green areas							
	Protection of flora and fauna (first section of Longchuan River)	● The river rehabilitation shall be limited to the existing river embankment repairs, tree planting to stabilize the exiting riverbank, water channel sediment removal. The existing waterway channel, tree line and vegetation will be preserved;	DI, Contractor, CSCs	LPMO, FB and EPB, LIEC, EEM	-	-	-	-	Included in detail design
Socio-economic impacts	Impact on physical cultural resources	● Contractors shall establish chance-find procedures for physical cultural resources; ● If a new site is unearthed, work shall be stopped immediately and local BCR and the LPMO promptly notified, and construction will resume only after thorough investigation and with the permission of the appropriate authority.	Contractors, CSCs	LPMO,, LIEC, City BCR[12], EEM	12.8	12.8	12.4	80.4	Included in construction contract
	Community health and safety	● The civil work contractors shall implement the following measures to ensure community health and safety during construction: - Develop and implement **temporary traffic control and operation plan**, to be cleared by local traffic management administrations							

[12] Bureau of Cultural Relics

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		before construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings, selecting transport routes to reduce disturbance to regular traffic, reinstating roads, and opening them to traffic as soon as the construction is completed; **- Conduct underground facilities survey and protection** to avoid disturbances to utility services, where needed. **- Disclose information** to residents and businesses in advance through media of the construction activities, given the dates and duration of expected disruption; **- Ensure that construction sites are well protected** but placing **c**lear signs 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 shall be secured, disabling access by members of the public through appropriate fencing whenever appropriate.						
	Occupational. health and safety	● Each civil works contractor shall develop and implement an **environmental, health and safety management plan (EHSMP)** which shall include the following provisions: - Provide a clean and sufficient supply of fresh water, for construction sites and for all camps, offices and workshops; - Provide an adequate number of latrines and other sanitary arrangements at construction sites and work camps, and ensure that they are cleaned and maintained in a hygienic state; - Garbage receptacles at construction site and camps will be setup, which will be periodically cleared to prevent outbreak of	Contractors	CSCs, LPMOs, LBs, EPBs, LIEC, EEM	46.0	46.0	110.8	106.8	Included in construction contract

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget of Component (10,000 CNY)				Source of Funds
			Who Implements	Who Supervise	Chuxiong		Lufeng River & Infra.	Wuding River & Infra.	
					Infra.	River			
		diseases; - Provide personal protection equipment, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations for workers; - An emergency response plan to take actions on accidents and emergencies will be prepared, including environmental and public health emergencies associated with hazardous material spills and similar events, and submitted to the local EPBs for review and appraisal. Emergency phone link with hospitals in the three project towns will be established. A fully equipped first-aid base in each construction camp will be organized; - A records management system that will store and maintain easily retrievable records protected against loss or damage will be established. It will include documenting and reporting occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits; - Ensure that occupational health and safety matters are given a high degree of publicity to all persons regularly or occasionally on each construction site. Posters will be displayed prominently in relevant areas of the site; and - Train all construction workers in basic sanitation, general health and safety matters, and on the specific hazards of their work. Implement SITs/HIV/AIDS and other communicable diseases awareness and prevention program to target the local community and construction workers.							
TOTAL					**345.76**	**372.37**	**543.45**	**560.52**	

Source: Domestic EIAs and FSRs, PPTA Consultant's Report, and consultations with city EPBs, WCBs, FBs and other government divisions.

Table EMP-3: Potential Impacts and Mitigation Measures during Operation for Infrastructure Components

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Wuding	Lufeng		
Ambient Air	Excessive vehicle emissions, affecting ambient air quality	● Conduct periodic examination of emission of vehicle exhaust pollutants for each vehicle in accordance with PRC regulation (such as GB18352.3-2005); ● Refuse registration to vehicles with excessive emissions; and ● Conduct air quality monitoring (through EMS) in accordance with the monitoring program until a PCR is issued.	UMB[13], TMB[14], EMSs[15]	City/county EPBs, CSPMO	3.6/a	3.6/a	2.5/a	UMBs' operation budget	NO_2, CO, TSP, SO_2 (GB3095-1996 until 31/12/2015; GB 3095-2012 after 01/01/2016)
Acoustic Environment	Traffic noise along project roads, expecting to exceed standard at 166 households (prediction for 2015).	● Plant trees and shrubs along the proposed roadsides after construction; ● Install double-glazed windows for 166 hh in the three project cities in accordance with the plan defined in the EIA and domestic EIAs.	Contractors	PIUs, LIEC, EEM	58.0	12.0	55.0	Included in civil works contracts	Number of trees planted, area of vegetation (m2) Number and m2 of double-glazed windows installed.
		● Conduct ambient noise monitoring, determine whether mitigation measures will be required for sites where noise levels are expected to exceed by more than 3 dB(A);	IAs (through EMSs)	LEPBs	10.0/a	6.0/a	6.0/a	UMBs' operation and maintenance budget	GB 3096-2008 Class II
Surface & Ground Water	Pollution from storm water runoff and solid waste	● Routinely collect and properly dispose litter and debris from sidewalks, driveways, and parking lots, especially near rivers; ● Install litter traps along waterways (small floating mesh traps attached to one	IAs, UMB, EMSs	LEPBs, WRBs	20.0/a	20.0/a	20.0/a	UMBs' operation budget	SS, COD, Petroleum (GB3838-2002) (GB/T14848-1993)

[13] After one year operation, the proposed transport facilities will be transferred to Urban Management Bureaus (UMB) of the IAs
[14] Traffic Management Bureau
[15] Environmental Monitoring Station

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Wuding	Lufeng		
		bank) and regularly empty these; ● Clean the roadside catch basins before rainy season to avoid surface water pollution by storm water runoff flushing debris and silt; ● Place garbage bins and containers along the road networks; ● Maintain storm-water retention and pre-treatment systems along the roads nearby the rivers.							
	Sewers, wastewater collection and treatment	● Regularly inspect and maintain project sewers; ● Review performance of linked WWTP[16]s in the project cities (treatment performance, compliance with effluent standards)	WWTP Operators, City/county EMSs, PIUs	LEPBs	5.0/a	3.0/a	3.0/a	UMBs' operation budget	SS, COD, BOD, Petroleum (GB 18018-2002)
Health and Safety	Traffic safety, ITS system	● Implementation of road safety and transport planning assessment and training: - conduct traffic safety audit for the project city/towns; - identify safety concerns in traffic safety feature implementation, traffic safety education and enforcement needs, - develop program for public safety education and safety awareness. ● Implementation of ITS, include traffic monitoring system, red light and	CSPMO, PIC, IAs, Traffic Police	City/county EPBs, TMB, PSB[17]	10.0	10.0	10.0	Capacity building budget of the loan	Training course satisfaction survey, assessment report with recomm.

[16] Wastewater treatment plant
[17] Public Security Bureau

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Wuding	Lufeng		
		speeding violation monitoring system, real time traffic condition displays							
	Spills of dangerous goods	● Ensure that all trucks carrying hazardous materials are marked according to PRC norms; ● Enforce traffic controls, and set speed limits for trucks carrying hazardous material; ● Prepare a rapid spill response and clean up protocol so that in the event of a spill the appropriate people and equipment are quickly notified and action can be taken.	UMB, Local Traffic Police	IAs, LEPBs, PSB[18]	10.0/a	10.0/a	10.0/a	UMBs' operation budget	Presence of rapid spill response protocol
Flora	Vegetation	● Routinely inspect and properly maintain all roadside trees, slope stabilization sites, and landscaping vegetation. Keep at least 98% of survival rate.	PIUs, UMBs	LEPBs	5.0/a	3.0/a	3.0/a	UMBs' operation and maintenance budget	Survival rate of roadside vegetation (%)
Soil	Soil erosion	● Inspect and properly maintain erosion protection measures including seeded or stabilized slopes, drainage structures and retaining walls at least twice during the first year of the roads' operation to ensure that they are maintained properly and are functioning as designed.	PIUs, UMBs	LEPBs, WRBs	4.0/a	2.5/a	2.5/a	UMBs' operation and maintenance budget	Marks (0-100) given by inspection expert team.
Natural Hazard	Reduced flood discharge capacity as result of accumulation	● Clean culverts, bridge pears, and drainage pipes before rainy season;	UMBs	City/county LEPBs, WRBs	10.0/a	7.0/a	6.0/a	UMBs' operation and maintenance budget	Annual EMR

[18] ibid

Item	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Wuding	Lufeng		
	of debris.								
TOTAL		**One time investment**			**68.0**	**22.0**	**65.0**		
		Recurrent costs			**67.6/a**	**55.1/a**	**53.0/a**		

Source of the budget: the domestic EIA Reports, SEPPs, draft project administration manual (PAM)

Table EMP-4: Potential Impacts and Mitigation Measures during Operation for River Habitation and Flood Control Components

Item	Potential Impacts/Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Lufeng	Wuding		
Embankment	Embankment stability	● Inspect all river embankment stabilization works for physical integrity. If signs of failure are discovered, a repair program will be implemented immediately;	WRBs	LEPBs, IAs	5.0/a	5.0/a	2.0/a	Included in the WRBs' operation cost	Annual EMR
Routine maintenance of river embankment	Impaired flood flow capacity as a result of obstructions and waste accumulation, Pollution and blockage of rivers due to solid waste and wastewater discharge	● No artificial structures are allowed to be constructed to impound water restricting free flow of flood waters; ● Regularly maintain the rivers and their embankments, including removal of garbage and vegetation. ● Periodically remove solid waste and debris, and dispose in municipal landfill; ● Inspect surrounding areas and ensure that no wastewater is discharged to the rivers without prior treatment.	WRBs, UMBs	IAs, EPBs	40.0/a	50.0/a	10.0/a	Included in the WRBs' operation cost	Visual inspection, satisfaction survey (after one year).
Routine maintenance	Impaired flood flow	● Daily maintenance: manage the vegetation including pruning, weeding and	WRBs, UMBs	IAs, LEPBs	50.0/a	70.0/a	20.0/a	Included in the WRBs'	Visual inspection,

Item	Potential Impacts/Issues	Mitigation Measures and/or Safeguards	Responsibility		Budget (10,000 CNY)			Source of Funds	Performance Indicator
			Who Implement	Who Supervise	Chuxiong	Lufeng	Wuding		
of riverside vegetation and landscaping area	capacity as a result of poor riverine vegetation maintenance	replacement of dead or dying trees and shrubs; ● Pest control: The guiding principle will be prevention first followed by integrated treatment; ● Fire prevention: Measures for prevention of fire will be put in place.						operation cost	satisfaction survey (after one year).
Flood protection over design flood levels	Flood monitoring and early warning	● Installation of flood early warning system including a coordination center, water/rainfall monitoring stations, real-time monitoring cameras, flood warning broadcasting stations ● Establish framework and mechanism for periodic review and upgrade of flood protection works to account for future climate change (with clear timeframe and triggers).	IAs, PIUs, WRBs, PIC	CSPMO, ADB	262.0	231.0	226.0	Included in project procurement plan	Project completion report
Qingshanzui Reservoir	Minimum ecological flow	● Review and adjust the operating procedures of the Qingshanzui Reservoir to ensure that the Longchuan River receives a minimum flow at all times in accordance with the reservoir operating rule on minimum flow provision as defined in the reservoir EIA approved by the Ministry of Environmental Protection in 2005.	Chuxiong WRB	CSG	-	-	-	WRB operational budget	Annual EMR (first year operation)
TOTAL		**One time investment**			**262.0**	**231.0**	**226.0**		
		Recurrent costs			**95.0/a**	**125.0/a**	**32.0/a**		

Source of the budget: the domestic EIA Reports, SEPPs, draft project administration manual (PAM)

D. Environmental Monitoring, Inspection and Reporting

14. The project monitoring program focuses on the environment within the project's areas of influence in the project city/counties. A detailed environmental monitoring program is shown in **Table EMP-7 and Table EMP-8**, which covers the scope of monitoring, monitoring parameters, time and frequency, implementing and supervising agencies, internal and impact monitoring, and estimated costs. The monitoring shall comply with the methodology provided in the relevant national environmental monitoring standards. Other associated standards to be followed are the national environmental quality standards of air, water and noise, and the pollutant discharge standards.

15. **Internal monitoring and reporting by contractors.** During construction, contractors will be responsible for conducting internal environmental monitoring in accordance with the monitoring plan (**Table EMP-7**, **Table EMP-8**). Internal monitoring results will be reported through the contractors' monthly project progress reports to the IAs (LPMOs).

16. **Environmental impact monitoring by monitoring stations.** The PIUs will contract the local environmental monitoring stations (EMS) to conduct environmental impact monitoring in accordance with the monitoring plan (**Table EMP-7, Table EMP-8**). A detailed cost breakdown will be provided by the three local EMSs when the environmental monitoring program is updated at the start of each component implementation. Monitoring will be conducted during construction and operation period, until a project completion report (PCR) is issued. Quarterly monitoring reports will be prepared by the EMSs and submitted to CSPMO, LPMOs and the PIUs.

17. **EMP implementation monitoring and progress reporting.** The LIECs will review project progress and compliance with the EMP based on field visits, and the review of the environmental impact monitoring conducted by the EMSs. The findings of the LIECs will be reported to ADB through the semi-annual EMP monitoring and progress reports. The reports will include (i) progress made in EMP implementation, (ii) overall effectiveness of the EMP implementation (including public and occupational health and safety), (iii) environmental monitoring and compliance, (iv) institutional strengthening and training, (v) public consultation (including GRM), and (vi) any problems encountered during construction and operation, and the relevant corrective actions undertaken. The LIECs will help CSPMO prepare the reports and submit the English report to ADB for appraisal and disclosure.

18. An **external environment monitor (EEM)** will be engaged by the EA (CSPMO) to conduct independent verification of the project's compliance with the EMP and relevant PRC regulations and standards. The EEM will review all environment reports, including the quarterly environmental impact monitoring reports and the annual EMP monitoring and progress report, and prepare a concise annual EMP verification report. The report should confirm the project's compliance with the EMP and PRC legislation standards, identify any environment-related implementation issues, and recommend corrective actions.

19. **Project completion environmental audits.** Within three months after each subproject completion, or no later than one year with permission of the City or County EPBs, environmental acceptance monitoring and audit reports of each subproject completion shall be (i) prepared by a licensed environmental monitoring institute in accordance with the PRC Guideline on Project Completion Environmental Audit (2001), (ii) reviewed for approval of the official commencement of

individual subproject operation by environmental authorities, and (iii) finally reported to ADB through the semi-annual EMP monitoring and progress reporting process.

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

i) *Regulations of QA/AC Management for Environmental Monitoring* issued by the State Environmental Protection Administration in July 2006;

ii) *QA/QC Manual for Environmental Water Monitoring* (Second edition), published by the State Environmental Monitoring Centre in 2001; and

iii) *QA/QC Manual for Environmental Air Monitoring* published by the State Environmental Monitoring Centre in 2001.

21. **Standard monitoring methods. Table EMP-5** shows the standard monitoring methods, detection limits, and the standard code for each of the monitoring parameters.

Table EMP-5: Standard Monitoring Methods of Ambient Air, Noise and Water

Media	Monitoring Parameter	Method (Standard No.)	Detection Limit	Standard Limit
Air	TSP (mg/m^3)	Gravimetric (GB/T15432-1995)	0.001	0.30[19]
	PM_{10} (mg/m^3)[20]	Gravimetric with specific sampler (HJ/T93-2003)	0.0002	0.15
	SO_2 (mg/m^3)	Spectrophotometry (GB/T15262-1994)	0.003	0.15
	NOx (mg/m^3)	Saltzman Method (GB/T15435-1995)	0.002	0.12
Noise	Equivalent Continuous A Sound (Leq)	Acoustimeter Method (GB12524-90)	0.5	60/55 (day); 50/45 (night)[21]
Surface water	pH value	Glass electrode method (GB6920-86)	0.02 pH	6-9[22]
	COD_{Mn} (mg/L)	Permanganate index (GB11914-89)	0.5	6
	Petroleum (mg/L)	Infrared spectra photograph (GB/T16488-1996)	0.04	0.05
	SS (mg/L)	Gravimetric method (GB11901-89)	4	250
	Total coliforms (no./L)	Membrane filter (GB/T575.12-2006)	10	10,000

[19] All the air parameters are Grade II ambient air standard (daily average).
[20] The local EMSs have no capacity to monitor $PM_{2.5}$.
[21] Grade II and I standard, respectively (Grade I applying to the suburb area).
[22] All the water parameters are Grade III standard.

Table EMP-6: Environmental Reporting Plan

Report	From	To	Frequency of Reporting
A. Construction Phase			
Progress reports	Contractor	LPMOs	Monthly
Environmental impact monitoring reports	Local EMSs	LPMOs, PIUs	Quarterly
EMP monitoring and progress report	CSPMO, LIEC	ADB	Semi-annually
External verification report	EEM	CSPMO, LPMOs, PIUs, ADB	Annually
Environmental acceptance monitoring and audit reports	Licensed institute	City/county EPBs, CSPMO, IAs, PIUs, ADB	Within three month after component completion
B. Operation Phase (until PCR is issued)			
EMP monitoring and progress reports	LPMOs, EMSs	CSPMO, ADB	Annually

Source: Domestic EIAs and Consultant's proposal

Table EMP-7: Environmental Monitoring Program (For Infrastructure Components)

Subject	Parameter	Location	Frequency	Who Implements	Who Supervises	Estimated Cost (RMB 10,000)		
						Chuxiong	Wuding	Lufeng
	Construction							
Surface water	SS, NH3-N, oil, COD, total coliforms	At each project bridge, 50m upstream, and 50 and 100m downstream	Impact Monitoring: Once per day, for 3 consecutive days, 4 times per year during construction activities.	EMS	LPMOs, EPBs	12.5	6.0	6.5
Air	Inspection of dust mitigation measures (water spraying, cover transport vehicles, etc.); and maintenance of vehicles and construction equipment	Visual inspection at all construction sites.	Internal Monitoring: weekly	CSC	PIUs	Included in the construction supervision contract		
			External Monitoring: At least twice per year	LIEC, (EEM)	PIUs, EPBs	Included in PIC and EEM contracts		
	TSP, SO_2, NOx	At all construction sites (at least one point upwind, two points downwind) and sensitive receivers nearby (see Chapter IV-sensitive receivers within project area of influence)	Impact Monitoring: Twice per day for 3 consecutive days, 4 times per year during construction activities.	EMSs	LPMOs, EPBs	9.5	5.0	6.0
Noise	LAeq	At the boundary of all construction sites and sensitive receivers nearby (see Chapter IV-sensitive receivers within project area of influence)	Impact Monitoring: Twice per day (once in day time and once at night time) for 2 consecutive days, 4 times per year during construction activities.	EMSs	LPMOs, EPBs	6.5	4.0	4.0
Solid Waste	Garbage from work-camps and construction waste at construction sites	Visual inspection at all construction sites and work-camps	Internal Monitoring: weekly	CSCs	PIUs	Included in the construction supervision contract		
			External Monitoring: Twice per year	LIEC, (EEM)	EPBs, EA, ADB	Included in PIC and EEM contracts		
Soil erosion, vegetation	Soil erosion intensity, re-vegetation	Visual inspection at borrow pit and spoil sites	Internal Monitoring: Random check after rainstorm (rainfall > 50mm)	CSCs	PIUs	Included in the construction supervision contract		

Subject	Parameter	Location	Frequency	Who Implements	Who Supervises	Estimated Cost (RMB 10,000)		
						Chuxiong	Wuding	Lufeng
			External Monitoring: twice per year, and once after completion of construction	LSMI, LIEC, (EEM)	EPBs, EA, ADB	Included in loan implementation TA contract		
	Slope stability, topsoil stockpile and rehabilitation of construction sites	Visual inspection of all subgrade slopes and retaining walls, bridges, culverts	Internal Monitoring: At least four times per year	CSCs	PIUs	Included in the construction supervision contract		
			External Monitoring: Twice per year, and once after completion of construction	LIEC, (EEM)	EPBs, EA, ADB	Included in PIC and EEM contracts		
	Compensatory plantings and re-vegetation of borrow pits, spoil disposal sites and construction sites	Visual inspection at all disposal sites, borrow pits and temporary occupied lands	Internal Monitoring: At least four times per year	CSCs	PIUs	Included in the construction supervision contract		
			External Monitoring: Twice per year, and once after completion of construction	LIEC, (EEM)	EPBs, EA, ADB	Included in PIC and EEM contracts		
Occupational health and safety	Work camp hygiene and safety, availability of clean water and emergency response plans	Inspection at all construction sites and work-camps	Internal Monitoring: Monthly	CSC	City/county IAs, PIUs	Included in the construction supervision contract		
			External Monitoring: Twice per year	LIEC	City/county Health Bureau	Included in loan implementation TA contract		
Subtotal						**28.5**	**15.0**	**16.5**
Operation Phase								
Noise	LAeq	All sensitive receivers along the roads and nearby bridges	Twice per day (once in day time and once at night time) for 2 consecutive days, twice per year	EMSs	IAs, EPBs	1.5/a	1.0/a	1.5/a
Air	TSP, SO2, NOx, PM10	All sensitive receivers along the roads and nearby bridges	Twice per day for 3 consecutive days, twice per year	EMSs	IAs, EPBs	3.0/a	2.0/a	3.0/a
Surface water	pH, SS, DO, NH3-N, oil, COD, total coliforms	50m upstream and 50 and 100m downstream of project bridges.	Once per day, for 3 consecutive days, once per year	EMSs	IAs, EPBs	6.0/a	4.5/a	6.0/a
Soil and Vegetation	Vegetation survival and coverage rate	Re-vegetated sites (spoil disposal sites, construction	Spot check, twice per year	OPFs, LPMOs	EPBs, Forestry Bureau,	Included in OPF's operation budget		

Subject	Parameter	Location	Frequency	Who Implements	Who Supervises	Estimated Cost (RMB 10,000)		
						Chuxiong	Wuding	Lufeng
		sites)			CSPMO			
Traffic flow and safety	Vehicle numbers and road use (against predictions), accident incidents	Project roads	Road traffic monitoring program	OPFs, LPMOs	City/county Traffic Bureau, CSPMO			
Subtotal						**10.5/a**	**7.5/a**	**10.5/a**

BOD5 = 5-day biochemical oxygen demand; CODcr = chemical oxygen demand; CSC = construction supervision company; EMS = environmental monitoring station; EPB = environmental protection bureau; IA = implementation agency; LAeq = equivalent continuous A-weighted sound pressure level; LSMI = licensed soil erosion institute; NH_3-N = ammonia nitrogen; NOx = nitrogen oxides; OPF = operators of project facilities; PM10 = particles measuring 10Âµm or less; PMO = project management office; SO_2 = sulfur dioxide; SS = suspended solids; TSP = total suspended particle

Table EMP-8: Environmental Monitoring Program (For River Rehabilitation and Flood Control Components)

Subject	Parameter	Location	Frequency	Who Implement	Who Supervise	Estimated Cost (RMB 10,000)	
						Chuxiong and Lufeng	Wuding
Construction Phase							
Construction wastewater	pH, SS, oil	At discharge points of all construction sites	Impact Monitoring: One sampling each day each time, twice per year	EMS	PIUs, EPBs, WCBs	2.0	1.0
Work-camp domestic wastewater	pH, SS, NH3-N, CODcr, oil, total coliform	At domestic wastewater discharge points of all work-camps	Impact Monitoring: One sampling each day each time, twice per year	EMS	PIUs, EPBs, WCBs	4.0	2.0
Surface water	pH, DO, SS, NH3-N, CODcr, oil, anionic surfactants	50m upstream, and 50m and 100m downstream of construction activities on project river.	Internal Monitoring: one sampling each day, 3 consecutive days, 6 times per year.	Contractors	PIUs, CSCs	10.0	5.0
			Impact Monitoring: one sampling each day, two consecutive days, 4 times per year	EMS	LPMO, EPBs	5.0	2.5
Air	Inspection of dust mitigation measures (water spraying, cover transport vehicles, etc.); and maintenance for vehicles and construction equipment	At all construction sites	Internal Monitoring: At least six times per year	CSC	PIUs	Included in the construction supervision contract	
			External Monitoring: Twice per year	LIEC, (EEM)	EPBs, WCBs	1.0	0.5
	PM10, SO2, NOx	At all construction sites (at least one point upwind, two points downwind); and	Impact Monitoring: Twice per day for three consecutive days, twice	City/county EMS	City/county PIUs, EPBs,	3.0	1.5

Subject	Parameter	Location	Frequency	Who Implement	Who Supervise	Estimated Cost (RMB 10,000)	
						Chuxiong and Lufeng	Wuding
		at the proposed 10 monitoring sites/stations	per year				
Noise	LAeq	At boundary of all construction sites.	Impact Monitoring: Twice per day (once in day time and once at night time) for 2 consecutive days, twice per year	EMS	PIUs, EPBs,	1.0	0.5
Soil erosion	Inspection of topsoil stockpile and construction site rehabilitation (e.g. compensatory plantings)	At all construction sites	Internal Monitoring: At least four times per year	CSC	City/county PIUs,	Included in the CSC contract	
			External Monitoring: Twice per year	LIEC, (EEM)	EPBs	Included in TA contract and EEM contract	
Occupational health and safety	Inspection of hygiene status, availability of clean water and emergency response plans	At all construction sites and work-camps	Internal Monitoring: Monthly	CSC	City/county PIUs,	Included in the CSC contract	
			External Monitoring: Twice per year	LIEC, (EEM)	LBs	Included in TA contract and EEM contract	
Subtotal						**16.0**	**8.0**
Operation Phase							
Surface water	pH, DO, SS, NH3-N, TP, CODcr, oil, anionic surfactants	4 points along the rivers, and at the proposed 10 monitoring sites/stations	Compliance monitoring: One sampling each day, three consecutive days, four times per year	City/county EMS	City/county EPBs	5.0/a	1.0/a
Fauna	Selected fauna species, total bird and fish populations	First section of Longchuan River	Internal Monitoring: Twice per year	City/county WRBs	City/county EPBs, FBs	2.0/a	1.0/a
Flora	Health and recovery of re-vegetated areas	Along all proposed river	Internal Monitoring: Once per year	City/county WRBs	City/county EPBs, FBs	2.0/a	1.0/a
Subtotal						**9.0/a**	**3.0/a**

CODcr = chemical oxygen demand; COD_{Mn} = permanganate index; CSC = construction supervision company; EMS = Environmental Monitoring Station; EPB = Environmental Protection Bureau; IA = implementation agency; LAeq = equivalent continuous A-weighted sound pressure level; NH_3-N = ammonia nitrogen; NOx = nitrogen oxides; PM_{10} = particles measuring 10Âµm or less; SO_2 = sulfur dioxide; SS = suspended solids; TP = total phosphorus; TSP = total suspended particle;

E. Training

22. To ensure effective implementation of the EMP, the capacity of the CSPMO, LPMOs, PIUs, OPFs, CSCs and contractors must be strengthened, and all parties involved in implementing mitigation measures and monitoring of environmental performance must have an understanding of the goals, methods, and the best practices of project environmental management. The Yunnan Provincial EPB, Chuxiong Prefecture EPB and LIECs will offer training specific to their roles for the project. The main training emphasis will be to ensure that the contractors, CSCs, IAs and OPFs are well versed in environmentally sound practices and are able to undertake all construction and operation with the appropriate environmental safeguards.

23. The training program addresses immediate training needs, i.e. training needed for project personnel in order to ensure that involved institutes are well versed in environmentally sound practices and are able to undertake all construction with the appropriate environmental safeguards.

24. The training program also addresses long-term capacity building needs, i.e. for the operational phase of the project. Training will be provided by qualified experts on solid waste management planning, operation and maintenance of storm water retention ponds, strategic urban and regional planning (including strategic environmental impact assessment of urban development plans), sustainable urban transport planning, road safety, and emergency preparedness and response planning.

25. The following training programs will be delivered or organized by the project management consulting service during the course of project implementation. Training Needs Assessments will be conducted by the Project Implementation Consultant to tailor the training for maximum impact. The trainer will include in their program a before/after assessment to evaluate the success of the training. The PIC (environment specialist) will design an evaluation questionnaire to gauge the usefulness of the training/capacity building design and performance of the trainer. The evaluation will be taken into account in the trainer’s performance evaluation.

Table EMP-9: Indicative List of Training Program Related to Environment

Training program	Scope of Training	Trainer	Trainee
Procurement and contract management	– ADB's procurement process – Bidding document preparation, including EMP clauses – ADB's guideline for bid evaluation – Risk of improper procurement and mitigation measures – Handling variation orders and contract management	SCS, PMC	CSG, IAs, PIUs
Operation and maintenance of storm water retention ponds	– Basic facility operation and maintenance of storm water retention ponds – Routine maintenance and monitoring – Technical requirement – Facility management (e.g., financial management, governance, emergency response mechanism, occupational health and safety) – Innovative approach in foreign countries	PMC	CSG, IAs, PIUs
Implementation of EMP and other health and safety requirements	– EMP implementation, including implementation responsibilities, environmental monitoring, inspection and reporting, consultation and participation, mechanism of EMP review, feedback and adjustment; – Grievance Redress Mechanism (GRM), including GRM structure, responsibilities and timeframe, types of grievances, eligibility assessment; – Environment, Health and Safety (EHS) considerations during project construction and operation, including community and occupational health and safety; – Monitoring and inspection methods, data collection and processing, interpretation of data, reporting system; – Communication with the public by different means (Innovative community-based advocacy campaigns) – Prevention and control of transmissible diseases and HIV/AIDS	PMC, LIEC	CSG, IAs, PIUs Contractors, local EPBs, GRM access points, other related local bureaus (e.g., water resources bureaus)
Strategic urban and regional planning	– Policy analysis on for Chuxiong Yi Autonomous State's overall regional and urban planning – International and national good practices for strategic regional and urban planning – Regional SWOT assessment for the Chuxiong Yi Autonomous State and its small- and medium-sized cities – Strategic environmental impact assessment for urban development plans	PMC External resource person engaged by the project management consulting	CSG and IAs

Training program	Scope of Training	Trainer	Trainee
		service	
Municipal solid waste management	– International and national good practices for solid waste management – Municipal solid waste management planning approaches – Municipal solid waste management technologies and options – Data collection procedure and waste composition analysis – Stakeholder assessment – Institutional responsibility and set-up – Municipal solid waste management policy making – Public awareness program and public willingness – Use of performance indicators – Short-, medium- and long-term planning	PMC	CSG, IAs, PIUs, other related local bureaus (e.g. urban management bureau),
Sustainable transport planning	– International and national good practice for urban transport planning – Coordination with urban and regional plans – Transport demand and projection analysis – Transport data collection procedure (person-trip survey) – Stakeholder assessment – Institutional responsibility and set-up – Policies for promoting sustainable, green and inclusive urban transport planning – Public awareness program and public willingness – Use of performance indicators – Short-, medium- and long-term planning	PMC	CSG, IAs, PIUs, other related local bureaus (e.g. transport bureau),
Road safety	– International and national good practice for road safety – Road safety audit tools and approaches – Data collection for road safety – Stakeholder assessment – Institutional responsibility and set-up – Policies for improving road safety – Public awareness program and education – Use of performance indicators – Short-, medium- and long-term planning	PMC	CSG, IAs, PIUs, other related local bureaus (e.g. transport bureau),
Emergency preparedness and response planning	– Environmental accidents, mitigation measures; – Emergency response team, procedure and actions; – Flood emergency planning – Flood early warning system – Framework and mechanism to review and adapt flood protection works to climate change	PMC	CSG, IAs, PIUs, other related local bureaus.

ACWF = All China Women's Federation, ADB = Asian Development Bank, CSG = Chuxiong Yi Autonomous Prefecture Government, EA = executing agency, EHS = environment health and safety, EMC = environment management consultant, EMP = environment management plan, EPB = environment protection bureau, GRM = grievance redress mechanism, IA = implementing agency, PIU = project implementing unit, PMC = project management consulting service, RP = resettlement plan, SCS = start-up consulting service.

F. Public Consultation

26. Meaningful consultation was conducted during project preparation. The consultation process and its outcome are described in Chapter VII of this project EIA. Direct public participation was conducted as an ongoing element in the development of the sub-components. These activities were carried out by the DIs in their preparation of the FSRs and EIAs and by the Technical Assistance (TA) Consultants following PRC National Environmental Impact Assessments Technical Guidelines and Asian Development Bank guidelines and the Safeguard Policy Statement (2009).

27. Future plans for public involvement during construction and operation phases were developed during the project preparation. These plans include public participation in (i) verifying impacts and mitigation measures during the construction and operation stages, (ii) evaluating environmental and economic benefits and social impacts, and (iii) interviewing the public after the sub-components are completed.

28. Public participation plans are part of the project implementation and management plan. The LPMOs and PIUs are responsible for public participation during project implementation. They will be supported by the LIEC. The EEM may conduct his/her consultation during site visits, as needed. Costs for public participation activities during construction are included in the project funding.

Table EMP-10: Consultation and Participation Plan

Organizer	Approach	Times/Frequency	Subjects	Participants
Project preparation				
EIA preparation authors (Institutes)	Questionnaires and interviews	During field work for EIA	Project priority, effects, attitudes to the Project/ components, and suggestions	Residents within subproject areas and construction area
TA Consultants, ADB	Site visits, and public consultations	Two rounds of formal consultation in each city, 5 review missions	Comments and recommendations of affected people and stakeholders	Representatives of affected people and stakeholder agencies
TA Consultants, and LPMOs	Establish Grievance Redress Mechanism arrangements in each county/city	Ongoing	Pathway for complaints from and resolution of environmental problems in construction and operation	Affected persons, AP representatives and other stakeholders
Construction				
PIUs, LPMOs, LIEC	Public consultation through questionnaire survey, site visits	At least once a year	Adjusting mitigation measures if necessary,	Work staff within construction area; Residents within construction area

Organizer	Approach	Times/Frequency	Subjects	Participants
			construction impacts, comments and suggestions	
	Expert workshops	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinions; adjusting mitigation measures accordingly	Experts from various sectors
	Public workshops	At least once prior to mid-term review mission	EMP implementation progress, adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Representatives of residents and social sectors
Test Operation				
LPMOs, PIUs, Operators	Site visits	Multiple, depending on results of Project completion environmental audit	Comments and suggestions on operational impacts, public suggestions on corrective actions	Local residents and social sectors, EPBs
Operation				
LPMOs, PIUs, Operators	Public satisfaction survey	At least once after one year of operation	Comments and suggestions	Project beneficiaries

EIA = Environmental Impact Assessment, PIU = Project Implementing Unit, LPMO = Local Project Management Office, LIEC = Loan Implementation Environmental Consultant, TA = Technical Assistance.

G. Mechanisms for Feedback and Adjustment

29. Based on environmental inspection and monitoring reports, the CSPMO, LPMOs, PIUs shall decide, in consultation with the LIEC and the EEM, whether (i) further mitigation measures are required as corrective actions, or (ii) some improvements are required for environmental management practices.

30. The effectiveness of mitigation measures and monitoring plans will be evaluated by a feedback reporting system. Adjustment to the EMP will be made, if necessary. The LPMOs and their EMUs will play a critical role in the feedback and adjustment mechanism.

31. If during inspection, substantial deviation from the EMP is observed or any changes are made to the project that may cause substantial adverse environmental impacts or increase the number of affected people, then the CSPMO and the LPMOs will immediately consult with ADB and form an environmental assessment team to conduct additional environmental assessment and, if necessary, further public consultation. The revised EIA report including the EMP will be submitted to the ADB for review and appraisal, and disclosure. The revised EMP will be passed to the contractors, CSCs and OPFs for implementation. The mechanism for feedback and adjustment of the EMP is shown in **Figure EMP-1.**

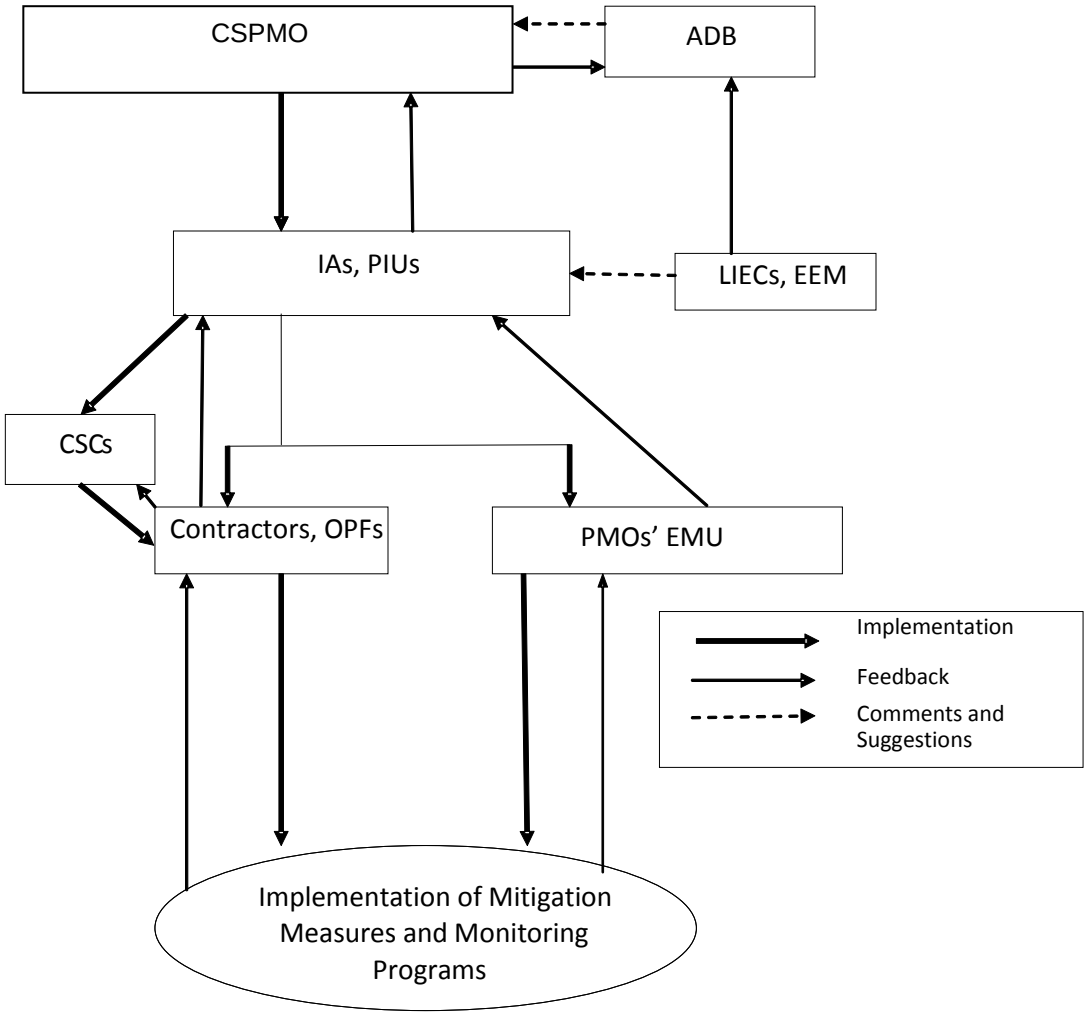

Figure EMP-1: Mechanism for Feedback and Adjustment of

H. Grievance Redress Mechanism (GRM)

32. Each IA (through their LPMO) will establish a grievance redress mechanism (GRM) to address community concerns and complaints. Grievances will most likely include disturbance of traffic; dust emissions; construction noise; soil erosion; inappropriate disposal of waste materials; damage to private houses; safety measures for the protection of the general public and construction workers; or water quality deterioration during riverbank works. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project components; (ii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations; (iii) improve mutual trust and respect and promote productive relationships with local communities

and other stakeholders; and (iv) build community acceptance for the project.

33. The GRM will be accessible to diverse members of the community and stakeholders. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available.

34. Each LPMO will establish a Project Public Complaint Unit (PPCU), which will be coordinated by the environment management unit (EMU) of the LPMO. The PPCUs will instruct contractors and CSCs if people complain about the project. The PPCUs will coordinate with the local EPBs and other government divisions, if necessary, and will be supported by the Loan Implementation Environmental Consultant (LIEC), hired under the Project Implementation Consultant Support (PIC). The PPCU will establish a GRM tracking and documentation system, including procedures to retrieve data for reporting purposes to the CSPMO and ADB.

35. The contact persons for different GRM entry points, such as contractor, operators of project facilities (OPFs), local EPB, PPCU, etc., will be identified prior to construction. The contact details for the entry points (phone numbers, addresses, e-mail addresses) will be publicly disclosed on information boards at construction sites and on the website of the local EPBs. The chart of proposed GRM is shown in **Figure EMP-2.**

36. Once a complaint is received and filed, the PPCU will identify if complaints are eligible. Eligible complaints include those where (i) the complaint pertains to the project; and (ii) the issues arising in the complaint fall within the scope of environmental issues that the GRM is authorized to address. Ineligible complaints include those where: (i) the complaint is clearly not project-related; (ii) the nature of the issue is outside the mandate of the environmental GRM (such as issues related to resettlement, allegations of fraud or corruption); and (iii) other procedures are more appropriate to address the issue. Complaints illegible to the project or the environmental GRM will be recorded and passed onto relevant authorities. If an eligible complaint is rejected, the complainant will be informed of the decision and the reasons for rejection.

37. The **procedure and timeframe** for the grievance redress mechanism are described as follows (see F**igure EMP-2**):

38. **Stage 1:** If a concern arises during construction, the affected person will submit a written or oral complaint to the contractor directly. Whenever possible, the contractor will resolve the issue directly with the AP. The contractor shall give a clear reply within five (5) days. If successful, the contractor will inform the PPCU accordingly.

39. **Stage 2:** If no appropriate solution can be found after the Stage 1 process applied (i.e., after 5 days), the contractor has the obligation to forward the complaint to the PPCU. The AP may also decide to submit a written or oral complaint to the PPCU, either directly or via one of the GRM entry points (local EPB, PIU, community leaders). For an oral complaint, proper written records must be made. The PPCU will assess the eligibility of the complaint, identify the solution and provide a clear reply for the complainant within five (5) working days. The LIEC will assist the PPCU in replying to the affected person, if needed. The PPCU will also inform the ADB project manager and submit all relevant documents. Meanwhile, the PPCU will timely convey the complaint/grievance and suggested solution to the contractors or OPFs. The contractors during construction and the OPFs during operation will implement the agreed upon redress solution and report the outcome to the PPCU within seven (7) working days.

40. **Stage 3:** In case no solution can be identified by the PPCU, or the complainant is not satisfied with the proposed solution, the PPCU will organize, within two (2) weeks, a multi-stakeholder hearing (meeting) involving all relevant stakeholders (including the complainant, contractor, OPFs, local EPB, PIU, LPMO, CSPMO). The hearing shall identify a solution acceptable to all, and formulate an action plan. The contractors during construction and the OPFs during operation will implement the agreed-upon redress solution and report the outcome to the PPCU within the agreed upon timeframe.

41. The PPCU shall accept the complaints/grievances lodged by the AP free of charge. Any cost incurred should be covered by the contingency of the project. The grievance procedures will remain valid throughout the duration of project construction and until project closure.

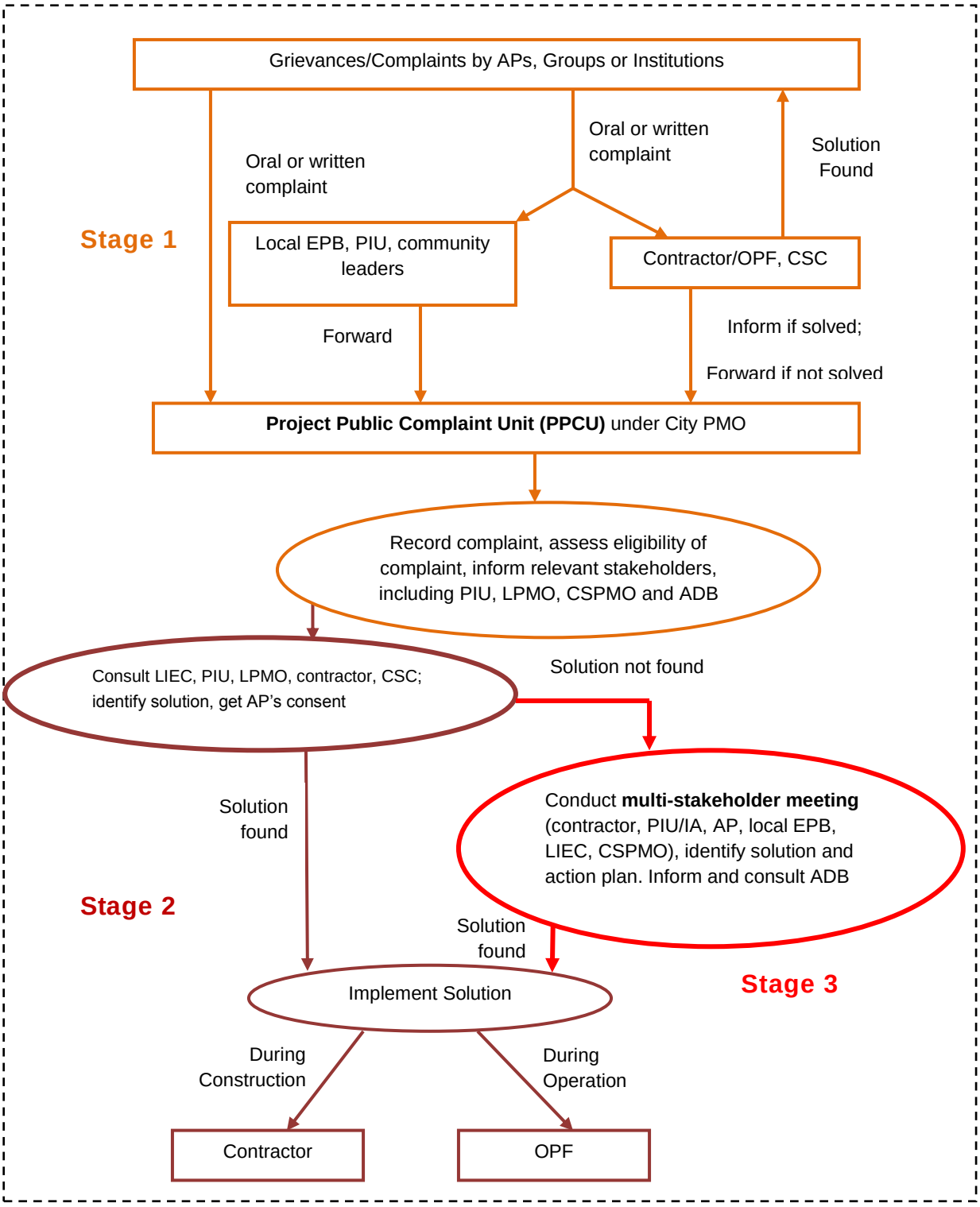

Figure EMP-2: Proposed GRM (to be reviewed and adjusted at project inception)

Note: AP = affected person, EPB = environmental protection bureau, OPF = operator of project facilities, LIEC = loan implementation environmental consultant; CSPMO = Chuxiong State project management office; LPMO = local project management office; PIU=project implementation unit; CSC=construction supervision company.