Environmental Impact Assessment (Draft)

May 2018

PRC: Yunnan Lincang Border Economic Cooperation Zone Development Project

Prepared by Lincang Border Economic Cooperation Zone Development Project, People's Republic of China for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 23 May 2018)

Currency unit	–	Chinese Yuan (CNY)
CNY1.000	=	$0.157
$1.000	=	CNY6.368

ABBREVIATIONS

ADB	–	Asian Development Bank
AH	–	Affected Households
AP	–	Affected Persons
CB	–	Construction Bureau
CRVA	–	Climate Risk and Variability Assessment
CPS	–	Country Partnership Strategy
DI	–	Design Institute
EA	–	Executing Agency
EIRR	–	Economic Internal Rate of Return
EIA	–	Environmental Impact Assessment
EMoP	–	Environmental Monitoring Plan
EMP	–	Environmental Management Plan
EPB	–	Environment Protection Bureau
FIRR	–	Financial Rate of Return
FSR	–	Feasibility Study Report
GHG	–	Green House Gas
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
LBECZ	–	Lincang Border Economic Cooperation Zone
LDI	–	Local Design Institutes
LEPB	–	Lincang Environmental Protection Bureau
LMDRC	–	Lincang Municipal Development and Reform Commission
LMFB	–	Lincang Municipal Financial Bureau
MASL	–	meter above sea level
MCM	–	million cubic meter
MOU	–	Memorandum of Understanding
MSL	–	Mean Sea Level
O&M	–	Operations and Maintenance
PMO	–	Project Management Office
PRC	–	People's Republic of China
RCI	–	Regional Cooperation and Integration
RoW	–	Right of Way
RP	–	Resettlement Plan
SEPP	–	Soil Erosion Prevention Plan
SPS	–	ADB's Safeguards Policy Statement 2009
TA	–	Technical Assistance
WTP	–	Water supply treatment plant
WWTP	–	Waste water treatment plant
YEPB	–	Yunnan Provincial Environment Protection Bureau

WEIGHTS AND MEASURES

1 ha	–	1 hectare=10,000 sq. meters = 15 mu
km	–	1 kilometer = 1000 meters
kV	–	1 kilovolt =1,000 volts
1 mu	–	Chinese unit of area (15 mu = 1ha, 1 mu=666.7 square meters)
1 ton	–	1000 kg

GLOSSARY

project site	–	individual sub-project site
project area	–	13 project sites funded by ADB
assessment area	–	Lincang Border Economic Cooperation Zone
project influence area	–	Gengma County including Zhenkang and Cangyuan Counties

NOTES

(i) The fiscal year (FY) of the People's Republic of China and its agencies ends on 31 December. FY befo a calendar year denotes the year in which the fiscal year ends, e.g., FY 2017 ends on 31 December month 2017.

(ii) In this report, "$" refers to US dollars.

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PREFACE

This document describes the environmental studies conducted for the Lincang Border Economic Project. These studies were conducted between 2017-2018 on behalf of the Project Proponent - The Lincang Border Economic Cooperation Zone (LBECZ) Project.

This Environmental Impact Assessment (EIA), prepared according to the Asian Development Bank (ADB)'s Safeguard Policy Statement (SPS) 2009 for evaluation of project impacts and mitigation measure, comprises of the following:

- Environmental Management Plan (EMP) prepared to comply with the ADB's SPS 2009.
- Environment Monitoring Plan (EMoP) and Grievance Redress Mechanism, including public disclosure according to ADB SPS 2009.

The report comprising EIA document is arranged as follows:

EIA Document: Environmental Impact Assessment including Environmental Management Plan

This Main body of the document presents the final assessment of the environmental impacts of the Lincang Border Economic Cooperation Zone Project and the cumulative impact assessment of the Lincang prefecture prepared in compliance with ADB SPS 2009 policy.

Annexures 1-11 includes Environment Management Plan, Public Consultations held in 2018, Environment Monitoring program; Consent by Lincang Environmental Protection Bureau, Lincang Water Resources Bureau to the LBECZ, Water allocation agreement, annual GHG Estimation affected by project.

Appendixes 1-4 includes Biodiversity Report and Water, Soil Conservation Plan and the Climate Risk and Variability Assessment for the area is attached. The reports are attached separately. Appendix 4 consists of a summary of the Water Resources Allocation Report prepared for water supply requirements for LBECZ.

EXECUTIVE SUMMARY

1. The project covers three Chinese border cities/towns, namely Qingshuihe, Zhenkang and Cangyuan as shown in Figure 1. 4, along the China-Myanmar border in Lincang prefecture in Yunnan Province in China. The project area is a much less developed area in comparison to other parts of the country in a remote mountainous area. Most of the populations are ethnic minorities consists of Wa, Dai, Yi, Miao, Bai etc. This part of China shares a long inland border with Myanmar without very obvious physical separations, and many local residents from both countries are from the same ethnic groups with similar living styles and habits, and share the similar culture, language, habits and economy. The interactions and exchanges of merchandise as well as border trades have existed throughout the long history of the area. The Asian Development Bank (ADB) and PRC government reached an agreement to use ADB loan of $250 million with a similar amount of counterpart fund from PRC local government for the improvement of regional cooperation and integration facilities and infrastructures to promote the regional cooperation and local economic development.

Introduction

Components and Summary Environmental Issues

2. The EIA report comprises of baseline data on the existing condition of the physical and biological environment, the anticipated environmental impacts, proposed mitigation measures, monitoring frameworks, grievance procedure and public consultations. The consultant team undertook field surveys to sub-project sites to assess the physical and biological environment – factors such as site ecology, management of construction, sanitation, use of equipment and machineries, environmental health and safety, occupational hazard etc. The environment management and monitoring plan have been dealt with in detail in the respective sections of the report. A generic environment management plan has been attached separately. However, a summary list of key impacts on environment parameters are briefly enumerated in **Table 1** below:

Table 1: Summary Impacts on key environment parameters

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures
1	Air Quality	High	Large scale air emission from the construction activity during cutting/filling /stacking/storage of soil, construction material at site	Sprinkling of water, proper handling of excavated soil, construction material, banned substances/VOCs etc.
2	Water Quality	Medium	The project will require huge quantities of water for construction. No hazardous effluent is envisaged to be discharged during construction	The required water will be sourced from tankers by the Construction contractor. Domestic effluent shall be discharged in tanks which will be cleaned regularly and waste thrown at urban body's solid waste management site.
3	Soil Quality	High	Government/private land is available.	Construction contractor to ensure proper housekeeping, sanitation

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures
				and cleanliness at work site.
4	Noise Quality	Medium	The construction activity may lead to noise pollution during concreting –steel cutting, bending, casting using vibrators, operation of mechanised equipment and drills etc. that will affect the residents of the area. Small noise related installations within shell structure may continue beyond school holidays at Qingshuihe school.	The Qingshuihe school shall be closed for summer vacation during shell construction of the building to minimize disruption. Noise monitoring will be done at regular intervals. If any night construction activity that is noise intensive is undertaken at this school areas, neighbourhood must be consulted to determine suitable timings.
5	Hazardous Substance – eg. VOCs	Minimal	Buildings such as Hospital, school, offices will not contain any Hazardous substance.	Construction design that contains using any hazardous material will not be selected for implementation.
6	Terrestrial Ecology	High	No EN or CR species of amphibian/reptile fauna removed from site. No ecologically sensitive place (protected area/reserved forest/Important flora and fauna species) within 5 km radius from each sub-project site	Tree replantation to be carried out at the designated green belt areas. For terrestrial fauna, catch and release programs to be implemented during the project implementation. Regular Monitoring to be implemented. The afforestation to be implemented annually in each county to compensate the loss of timber land.
7.	Aquatic Ecology	Medium	No EN or CR species of aquatic fauna at site. Only two NT fish migrate passing across bridge area.	Construction over water during April-June to be avoided due to spawning period and vibration and drilling between June-September due to migration upstream.
8	Health and safety of local community members and workers	The construction phase increases the risk of communicable and vector-borne diseases (Malaria, Dengue Fever, HIV/AIDS, other STIs), traffic injury	Vector-borne and communicable disease risks are present given the location of the project site. The risks are well known and accepted as part of the construction of projects where a mobile worker population is required.	A rapid HIA is currently being conducted that will inform a Public Health Management Plan as standalone or as part of the Environmental Management Plan.

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures
		and mortality and can risk a number of determinants of health if not identified and managed appropriately. The above is applicable for both the workforce and local community members.		

3. **Table 2** below gives key features, including environmental issues (if any) for the sub-projects:

Table 2: Key features and environmental issues for each Sub-project

No	Sub-Project components	Key features of sub-project component	Environmental Mitigation issues
Infrastructure Construction and Comprehensive Development Project of Yunnan Lincang Border Economic Cooperation Zone			
A	**Cross Border Capacity Improved**		
1	Qingshuihe Border Trade Facilities - Border resident trade market	Land area is 320.44 mu. Construction Area: 213,629 m^2 Building Area: 107,454 m^2	6110 Rubber trees cut. Sloping hill side. Large cutting and filling of land involved, soil and water erosion, associated/linked utility facilities such as roads, power, water supply, waste water, and solid wastes
2	Qingshuihe Border Trade Facilities- International Cooperation Area	533.4 mu, with constructions of bulk commodity logistics zone, general warehousing and logistics zone, warehousing, workshop buildings for production and processing, and service buildings, with a total floor area of 171,633 m^2; exterior components including access roads, parking lot, landscaping, etc.	9,124 Rubber trees cut. Sloping hill side. Large cutting and filling of land involved, soil and water erosion, foundation design and ground water drainage, associated/linked utility facilities such as roads, power, water supply, waste water, and solid waste and hazardous wastes, type of industry- polluting/non-polluting, labor migration etc.
3	Qingshuihe Border Trade Area Roads	475.56 mu Roads no 1-6 comprising 5.07 km within the core zone of Qingshuihe Border Port area	18,829 Rubber trees, Restoration of road sides, tree cutting, green belt plantations, earthwork balance, road drainage systems, design of water supply, sewage, power lines
4	Nanting River Bridge	Nantinghe Bridge and connecting road to Mangka Border Crossing, Nantinghe River, starting from; Nantinghe No.1 Bridge, 400 meters in length and 50m in height	No EN and CR species in the river (bio-diversity), pier construction on river banks, tree, Green Belt, connected to road tunnel (an associated facility), water quality in river, removal of debris from river bed, avoid migration paths of fish (if any)
B	**Integrated urban environmental infrastructures Qingshuihe border area improved**		
1	Qingshuihe Border	Water treatment plan with a capacity	900 Rubber trees and 1800 shrub trees

No	Sub-Project components	Key features of sub-project component	Environmental Mitigation issues
	Area Water supply System	of 20,000 m^3/d and 32 km transmission pipe lines, 28.1 km distribution pipe line. Land area: 75mu.	cutting. Water resources assessment using long term hydrological data series, Water allocation and sustainability of the water sources, Agricultural land, odor, sludge disposal system, quality of waste water disposal
2	Qingshuihe Border Area Wastewater Treatment System	Capacity of 10,000m^3/d; and sewage pipelines of 28.1 km. Land area: 2.38ha.	1030 rubber trees cut and agricultural area cleared. Conduct water quality modeling to assess the impacts of water quality after discharging the effluent into Qingshuihe river and Nanpa river, trees, agricultural land lost, sludge disposal plan, odor. Length of sewage lines, gravity disposal, green belt development
3	Qingshuihe Border Area and Mengding MSW Management	MSW management system of 6 MSW collection stations with toilet in Mengding and a 27 t/d transfer station and two collection stations with capacities of 7 t/d and 8 t/d in Qingshuihe as well as the MSW handling equipment for both towns	200 Rubber trees cut. Leachate disposal strategies, Residents around the project sites might be affected by odor, sanitation, water, air, and noise from the collection vehicles. Potential impacts include traffic congestion, threat to public safety, agreements with landfill sites.
4	Qingshuihe Border Area River Rehabilitation	Rehabilitation for 3.43 km of Qingshuihe River and Nanpa River rehabilitation of 1 km, including engineering measure and biological improvements, and sewage inceptors along the river. Clear water channel of 51,923m^2, greening area 66,568 m^2, and permanent foot print of 131,298 m^2	2000 Rubber trees cut and 3500 shrub cut. Design for bank embankments, measures for containment of soil erosion, drainage and storm water flow with eco-friendly design, river bed sediment, bottom cleaning and disposal, downstream impacts, biodiversity plan, green belt development.
5	New Energy Public transport facilities	A land area of 10mu at Mengding and 12 mu at Qingshuihe area; One of each electric charging station in Mengding and Qingshuihe and purchase of 6 new energy buses	Facility design depicting charging stations and transformers location, Arrangements for storage and disposal of batteries, oils and workshop management. Traffic safety, sustainable public transport management
C	**Social Infrastructure and service improved**		
1	Cangyuan Guomen No 2 Elementary School	Total building area; 18,311 m^2. Land area 47.13 mu. Teaching building, multiple-use building, student dormitory, canteen, sports room, track and field, gymnasium, flag-raising platform, parking lot, etc. and teaching equipment.	Vacant plot of land that is divided by a stream and has adjoining housing and shopping areas, comply with the flood prevention Code, noise and congestion on roads
2	Qingshuihe Guomen Elementary School Upgrade	Total building area = 7,691 m^2. Canteen, student dormitory and track and field; and teaching equipment.	Demolished material to be disposed of at two demolished material disposal sites finalised by local government, connectivity to new sewage system, construction in holiday season, student health and safety
3	Zhenkang Sino - Myanmar Friendship Hospital	Class 2A general hospital with 500 inpatient beds, and a building area of 56,0098.46 m^2, medical equipment and devices. Land Area 40 mu.	Power transmission line is passing above the project site, solid waste, medical waste, water supply, storage and transfer locations onsite, drainage of storm water
4	Qingshuihe Hospital	Class 2A general hospital with 100 inpatient beds, and a building area of 8,946 m^2, and medical equipment and device.	1650 Rubber trees cutting. Solid waste, medical waste, water supply, storage and transfer locations onsite, drainage of storm water, tree cutting, green belt

No	Sub-Project components	Key features of sub-project component	Environmental Mitigation issues
			development
D	**Institutional capacity of involved agencies Improved**		
	No environmental issues – mostly trainings, monitoring and reporting		

4. Potential impacts are mostly temporary, predictable, and reversible, and can be mitigated through adherence to national[1] and international standards[2], design criteria, and/or implementation of Environment Management Plan (EMP). Project components are proposed on government/community owned lands and the location is not situated close to any sanctuary/protected areas or any other environmentally-sensitive areas. Utilization of the best available technology and best management practices are built-in to the project design and listed through EMP.

5. EIA including EMP has been prepared to mitigate the potential adverse impacts of construction. The project components are proposed only on land owned by the Government or community lands thereby requiring some acquisition of land from the surrounding communities. Environment Monitoring requirements have also been elaborated in the report.

6. For most of the proposed project components, their Feasibility Status Reports (FSR) (technical reports) have been finalized after conducting detailed physical survey of the land through technical experts/firms engaged by the EA under the project. The construction will be done mostly avoiding existing community houses, buildings, trees or any other existing settlement directly related with the livelihood of people. As assessed, the project benefits outweigh the negative impacts. The negative environmental impacts are likely to be associated with construction activities of the building, roads, bridge, tunnels etc. mostly related to - noise during construction, transportation of construction material to site, disposal of waste soil, and inconvenience to neighbouring communities to increased traffic due to new building/road/tunnel construction activities.

7. During site visits, the officials and consultants made numerous observations and held discussions with LBECZ Project Management office (PMO) and local communities which would be helpful for project design (summarized below):

(i) noted location of proper access roads, laydown area for materials to be used by the construction companies to use without disturbing the adjoining land area for working and minimizing utilization of populated areas,
(ii) proper discussion on avoidance of underground existing pipes for water, heating, sewage etc. at these proposed work sites,
(iii) discussions on ensuring right of way for construction vehicles and provide traffic safety during construction to local residents living adjoining these project sites (specially near two schools),
(iv) traffic caused by construction of new buildings/expansion projects by use of concrete, dump trucks etc. transporting materials inside two school premises;
(v) discussed traffic safety for children and their parents during operations of school in normal

[1] Relevant PRC Standards mentioned in section 2 later

[2] World Bank/IFC Environment Health and Safety guidelines 2007

work hours (for Qingshuihe Guomen School),

(vi) review the distances of these project sites from non-sensitive biodiversity areas and cultural heritage sites to ensure minimal impact,

(vii) dust and noise emissions from the construction subprojects and their impacts on two school children and apartment dwellers adjoining the sub-project areas,

(viii) noises from any surroundings areas during construction and operations,

(ix) review the impact of project activities on linked/associated facilities to the project, and

(x) Determine the offset required for carbon sequestration and increase in emission due to reduction of carbon sink, increase in vehicular emissions, construction project and operations of schools, hospitals, water treatment plant (WTP), waste-water treatment plant (WWTP), solid waste management (SWM), trade and production activities. Review options to reduce climate change vulnerability for each sub-projects.

8. The project construction is in accordance with the Regulatory Detailed Plan for Mengding Qingshuihe River Area of Lincang Border Economic Cooperation Zone (2015-2035) and Overall Planning of Lincang Mengding City (2011-2030). No proven mineral resources or mineral overburden have been found within the scope of construction land of the planned project by now. The Project does not involve any nature reserve, scenic spot, drinking water source conservation area, basic farmland preservation area or other areas requiring special protection. Therefore, the construction of the project conforms to the national industrial policy and the relevant planning.

9. The consultant team along with PMO and local government officials conducted two rounds of public consultations with the public residing in these sub-project areas to sensitize them about project activities, their impacts and get their suggestions. The project has received a support rate of 100% from the local community during the public consultation survey carried out by the Employer as most local people believe that the project is conducive to local economic development and generate employment. They have also proposed expectation for attaching importance to environmental protection issues and vital interests of local residents.

10. The region possesses good quality of ambient air and water environment quality. The data regarding soil, topography, contour, land cutting and filling required, distance from water body and distance from major roads, details of trees cut, land details will be collected by Design Institutes/engineering firms. If sites are changed other than those indicated in the EIA, supplementary information will be supplied for each of new location for these subprojects by LBECZ Project Management Office (PMO) to ADB for prior approval before finalizing design drawings.

11. Before start of construction, the Construction contractor shall procure all requisite regulatory approvals from all concerned authorities. Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs in the EIA. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures as per the EMP by the Construction contractor.

12. During the construction period, the social and living environment will be affected, such as traffic barrier, land acquisition, noise and vibration caused by construction, construction dust,

earthwork excavation and so on, which will affect the residents' normal life, rest and learning environment. Some of the adverse environmental aspects that need to be addressed in the EMP include:

Air Pollution

- Air pollution at project sites due to dust generated in the surrounding environment can be minimized by such measures as watering and shelters, and the sensitive locations nearby will be slightly impacted.
- The exhaust emission from construction vehicles will have temporary impact during impact and will have little impact on ambient air during operations.
- Due to stench from sewage treatment, the plant should not be put up within 50 m each side of living amenities (called as sanitary protection zone) and afforestation around the plant boundary shall be enhanced.

Waste-water

- Construction wastewater to be collected for sedimentation process in the sedimentation basins to be used later.
- Domestic sewage generated by construction personnel to be used to water at sites to control dust after sedimentation process; sewage discharge of the project has little impact on surface water.
- Surface runoff will be collected for sedimentation process in the grit basins and discharged to gullies nearby. The roads will be provided with rainwater and sewage pipe network after put into operation.
- No sewage is planned to be discharged into Nanting River under normal condition. Wastewater generated by sub-projects infrastructure during operation will be discharged to municipal sewage pipe network embedded in roads nearby after pretreatment to be eventually sent to the sewage treatment plant in Qingshuihe River Area.
- Corresponding environmental protection measures in the project decreases pollutant discharge, reduces the pollution load on Nanting. All pollutants in sewage water in Nanting River can meet the regulatory requirement for discharge into river.

Soil and soil erosion

- The abandoned earthwork excavated during the construction of the project to be returned to the site of the construction land of Qingshuihe River Area for leveling and backfilling without setting up a special waste disposal site.
- To prevent secondary contamination produced such as water and soil loss as well as airborne dust when earthwork is backfilled in the low-lying area in Qingshuihe River Area, the backfilled earthwork must be timely compacted. In addition, the surface soil excavated during the construction of the project shall be deposited in the green belt of each subproject.

Waste management

- The construction waste generated in the construction process shall be recycled and utilized as backfill for land leveling in Qingshuihe River Area.
- Household garbage generated in the construction period will be collected and treated by an

entrusted environmental sanitation department. Solid waste will be properly disposed in the construction period to generate little impact on the external environment. All solid waste generated in the operation period must be properly disposed.

- The hospitals shall perform complete classification, collection, management and disposal of solid wastes during operation to prevent bacteria-bearing solid wastes from being mixed with household garbage or discarded at random thereby exerting minor impacts to the external environment.
- Disposal of sludge generated in construction project and heavy metal pretreatment system of the Project that adopts activated carbon absorbent in heavy metal wastewater treatment and detection by chemical precipitation method, which will generate certain weight of heavy metal sludge and exhausted activated carbon, and being a hazardous waste, it should be cleaned, transported and disposed by entrusting its disposal to company with relevant qualifications.

Ecology conservation

- Trees, flora and fauna shall be impacted adversely during the construction. Green belts will be constructed at all facilities offsetting the removal of about 47,234 rubber trees and 5,300 shrub trees by twice the number to offset GHG sequestration damage to the project area.. The county governments have the afforestation plan in each year to compensate the loss of timber land, which also offset GHG emission and biodiversity loss in project area.
- After completion, the operations of project components exert minor impacts on the plant resources in the assessed area. Most buildings are used for warehousing logistics, almost no effect on plants; after the road for the projects is completed, vehicle passing will produce dust and vehicle exhaust, but exert minor effect on ecological environment through filtration and purification by greening facilities.
- Generally, the terrestrial flora has low conservation values due to the extensive human intervention and occupation. Seven terrestrial fauna including five national protected animal species and two 'Vulnerable' (VU) species by the IUCN Red List, such as Soft-shell Turtle *Pelodiscus sinensis* and King Cobra *Opiophagus hannah*, were recognized as the vulnerable (VU) by IUCN RedList.
- Taking into account of the world population estimate and geographical distribution ranges of five NPAs and two VU reptile species, together with their population number and habitats in the project area, the two NPAs such as Tiger frog and Tokay gecko have low conservation values, and the other five species including three NPAs such as Common buzzard, Great coucal and Asian water monitor, and two VU reptile species such as Chinese softshell turtle and King cobra have medium conservation values, but not significant.
- The terrestrial fauna are widespread and common species, which can adapt to the new habitats very fast. The population size of Chinese softshell, Tokay gecko, Asian water monitor and King cobra are rare because the river beaches of Qingshuihe River and Nanpa River in the project area have been almost developed for garden fields. The land clearance may destroy the nesting habitats of some birds, and hibernation ground of amphibians and reptiles. With the high intensive human activities in project area, these impacts would be very limited.

Aquatic flora and fauna

- Construction of bridge over the Nanting River will cause certain impact on the river water body, especially disturbance to the river bottom and scattering of drill slags will increase concentration of suspended solids in some water body.
- River rehabilitation of the Qingshiuhe River will cause sediments in the river and would lead to disturbance of river banks, river bed and lead to negative impacts on riverine flora and fauna.
- 48 fish species were identified in Nanting River system, which do not include any protected fish species in national and provincial levels. However, *Anguilla nebulosi* and *Bagarius yarrelli* are recognized as near threatened (NT) by IUCN RedList. In addition to two endemic fish (*Neolissochilus baoshanensis* and *Balitora nantingensis*), the four fish were recognized as the conservation targets by the NAGR in lower reach of Nanting River.
- The four fish are assigned with medium conservation values according to the category of IUCN RedList. However, the four fish are assigned with high conservation values based on the PRC standard. The main considerations include: (1) The Nationally Protected Animal List (NPAL) was issued in 1989, which cannot reflect the actual situation of population status and distribution of partial wild animals in China with the availability of limited information. (2) The State Council of PR China established the National Aquatic Germplasm Reserve in the lower reach of Nanting River in 2013, aiming to protect these four endemic fish. That means the four fish have been given the conservation with higher priority, even they are not under the NPAL. Therefore, we defined them as the fish species with high conservation value. Considering the proposed Nanting Bridge is designed as three span twin cable staged style, the construction will have limited impact on the fish migratory path. Therefore, we defined them with the medium conservation value in this report.
- For the habitats, the river course of proposed Nanting Bridge has the relatively medium conservation value for fish migration. The river course in the vicinity is the important migration pathway of migratory fishes from Salween River and India Sea, especially for the two NT fish species under IUCN RedList and the other two fish species (*Neolissochilus baoshanensis* and *Bagarius yarrelli*) identified as the conservation target by the National Aquatic Germplasm Reserve in the Lower Reach of Nanting River. The reserve is located 6.8 kilometers in the upper reaches of Nanting Bridge.
- The potential spawning site for fish laying floating-eggs is identified, which is located over 2.7 kilometers in upper reach of proposed Nanting Bridge. The total length of river course with potential spawning area is 5.9 kilometers.
- The integrated biodiversity Assessment Tool (IBAT) was accessed to determine the category of documented flora and fauna affecting the project. The description of the Nanting River area and Nangunhe national reserve are attached in **Annexure 9**. This shows there is no EN or CR variety of fish and fauna in the project areas.
- Road runoff of the Project in the operation period will generate little impact on the water quality along the river, which will neither change the current level of water quality nor affect the aquatic organism.

Vector-borne and other Communicable Diseases

- The project site is located in an area where new cases of important vector-borne and communicable diseases occur.
- The project will require a migrant workforce during the construction phase.
- The project area already sees a mobile population, primarily from Myanmar, which is an additional source location for vector-borne and other communicable diseases.
- The above scenario places the risk of transmission as high. As such, a standalone rapid HIA is currently being conducted which will inform the development of a public health management plan chapter as part of the EMP. This is required to protect community members and workers alike.

Traffic Injury and Mortality

- The project will involve a complex construction phase with multiple sites. This will increase traffic in the project area
- Increased industrial traffic can increase the risk of traffic related injury and mortality rates, especially in rural areas where road users are diverse, road user behaviors are typically poor and road conditions are subpar.
- To prevent traffic injury and mortality a standalone rapid HIA report will begin to identify risks, a Public Health Management Plan chapter as part of the EMP will identify risk mitigation measures, and a traffic risk assessment will be undertaken prior to the start of construction to develop a traffic plan to minimize the risk of injury and mortality to local community members.

13. An Emergency Response Program will be prepared by Contraction Company in consultation with Environment Supervision consultants of the PIUs. ERP training will be provided to all stakeholders in the project construction and operations stages.

14. Mostly rubber tree plantation areas and agricultural lands have been selected for removal for the proposed project components. The loss of vegetation area caused by the construction of this project will mainly result in the decrease in the number of plant species but that will not lead to the disappearance of species; will not have obvious adverse effects on the plant resources and plant species diversity in the area and will not have major adverse effects on the plant species and their distribution. The surface plants damaged by project construction are mainly rubber and the land occupation of the project does not belong to basic farmland preservation area.

Linked /Associated Facilities

- The project has been assessed to consist of seven linked facilities. There are no associated facilities[3] in the project:
- Solid Waste Management Sites:
    a. The entire solid waste collected from LBECZ would be transported to Mengding Municipal Solid Waste site for its disposal.

[3] According to ADB SPS 2009, the associated facilities that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

b. The solid waste from the hospital site would be transported to the Fenqing Solid Waste Management site.

- Medical Waste Management Sites:
  a. Lincang Jinsheng Medical Waste Disposal Company, the medical waste handling agency appointed by Lincang government will transfer the medical waste collected from Qingshuihe hospital would be transported to Lincang Municipal Medical Waste Centralized Disposal Center.
  b. The medical waste from the Zhenkang hospital site to the under construction Liying Medical Waste Treatment Center in Fengquing city. Lincang
- Traffic tunnel to be constructed as on the road connecting to the China Myanmar Avenue to the Mangka border. China-Myanmar Avenue that connects to this tunnel and road is not an associated facility. However, the tunnel is dedicated to this road between China-Myanmar Avenue to Mangka border road via the bridge and therefore an associated facility for the project.
- China Myanmar Avenue (Phase I and II) are under expansion by the government and will be completed by December 2018.
- Water Supply Downstream facility: Electrical hydropower plant is entirely dependent upon water supply from water reservoir at the base of Nanting Nature Reserve along with Mengding town. However, the water supply will also be extended to LBECZ through water pipeline thereby reducing amount of water available for generation by the plant in some periods of lean flow. The electric power generation of the facility may be affected for some period due to lack of sufficient water to generate electricity. No upstream facility is connected upstream to this sub-project. Approval of Lincang Municipal Water Affairs Bureau on the Water Intake Permit Application of Mengding Qingshuihe Port Area Water Supply System No.6 Document dated April 27, 2018 has accorded to the project.

CO_2 Sequestration

15. Based on the environmental survey carried out during the study, one notable negative environmental impact of the Project is the requirement to cut 47,324 rubber trees and removal of 5300 shrubs resulting in a reduction in CO_2 sequestration. Besides carbon monoxide (CO) and CO_2 emissions will increase due to increase of traffic while CH_4 would increase due to waste water and sewage in the area. Appropriate offset mechanism will be required for carbon sequestration as well as offset increase in emission due to reduction of carbon sink, construction and operation of project facilities. ADB SPS 2009[4] requires adequate GHG mitigation procedures to be adopted to reduce

[4] Notes on GHG Emissions from SPS 2009
Page 38, Appendix 1 **e. Greenhouse Gas Emissions**
39. The borrower/client will promote the reduction of project-related anthropogenic greenhouse gas emissions in a manner appropriate to the nature and scale of project operations and impacts. During the development or operation of projects that are expected to or currently produce significant quantities of greenhouse gases,[10] the borrower/client will quantify direct emissions from the facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project. The borrower/client will conduct quantification and monitoring of greenhouse gas emissions annually in accordance with internationally recognized methodologies.[11] In addition, the borrower/client will evaluate technically and financially feasible and cost-effective options to reduce or offset project-related greenhouse gas emissions during project design and operation, and pursue appropriate options.

[10] Even though the significance of a project's contribution to greenhouse gas emissions varies between industry sectors,

GHG emission footprint. Some agriculture may also be impacted for which compensations will be paid by the EA. Based on domestic procedure, tree replantation costs are paid for Forestry Bureau during land acquisition. It has been already included into PR budget table with total 20.8748 million yuan for all project components. The annual Carbon Emission Balance for the project has been calculated at 35,890 eTCO2 Emission Increase (Annexure 11).

16. Upon completion, a new traffic environment will be provided, which will change the poor transport condition of the original urban road. The Project will stimulate the development of education, community and economic development of the area. The implementation of the Project can accelerate the infrastructure construction in the Lincang Border Economic Cooperation Zone, complete the road network structure in the area, save energy, improve the service levels of social undertakings such as education, medical, environment, sanitation etc. and promote the rapid economic development in the area. The project will bring long-term sustainable development, considerable social, environmental and economic benefit.

17. The Project is consistent with industrial policies and relevant planning in China. The project site does not involve any natural reserves, tourist attractions, drinking water source protection areas, basic farmland preservation areas and other areas needing special protections. The operation of the Project will bring some impacts on ambient air, water environment, acoustic environment and ecologic environment, but will not change the local environmental functions. Strictly implementing the requirements in this report can avoid and solve those impacts. Exhaust, noise, solid waste and wastewater arising from the operation of the Project can all be treated with relevant treatment measures. Emission to standard can be realized at each source of pollution.

18. The EIA and its appendixes present the results of the environment impact assessment conducted for the project. Based on the LEPB Guidelines of PRC, the proposed project requires preparation of an EIA. The domestic EIA document was prepared by LBECZ has also been approved by the LEPB for the project. The LBECZ will fulfill any environmental mitigation measures during construction and operation stages of the project and its linked facilities in future. Accordingly, the environmental classification for the project is Category A. This Environment Impact Assessment (EIA) document prepared for ADB approval is consistent with ADB's SPS 2009.

19. To sum up, this EIA has a premise of strictly implementing various pollution control measures and strategies based on three-synchronism policy (i.e., design, construction and production in synchronization), is consistent with the social, economic and environmental coordinated development policy and the principles of assessment in China, and will be feasible for environmental protection.

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the significance threshold to be considered for these requirements is generally 100,000 tons of carbon dioxide equivalent per year for the aggregate emissions of direct sources and indirect sources associated with electricity purchased for own consumption.

11 Estimation methodologies are provided by the Intergovernmental Panel on Climate Change (IPCC), various international organizations, and relevant host country agencies.

1.0 INTRODUCTION

1.1 Background

1. The People's Republic of China (PRC) Government has requested the ADB to provide a $250 million loan project to fund part of the long-term investment needs for implementing Yunnan's strategies on enhancing RCI and to support the development plan of the LBECZ and of the border counties of Zhenkang, Cangyuan Wa, and Gengma Dai and Wa.

2. ADB approved a Transactional Technical Assistance (TRTA) facility for preparing Regional Cooperation and Integration (RCI) projects in the PRC on 12th September 2017. This TRTA facility allocated a total of $600.000 to assist the Government in preparing the Yunnan Lincang Border Economic Cooperation Zone Development Project. Subsequently a Project Concept Paper (PCP) for this project was approved by ADB on 28th September 2017.

3. Lincang Prefecture is situated in the southwest of Yunnan Province and shares a 290-kilometer (km) long border with Myanmar. It has the potential to become an important trade gateway for the PRC to reach the Myanmar ports on the Indian Ocean and facilitate access to strategic sea trade routes towards South Asia, the Middle East, and ultimately Europe. However, Lincang Prefecture's poor infrastructure and low competitiveness of its second- and third- tier cities have become a bottleneck for enhancing cross-border trade and achieving sustainable economic and social development. Lincang Prefecture is also characterized by significant levels of poverty among urban and rural populations which include large numbers of Myanmar nationals that live and work in the border counties.

4. The development of the LBECZ is firmly set in the PRC's national and provincial strategic frameworks for enhancing regional RCI. Yunnan province has mainstreamed RCI into its own Thirteenth Five-Year Plan, with emphasis on prioritizing the development of economic corridors and the improvement of cross-border connectivity while highlighting the importance of cross-border cooperation as a way to enhance the benefits for neighboring countries, especially Myanmar. Yunnan's action plan for RCI includes a list of priority investments for the development of the Lincang economic and transport corridor and these are intended for financing by various sources including the PRC central and Yunnan governments, multilateral development banks, and the private sector.

1.2 Project Impact and Outcome

5. The project impact is the regional cooperation enhanced and the regional economic development improved in the border areas in both China and Myanmar. The project outcome is the improved border port facilities, infrastructures, municipal services, environment and living standards.

1.3 Project Outputs

6. The project will build new border port facilities to improve the cross border trade capacity including the import and export goods handling facilities and border resident trade market. It will

also provide border port access roads and urban infrastructures, build new municipal service facilities to improve living condition and environment in the border town, and build new hospitals and elementary schools to improve the social service for the border area. The proposed project will have four outputs:

Output 1: Cross border trade capacity improved. This project component includes: (i) construction of a border resident market of 93,072 m^2; (ii) construction of an international production cooperation area of 171,633 m^2; (iii) construction of 5 urban branch roads with a total length of 4.55 km; (iv) build a new 350 m bridge with the approach road and rehabilitate 523m existing Class II road to connect Qingshuihe and Mangka border path.

7. **Output 2: Integrated urban environment infrastructures in Qingshuihe border areas improved.** The component includes (i) Qingshuihe water supply system of 20,000 t/d capacity with 32.0 km water transmission line and 28.1km water distribution line; (ii) Qingshuihe wastewater treatment plant of 10,000 t/d capacity with 28.1 km sewer piping network; (iii) MSW management system of 6 MSW collection stations with toilet in Mengding and a 27 t/d transfer station and two collection stations with capacities of 7 t/d and 8 t/d in Qingshuihe as well as the MSW handling equipment for both towns; (iv) Qingshuihe River rehabilitation for flood and pollution control of 3.43km and Nanpa River rehabilitation of 1 km; (v) One of each electric charging station in Mengding and Qingshuihe and purchase of 6 new energy buses

8. **Output 3: Social infrastructure and services improved.** This component includes (i) construction of a new Cangyuan Guomen No. 2 Elementary School with a total capacity of 1080 students and total building area of 18,311 m^2; (ii) construction of new Zhenkang Sino-Myanmar Friendship Hospital of 500 inpatient beds in Zhenkang with a total building area of 56,009 m^2; (iii) construction of Qingshuihe Hospital of 100 bed capacity with a total building area of 8,946 m^2; and (iv) upgrade of Qingshuihe Guomen Elementary School with a new classroom building, a new student dormitory and a new cafeteria with a total building area of 7,691 m^2.

9. **Output 4: Institutional capacity of involved agencies improved**. This component includes project implementation management and support, monitoring on environmental, resettlement, social and ethnic minority, training and study tours, and technical assistance on border trade and logistics improvement, teacher training, healthcare service and hospital management, RCI development and capacity building etc.

1.4 Project Cost Estimates and Financing Plan

10. the total cost of the proposed project is about $325.71 million, or CNY 2,051.99 million equivalents, including taxes and duties of $11.14 million. The ADB loan of $250 million will be financed by ADB from ordinary capital resource and the remaining project cost will be financed by Lincang Border Economic Cooperation Zone, Zhenkang County Government and Cangyuan County Government under Lincang Municipal Government. The project investment plan and financing plan are shown in **Table 1.1** and **Table 1.2** respectively.

Table 1.1: Project Investment Plan

No.	Item	Amount		Share of
		(CNY million)	($ million)	Total (%)
A.	Base Cost[b]			
	1. Cross-border capacity improved	1,551.49	246.27	55.8%
	2. Integrated urban environmental infrastructures in Qingshuihe	284.59	45.17	10.2%
	3. Social service infrastructure and service improved	497.73	79.00	17.9%
	4. Capacity Development and Institutional Strengthening	31.50	5.00	1.1%
	Subtotal (A)	2,365.31	375.45	85.1%
B.	Contingencies [c]	266.28	42.27	9.6%
C.	Financing Charges During Implementation [d]	148.26	23.53	5.3%
	Total (A+B+C)	2,779.84	441.24	100.0%

a. Includes taxes and duties to be financed from ADB loan resources of $11.29 million
b. In mid 2018 prices.
c. Physical contingencies computed at 6% for civil works; and 6% for field research and development, training, surveys, and studies. Price contingences computed at 1.6% on foreign exchange costs and 2.5% on local currency cost; includes provisions for potential exchange rate fluctuation.
d. Includes interest and commitment charges. Interest during construction for ADB loan(s) has been computed at the 5-year forward London interbank offered rate plus a spread of 0.5% and additional 0.1% surcharge for average loan maturity premium. A commitment charge for an ADB loan is at 0.15% per year on the undisbursed loan amount.

Note: Numbers may not add precisely due to rounding.

Source: Asian Development Bank estimates.

Table 1.2: Project Financing Plan

Source	Amount in CNY(million)	Amount in $ (million)	Share of Total (%)
Asian Development Bank	1,575.00	250.00	56.66%
Lincang Border Economic Cooperation Zone	1,029.30	163.38	37.03%
Zhenkang County	142.74	22.66	5.13%
Cangyuan County	32.80	5.21	1.18%
Total	2,779.84	441.24	100.00%

Note: Numbers may not add precisely due to rounding.

Source: Asian Development Bank estimates.

11. The indicative outcome of the project is: competitiveness of urban centers, logistics and industrial ports, and land ports in project counties and the LBECZ facilities will be enhanced. The project will be aligned with the following indicative impacts: (i) economic growth potential for the LBECZ and border areas of Myanmar enhanced; (ii) benefits of regional cooperation and integration in the LBECZ and border areas of Myanmar realized; and (iii) living conditions and public health of residents of the LBECZ and border areas of Myanmar improved.

1.5 Methodology

12. The objectives of the work to be conducted are:

a. Physical features of the existing environment in the area selected for development of LBECZ as well as the surrounding areas in sufficient details that will enable complete assessment of impacts that may arise due to proposed development and to provide a baseline against which predicted and future changes can be measured.
b. Description of the geology and soil types found in the project site; elevation, topography and landforms of the LBECZ block including slope and terrain components, likely impacts on soil erosion, siltation due to construction activities.
c. Information required and the project activities which are likely to cause impacts will also be identified. The data/information gathered will be critically evaluated and the ones that are likely to give rise to adverse impacts will be studied in detail and mitigation measures to lessen such impacts will be proposed.
d. The availability of water resources and their conditions will be identified by using existing reports and maps. This information will be matched with the available water resources data in the area and it will be useful to identify the surface water conditions and groundwater occurrence and distribution pattern in the proposed project areas.
e. Determination of existing habitats/ vegetation formations, or protected areas and ecological sensitive areas in the project influence area or in vicinity of the LBECZ area:
f. Project related impacts on Nanting river environment mainly from construction of bridge and river embankment rehabilitation project, identify sensitive aquatic environments (if any), specify anticipated impacts and plan mitigation, monitoring and management measures to be implemented to reduce or avoid the identified potential adverse impacts.
g. To ensure that proposed development is conducted through avoidance of any national reserve, or any protected area or adversely affecting and endangered (EN) or critical (CR) flora and fauna in the project area.
h. Study potential for community participation in the project cycle.
i. Incorporate findings of the Climate Risk and Variability Assessment (CVRA) report.

13. An assessment of project activities to specify anticipated impacts, plan mitigation, monitoring and management measures to be implemented to reduce or avoid the potential adverse impacts on the adjoining communities. The detailed studies consisted of physical, ecological (biodiversity, flora and fauna) and social environment survey reports present site conditions (baseline information). Information collected on environmental parameters, public opinion will be assessed while requisite data was collected using modern techniques. During the process of undertaking the studies, the study team reviewed the natural habitats, government and community lands in the LBECZ area that are likely to be affected due to the establishment of border economic zone.

Table 1.3: Review of documents

1.	Master Plan and Detailed Plan of the Lincang economic development zone
2	Lincang 13th Five Year Plan indicating the construction plan of medical waste treatment facility
3	Water resources assessment report for the water supply component and water allocation plan of the Nangun River (from water resources bureau)
4	Fish survey report of the Nanting River fish protection zone and map for determining the species composition, numerical abundance, distribution and spawning grounds of migratory fish species.
5	Water and soil conservation report for all components, including earth cut and fill balance, soil

	erosion estimation and prevention measures.
6	Permanent and temporary land take area size and existing land use for all components
7	Maps showing spoil disposal (including dredged sediment) area size and location
8	Maps showing borrow area size and location
9	Water protection zone plan for the drinking water source (Nangun river)
10	Historical hydrological data series of Nanting River, Qingshuihe River and Nanpa River
11	Soil erosion map of the whole economic development zone

1.6 Structure of the EIA document

14. The EIA report comprises baseline data on existing physical, ecological, economic, and social condition, together with the anticipated environmental impacts and proposed mitigation measures. **Annexures 1-5** describes various aspects of environmental assessments such as the Environmental Quality Parameters (**Annexure 1**), Baseline environmental data (**Annexure 2**). **Annexures 3-5** on Environmental Management Plan, Environmental Monitoring Plan and Environment Reporting Format respectively.

15. Observations were made through site visits to the proposed project locations, as well as in and around the proposed LBECZ between July 2017 to April 2018. Public consultations were held twice at three locations (attached in **Annexure 6**) with the project affected communities, stakeholders that relate to existing environmental conditions around the proposed LBECZ and the potential impacts that could happen due to project implementation. In addition, secondary data was collected from published data from PRC documents, as well as from authorities such as LBECZ, LEPB, Water resources bureau, forestry bureau, agriculture bureaus and other departments.

16. The EIA report and its appendixes present the results of the Environment Impact Assessment conducted for the infrastructure development project. Based on the Guidelines of PRC, the proposed infrastructure development requires development of an EIA. This EIA prepared by Local EIA institute for LBECZ has also been approved by the LEPB in **Annexure 7**. Consent letters from other agencies are attached in **Annexure 8**, which conforms to the PRC regulations. This EIA document prepared for ADB approval is consistent with ADB's SPS 2009. **Annexure 9** provides the Integrated Biodiversity Assessment Tool (IBAT) analysis for project area. **Annexure 10** provides details about water availability at the LBECZ and Mengding areas while **Annexure 11** details the GHG emission reduction requirements computation.

17. **Appendices 1 and 2** are separately prepared reports that supplement information to the EIA report in terms of Biodiversity Management and Water and Soil Conservation in the project assessment area. **Appendix 3** is the Climate Risk and Variability Assessment report. **Appendix 4** consists of a summary of the Water Resources Allocation Report prepared for water supply requirements for LBECZ.

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

18. This section discusses the national and the local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a signatory.

2.1 Applicable PRC Environmental Law and other Legislations

19. The PRC has established a comprehensive regulatory framework for environment safeguards, composed of laws and administrative legislation promulgated by the State Council departmental regulations issued by Ministry of Environment Protection (MEP) and provincial legislation and regulations, environmental standards and international agreements. The amended Environmental Protection Law of the PRC (2014) further strengthens the requirement of public participation and information disclosure. The framework of laws, regulations, guidelines and standards relevant to this project is show in **Table 2.1** below.

Table 2.1: Applicable Environmental Laws

Title	Year
Environmental Protection Law	2014
Environmental Impact Assessment Law	2003
Water Law	2002
Water Pollution Prevention and Control Law	2008
Air Pollution Prevention and Control Law	2000
Noise Pollution Control Law	1997
Solid Waste Pollution Prevention and Control Law	2005
Water and Soil Conservation Law	2011
Forest Law	1998
Wild Fauna Protection Law	2004
Cleaner Production Promotion Law	2002
Urban and Rural Planning Law	2008
Land Administration Law	2004
Circular Economy Promotion Law	2009
Fishery Law	2000
Flood Control Law	1998
Protection of Cultural Relics Law	2013

Key Environmental Legislation in PRC listed above

Water Law of the PRC

20. This law regulates human activities in connection with the prevention and control of water pollution and the exploitation, utilization, protection and management of water resources and the various water-related relations thus generated. The Law states that the water resources are owned by the people and/or by collectives. The management of water resources utilization is strengthened through economic means such as the collection of water rates and water resources fees. The law reinforces the role of government in flood control and specifies the measures that may be taken by the flood control command agencies in an emergency situation.

Prevention and Control of Water Pollution

21. This law seeks to prevent and control water pollution, protect and improve the environment, ensure the safety of drinking water, and promote the comprehensive, coordinated and sustainable development of the economic society. In the prevention and control of water pollution, the law adopts the principle of putting prevention first while combining prevention and control and carrying out comprehensive treatment. The law seeks to protect drinking water resources as a priority, strictly control industrial and domestic wastewater pollution, prevent and control widespread pollution from the over-use of fertilizers and pesticides in rural areas, actively promote the construction of ecological management projects, and prevent, control and reduce ambient water pollution and ecological damages.

Prevention and Control of Atmospheric Pollution

22. Clear and detailed provisions have been made with respect to the supervision and management of air pollution prevention systems and measures. The law covers air pollution generated by combustion, the prevention and control of vehicle and vessel emissions, and the prevention and control of waste gas exhaust, dust and odour. The main control mechanisms are: total control on the discharge of air pollutants and licensing system; legally binding discharge standards; and a pollution charging system.

Prevention and Control of Noise Pollution

23. This law aims to prevent and control noise pollution, protect and improve the living environment, ensure human health, and promote economic and social development. Provisions are made for the supervision and management of the prevention and control of ambient noise, industrial noise, construction noise, transportation noise and neighborhood noise.

Prevention and Control of Environmental Pollution by Solid Waste

24. This law sets out the supervision and management systems for the prevention and control of solid waste, which are required in the environmental management of industrial, domestic and hazardous wastes, together with legal responsibilities.

Water and Soil Conservation

25. This law seeks to prevent and control soil erosion, protect and reasonably use water and soil resources, mitigate flood, drought and sandstorms, improve the ecological environment and develop agricultural production. The law includes requirements for comprehensive planning and integrated control of water and soil conservation, and management according to the local conditions.

Land Administration Law

26. This law seeks to intensify land management and maintain the public ownership of land, protect and develop land resources and use lands reasonably, protect arable lands and promote the sustainable development of the social economy. This law sets out ownership and land use rights, formulates general land use planning, implements the protection of arable lands and management of construction land, and provides a system for supervision and inspection.

Protection of Cultural Relics

27. The purpose of this law is to strengthen the protection of cultural relics, safeguard the

excellent historical and cultural heritage of the Chinese nation, and regulate archaeological excavations, cultural relics in museums, cultural relics collected by the general public, and the import and export of cultural relics.

Protection of Wildlife

28. This law seeks to protect and save rare and endangered wildlife, protect and develop the reasonable use of wildlife resources and maintain the ecological balance.

Fishery Law

29. The purpose of this law is to strengthen the protection, proliferation, development and reasonable use of fishery resources, develop artificial breeding programs; safeguard the legitimate rights and interests of fishermen and promote the development of fishery production. The law standardises the relevant matters in aquaculture and the fishing industry and strengthens the proliferation and protection of fishery resources.

Flood Control Law

30. This law seeks to prevent and control floods, mitigate flood damages, safeguard people's lives and property and ensure the smooth development of society. This law includes: the basic principles and systems that should be observed in flood control, the incorporation of flood control facilities into national economy and social development plans, the basic responsibility of the government in the work of flood control, the division of duties among government agencies in flood control and the legal obligations of all entities and individuals to participate in flood control activities.

Prevention and Treatment of Infectious Diseases

31. This law seeks to prevent, control and eliminate the occurrence and prevalence of infectious diseases and ensure human health and public sanitation. This law includes an infectious diseases prevention system, requirements for the reporting of epidemics, a notification and publication system, epidemic control procedures and methods and medical treatment.

Forestry Law

32. The Forest Law of the PRC entered into force on January 1, 1985. Article 8 sets out the main protective measures that the State carries out in relation to forest resources, which include: (i) practicing quota forest felling, encouraging afforestation and closing hills and mountains to facilitate afforestation and expanding forest coverage; and (ii) providing financial support or long-term loans to collectives and individuals for afforestation and facilitation of afforestation in accordance with the relevant regulations of the state and local people's government.

33. Article 26. Defines the responsibilities of all levels of government to increase forest coverage and their obligation to involve the rural and urban population in this activity. In particular: "On barren hills and waste lands suitable for afforestation that belong to the state, Annex 2 afforestation shall be organized by the competent departments of forestry and other competent departments; on those belonging to collectives, afforestation shall be organized by collective economic organizations. State-owned and collective-owned barren hills and waste lands suitable for afforestation may be contracted out to collectives or individuals for afforestation."

34. The 1998 revision of the Forest Law[5] represented a policy turning point, with the reform of the Ministry of Forestry into the State Forest Administration, with a devolved structure at Province and County levels, and a more indirect facilitating role for SFA in forest management. The reform included recognition of ecological forests as distinct from commercial forests and introduced a logging ban in natural forests. In addition the law introduced financial incentives and access to long-term loans in support of afforestation and conservation.

Applicable Administrative Regulations

35. In the PRC there is an extensive body of environmental law which has been promulgated at the state, provincial and local levels, supplemented by Ministry guidelines, norms and environmental quality standards. **Table 2.2** lists some of the key administrative regulations relevant to the Project.

Table 2.2: Applicable Administrative Regulations

Regulation	Year
National	
Regulation on EIA of Plans and Programs	2009
Regulation on Environmental Protection Management for Construction Projects	1998
Directive on Wetland Protection and Management	2013
Environmental Protection Supervision Rules for Construction Projects	1998
Regulation on Culture Heritage Protection	2003
Regulation on River Course Management	1988
Requirements for the EIA Summary of Construction Project	2010
Classification of Construction Project Environmental Protection Management (MEP)	2009
National Biodiversity Strategy and Action Plan (2011-2030)	2010
Requirement for Social Risk Assessment of Large Investment Projects	2012
National Biodiversity Strategy and Action Plan (2011-2030)	2010
National regulation for public disclosure of EIAs (NDRC)	2012
Regulations on Scenic and Historic Areas	2006
Regulation on Hazardous Chemicals Safety Management	2011
Regulation on Wild Flora Protection	1996
Regulation on Wild Fauna Protection	1992
Regulation on Aquatic Wildlife Protection	1993
Regulation on Urban Water Supply	1994
Management of National Wetland Park (trial)	2010

36. Implementation of the environmental laws and regulations is supported by a series of associated management and technical guidelines (**Table 2.3**).

Table 2.3: Applicable Environmental Impact Assessment Guidelines

Guideline	**Year/Code**
Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
Guideline on EIA Categories of Construction Projects	2015
Interim Guideline on Public Consultation for EIA	2006
Technical Guideline on EIA: Outline	HJ2.1-2011
Technical Guideline on EIA Regarding Surface Water	HJ/T 2.3-1993

[5] Decision on Revision of the Forest Law of the PRC, 2nd Session of the 9th National People's Congress, April 29, 1998.

Guideline	Year/Code
Technical Guideline on EIA Regarding Atmospheric Environment	HJ 2.2-2008
Technical Guideline on EIA Regarding Acoustic Environment	HJ 2.4-2009
Technical Guideline on EIA Regarding Ecological Impact	HJ 19-2011
Technical Specification on Water and Soil Conservation Plan	GB50433-2008
Technical Guideline on Environmental Risk Assessment for Construction Project	HJ/T 169-2004
Industrial Restructuring Directory (2011)	Revised in 2013

Environmental Quality Standards

37. The PRC environmental quality standard system that supports the environmental laws and regulations is classified into two categories by function: pollutant emission/discharge standards; and, ambient environmental standards. Environmental quality standards are technical specifications of a legal nature, which are used in formulating environmental objectives and in environmental planning. They are also the statutory basis for judging whether the environment is polluted and to formulate pollutant emission standards.

38. Environmental standards can be divided into four categories, namely, environmental quality standards, pollution emission standards, basic standards and method standards. The environmental standards relevant to the Project are listed below in **Table 2.4**.

Table 2.4: Applicable Environmental Standards

Standard	Code
(i) **Environmental Quality Standards**	
Environmental Quality Standards for Surface Water	GB 3838-2002
Underground Water Quality Standard (Ground Water)	GB/T 14848-1993
Environmental Quality Standard for Soil	GB15618-1995
Ambient Air Quality Standard	GB 3095-1996/2012
Urban Ambient Acoustic Quality Standard (Environmental Quality Standard for Noise)	GB 3096-2008
(ii) **Pollution Emission Standards**	
Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant	GB 18918-2002
Integrated Emission Standard of Air Pollutants	GB 16297-1996
Integrated Wastewater Discharge Standard	GB 8978-1996
Domestic Drinking Water Quality Standard	GB 5749-2006
Emission Standard of Environmental Noise for Boundary of Construction Site	GB 12523-2011
Noise Limit of Industrial Enterprises	GB 12348-2008
Standard for pollution control on hazardous waste storage	GB 18597-2001
Pollution control for storage and disposal site for industrial solid wastes	GB18599-2001
Emission Standards for Odor Pollutants	GB 14554-93

2.2 Environmental Impact Assessment and Protection Laws

39. The PRC's environmental law system aims to achieve a balance between protecting the environment and the society and exploitation of natural resources. The PRC's environmental law system is mainly composed of the following:

- provisions on environmental protection in the Constitution,
- comprehensive fundamental environmental laws,

- separate laws on environmental protection,
- legal procedures for the settlement of environmental disputes,
- environmental standards for air, water, soils, etc.,
- regulatory documents on environmental protection,
- local environmental laws and regulations, and,
- International environmental treaties to which PRC has acceded.

Provisions on Environmental Protection in the Constitution.

40. The Constitution provides the basis for the legal protection of the environment and natural resources at the highest level. The 1982 Constitution includes a series of provisions for environmental protection, which confirm that environmental protection is a basic duty of the State, define the ownership of natural resources and important environmental elements, and protect the environment, natural resources, and places of historic interest, precious cultural relics and other important historical legacies.

41. There are two types of special regulatory environmental legal tools: (a) comprehensive environmental protection laws and (b) environmental laws which protect individual environmental elements or make provisions for specific environmental management systems.

2.2.1 Comprehensive Environmental Protection Laws: Environmental Protection Law of the People's Republic of China.

42. The Environmental Protection Law of the PRC was promulgated in December 1989 and provides the basis for PRC's comprehensive laws on environmental protection. The Environmental Protection Law sets out the basic principles, systems and requirements for environmental protection. There is a requirement to include environmental protection in economic and social development plans and co-ordinate between economic development and environmental protection. Emphasis is to be placed on prevention. The law requires an environmental impact assessment system. There is to be an integrated approach to environmental protection, pollution charging, and treatment [of wastes] within prescribed deadlines and a permitting system. The Law contains basic requirements for protecting the natural environment and the legal obligations of persons exploiting and using environmental resources. There are basic requirements and corresponding obligations for preventing and controlling environmental pollution. The authority and roles of environmental management agencies in environmental supervision and management, and the obligations and legal liabilities of entities and individuals in environmental protection are also covered.

2.2.2 Environmental Law: Legislation on Environmental Elements.

43. There is also separate legislation on the protection of environmental elements (air, water, sea, etc.), the control of pollutants (solid wastes, pesticides and noise, etc.), resources (forests, grasslands and lands, etc.) and specific environmental administration systems. This body of legislation can be divided into two categories: (a) laws with the purpose of preventing environmental pollution and controlling public hazards, the content of which is mainly embodied in the prevention of pollution of air and water, noise, waste disposal, use of pesticides and other toxic substances, and the prevention and control of other public hazards such as vibration, odour, radiation, electro-magnetic radiation and thermal pollution, and (b) laws with the purpose of managing natural

resources and protecting the ecology.

Environmental Impact Assessment requirements of the PRC

44. The requirements for EIA in the PRC are prescribed by the Law on Environmental Impact Assessment. The purpose of this law is to protect the environment, prevent ecological imbalances, regulate natural resource use, assess the environmental impacts of projects, and set out procedures for decision-making regarding the implementation of projects. The Law applies to all new projects, as well as the rehabilitation and expansion of existing industrial, service or construction activities, and projects that use natural resources. The EIA requirements are further elaborated in a series of Technical guidelines and standards which cover general principles, a range of topic areas (surface water, air, noise, etc.) and issues related to construction in general and the development of hydropower and water conservancy projects.

45. The EIA Consultants prepared an EIA Outline setting out information about the project, and the proposed approach to the EIA including baseline evaluation and impact assessment. The EIA was reviewed by technical specialists and recommendations were made for specialist studies in the impact on fisheries and polluted river bed sediments. The EIA Consultants commissioned these studies, which were reported separately, and summarized the results in the EIA report. The draft EIA report was completed in July 2017 and revised in February 2018.

Administrative framework

National Level

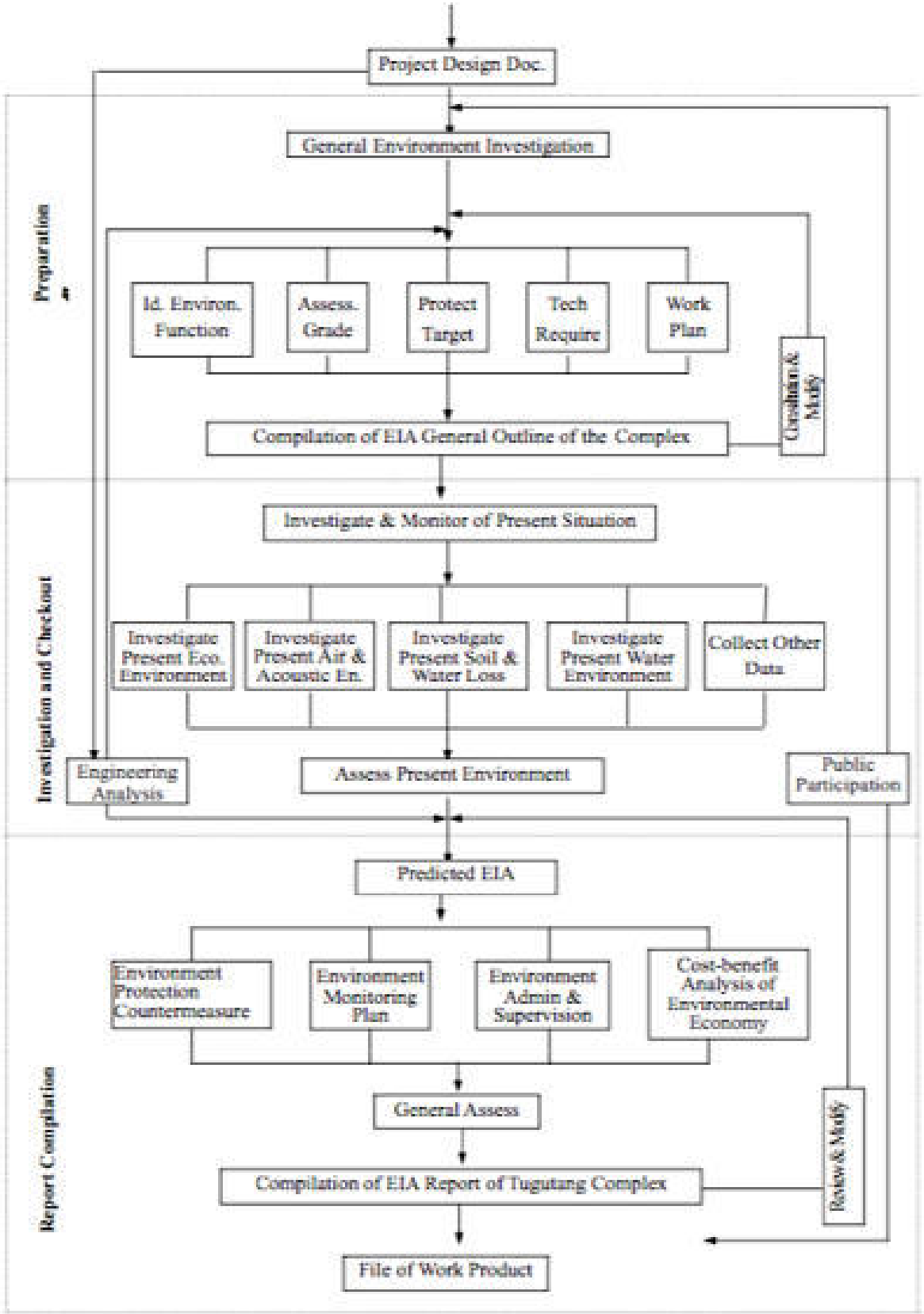
46. The Ministry of Environmental Protection (MEP) has responsibility for establishing a sound basis for environmental protection at the national level. This includes developing national policy, legislation and national objectives for emissions reduction. The MEP carries out EIAs for important economic and technological policies, development plans and major economic development plans. They are also responsible for approving EIA reports for major development and construction projects. The MEP also supervises and manages the prevention and control of environmental pollution.

Provincial Level

47. The Yunnan Province Environmental Protection Bureau is responsible for various activities. The Yunnan EPB is responsible for implementation of the EIA process for projects which are reviewed and approved by them, including the three counties - Mengding, Zhenkang, and Cangyuan. They are also responsible for the preparation and implementation of action plans to comply with the Province's emission reduction objectives and to that end they have prepared and implemented several plans. The Yunnan EPB and is responsible for conducting environmental monitoring programmes for air, water, soil, and noise quality.

48. **Figure 2.1** below presents a simplified diagram of the EIA procedure in the PRC.

Figure 2.1: EIA Procedure in PRC



2.2.3. Environmental Management and Protection Sector

National Level

49. The Ministry of Environmental Protection has responsibility for: establishing a sound basis for environmental protection, overall coordination, supervision and management of important environmental issues, implementation of national objectives for emissions reduction, advising on the scale and direction of investments in fixed assets and funding in the field of environmental protection, and approval of the fixed asset investment projects in the State plan within the scale of the annual plan based on the authority specified by the State Council, prevention and control of environmental pollution and damage from the source. The Ministry carries out environmental impact assessments for important economic and technological policies, development plans and major economic development plans. They approve environmental impact assessment reports for major development and construction regions and projects according to State regulations. The Ministry supervises and manages the prevention and control of environmental pollution. They guide, coordinate and supervise ecological protection and carry out environmental monitoring and information distribution.

Provincial Level

50. The Hunan Environmental Protection Bureau is responsible for various activities, including: drawing up provincial environmental protection laws and regulations, environmental protection technology policies, and supervising their implementation, coordinating the response to major and serious environmental pollution accidents, implementing action plans to comply with the provincial emission reduction objectives, advise on investments in environmental protection and funding, managing pollution control at source, undertake environmental impact assessments for important economic and technological policies, development plans and major economic development plans and approve environmental impact assessment reports for major regional developments and individual projects, supervise and manage procedures to prevent and control environmental pollution for the whole province, ecological protection, and carry out environmental monitoring and information distribution.

51. The Yunnan Province Land Resources Committee is responsible for *inter alia*: drawing up local regulations and rules on land and mineral resources, managing surveying and mapping, and implementation, preparing general land use and other special plans, land registration regulations and implementation, land use rights and implement, land pricing, regulation of mining rights, and the monitoring, prevention and control of geological hazards.

52. The Yunnan Fisheries Protection Bureau is responsible for: the formulation of medium to long term strategies and implementation of projects to develop fisheries in the province, develop scientific programmes, and supervise the fisheries legislation including protection of the fishery resource, the inspection of fishing vessels and fishing ports, and protection of aquatic life.

Administrative Framework

53. Implementation of environmental protection laws, regulations and standards:

- Environmental protection law of the People's Republic of China.
- Ambient air quality Standard (GB3095-2012)
- Comprehensive Effluent Discharge standard (GB8987-1996)
- Sound Environmental Quality standards (GB3096-2008)
- Comprehensive emission standard for atmospheric pollutants (GB16297-1996)
- Surface water Environmental Quality standards (GB3838 -2002
- Cooking Fume Emission Standard (GB18483-2001)
- The People's Republic of China Law on the prevention and control of solid waste pollution
- Environmental noise emission standard for construction field (GB12523-1993) on further improvement of environmental protection management of construction projects
- Regulations on environmental protection management of construction projects (Order. No. 253 of the State Council)
- Sewage Comprehensive Discharge standard (GB8987 - 1996)
- environmental noise emission standards for construction site boundaries (GB12523)
- The Directory of classified management of environmental impact assessment of construction projects (order 2nd of the Ministry of Environmental Protection)

2.2.4 PRC Work Safety Legislation

54. Law of the People's Republic of China on Work Safety as adopted at the 28th Meeting of the Standing Committee of the Ninth National People's Congress on June 29, 2002. The law:

- Is enacted for enhancing supervision and control over work safety, preventing accidents due to lack of work safety and keeping their occurrence at a lower level, ensuring the safety of people's lives and property and promoting the development of the economy.
- Is applicable to work safety in units that are engaged in production and business activities (hereinafter referred to as production and business units) within the territory of the People's Republic of China. Where there are other provisions in relevant laws and administrative regulations governing firefighting, road traffic safety, railway traffic safety, water way traffic safety, those provisions shall apply.
- Ensuring work safety, principle of giving first place to safety and laying stress on prevention shall be upheld.
- Production and business units shall abide by this Law and other laws and regulations concerning work safety, setting up and improving the responsibility system and improving the conditions for it to guarantee work safety.

National and Provincial levels

55. The law stipulates that:

- The State Council and the local people's governments at all levels shall strengthen their leadership over work safety and support and urge all the departments concerned to perform their responsibilities in exercising supervision and control over work safety in accordance with law.
- The people's governments at or above the county level shall, in a timely manner, provide coordination and solution to major problems existing in supervision and over work safety.
- The department in charge of supervision and control over work safety under the State Council

shall, in accordance with this Law, exercise all-round supervision and control over work safety throughout the country. The departments in charge of supervision and control over work safety of local people's governments at or above the county level shall, in accordance with this Law, exercise all-round supervision and control over work safety within their own administrative regions.

- The relevant departments under the State Council shall, in accordance with the provisions of this Law and relevant laws and administrative regulations, exercise relevant supervision and control over work safety within the scope of their respective responsibilities. The departments concerned under the local people's governments at or above the county level shall, in accordance with the provisions of this Law and relevant laws and administrative regulations, exercise supervision and control over work safety within the scope of their respective responsibilities.
- The relevant departments under the State Council shall, in compliance with the requirements for safeguarding work safety and in accordance with law, formulate relevant national standards or industrial specifications without delay and make timely revisions on the basis of technological advancement and economic development.
- Production and business units shall implement the national standards or industrial specifications for work safety formulated in accordance with law.
- People's government at all levels and the relevant departments under them shall make efforts to publicize laws and regulations regarding work safety and disseminate knowledge about it in different forms in order to enhance the employees' awareness of the importance of work safety.

2.2.5 Water Resources Sector

National Level

56. The Ministry of Water Resources (MoWR) has overall responsibility for the management and co-ordination of water resources. Plans for inland waterway infrastructure and ports by Ministry of Transport (MOT) have to be co-ordinated through the MoWR and have to comply with the Ministry’s integrated plans for the overall use of water resources.

Provincial Level

57. The Water Resources Bureau of Yunnan Province is responsible for various activities including: the formulation and implementation of guidelines, policies, development strategies, medium and long-term planning, and annual planning for water conservancy, the management of water resources (including atmospheric water, surface water and groundwater), the construction and management of water conservancy projects, including studies for large and medium-sized water conservancy infrastructure, the management and protection of water conservancy facilities, water resources and shorelines, and soil and water conservation research, planning and monitoring.

2.2.6 Forests Sector

58. National Non Commercial Forests (NCF) refers to the protection forests and special use forests with extremely importance of ecological niches or extremely fragility of ecological status,

playing an important role in the land ecological security, biodiversity protection, and sustainable economic and social development. The forest management aims to generate the forest ecological and social service function. According to the National Non-commercial Forest Management Regulation (2017), the management should follow the principle of "ecological priority, strict protection, classification management, unity of responsibility and right, scientific management and rational utilization". The regulation requests to strictly control the use of national public forests for exploration, mining and construction. It is necessary to use the woodland procedures in strict accordance with the regulations on the administration of forest land examination and approval for construction projects. Those involved in tree cutting shall deal with tree cutting procedures according to relevant regulations.

2.2.7 Energy Conservation

59. Energy Conservation is a basic national policy of China's national economy, energy saving and consumption is the consistent policy of the State infrastructure, saving production resources and resources, energy reuse is particularly important for enterprises. It first embodies the scale, technology and management level of the enterprise, at the same time can reduce production costs, increase economic, social and environmental comprehensive benefits. Energy saving measures to be implemented must meet the use and guarantee of power quality, the use of energy-saving design and new products, improve the use of electrical equipment to save energy.

Adopting Energy saving concepts for road projects

60. Saving energy and protecting resources is one of China's basic state policies. Implementing road transportation energy-saving requires accomplishing the same transportation production task by taking some measures to reduce the consumption of energy.

2.3 Clearances/permits from relevant state/provincial agencies or local Authorities

61. **Table 2.5** shows the required permits/ clearances relevant to the LBECZ Project.

Table 2.5: Details of clearances/permits obtained or should be obtained

#	Clearance/ Permit	Relevant Law, Act, guideline	Status (Obtained/to be obtained/Not Applicable)
1	Provisional approval from People's Republic of China from National Government	National-level Approval	In February 2016, the National DRC and the Ministry of Finance issued the "Circular of Planning for Alternative Projects for the Use of International Financial Organization Loans in 2016-2018 in China" (Development and Transformation of Foreign Investment [2016] No. 323), and the Yunnan LBCEZ was awarded Apply for a project plan with a loan amount of 250 million U.S. dollars from the Asian Development Bank.
2	Letter of Intent from LBECZ to develop the Project	LBCEZ Project Development Proposal	"Request for Approval of the Proposal for the Comprehensive Development of the Linyi Border and

#	Clearance/ Permit	Relevant Law, Act, guideline	Status (Obtained/to be obtained/Not Applicable)
			Economic Cooperation Zone of the Asian Development Bank Lending Approval"
3	Approval from the Border Department	Border Department (Port Office) Approval Documents	NA
4	Approval from the County/Township	County/township approval documents	NA
5	Water Resources Bureau Approval	Water Authority approval document	On April 13, 2018 the water rights permit approved by the Water Affairs Bureau of Lincang
6	Agriculture Bureau Approval	Agricultural Bureau Approval Documents	NA
7	Township Coordination Committee approval	Township Coordinating Committee approved documents	NA
8	County Land Utility Committee Approval	County Land Use Committee (State Land Bureau) Approval Documents	Land use is being approved
9	City/County Environmental Committee Approval	Municipal/County Environmental Committee (Environmental Protection Bureau) Approval Documents	Environmental Committee approval received for LBEZ, Zhenkang, Cangyuan received.
10	District Agricultural Committee approval	District Agricultural Committee approval documents	NA
11	Approval from the Village councils	Village committee approval	NA
12	Economic Zone License	Economic Zone License	NA
13	Civil Aviation Authority Approval for construction	Civil Aviation Authority approved the construction	NA
14	Approval from Road Development Agency for transportation of heavy vehicles and equipment	Road Development Agency (Road Transport Authority) approves documents for the transport of heavy vehicles and equipment	NA
15	Approval from Department of Agrarian Development	Agricultural sector approval documents	NA
16	Approval from Rubber Trees Cultivation Board	Rubber Tree Cultivation Committee Approval Documents	NA
17	Approval from LEPB	Lincang Environmental Protection Bureau approval	Domestic EIA was approved by Lincang Municipal Environmental Protection bureau on 25 March, 2018
18	Approval from the Land Survey Department	Land Surveying Department Approval Documents	NA
19	Approval from the Wildlife Conservation	Wildlife Conservation Association approval documents	NA
20	Approval from the Forest Bureau	Forestry Bureau approved documents	Only the border-crossing projects involve state-owned rubber forests, and there are approvals. The rest of the project forest land is community forest land, and no forestry bureau approval is required
21	Approval from the Defense, public Security, law and Order	National Defense Department, Public Security Department, Legal Department Approval Documents	NA
22	Approval from Archaeology	Archaeological department approval documents	NA
23	Solid waste disposal	Project's Solid Waste Disposal	Qingshuihe belongs to the Mengding

#	Clearance/ Permit	Relevant Law, Act, guideline	Status (Obtained/to be obtained/Not Applicable)
	arrangement with Mengding Landfill site during operational phase of the project	Agreement with Mengding Landfill in the Operation Phase	area and can use Mengding's landfill site without a disposal agreement.
24	Hazardous waste disposal agreement	Hazardous Waste Disposal Agreement	The "Approval of the People's Government of Linyi City on the Construction of Liying Medical Waste Treatment Center in Fengqing County" issued by Lincang municipal government and approved treatment of Zhenkang Hospital at Fengqing.

62. **Annexure 1 part A** contains the Letter for the Standard for Environment Impact Assessment for General Development Project for the Infrastructure of Yunnan Lincang Border Economic Cooperation Zone. All Environmental Standards mentioned in the letter will be followed in accordance to the PRC laws and standards.

2.4 Status of clearances of DEIA

63. The categorization for each of the subcomponent as per National EIA law of PRC is Class II (which is equivalent to category B of ADB). The domestic EIA (DEIA) for Mengding county initially submitted in July 2017 was appended with Cangyuan County and Zhenkang county projects. The final revise DEIA was approved by LEPB on March 25, 2018. **Table 2.6** provides lists of applicable PRC categorizations' for each component.

Table 2.6: Applicable PRC categorization for each subcomponent

No	Subcomponents	Applicable PRC categorization				
		Ambient air	Noise	Surface water	Underground water	Ecological environment
1	Border resident trade market	Grade III	Grade III	Grade III	N/A	Grade III
2	International Cooperation Area	Grade III	Grade III	Grade III	N/A	Grade III
3	Qingshuihe Border Area Branch Roads	Grade III	Grade III	Grade III	N/A	Grade III
4	Nanting River Bridge	Grade III	Grade III	Grade III	N/A	Grade III
5	Qingshuihe Border Area Water Supply System	Grade III	Grade III	Grade III	N/A	Grade III
6	Qingshuihe Border Area Wastewater Treatment System	Grade III	Grade III	Grade III	Grade III	Grade III
7	Qingshuihe Border Area and Mengding MSW Management	Grade III	Grade III	Grade III	N/A	Grade III

No	Subcomponents	Applicable PRC categorization				
		Ambient air	Noise	Surface water	Underground water	Ecological environment
8	Qingshuihe Border Area River Rehabilitation	Grade	Grade III	Grade III	N/A	Grade III
9	New Energy Public Transport Facilities	Grade	Grade III	Grade III	N/A	Grade III
10	Cangyuan Guomen No 2 Elementary School	Grade	Grade III	Grade III	N/A	Grade III
11	Qingshuihe Guomen Elementary School Upgrade	Grade	Grade III	Grade III	N/A	Grade III
12	Zhenkang Sino-Myanmar Friendship Hospital	Grade	Grade III	Grade III	N/A	Grade III
13	Qingshuihe Hospital	Grade	Grade III	Grade III	N/A	Grade III

2.5 Multinational Agreements

64. People's Republic of China has acceded or ratified around 40 Multilateral Environmental Agreements (MEA). All entities and individuals must observe these Conventions, the validity of which prevails over domestic law, except where PRC has announced reservations on certain provisions of the Conventions. The MEAs that are relevant to this project are shown in **Table 2.7**.

Table 2.7: Project-relevant international agreements to which People's Republic of China is a party

Agreement	Ratification Date	Objectives
Atmosphere		
Vienna Convention for the Protection of the Ozone Layer (1985)	Accession: September 1989	Protection of the Ozone Layer through international cooperation in the areas of scientific research, monitoring and of information exchange
Montreal Protocol on Substances That Deplete the Ozone Layer (1987)	Accession: June 1991	Reduction and the eventual elimination of the consumption and production of Un-anthropogenic Ozone Depleting Substances
United Nations Framework Convention on Climate Change (UNFCCC-1992)	Signed: 11 June 1992 Ratified: January 1993 Entry into Force: March 1994	Stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climatic systems
Kyoto Protocol (1997)	Signed: May 1998 Ratified (Approval): August 2002 Entry into Force: February 2005	The Annex 1 parties (Developed Countries) to reduce their collective emissions of greenhouse gases by at least 5% of the 1990 level by the period 2008 –2012.
Biodiversity		
International Plant Protection Convention (1951)	Entry into Force: July 1, 2009.	To maintain and increase international co-operation in controlling pests and diseases of plants and plant products, and in preventing their introduction and spread across national boundaries
Plant Protection Agreement for Asia and	Entry into Force: July 2, 1956	To prevent the introduction into and spread within the region of destructive plants

Agreement	Ratification Date	Objectives
Pacific Region (1956)		
CITES - Convention on International Trade in Endangered Species of Wild Fauna & Flora (1973)	Accession: January 1981 Entry into Force: April 1981	To protect certain endangered species from being over-exploited by adopting a system of import/export permits, for regarding the procedure.
Convention on the conservation of Migratory Species (CMS-1979)	Signed: June 23, 1979; Entry to Force: December 1, 1983	To protect those species of wild animals which migrate across or outside national boundaries
Convention on the Protection of Wetlands of International Importance (Ramsar)	Entry into Force: July 1992	To protect wetlands that serve as critical habitats for migratory birds. People's Republic of China presently has 6 sites designated as Wetlands of International Importance, with a surface area of 198,172 hectares.
Convention on Biological Diversity (CBD-1992)	Signed: June 1992 Ratified: January 1993 Entry into Force: November 1993	Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including appropriate access to genetic resources and by appropriate transfer of relevant technologies and appropriate funding
Cartagena Protocol on Bio Safety (2000)	Signed: August 8, 2000	To contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specially focusing on trans boundary movements.
Land		
United Nations Convention to Combat Desertification (UNCCD-1994)	Entry to Force: December, 1996	To combat desertification and to mitigate the effects of drought in countries experiencing serious droughts and/ or desertification with the final aim being to prevent land degradation in the hyper arid, arid, and semi-arid, dry sub humid areas in the countries that are parties of the Convention
Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and Their Disposal (1989)	Signed: March 1990 Ratified: December 1991	To reduce trans boundary movements of hazardous waste; to dispose of hazardous and other waste as close as possible to the source; to minimize the generation of hazardous waste; to prohibit shipments of hazardous waste to countries lacking the legal, administrative and technical capacity to manage & dispose of them in an environmentally sound manner; to assist developing countries in environmentally sound management of the hazardous waste they generate
Rotterdam Convention (1998)	Signed: 1999	To promote shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals, to protect human health and the environment; to contribute to the environmentally sound use of those hazardous chemicals by facilitating information exchange, providing for a national decision-making process on their import/export
Stockholm Convention on Persistent Organic Pollutants (POPs -2001)	Signature May 2001, accession Aug 2004, entry into force Nov 2004	To protect human health and the environment from persistent organic pollutants (POPs).
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage	1985	This convention integrates the practice of heritage conservation in the PRC with that being done around the world.

2.6 Asian Development Bank's Safeguards Policies

65. The ADB's SPS 2009 sets out policy principles and outlines the delivery process for ADB's safeguard policy in relation to environmental safeguards. The ADB has adopted a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB will ensure that borrowers/clients comply with these requirements during project preparation and implementation.

2.6.1 Environmental Impact Assessment Requirements of ADB

66. The safeguard policies are operational policies that seek to avoid, minimize or mitigate the adverse environmental and social impacts of projects including protecting the rights of those people likely to be affected or marginalized by the development process. ADB's safeguard policy framework in the SPS consists of three operational policies on the environment, indigenous people and involuntary resettlement. ADB has developed Operational Procedures to be followed in relation to the SPS policies and these are included in the ADB Operations Manual.

67. The ADB's Safeguard Policy Statement (SPS), 2009 is applicable to all projects. These projects can be categorized as A, B, C or FI. **Table 2.8** below provides a list of categorization of the activities related to Environment, Safeguards, as per ADB's Safeguard Policy Statement 2009 requirements:

Table 2.8: Environment Safeguards Categorization: Definition

Category	Environment
A — Significant	Investments that anticipate significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works.
B — Less Significant	Investments with potential adverse impacts that are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be more readily designed than for Category A investments.
C — Minimal or impact	Investments that have minimal or no adverse environmental impacts.
FI — Financial Intermediation	Investment of ADB funds through financial intermediaries (FI)

68. All projects considered for loans and investments by ADB are subject to classification for the purposes of determining environmental assessment requirements. The determination of the environment category is to be based on the most environmentally sensitive component of the project. Within this system, projects are screened for their expected environmental impacts and reporting prepared as follows in **Table 2.9**:

Table 2.9: Type of reporting

No	ADB Category	Type of Impact	Type of reporting required.
1	Category A	Projects with potential for significant adverse environmental impacts.	An environmental impact assessment (EIA) is required to address significant impacts.
2	Category B	Projects judged to have some adverse environmental impacts, but of a lesser degree and/or significance than those of category A projects.	An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report
3	Category C	Projects unlikely to have adverse environmental impacts.	No EIA or IEE is required, although environmental implications are still reviewed.
4	Category FI	Projects are classified as category	The financial intermediary must apply an

		FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary.	environmental management system, unless all subprojects will result in insignificant impacts.

2.6.2 ADB Prohibited Investment Activities List (PIAL)

69. At an initial stage of identifying project activities, the ADB's Prohibited Investment Activities List (described below) will apply. If the investment involves a prohibited activity, EA will not consider the investment.

70. The following type of projects do not qualify for Asian Development Bank financing:

(i) production or activities involving harmful or exploitative forms of forced labour[6] or child labour[7];'

(ii) production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phase outs or bans, such as (a) pharmaceuticals[8], pesticides, and herbicides[9],(b) ozone-depleting substances[10], (c) polychlorinated biphenyls[11]and other hazardous chemicals[12],(d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora[13], and (e) trans-boundary trade in waste or waste products[14];

(iii) production of or trade in weapons and munitions, including paramilitary materials;

(iv) production of or trade in alcoholic beverages, excluding beer and wine[15];

(v) production of or trade in tobacco;

(vi) gambling, casinos, and equivalent enterprises;

(vii) production of or trade in radioactive materials[16],including nuclear reactors and components thereof;

(viii) production of, trade in, or use of unbonded asbestos fibers[17];

(ix) commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and

(x) marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to

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[6] Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

[7] Child labor means the employment of children whose age is below the host country's statutory minimum age of employment or employment of children in contravention of International Labor Organization Convention No. 138Minimum Age Convention (www.ilo.org).

[8] A list of pharmaceutical products subject to phaseouts or bans is available at http://www.who.int.

[9] A list of pesticides and herbicides subject to phaseouts or bans is available at http://www.pic.int.

[10] A list of the chemical compounds that react with and deplete stratospheric ozone resulting in the widely publicized ozone holes is listed in the Montreal Protocol, together with target reduction and phaseout dates. Information is available at http://www.unep.org/ozone/montreal.shtml.

[11] A group of highly toxic chemicals, polychlorinated biphenyls are likely to be found in oil-filled electrical transformers, capacitors, and switchgear dating from 1950 to 1985.

[12] A list of hazardous chemicals is available at http://www.pic.int.

[13] A list is available at http://www.cites.org.

[14] As defined by the Basel Convention; see http://www.basel.int.

[15] This does not apply to investee companies who are not substantially involved in these activities. Not substantially involved means that the activity concerned is ancillary to an investee company's primary operations.

[16] This does not apply to the purchase of medical equipment, quality control (measurement) equipment, and any equipment for which ADB considers the radioactive source to be trivial and adequately shielded.

[17] This does not apply to the purchase and use of bonded asbestos cement sheeting where the asbestos content is less than 20%.

marine biodiversity and habitats.

2.6.3 ADB SPS Requirements (SR1): Environment Policy

71. ADB's SPS sets out the policy objectives, scope and triggers, and principles for the environmental safeguards. To achieve the policy objectives and deliver the policy principles, ADB carries out the actions described in the Policy Delivery Process (subsection B of the SPS). To help borrowers/clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB staff, through their due diligence, review, and supervision, will ensure that borrowers/clients comply with these requirements during project preparation and implementation. These safeguard requirements are as follows:

Objectives: The objective of ADB's due diligence for the Project loan is that EA ensures the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process.

Scope and Triggers: Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts.

Policy principles:

a. Use screening process for each proposed project to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.
b. Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate.
c. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.
d. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.
e. Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers

and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.

f. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.
g. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.
h. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.
i. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.
j. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.
k. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of chance find procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.

72. This Project has been evaluated as a Category A Project, requiring a full EIA. Guidelines on the ADB's requirements for EIA include the *Safeguard Policy Statement* (June 2009).

2.7 Equivalence of International Best Policies in Infrastructure Development

73. The Project is required to meet the ADB SPS guidelines as well as international standards of

the IFC, which is part of the World Bank Group. The international environmental and social safeguard policies of these organizations are outlined below.

(i) World Bank Group's Environment, Health and Safety (EHS) Guidelines, 2007 (currently under revision).
(ii) Environmental, Health, and Safety Guidelines for Waste Management Facilities
(iii) Environmental, Health, And Safety Guidelines for Water and Sanitation
(iv) Environmental, Health, And Safety Guidelines for Port Harbor and Terminals
(v) Environmental, Health, And Safety Guidelines for Health Care Facilities
(vi) ADB's Environmental Safeguards: A Good Practice Sourcebook-Draft Working Document (November 2012).
(vii) ILO Core Labor Standards.

Assessment Standards

74. The environmental standard system that supports the implementation of the environmental protection laws and regulations in the PRC can be classified by function-ambient environmental quality standards, and by pollutant emission and/or discharge standards. ADB's SPS requires projects to apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group's Environmental, Health and Safety Guidelines (EHS).[18] For this assessment, where EHS standards exist for parameters and are relevant, they are used in parallel with PRC standards in this assessment.

75. **Annexure 1 part B** discusses these EHS assessment standards as compared to PRC standards.

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

3.0 DESCRIPTION OF THE PROJECT

76. The project covers three Chinese border cities/towns, namely Qingshuihe, Zhenkang and Cangyuan as shown in **Figure 3.1**, along the China-Myanmar border in Lincang prefecture in Yunnan Province in China. The project area is a much less developed area in comparison to other parts of the country in a remote mountainous area. Most of the populations are ethnic minorities consists of Wa, Dai, Yi, Miao, Bai, etc. This part of China shares a long inland border with Myanmar without very obvious physical separations, and many local residents from both countries are from the same ethnic groups with similar living styles and habits, and share similar culture, language, habits and economy. The interactions and exchanges of merchandise as well as border trades have existed throughout the long history of the area. The Asian Development Bank (ADB) and PRC government reached an agreement to use ADB loan of $250 million with a similar amount of counterpart fund from PRC local government for the improvements of regional cooperation and integration facilities and infrastructures to promote the regional cooperation and local economic development.

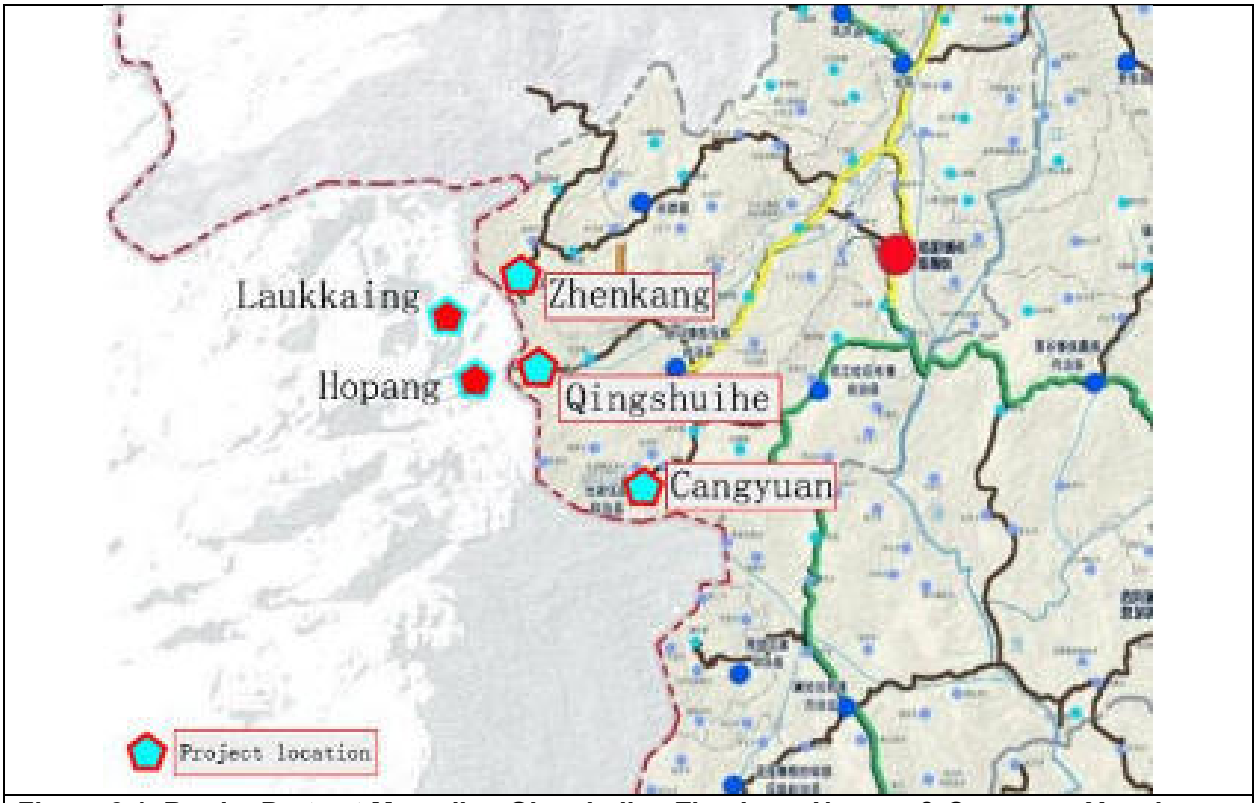


Figure 3.1. Border Ports at Mengding Qingshuihe, Zhenkang Nansan & Cangyuan Yongh
(Source: PMO, PPTA Consultants)

3.1 Project

77. In order to promote border trade and local economic development, Lincang Prefectural Government established the LBECZ in 2011. In May 2012, the Yunnan Provincial Government issued. Suggestions on expediting the construction of Border Economic Cooperation Zone,

identified the Mengding Border Port as one of the key border trade construction projects in Yunnan Province. In September 2013, the State Council approved the establishment of LBECZ as one of the 16 PRC national level border economic cooperation zones. In May 2014, Yunnan Provincial Government issued Notice on Supporting the Construction of Lincang Border Economic Cooperation Zone to establish 25 supporting policies for the construction of the cooperation zone. In December 2015, the State Council issued Suggestions on Supporting the Development of Key Border Cooperation Zones, identified LBECZ and Mengding Border Port as one the key open ports along PRC border and as one of the five major export gateways in Yunnan Province.

3.2 Proposed Lincang Border Economic Border Cooperation Zone Project

78. The Lincang Border Economic Cooperation Zone (LBECZ) covers about 20 square kilometers along China-Myanmar border with Qingshuihe Town at the center, Zhenkang County in the north, and Cangyuan County in the South. The core development area at the current stage is about 3.47 square kilometers with the national level border port of Mengding at the center. The construction of new border port facilities including the new custom building, goods inspection yard, warehouses, etc. are under construction by domestic funding. The Mengding border port is the first special border economic zone among the five zones planned to be developed in Yunnan Province.

Qingshuihe Port and Trade Route to Port at Indian Ocean

79. Qingshuihe Port is a China – Myanmar land port located in Mengding Township in Gengma Dai and Wa Autonomous County in Lincang. Across the border, it is the Shan State of Myanmar with the Chinshwehaw (Qingshuihe) Port connecting to China Qingshuihe Port. The Qingshuihe Border Port is the only state level Tier-1 port in Lincang approved by the State Council and was officially opened in November 2007. The Qingshuihe Border Port is located in the middle of the corridor from Kunming to Jiaopiao ocean port at Indian Ocean in Myanmar, and also the important strategic node connecting South Asia and Southeast Asia. The travel distance of good transport from Kunming to Jiaopiao seaport vs. Qingshuihe border port is about 1540 km, which is about several thousand kilometers shorter than that from Fangcheng sea port at Guangxi vs. Pacific Ocean through Malacca Strait. It is an important alternative route to access Indian Ocean and other parts of the world from China.

80. The highway from Qingshuihe Port to Hseni of Myanmar was constructed and in operation since 2014, connecting Qingshuihe Port to No.3 Highway of Myanmar and heading to Mandalay, and eventually reaching the Jiaopiao seaport (Kyaukpyu Port) at Indian Ocean as well as for accessing southeast Asia and south Asia[19].

81. Lincang Airport is located in Lincang Town, the road from the Lin Xiang area of 23 kilometers, from Yunnan province, Kunming, the linear distance of 300 kilometers. The city of Lincang is also an important transportation center in southwestern Yunnan province, with trunk roads directly to Kunming, Dali, Chuxiong, Simao, Baoshan, XishuanGBanna and other counties as well as Lincang City district and county.

[19] China-Asean Yearbook, 2015

3.3 Temporal Context: Project Rationale and Justifications

82. The proposed project aims to promote the economic development and regional cooperation and integration through the improvements of border trade and regional cooperation capacity, the social services, the living environmental and living condition as well as the poverty alleviation in the border cities and towns. The proposed project will build new facilities and infrastructures in three border port cities and towns to accommodate the fast growing border trade actives and demands, new hospitals, new and/or rehabilitation of schools to improve the local education system, new water supply and wastewater treatment system for improved municipal services and environmental improvement, and capacity development to improve the management capacity of the staffs in EA and IAs. The project will bring in very positive social and environmental impacts with big potential for long term economic development. The project rationale and justifications include:

a. Improved regional cooperation and integration

83. The project is located in three border town/cities at the very southwest end of China with easy access to Jiaopiao seaport at Indian Ocean and major cities in Myanmar including Mandalay, Naypyitaw, Yangon, etc. The fast growth of the economy in China in last two decades can help and bring more business opportunities in Myanmar with proper access and easy facilitation at the border for the development. At the same time, there are business opportunities in China for the goods and services imported from Myanmar. In May 2017, the Ministry of Commerce of the PRC and Myanmar signed a memorandum for the joint development of border economic cooperation zones[20]. The project will contribute the construction of the economic cooperation zone in the PRC side. The improvement of the border trade capacity as well as the business development in the border towns will have great impact to this cooperation and integration, and promote the economic development in the region in both Myanmar and China.

b. Establishment of Transportation Corridor from Kunming to Indian Ocean Seaports

84. As an alternative transportation route from China to access Indian Ocean to reach Europe, the Kunming – Jiaopiao corridor has the shortest distance from China to reach the seaports at Indian Ocean. The travel distance from Kunming to Jiaopiao is only about 1540 km, which is about several thousand kilometers short than from other Chinese ports vs. Malacca Strait. It is a significant saving on time and logistics cost. The project is an important connection point in Kunming-JIaopiao transportation corridor at the Chinese border. The improvement of the border trade capacity and the improvement on the processing time will remove the bottleneck at this important transportation corridor and improve the good handling capacity at the border port.

c. Border Trade Development Improvement

85. The border trade is an important business activity for the residents from both sides of the border, which has existed throughout the history in the area. However, due to the limitations of the border trade market, supports and accommodations at the border crossing, product processing and staging and storage, the development of the border trade has been hindered and slowed. The

[20] The memorandum was signed on May 16, 2017 during the Belt and Road Forum for International Cooperation in Beijing.

border trade is an important business activity to help the local border residents to establish their own businesses and earn money to improve their life, and it is also a part of the regional cooperation for wider range of the business activities. The project will improve the border trade facilities to accommodate the needs for border trade growth and improvement on the border trade capacity.

d. Border Town Access Infrastructure Improvement

86. The Qingshuihe Town is designated as the National Tie-I Border Port and it is an important border port in Yunnan Province. The national regional cooperation development plan puts the border port in a very important position for further development and it is also a key connection point in the Kunming- Jiaopiao Seaport transportation corridor. The town will experience significant increase of the border good traffic and growth of the local business and border trade activities. The current border town infrastructures would not be able to handle the increase of the population growth and business activities. Yunnan Department of Transportation is currently building a high capacity connection road from the exit of Linqing expressway at Qingshuihe to the border port. According the DOT planning, the construction of both the expressway and the connection road will be completed by 2018. There is an urgent need to build the urban roads to connect to the connection road so that a local urban road network can be established to ensure the access of the border good traffic to the border port, the processing yards and workshops, storages and other facilities. The project will construct the connected urban roads to support the border goods transport and process needs.

e. Border Town Municipal Service Improvement

87. The border towns of Qingshuihe as well as Mengding are much less developed in comparison to other cities/towns in the developed areas in other part of the China. At Qingshuihe town, only about 26% of the residents have access to portable water and there is no public urban wastewater collection and treatment system. For most of the urban area, there is only limited and primitive municipal solid waste (MSW) collection and treatment system. There is an urgent need to improve the municipal services in these border towns and to improve the living conditions of the local residents. The project will effectively address these needs with the construction of a new water supply system, a new wastewater treatment system, and improved MSW collection and management system. A better urban environment and improved living standard are important conditions for better border town and city economic development.

f. Environmental Improvement in Border Town

88. The project town of Qingshuihe is located in a subtropical climate area with well-developed natural ecological environment. The forest and vegetation coverage in the area is very high and the natural environment is in pretty good natural condition. However, due to the outdated municipal services and inadequate environmental protection measure, there are many uncontrolled pollution discharges and MSW random dumping. The Qingshuihe River, which runs through the town of Qingshuihe, has many outlets with the urban sewage discharged without any treatment. The project will build the new river embankment to meet the flood control standard and also build the sewage inception pipes along both sides of the river to collect the sewage water for sending the same to the new wastewater treatment plant for treatment before discharge. The project will also improve the

urban MSW collection and treatment system. With these components, the project will help to reduce the environmental pollution and to protect the natural environment.

g. Social Service Improvement and Integration for Border Residents

89. As the development of RCI and border trade growth, especially after the completion of the Lincang- Qingshuihe expressway, the fast growth of the local population is expected. Additionally, the fast growth of economy in China has attracted many immigrated workers from Myanmar and also the interaction and business connection between both countries have grown steadily. All of these have contributed to more joint activities not only in business but also a much broader range including education, medical service, cultural exchange, etc. Many kids from immigrate workers or Myanmar residents living in China are attending Chinese schools and many Myanmar citizens come to Chinese hospitals for better services. As a result, there is a need to increase the capacities of the social service facilities to accommodate the local population growth and also increase number of Myanmar residents using these facilities. The project will help to construct two hospitals and one new elementary school and expand one existing elementary school to address these growing needs.

h. Poverty Alleviation and Ethnic Minority Development

90. All eight counties and districts under the jurisdiction of Lincang Prefecture are national level poverty counties/district according to the PRC poverty standard poverty line. The average per capital GDP in Lincang Prefecture (CNY 18,710 – 2015) is less than half of the national average (CNY 49,351 – 2015). Furthermore, the project cities/towns are ethnic minority concentrated areas with the minority population about 93.9% in Cangyuan County, 55.2% in Gengma where Qingshuihe is located, and 31.5% in Zhenkang County. The project will bring in a lot of job opportunities for local residents to help the poverty alleviation, and the project will also develop and implement the ethnic minority development action plan which will help to address the minority development needs and help them to improve their living standards.

3.4 Major Components of the proposed LBECZ

91. The summary of the project components is shown in **Table 3.1.**

Table 3.1: Summary of Project Components

No		Description	Type/ Classification	Unit	Quantity
1. Cross-border capacity improved					
	A	Qingshuihe Border Trade Facilities			
	1	Border resident trade market	Market	m^2	93,072
	2	International Cooperation Area	Industrial park	m^2	171,633
	B	Qingshuihe Border & Trade Infrastructures			
	1	Qingshuihe Border Trade Area Roads	Secondary/branch	m	5,070
	a	No 1 Road	Branch	m	900
	b	No 2 Road	Branch	m	788
	c	No. 3 Road	Branch	m	1,200
	d	No 3 Road Bridge over Qingshuihe		m	
	e	No 4 Road	Branch	m	644
	f	No 5 Road	Branch	m	955
	2	Nanting River Bridge		m	350
	a	Main: 3 span twin tower cable stayed bridge	S Approach 3/20m		

No		Description	Type/ Classification	Unit	Quantity
		(70+140+70)	pre-stressed T Beam		
	b	No 6 Road	Class II	M	523
2. Integrated urban environmental infrastructures in Qingshuihe border area Improved					
	A	Qingshuihe Border Area Water Supply System			
	1	Water intake	Nangui River	m^3/d	21,000
	2	Water transmission line	DIP Pipe	m	32,000
	3	Water treatment plant	Conventional	m^3/d	20,000
	4	Water distribution network	PE&DIP	km	28.1
	B	Qingshuihe Border Area Wastewater Treatment System			
	1	Wastewater treatment plant		m^3/d	10,000
	2	Wastewater pipeline network	HDPE & Conc	km	7.2
	C	Qingshuihe Border Area and Mengding MSW Management			
	1	Transfer Station (horizontal compression)		27t/d	1
	2	Collection Station at Logistics Area		7 t/d	1
	3	Collection Station at Corporation Area		8 t/d	1
	4	MSW collection station with toilet			6
	5	MSW equipment			1
	D	Qingshuihe Border Area River Rehabilitation			
	1	Qingshuihe River	River embankment	m	3,431
	2	Nanpa River		m	tbd
	3	Sanitary inception (frp pipe with manholes)		m	tbd
	4	Landscaping (77 - 158 m wide)		m	106,733
	5	Grey water from WWTP recharge pipe line		m	600
	E	New Energy Public Transport Facilities			
	1	Qingshuihe Electric charging Station		ea	12
	2	Mengding Electric Charging Station		Mu	10
	3	New energy bus		ea	6
3. Social infrastructure and service improved					
	A	Education Facilities			
	1	Cangyuan Guomen No 2 Elementary School	Building area	m^2	18,311
	2	Qingshuihe Guomen Elementary School Upgrade	Building area	m^2	7,91
	B	Hospitals			
	1	Zhenkang Sino - Myanmar Friendship Hospital	Building area	m^2	56,009
	2	Qingshuihe Hospital	Building area	m^2	8,946
4. Institutional capacity of involved agencies Improved					
	1	Project and contract management			
	2	Public financial management			
	3	Border trade and logistics capacity building			
	4	Teacher training and school leadership			
	5	Healthcare service and hospital management			
	6	Urban master planning			

MSW = municipal solid waste, DIP- ductile Iron pipe, PE=Polyethelene pipe, HDPE-high density polyethelene pipe, Conc=concrete, tbd=to be determined.

(Source: PPTA Consultants)

92. The summary of the project components and their location with respect to various settlements is shown in **Table 3.2.**

Table 3.2: Details of project component and settlements

No	Project sub-component	Name of the village	Type of Settlement
1	Urban transportation infrastructure components	Shantouzhai Village	Village
		Qingshuihe Village	Village
		Laipian Village	Village
		Manggang Village	Village
2	Border Trade Area	Qingshuihe Village	Village
		Shantouzhai Village	Village
3	Qingshuihe Hospital	Qingshuihe Village	Village
4	Qingshuihe Elementary School	Qingshuih town	Township
5	WWTP	Shantouzhai Village	Village
6	WTP	Qingshuihe Village	Village
		Mangmei Village	Village
7	Solid waste collection project	Qingshuihe Village	Village
8	Bridge and Connecting road	Laipian Village	Village
9	River Rehabilitation	Qingshuihe Village	Village
		Shantouzhai Village	Village
10	Cangyuan Guomen Elementary School	Mangfa Community	Village
		Baka Village	Village
11	Zhenkang China-Myanmar friendship Hospital	Baiyan Village	Village

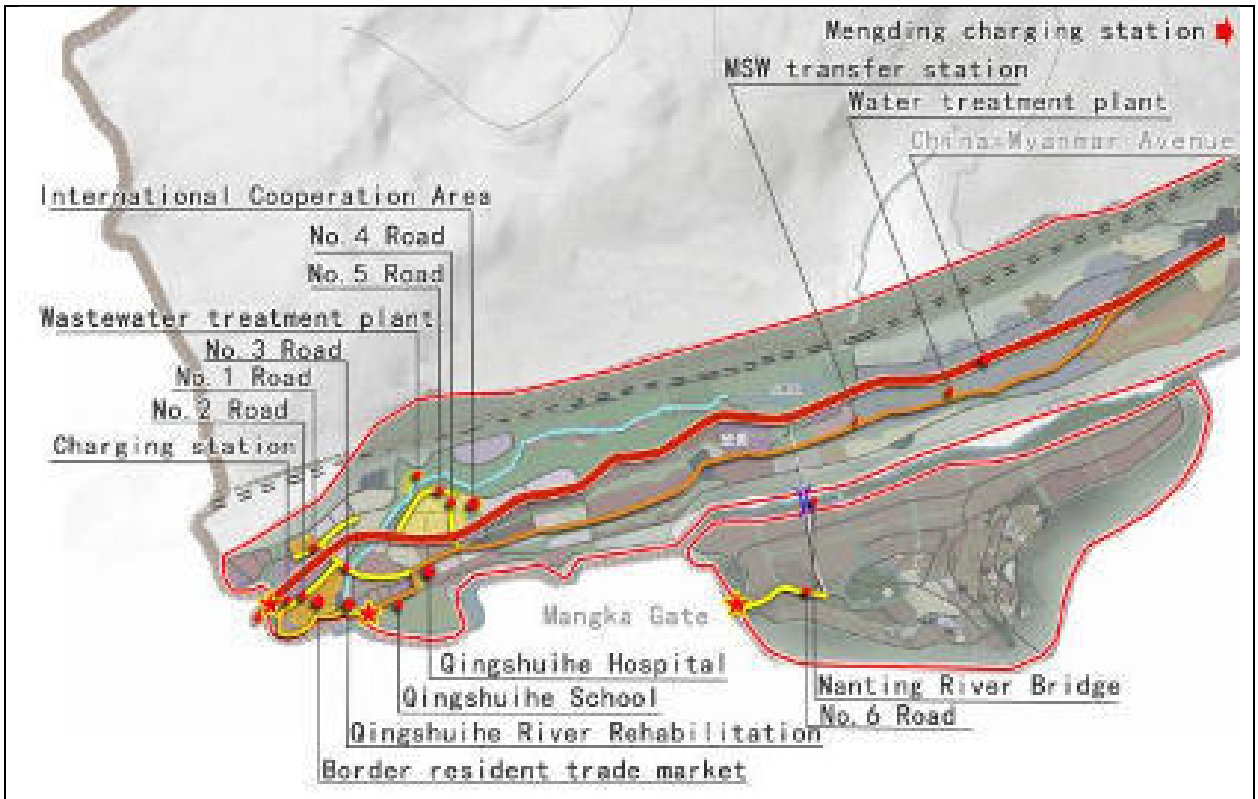


Figure 3.2: Project Components and their Locations in LBECZ Area

(Source: PMO, PPTA Consultants)

93. **Project core area layout plan** that indicate all project components, access roads to the site, reservation etc. in order to get a clear picture of the project is provided in **Figure 3.2** above. **Figure 3.3** shows the conceptual bird's eye view of the project area.

3.5 Size and Magnitude of the Operation

Summary of Planning and Phasing of Works

94. The establishment of the LBECZ can be considered as comprising construction, operational refurbishment and/or decommissioning phases.

Figure 3.3: A bird's eye view of the LBECZ project area

(Source: PPTA Consultants)

Construction

95. The construction phase of the LBECZ will include activities such as:

- Construction of roads, buildings, tunnels, bridges, culverts, hospitals, schools.
- Transportation of people, material and equipment to the LBECZ site.
- Civil works for access track upgrades and construction, building foundations, and trenching for auxiliary utilities such as water, sewer, drainage and power cables.
- Establishment, operation and removal of concrete batching plants.
- Potential use of rock crushing equipment, if required.
- Potential use of blasting in foundation excavation, if required.
- Preparation of concrete foundations, which must be cured for many weeks prior to installation.
- Construction of temporary offices and facilities.
- Temporary storage of construction materials.
- Restoration and re-vegetation of disturbed onsite areas on completion of construction works.
- Pre-commissioning checks on roads, buildings, bridges, water, sewer and electrical network.

96. The construction process will be managed by Construction contractor (s), who shall be responsible for development and implementation of Emergency safety procedures, site environmental management plans, community health and safety issues.

Operational

97. The operation phase of the LBECZ will include activities such as:

- The buildings, roads and other equipment requires regular maintenance, and occasionally major repairs or component replacements are required. Routine maintenance on infrastructure is generally conducted on 6 monthly intervals, with a focus on reducing wear and tear, whenever possible.
- Major repairs for environmental infrastructure might include replacing utilities such as water, sewer piping, machinery and power cables, etc.
- Maintenance activities will be contracted to the private infrastructure operators at least during the initial years of operation, while LBECZ builds their internal capacity to maintain the LBECZ.

3.5.1 Output 1: Cross-border Trade Capacity Improved

98. This project component includes:

(i) construction of a border resident market of 93,072 m^2;

(ii) construction of an international production cooperation area of 171,633 m^2;

(iii) construction of 5 urban branch roads with a total length of 4.55 km;

(iv) build a new 350 m bridge with the approach road and rehabilitate 523m existing Class II road to connect Qingshuihe and Mangka border path

3.5.1.1 Border Resident Trade Market facilities:

Summary Details about LBECZ Qingshuihe Cross-Border Point Border People's Trading Facilities

GPS	**GPS N 23.48692 E 98.83192 (About 50m away and not approachable on foot)**	**Total Area**	**200,526 m^2 Construction Area 93,972 m^2 Building Area**
Land Area	**320.44 mu, Sloping Hill side**	**Other facilities**	**Market sheds, warehousing and Administrative building, service building, facilities- water, sewage, drainage, rainwater, fire-fighting etc.**
Location	**Qingshuihe Cross-border Point – near newly constructed custom gate**	**Type of trees cut**	**6773 Rubber Trees**
Environmental issues	**Sloping hill side. Large cutting and filling of land involved, soil and water erosion, associated/linked utility facilities such as roads, power, water supply, waste water, and solid wastes**		

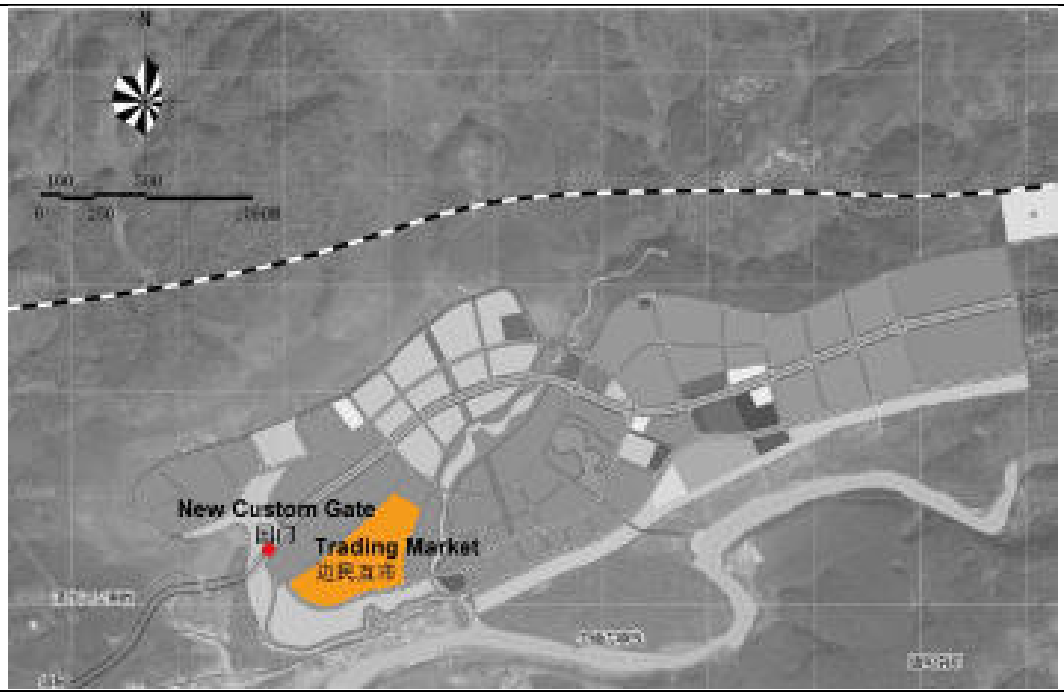


Figure 3.4: Border Resident Trade Market

Figure 3.5: Schematic Diagram of Plan Layout for Border Resident Trading Center

(Source: PPTA Consultants)

99. The border resident trade market is an important facility used by the local residents from both sides of the border. This kind of trading has been existed through the long history of the local area. It is an important part of the daily life for the local residents in both sides of the border. The current border trade market facility cannot meet the fast growing demand. The project will

construct a new border resident trade market. The location of the market complex is shown in **Figure 3.4**. **Figure 3.5** shows schematic diagram of the plan layout.

Construction Content and Scale:

100. The project covers an area of 320.44 mu The major structures in the border resident market include the market shed structure, warehouses, administration building, service building, etc. The cost for the border trading sub-component is CNY 51.202 million. The details of the major structures are shown in **Table 3.3** below:

Table 3.3: Summary of Border Resident Market Complex

No	Description	Area (m2)	Story	Structure	Height (m)	Remark
1	Border resident trade market	93,072				
	a. Market shed structure	51,600	2	steel	10.6	
	b. Warehouse	33,696	2	steel	10.6	
	c. Administration building	7,776	3-5	steel	21.0	
	d. Service building	14,382	3-6	steel	20.1	
	d. Site development (320.44 mu)					
	Grading, roads, parking, utilities, lighting, landscaping, etc.					
	e. Border resident trade market information system					
	Functions - data processing, security monitoring, information broadcasting, governing, logistics service, warehouse management, online trading, financial service, etc.					

101. The complex has three functional areas:

- Border Resident Market – This is the free market area where the local residents from both sides of the border can trade merchandise tax free. A limitation of the trade value is set for each resident, which is currently set at CNY 8,000. The tax will be required for the trade value over the limitation. The area is administrated and monitored by the custom authority.
- General Trading Area – This is the area where the conventional import and export trade can be conducted with necessary taxes following standard custom procedures for import and export. The area will serve as the general import and export facility to carry out trading activities for non-border residents.
- Receiving Area – The area serves as the receiving area for the goods imported from Myanmar and transferring area for the goods to be exported to Myanmar. The goods from Myanmar are unloaded and transferred to Chinese trucks to be transported to the goods destinies, and the same for the Chinese goods to be exported to Myanmar. The receiving area also has the functions of storage, goods distribution, logistics service, and other functions.
- Service Area – The service area is used for the employees for the market administration to provide supports and services for the operation of the market. The service area includes offices, cafeteria, dormitories, activity center, etc.
- Display Area – The area will be used for import and export products display, marketing and other trade activities.

102. The area is located on sloping hill side. Large cutting and filling of land will be involved. Proposed plan is to fill the adjoining valley with excavated material which is currently populated with rubber trees. About 6,773 rubber trees will be cut and result in environmental degradation of the

area. The facility will be connected to all associated/linked utility facilities such as roads, power, water supply, waste water, and solid wastes which will be set up in the LBECZ.

103. All buildings in the border resident market will be designed in according to national green building standard (GB/T50378-2006), and the considerations will be given to design the complex to meet the latest national standards for energy conservation, environmental protection, and green development.

Project Plot Layout

104. The project plots are divided into two parts, general trade area and barter area. One of the trading shed is located in the core location of the base, the size of the majority of the base area, and modular design for easy construction. Trading area in the shed and surrounding the warehouse is located in the north of Barter block, the management of the house is located in the west of Barter area, service area is located in the south of Barter block. The total construction area is 200,526 square meters. This is a comprehensive market within an area of 300mu besides the newly constructed custom gate. The construction includes a two-story trading market of 51,600m^2, a two-story warehouse of 33,696 m^2 and a four- to-five-storey management office building of 7,7760m^2. The special needs for border market such as loading and unloading area, storage and processing, workshop, services, etc. shall be considered which will be about 14,382 m^2. The site plan shall be developed to meet all functional requirements as well as to consider the future operation and maintenance requirements. **Table 3.4** provides details about schedule of works.

Table 3.4: Schedule for Construction Contents of Border Resident Trading Market

Type	Item Design	Project Contents	Remarks
Main works	Trading shed	The trading shed is a framed building with 1~2 storeys, covering a building area of 95,000m^2,	The hazardous chemical trade is not involved
	Warehouse	The warehouse is a framed building with 1~2 storeys, covering a building area of 20,000m^2	The hazardous chemical storage is not involved
Ancillary and industrial works	Management room	Concrete structure building with 2 storeys, covering a building area of 5000m^2	
	Porting lot	Covering an area of 4800m^2, with 666 open parking places inside	
	Water supply works	Uniformly supplied by water supply pipe network of Qingshuihe River Water Supply Plant	
Environmental protection engineering		Landscaping of 70,000m^2, rainwater and sewage pipe network, septic tank and several garbage collector	

Design basis and main parameters

Road traffic system design

105. Barter District would have upto 2 entrances and exits, located in the north and southwest of the plot, the main roadway can be circular, block west of the north entrance for the office, the central area of the block for trading and warehouse storage area. Access to the functional areas within

would be limited, reducing the car traffic inside the complex and limiting the parking space for 950 vehicles.

Access and Utility Connections

106. The access to the complex from the border and other urban roads shall be assessed and the utility connections of water, sewage, power, communication, etc. shall be considered, especially for the sewage connection in which the site elevation shall be designed to be able to connect to the city sewer system.

Green building, storm-water management (sponge city), traffic and fire safety

107. The design of the complex shall have demonstration features for innovation and green development. The green building design shall be included and the energy conservation design and use of solar energy shall be considered. The site development shall include the storm water management system, or sponge city concept, for ecological and environmental protection. The site traffic planning, especially for firefighting planning and access shall be detailed to ensure that fire truck could cover the entire complex.

Water supply*:*

- County government water supply interface for DN 150 water supply pipe, indoor water use; direct water supply to the county government network.
- Access to the project outdoor annular water supply network: Water source, water quality, hydraulic pressure in this project of pipe network of municipal tap water, water meter in the building inlet pipe to carry on the metering respectively by the surrounding city road water supply pipe network.
- The area is 120000 square meters, water quota to take 5l ㎡/d (Effective area 70% considered) daily water consumption 420m³/day.
- Fire-fighting water use quantity is: Indoor firefighting water quantity is 15 l/s, outdoor firefighting water quantity is 30 l/s.

Drainage/Sewage connection

- The sewage pipe in the sewage treatment in the rear of the project is discharged into the municipal sewage pipe network to prevent blockage of the port and the municipal sewage pipes.
- Drainage sewer and rainwater piping should be laid to make full use of the natural terrain and flow to the drainage network. Sewage is discharged into septic tank through indoor sewage riser and outdoor sewer network, and into septic tank.
- Drainage system of this project: indoor drainage using sewage and waste confluence system, outdoor drainage using rain sewage diversion system.
- Sewage quantity: The quantity of sewage is calculated according to 80% of the maximum daily water consumption. The amount of sewage is 420*0.8=336 m³/d.
- Domestic sewage after treatment will be used for greening and road flushing.
- The destination of the sewage and drainage water will be the new WWTP proposed for the project.

Rainwater

108. The roof rainwater of the building is discharged into the outdoor rain water well by the indoor rainwater pipe, and then together with the ground rainwater. It is discharged into the rainwater storage tank (the initial 10 min rain water dump), which is stored and used for greening and road sprinkle after the rainwater conditioning storage tank. Rainstorm intensity at Lincang is 5 min rainfall intensity: 3.63 l/100m^2/s.

Building energy-saving design

109. In the construction of this project, attention will be paid to the building's energy conservation measures and improve energy resource utilization efficiency and focus on energy saving, water saving, land, material and energy resources through comprehensive utilization. After the completion of the project, energy consumption is mainly electricity, water etc.

3.5.1.2 Qingshuihe International corporation area facilities:

Summary Details of Qingshuihe International Production Capacity Cooperation Zone

GPS	**GPS N 23.48852^0 98.84611^0 E (About 10 m away and not approachable on foot)**	**Total Building Area**	**Total building area of the construction project is 171,633 m^2**
Land Area	**533.4 mu**	**Other facilities**	**Bulk commodity logistics zone, general warehousing and logistics zone, warehousing, workshop buildings for production and processing, and service buildings, exterior components including access roads, parking lot, landscaping, etc.**
Location	**Qingshuihe Port Economic Zone**	**Type of trees cut**	**9,124 Rubber Trees**
Environmental Issues	**Sloping hill side. Large cutting and filling of land involved, soil and water erosion, foundation design and ground water drainage, associated/linked utility facilities such as roads, power, water supply, waste water, and solid waste and hazardous wastes, type of industry- pollution/non-polluting, labour migration etc.**		

110. The international cooperation area is another important component in Qingshuihe border area development. Qingshuihe is located in the border with Myanmar and the important note in the China-Myanmar international corridor, Using the locational advantage, the cooperation area can serve as the important site for manufacturing, storage, logistics, international trade and other activities under the protection of free trade zone (FTZ) policy. In comparison to Myanmar, the manufacturing businesses in China possess advanced technologies and better production capacity, whereas in Myanmar, the raw materials are much cheaper than those in China. It is a good combination for production in the international cooperation area under the protection FTZ policy. The Chinese manufacturing enterprise can setup production in the cooperation, receive raw materials from Myanmar, manufacture the products and send them back to Myanmar for resale without being charged for import and export taxes.

Construction Content and Scale:

111. The project covers an area of 488.4 mu, and the total building area of the construction project is 297,917.08 m^2. The project construction site is located at the Qingshuihe port area, with a

total land area of 358,401 ㎡. The site for international center is located at Longitude 99^{0}4', northern latitude 23° 33', having an average elevation of 510 meters. The land has no ruins, relics and other relics, and no mineral pressure. The terrain is irregularly rectangular with the ground being relatively flat. The terrain is open; no fault, liquefaction, gully and other undesirable geological phenomena are found in the proposed site. There is no ambient noise pollution from the surrounding area, is far away from the high voltage line, not affected by landslides, and other geological hazards.

112. This component will construct factory buildings and warehouses, office buildings and some other supporting buildings. The factory buildings and warehouses are in steel structure, while the other supporting buildings are constructed with reinforced concrete frame structure. Supporting facilities such as water supply, drainage, electricity, greening, will also be constructed. The location of the area is shown in **Figure 3.6**

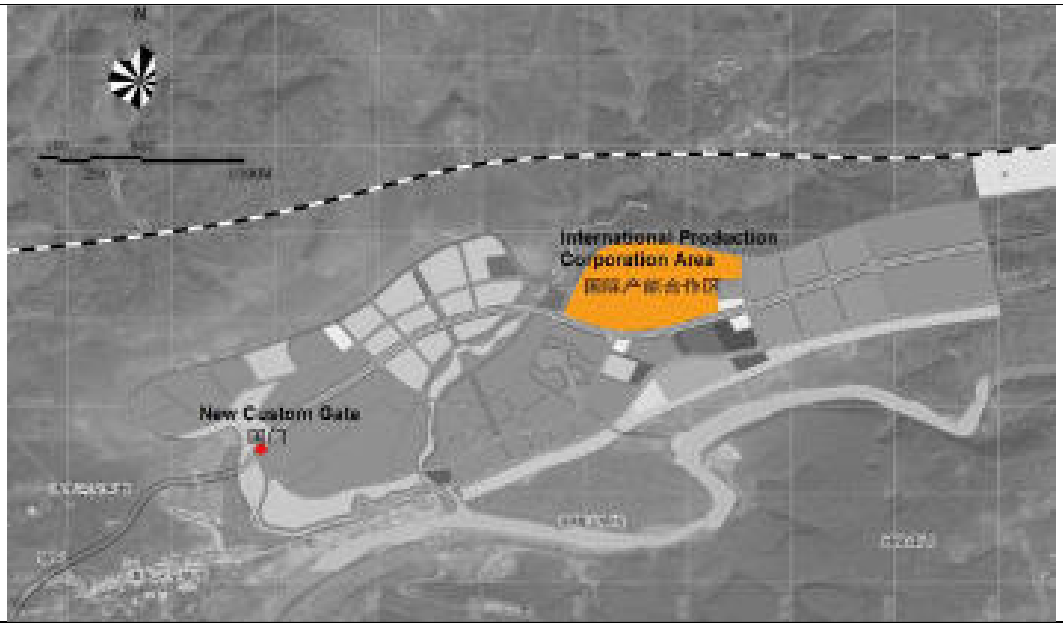


Figure 3.6: International Corporation Area

Figure 3.7: Schematic Diagram of International Cooperation Area

(Source: FSR)

113. The proposed project component covers about 533 mu with a total building area of 171,633 m^3. The rendering of the proposed international cooperation area is shown in **Figure 3.7** above shows the schematic diagram of general layout. There are five functional subareas:

- FTZ Manufacturing Area – The area occupies an area of about 150 mu to be used for FTZ manufacturing under the monitoring of custom. The FTZ manufacturing may include assembling of the imported materials, parts, electronics, equipment, etc. as well as the manufacturing of the imported raw materials. The area could also be used by Myanmar manufacturing enterprises making products using the materials or parts from China and resale the products back to China.
- FTZ Warehouse and Logistics Area – The area occupies an area of about 133 mu, and the area will be used as FTZ warehouses as well as logistics service. The imported products can be stored in the FTZ warehouses and exported back for resale without being charged for the import and export taxes. The area can be also served as logistics service center for product transport and shipment.
- Custom Joint Inspection Area – The area occupies an area of about 49 mu, which will be used by the custom for goods and manufacturing inspection for the compliance of FTZ and other import and export requirements.
- FTZ Working Area – The area occupies an area of about 83 mu with various types of warehouses. The area will be used for the temporary storage of the products as they are being processed for various custom clearance requirements.
- Product Display Area – The area will be used for product display and business development for

all enterprises in the cooperation area to promote more integration and corporation among these enterprises.

- The General Service Area – The area occupies an area of about 74 mu, including product display, offices, financial center, market, conference rooms, etc. The area serves as the general service area to provide supports for the enterprises in the cooperation area.

114. The total building area is about 171,633 m^2 for various warehouses, steam room, custom inspection building and inspection shed, financial and accounting center, incubation center, product display center, service and supporting area. The total site area is about 533.4 mu. The cost for international trade center is CNY 500.45 million. The details of the international cooperation area are shown in **Table 3.5**.

Table 3.5: Summary of International Cooperation Area

No	Description	Area (m^2)	Story	Structure	Height (m)	Remark
2	International Cooperation Area	171,633				
a.	Free Trade Zone (FTZ) - operation (82.5 mu)					
	Cold chain warehouse	3,744	1	Steel	9	
	Electronic warehouse	3,744	1	Steel	9	
	Valuable warehouse	3,744	1	Steel	9	
	Standard warehouse	8,670	1	Steel	9	
b.	FTZ - manufacturing (150.1 mu)					
	Standard warehouse	45,036	2	Steel	9 -12	
c.	FTZ - logistics area (132.9 mu)					
	Steam room	2,520		Steel		
	Warehouse	31,590		Steel		
d	Custom Inspection Area (49.1 mu)					
	Custom inspection building	7,614	5	RC frame	19.5	
	Inspection shed	5,760	1	Steel	9	
e.	Service and Supporting Area (73.8 mu)					
	Financial and accounting center	7,416	6	RC frame	18	
	Incubation center	16,128	9	RC frame	34.2	
	Product display center	13,986	3	RC frame	11.7	
	Supporting facility	8,073	2-4	RC frame	7.8	
	Dormitory and apartment	13,608	6	RC frame	21.6	
f.	Site development	533 mu				
	Roads, parking, utilities, landscaping, etc.					

(Source: PPTA Consultants)

115. The construction of a bonded operation area, a bonded processing area, a bonded warehousing logistics area, a customs national inspection and joint inspection area and a comprehensive supporting service area covers a total building area of 297,917.08 m^2, which is equipped with the construction of plant roads, parking lots and related outdoor projects such as landscaping. The total building area used for the construction of bulk logistics area, general warehouse and logistics area, warehouse, plant and service rood is 100,000 m^2; the supporting construction also includes relevant outdoor works of plant road, parking lot, landscaping, etc. **Table 3.6** gives the construction components as below:

Table 3.6: Construction Project Schedule for Infrastructures in International Capacity Cooperation Area at Qingshuihe River

Type	Item Design	Project Contents	Remarks
Main works	Plant building	Build 25 2-storey frame-structure standard logistics factory buildings. The total building area is 25000m^2.	The hazardous chemical trade is not involved
	Warehouse	Build 9 2-storey frame-structure standard logistics warehouses. The total building area is 7200m^2.	The hazardous chemical storage is not involved
Ancillary and industrial works	Management room	Build 2 2-storey management buildings. The building area is 860m^2.	
	Office Building	Build 6 5-storey office management buildings and one 8-storey office management building. The total building area is 26000m^2.	
	Public rental house	Building 12 5-storey public rental houses to provide houses for staff in Qingshuihe River Port Economic Zone. The total building area is 41000m^2.	
	Road	3 supporting lines with a total length of 5.0km are constructed to connect with China-Myanmar Highway.	
	Water supply works	Uniformly supplied by water supply pipe network of Qingshuihe River Water Supply Plant	
Environmental protection engineering		Landscaping of 32513m^2, rainwater and sewage pipe network, septic tank and several garbage collectors	

116. The area was mainly hilly that has rubber trees and will need to be cleared for developing the facility. The proposed plan is to fill the adjoining valley with excavated material which is currently populated with rubber trees. Approvals from Forest Bureau and household survey for trees have been taken before start of construction. About 11,411 rubber trees will be cut and result in environmental degradation of the area. The facility will be connected to all associated/linked utility facilities such as roads, power, water supply, waste water, solid and hazardous wastes which will be set up in the LBECZ.

117. **Building Infrastructure**:

- The steel structure warehouse is 9 meters high.
- The free trade zone, having floor height of 5.4 meters, building total height of 21.6 meters; processing plant a layer of 5.4 meters high, building total height of 21.6 meters; processing plant a floor height of 9 meters, building total height of 18 meters.
- Customs inspection Joint Inspection building a layer high 3.9 meters, building total height of 27.3 meters.
- Inspection of the greenhouse floor height of 9 meters.
- The apartment building is 3.6 meters high and the building is 28.8 meters.
- The Product display center is 3.9 meters high and the construction height is 15.6 meters.
- Double-invasive incubator building is 3.9 meters high, building total height of 46.8 meters.
- Comprehensive supporting service building a floor height of 3.9 meters, building total height of 11.7 meters.

- The Financial settlement center is 3.6 meters high and the building is 14.4 meters high.

***Power supply**:*

- This project draws all the way from the municipal grid 10 kV. The power supply is used as the power supply for the project.
- Standby power supply: Set one 120 kw/150 kva diesel generator is a standby power supply with a level two load.

***Access and Utility Connections**:*

- The access to the complex from the border and other urban roads shall be assessed and the utility connections of water, sewage, power, communication, etc. shall be considered, especially for the sewage connection in which the site elevation shall be designed to be able to connect to the city sewer system.
- Sewerage volume: The amount of water consumed by the maximum daily consumption per day. The amount of sewage is 2717.3m^3/day calculated at 90%.
- The port uses the rainwater sewage diversion drainage system, the industrial sewage waste water should dispose in the factory to the discharge standard, can be discharged into the drainage municipal pipe net system, and send to the side area sewage treatment plant after the discharge. The sewage pipe in the port should be laid along the road according to the topography as far as possible.
- Sewage discharged into municipal sewage pipes should meet the effluent quality standard of sewage discharged into urban sewers (cj18-86).
- Domestic sewage should be treated by septic tank, oil tank and other treatment structures, simple treatment can be discharged into municipal sewage dry pipe.

Green building, storm water management (sponge city), traffic and fire safety:

- The design of the complex shall have demonstration features for innovation and green development. The green building design shall be included and the energy conservation design and use of solar energy shall be considered. The site development shall include the storm water management system, or sponge city concept, for ecological and environmental protection. The site traffic planning, especially for firefighting planning and access shall be detailed to ensure that fire truck could cover the entire complex.
- The roof rainwater of the building is discharged into the outdoor rain water well by the indoor rainwater pipe. It is discharged into the rainwater storage tank (the initial 10min rain water dump), which is stored and used for greening and road sprinkling while the excess rainwater overflows to the municipal network.
- Road Traffic facilities: The use of reserved squares, roads, greening and other land to create open space, improve the environmental quality of the port.
- Greening of the area: The selection of tall tree species to achieve noise reduction, harmful dust in an absorption, blocking and air filtration role.

Details of Settled enterprises area

118. **Business Area**: The function of the international center would be to direct more investment in areas of:

- **Bonded processing** focus; on high-end equipment manufacturing, characteristics of agricultural products, gold jewelry processing, national apparel processing, bio-pharmaceutical processing and other industrial development. Energy-saving equipment, new energy vehicles, materials and other high-tech aspects of processing trade and industrial supporting construction.
- **Bonded warehousing**: The development of cold chain logistics, international trans-shipment, import dismantling and distribution, export collection and other related industries.
- **International trade:** Focus on the development of international trade business, logistics services as a supplement to the international trade logistics supply chain, the introduction of large banks, financial and credit institutions and other professional financial services institutions.
- **Modern Logistics**: Based on the characteristics of Yunnan agricultural and sideline products, traditional Chinese medicinal herbs, non-ferrous metallurgy and other resources, the integration of Linqing railway, such as trans-Asian railways, and with the existing trade advantages, strengthen cooperation with the Customs and excise Special Supervision region. Further optimize the logistics coverage network, develop bonded warehousing, cold chain logistics and other related business.

  Product Display: Develop the international capacity cooperation zone trade display function, establish the cooperation area cross boundary electric commerce platform, at the same time, speed up the docking of large data projects, the establishment of large data centers.
- **Other**: the characteristics of industrial innovation to explore a number of features of industrial development, such as bonded maintenance, cross-border financing leasing, to further deepen the function of the international capacity cooperation zone.

3.5.1.3 Qingshuihe Border Trade Roads

Summary Details of Qingshuihe Road Projects

GPS	**Various**	**Total Length of Roads**	**5.07 km within the core zone of Qingshuihe Border Port area**
Land Area	**475.56 mu**	**Other facilities**	**Earthwork, subgrade and road surface works, rainwater works, sewage works, water supply works, bridge works, road landscaping works, traffic works, road illumination works, pipeline works, etc.**
Location	**Qingshuihe Port Economic Zone**	**Type of trees cut**	**26,310 Rubber Trees**
Environmental Issues	**Sloping hill side. Large cutting and filling of land involved, soil and water erosion, foundation design and ground water drainage, associated/linked utility facilities such as roads, power, water supply, waste water, and solid waste and hazardous wastes, type of industry- pollution/non-polluting, labour migration etc.**		

119. The urban infrastructures in Qingshuihe border area include the construction of five new urban branch roads, a new 350 m long bridge and widening one Class II connection road from Qingshuihe to Mangka border path.

Construction works and scale:

120. Six new urban roads are to be constructed with a total length of 5.071 km having a length of No. 1 Road is 899.829m, the length of No. 2 Road is 788.28 m, the length of No. 3 Road is 1260 m, the length of No. 4 Road is 644.125 m, the length of No. 5 Road is 955 m, the length of No. 6 Road is 523 m. within the core zone of Qingshuihe Border Port area. All of them are urban secondary roads or branch roads. The main construction works include: earthwork, subgrade and road surface works, rainwater works, sewage works, water supply works, bridge works, road landscaping works, traffic works, road illumination works, pipeline works, etc. Road signs and markings, channelization, and ancillary facilities will also be constructed. The total cost for the roads component including the bridge is CNY 739.52 million. **Table 3.7** gives the details of the proposed road network.

Table 3.7: Mengding Qingshuihe River Port Road network

No	Construction project Name	Build Length (m)	Red line width (m)	Design speed (km/h)	Right of Way (m)	Grade	Remarks
1	Planning 1 Route	899.829	24	30	24	Secondary	
2	Planning 2 Route	788.288	18	20	18	Branch	
3	Planning 3 Route	1260	24	30	24	Secondary	A 3×40 T-Beam Bridge
4	Planning 4 Route	644.125	18	20	18	Branch	
5	Planning 5 Route	955	18	20	15	Branch	
	Sub Total	4,548 m					
6	Planning 6 Route	523	12	60	24	Secondary	
6a	Main: 3 span twin tower cable stayed bridge						350 m (70+140 +70)
6b	S. Approach						3x20 m prestressed T
7	Corresponding supporting water supply and drainage, greening, transportation, lighting works.						
	Total	5,071 m					

121. Qingshuihe Port Economic Zone crossing the South Ting River bridge connecting the Mangka border construction project consists mainly of bridges, tunnels and road crossings and intersections, with a total length of about 1.86m, of which the bridge length is 350m, tunnel length is 633 m, and number of intersections are 2. The road is laterally designed for two-way two lanes, with sidewalks set on both sides.

122. The urban branch road belongs to the network of the core area of the side-zone and the Red line width is 15-24m; 6 route the second grade road, is the important road connecting the Qingshuihe River Bridge (one bridge and one tunnel) with the Mangka port, and the roadbed width 12 m Burma Avenue 1. The is a city trunk road, (4107.407 m having Red line width 43m) which is the main border to connect with the outside trading.

Planning 1 Route

123. Planning 1: The route is located on the north side of the new area, east to west. The road is located north of the barter area, via planning 3 Road, near Qingshuihe having route length approx. 847.851 m, Red line width is 24 m city secondary Gan, design speed is 30 km/h. The total cost for this component is CNY 78.11 million.

124. There are no current pipelines, fewer buildings are demolished, construction conditions are good, the topography is high west, and the north Gao is low. In the planning 1 Road east, there is an issue of mountain flooding that needs to be resolved. **Figure 3.8** shows the planning route status.

Figure 3.8: Planning 1 route

(Source: FSR)

Planning 2 Route

125. The route 2 is located on the south side of the new country, parallel to China-Burma Boulevard, the road west to the northern Barter district, east to planning 3 Road; Route length is 809.034m, Red line width is 18m with design speed 20 km/h. The total cost for this component is CNY 70.26 million.

126. There is no current pipeline within the scope of the road project; a small number of demolitions of buildings is required. Construction conditions are good, the terrain is high west and north Gao is Low. Planning 2 number Road close to the new custom door, road design elevation and the new door design elevation closely linked. **Figure 3.9** shows the planning route status.

Figure 3.9: Planning 2 route

(Source: FSR)

Planning 3 Route

127. Planning 3 Route West from planning 1 route, through the planning of China-Burma Avenue, to the northeast to connect the clear line. The road full length 1,260 m, the road red line width is 24 m having design speed 30km/h. The total cost for this component is CNY 210.54 million.

128. The route is mainly connected to barter area and earthwork formation area, barter area has a small number of current municipal pipelines, a small number of buildings need demolition, and construction conditions are good.

129. The proposed road route passes through the barter area. The proposed road passes through many urban roads, the road profile elevation control and traffic intersection is more complex, in this road is particularly important to connectivity between the park subprojects. This road connected to the Qingshuihe River Bridge. **Figure 3.10** shows the planning route status.

Figure 3.10: Planning 3 route

(Source: FSR)

Planning 4 Route

130. The Planning 4 Road is located in the earth-leveling site area, starting from the northern part of China-Burma Road. The route length is 669.081 m, the Red line width is 18m with design speed 20 km/h. The total cost for this component is CNY 86.11 million.

131. The current status of the route is mainly connected to China-Burma Road and there is no current municipal pipeline and construction demolition, construction conditions are good, topography south of the North Low. **Figure 3.11** shows the planning route status.

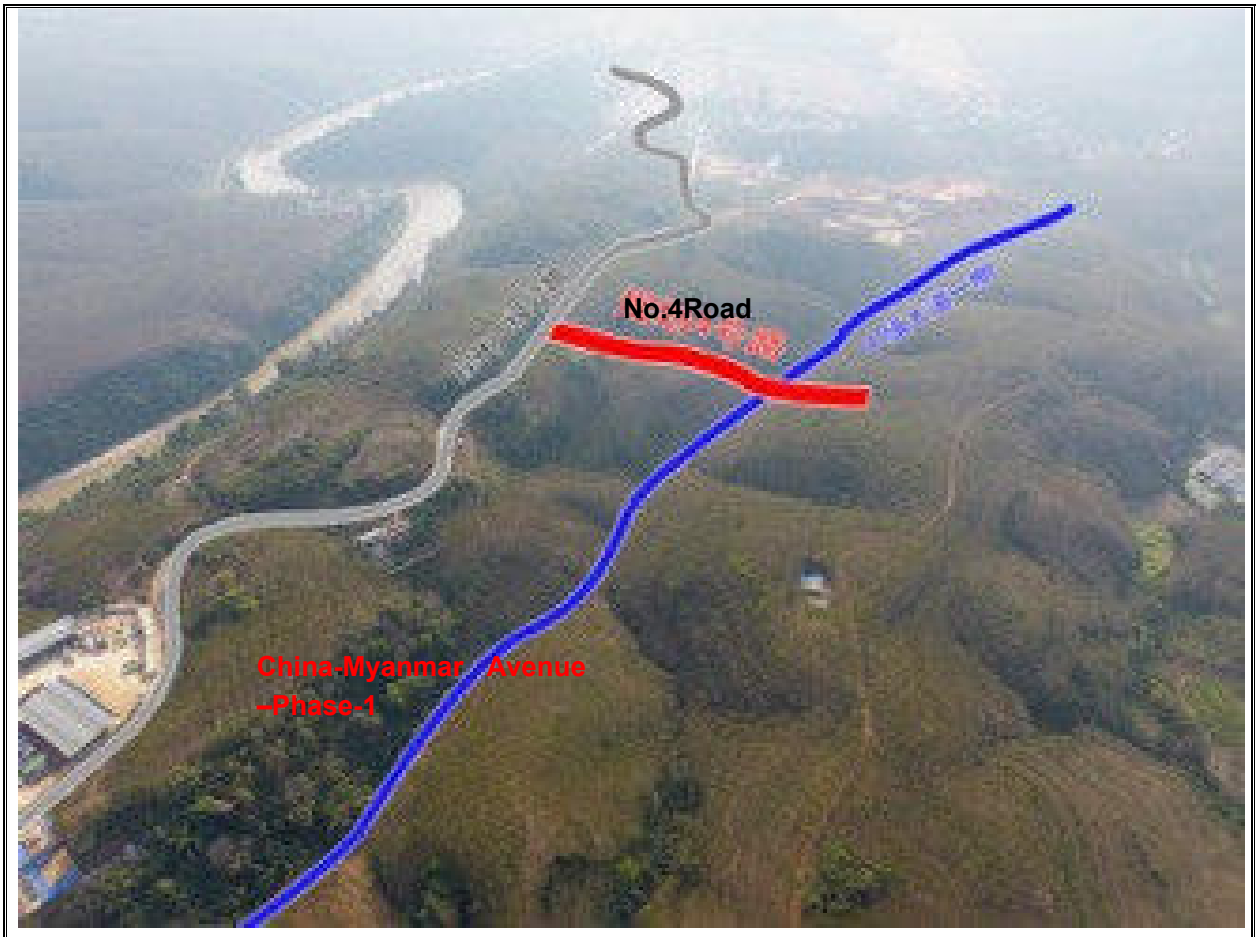


Figure 3.11: Planning 4 route

(Source: FSR)

Planning 5 Route

132. #5 Road is located in the north of the international capacity Zone, west from the China-Burma Road, the east through the planning 4 Road, stop at the planning 24m Road. The road length is 1,303.995 m and road red Line width is 18m. The total cost for this component is CNY 112.68 million.

133. The route is mainly connected to China-Burma Road and planning 4 Road; there is no current municipal pipeline and construction demolition, construction conditions are good, topography East is High and West side is low.

Planning 6 Route

134. Planning 6 Route from the beginning of the Mangka border (through one bridge and one tunnel), stop at the Mangka border China customs, length of about 350. The full line in the status of the Mangka boundary (wide 7 m) on the basis of widening the transformation, according to the two-level highway construction, the width of the roadbed 12m. The total cost for this component is CNY 11.10 million.

135. The road is mainly in the mountain area, and has no current municipal pipeline and building demolition, construction conditions are good, topography in west side is high, east side is low. **Figure 3.12** shows the entire planning route status.

Figure 3.12: #6 Planning route Tunnel location and Planning route Connectivity Point on China Myanmar Road

Earthwork

136. The amount of earthwork is huge and it will be a big concern for environmental impact. Minimizing environmental impact and reduction of earthwork will be considered. The road construction shall be planned in consideration of the land use development and the road construction shall be in coordination of the land use for the surrounding urban area. The roads shall be constructed by huge cutting and filling of soil which would leave the surrounding area un-useable for urban development.

Road Layout Design

137. **Figure 3.13** shows the entire road network. The scope of land use, the construction scale of the project is as follows, including road engineering, rainwater engineering, sewage works, traffic engineering, road lighting and greening landscape engineering is listed in **Table 3.8**.

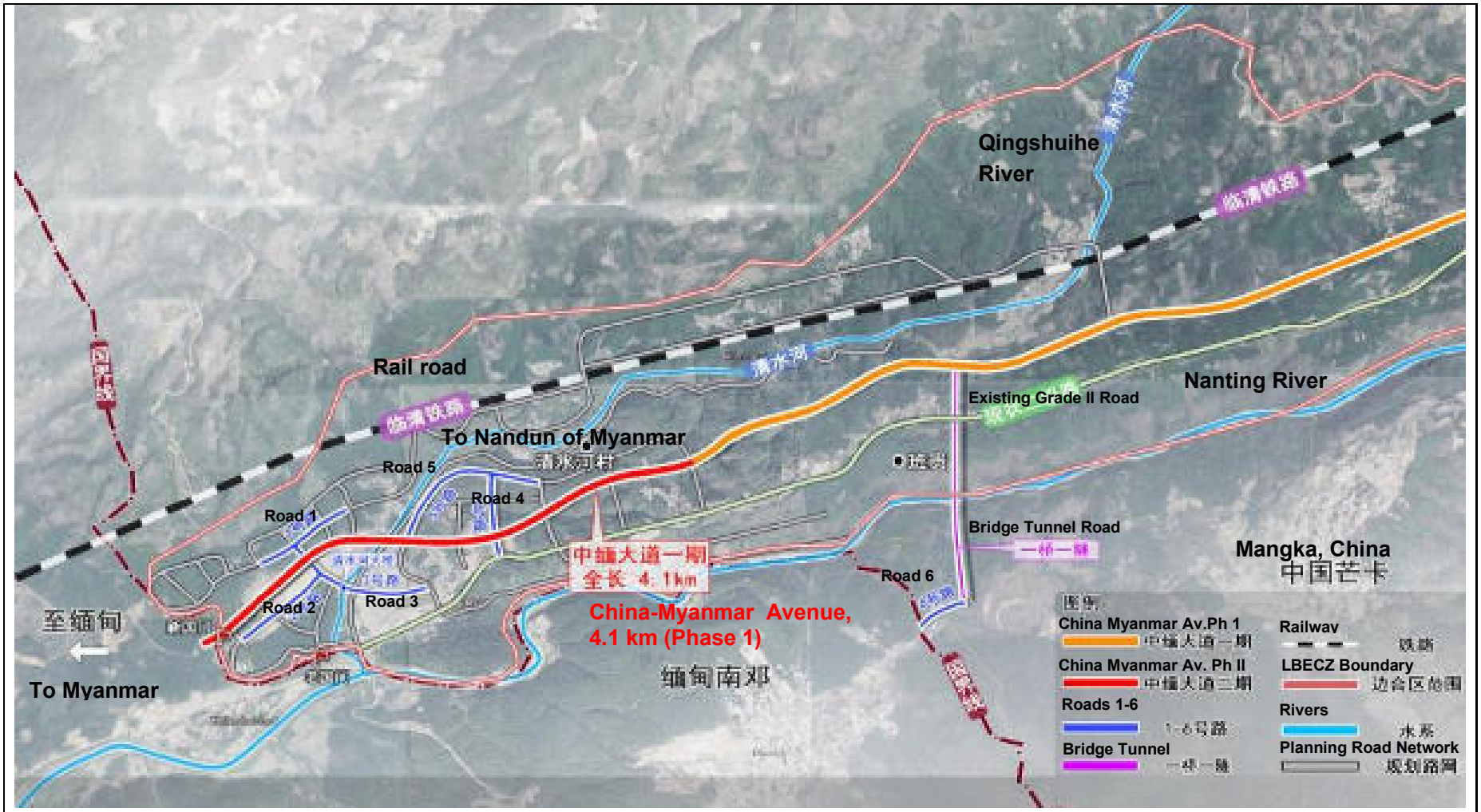


Figure 3.13: Road Network Map

(Source: FSR)

Table 3.8: Road Construction details

Construction project Name	Carriageway (㎡)	Sidewalk (㎡)	The amount of digging (³)	Crushed Earth Fill (³)	DN 300~dn1350Rain, sewer pipe (m)	Rain, sewage inspection well (block)	Green Belt Area (in m^2)	Requisition of Land (MU)
Planning 1 Route	15,015	5,866	140,091	124,117	3,112	128	3,523 m^2	69.75
Planning 2 Route	9,088	3,568	245,443	97,891	2,414	91	-	60
Planning 3 Route	17,686	19,652	548,845	290,685	4,950	220	10,100 m^2	168
Planning 4 Route	6,350	4,150	337,040	131,994	1,932	77	1,990 m^2	59.81
Planning 5 Route	12,809	5,130	542,452	121,455	3,278	189	-	118
Total								475.56

138. The layout of the road is mainly considered in the following five aspects:
- Consider the landscape demand of the road location;
- Consider the coordination of road surrounding buildings and landscape projects;
- Consider the coordination of sectional arrangement and road function;
- Consider the coordination of sectional arrangement and terrain features;
- Consider the near-long-term combination of sectional arrangement.

139. Design of the facilities in the project must include:
- According to the natural factors and geological conditions of the region, subgrade design is carried out in combination with roadbed filling and filling, construction, maintenance and operation.
- Fully consider the use of mechanized construction methods, the use of new technologies, processes and materials, local conditions, improve drainage systems and protection works, pay attention to environmental protection.
- Combined with topography and geology, conducive to environmental protection, landscape, pay attention to project landscape effect; with culvert, channel layout comprehensive consideration combined with geographical location, geographical features.
- Facilitate smooth traffic pattern during and after construction.
- Subgrade design should meet the construction schedule and technical and economic reasonable requirements; design to meet the requirements of flood control and drainage, to avoid and prevent landslides accident occurrence. The subgrade filling materials should be adapted to local conditions, but also conform to the requirements of the specification of the filler required.
- Comprehensive consideration of the impact of pipelines and surrounding buildings.

140. **Table 3.9** shows the construction costs.

Table 3.9: Construction Cost of Urban Roads (CNY Million)

Road	Construction Cost	Other Costs	Total
No. 1	45.2	32.91	78.11
No. 2	40.11	30.150	70.26
No. 3	124.07	86,47	210.54
No. 4	49.98	36.13	86.11
No. 5	65.41	47.27	112.68
No. 6	6.7	4.4	11.10
Total for Roads			568.83

141. **Figures 3.14-3.168** shows the road width schemes used for the above roads.

Road Traffic Logistics Planning

142. #1, #3 road in accordance with the C-level standard will install traffic signs, marking, intersection inlet section, central separation facilities for drainage and combination of intersection traffic selection - traffic lights, electronic police and video surveillance facilities.

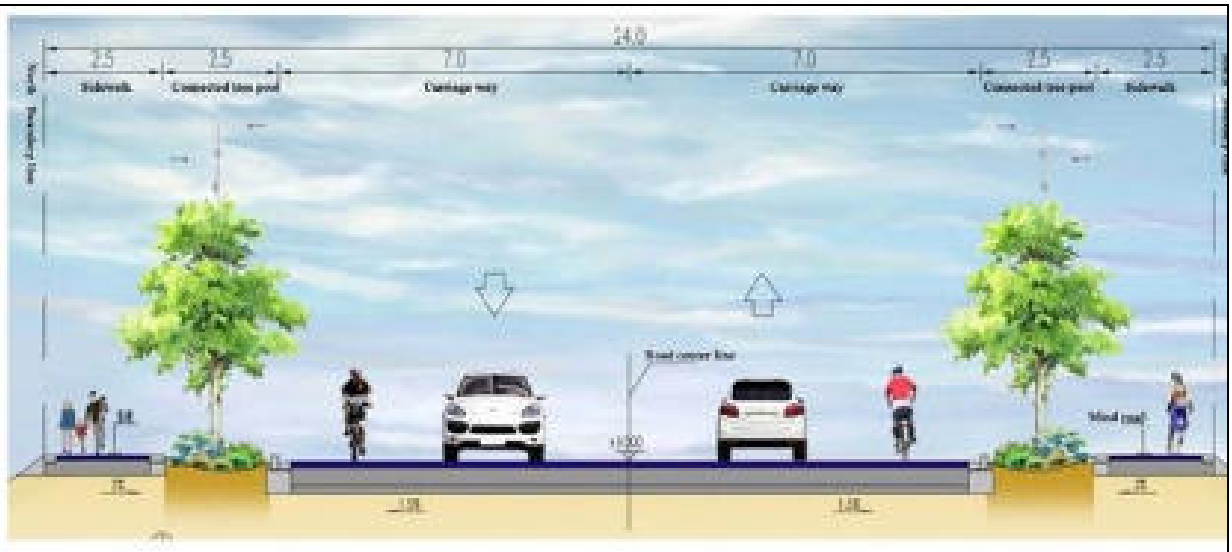


Figure 3.14: Scheme for 24m (No. 1, 3 and 6 Roads) Standard Cross Section

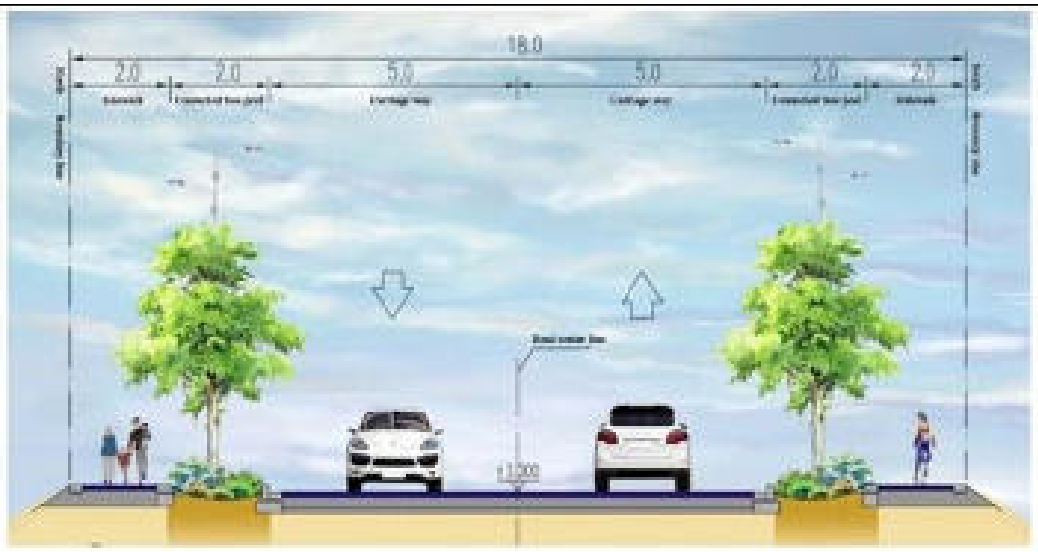


Figure 3.15: Scheme for 24m (No. 2 and 4 Roads) Standard Cross Section

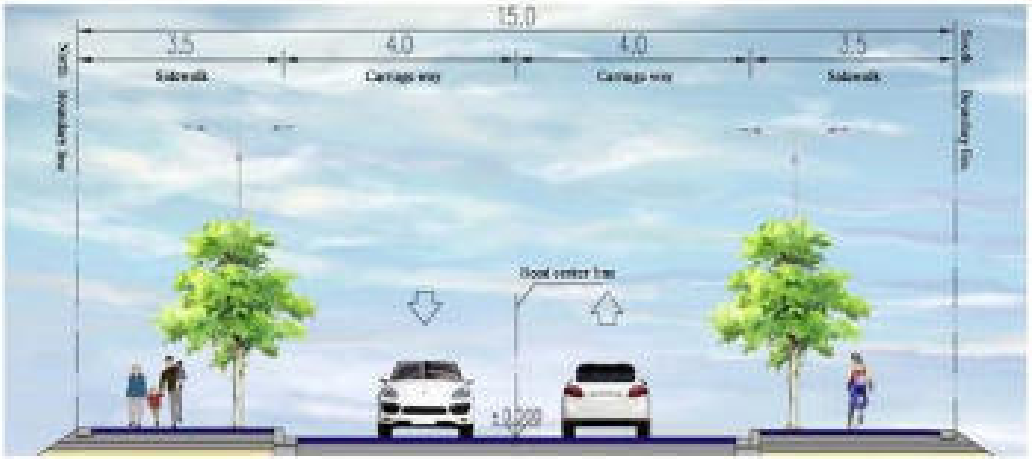


Figure 3.16: Scheme for 15m (No. 5 Road) Standard Cross Section

(Source: FSR)

143. All road and bridge projects must include a provision of cycling infrastructure. Promoting cycling and ensuring cyclists safety is an important public health measure (increased physical activity) also has additional environmental benefits. The project should include appropriate and safe cycling infrastructure, whenever feasible. Furthermore, safe and convenient cycling parking should be included in all infrastructures – hospitals, schools, border trade market and international cooperation area.

Bridge and Culvert project

144. 6 bridges with a total length of 993 m are set along the whole line, including 3 major bridges of 690m and 3 middle bridges of 303 m, without grand and small bridges set. There are 21 culverts. The total bridge length accounts for 13.75%.

145. A bridge is set up for the project to cross Qingshuihe River across the entire project. On China-Myanmar Avenue, the 6x30mT Beam Bridge having a bridge width 25.5m is required on the Planning 3 road. The original bridge would need to be constructed to ensure proper traffic parameters using a 6x30mT girder bridge width. Planning 3 Road would cross the Qingshuihe River using 3 x 40T girder bridge. **Table 3.10** lists details of the number of bridges and culverts along the whole Road infrastructure.

Table 3.10: Schedule for Major Bridge Distribution on Mangka Border Connecting Road

No	Central Pile No.	Name of River or Bridge	Opening quantity × span (opening ×m)	Structure Type
1	K0+222.39	Shuanglongjing Bridge	6×30	Fabricated prestressed concrete T-shaped beam
2	K3+281.00	Nanting River Bridge	9×40	Fabricated prestressed concrete T-shaped beam
3	K4+965.00	No.3 Mangka Bridge	4×30	Fabricated prestressed concrete T-shaped beam

Rainwater Engineering

146. The rain water is collected from the rain ditch and pipe, and the channel is divided into the ditches in the vicinity of the Qingshuihe and the road, and finally sinks into the South Ting River and the pipe diameter. d600 ~ d1800. The rainwater system of China-Burma Avenue is discharged into the Qingshuihe and the intersecting planning pipe network which, flowing on a longitudinal slope of the road will finally discharge into South Ting River.

147. The rainwater pipeline of the project is arranged with the longitudinal slope of the road, considering the rain discharge of the road and the transfer of rainwater in the surrounding plots. The rain pipe of this project is laid under the new road. It mainly collects the rainwater on both sides of the road and transfers some of the road rainwater. It relies on the natural slope of the ground to drain the rainwater into the nearby River channel and perfect the rainwater system of the city.

148. The rainwater pipeline is discharged into the river channel. The pipeline layout as far as possible consistent with the road to reduce earthwork volume.

- Planning 1 Route: Two-sided arrangement of rainwater pipelines, which are arranged at the lower margin of the motorway by 1.5m, the pipeline from east to west plan of the road and eventually access to the West river through rain pipe of diameter d600-d800 .
- Planning 2 Road: One-side layout of the rainwater pipe, the pipeline laid at the south side of the motorway lane margin stone 1.5m, pipelines are divided into two sections to plan 3 Road and West Planning road with storm pipe diameter d600 .
- Planning 3 Route: Two-sided arrangement of rainwater pipelines, which are arranged at the lower margin of the motorway 1.5m where the pipe is divided into two sections from west to east and from east to west to Qingshuihe with storm pipe diameter d600-d1800 .
- Planning 4 Road: One-side layout of the rainwater pipe, the pipeline laid on the west side of the motorway lane margin Stone 1.5m, the pipeline is divided into two sections to plan the road of the North China-Burma Avenue and the northern part to plan the rainwater pipe, the storm pipe diameter d600-d800 .
- Planning 5 Road: One-side layout of the rainwater pipe, the pipeline laid at the south side of

the motorway lane margin stone 1.5m where the pipe is divided into two sections from North to South and from South to North to the west to plan the road rainwater pipe and eventually into the Qingshuihe River. The storm pipe has diameter d600-d1000.

- China-Myanmar Avenue: The two-side arrangement of rainwater pipelines, the pipeline is located in the road below the motorway red line 7.5m, pipe points 6 the sections are lined with culverts along the line, Qingshuihe and Western ditches. The storm pipe has diameters d800-d1350.

Sewage Pipeline Layout

149. Detailed planning for Lincang border economic cooperation zone (2015-2035) area was prepared to meet Urban Development requirements such as sewage treatment, drainage system using rainwater. According to the LBECZ construction plan, Qingshuihe River Area sewage quantity is 9 million m^3/d. Accordingly, a new wastewater treatment plant is planned for a scale of 9 million m^3/day. According to the city master plan of the Mengding town (2011-2030), Mengding Center urban population total size was 7.5 million people in 2015. This project determined that the highest flow rate/day of water in the Qingshuihe area's comprehensive domestic consumption index is 210 l/d and the average day is 160 l/d.

150. In north side of the Qingshuihe River West Bank a sewage treatment plant will be built, taking into account the production and marketing rate of domestic sewage, the rate of interception and the coefficient of daily change. the scale of sewage treatment facilities is 10000m^3/day, covering 2.4 ha, which is located in the entire planning area. Tthe site is located in the vicinity of centralized water supply and town, factory, and residential areas.

151. Sewage collection pipe network slopes along the road flows from north to south, from west to east to downstream sewage lifting pumping station, along the Qingshuihe sewage treatment plant drainage, using a pipe diameter d500. The sewage pipe is arranged with the longitudinal slope of the road, and the sewage pipe is arranged according to the elevation of the plot and the road design. Under the new road, the sewage pipe of this project collects the sewage on both sides of the road, and the sewage is discharged into the downstream into sewage collection pipe due to natural slope.

Water supply

152. The main function of the proposed road water supply pipeline is to meet the needs of the planned land use along the road. The detailed planning LBECZ (2014~2030) area is mainly built with landmarks between 474 m to 592 m elevation having a height difference of 118m. The water pipe uses the steel wire net skeleton plastic compound pipe, the pipe soil burying depth is not less than 0.7m, laying on the sidewalk, the road red line is greater than or equal to the 18m road, bilaterally furnished to plumbing uses medium and low voltage systems.

Gas Engineering

153. The gas pipeline is arranged under the pavement, and the pipe diameter is designed to be dn 200-dn 300.

3.5.1.4 Nantinghe Bridge and connecting road to Mangka Border Crossing

Summary Details about bridge over Nanting River connecting Qingshuihe Border Point Economic Zone and Mangka Cross-Border Passageway and infrastructure

GPS of Bridge	**N $23^0$2917 E $98^0$52'27**	**GPS of Tunnel**	**N 22.49960 E 98.88130 (Linked facility)**
Land Area	**350m cable-stayed bridge and 50m in height**	**Land Area**	**40 m below the top of the hill that has houses and road.**
Location	**Nantinghe Bridge and connecting road to Mangka Border Crossing; Nantinghe No.1 Bridge, 350 meters in length and 50m in height**		
Environmental Issue	**No EN and CR species in the river (bio-diversity), pier construction on river bank, tree, Green Belt, connected to road tunnel (an associated facility), water quality in river, removal of debris from river bed, avoid migration paths of fish (if any)**		

154. The bridge will connect the existing two major roads to avoid the long roundabout (to improve connection between Qingshuihe Cross-border Point and Mangka Cross-border Point). The river lies at border between China and Myanmar several hundred meters downstream. The 5.17 km link road will pass through natural rubber forest. A road traffic tunnel is also being constructed to facilitate the traffic. **Figure 3.2** shows the location of the Nanting River bridge.

Construction Content and Scale:

155. For the bridge over Nanting River, the bridge width is 16.5m, and the cross section of 7.0m lanes with 2.5m shoulder and 2.25m sidewalk in each side will be used. The main bridge is a twin-tower three-span cable-stayed bridge with a span arrangement of 70m+140m+70m. The main tower is a two-pillar bridge tower; the approach bridge uses 2 × 30m span fabricated prefabricated prestressed concrete T-beam; the total bridge girder length is 350m; the route crosses Nanting River and then is set a horizontal curve (R = 2000m) at K1 +390.525 and connects Xianzhuang Road Mangka Boundary (H=573.33m) at K1 +865.612. The total length of the road is 1866m with a subgrade width of 16.5m; it is a secondary road with a design speed of 60km/h. The total cost for this component is CNY 170.69 million.

156. Starting point (K0+000, H=570.00m) is located at K150+080.461 of China-Myanmar Avenue; the route is from the starting point to the south for a straight line; at K0+239 - K0+872, 633m middle tunnel crosses the peak vertically to the north bank of Nanting River; then at K0+882 - K1+232, the bridge is set across the Nanting River.

157. A twin tower cable stayed bridge was selected for the bridge. First of all, the most suitable span length of utilizing cable stayed bridge is about 700 m – 800 m which is cost effective and aesthetic. Secondly the bridge site is at a deep V shape valley with one end of the bridge connecting to the tunnel exit directly. The twin tower cable stayed bridge, which has to be scaled down to a mini cable stayed bridge due to the short span length, will not be very attractive aesthetically. However, the construction cost will be much higher than other suitable bridge types because at this span length the cable stayed bridge is not the most cost effective bridge type.

Figure 3.17: Proposed Design of Bridge

(Source: FSR)

158. **Figure 3.17** shows an illustrative sketch of the proposed bridge. The bridge is a 350m cable-stayed bridge; Nantinghe No.1 Bridge, 350 meters in length and 50m in height. The design has been optimized without pillars in the water. The river stream will be maintained while there might be a side protection (normally called coffer dams) during the construction when the column is going to be set up.

159. **3x40T Girder Bridge:** The bridge foundation uses the bored pile foundation, the pier station uses the cast-in-place concrete construction, the superstructure construction prefab T beam using workshop prefabrication, two bridge pier top using structure continuous, need to carry out two times Zhang pull, site hoisting construction. Details are as follows:

- The main bridge of the project is the twin-tower three-span cable-stayed bridge, the bridge span is arranged as 70m+140m+70m, the tower adopts double column bridge tower, tower column height is 30m, the lower column maximum height is 63m, The main girder adopts prestressed concrete chamber structure. The approach adopts the 2x30m assembly type prestressed concrete T Beam, the bridge length is 350m.
- The medium-SPAN 1 hole crosses the channel, without piers in the river, and has a better landscape without flood control.
- Deck Layout Form 2.25m (sidewalk) +2.5m (side width) +2x3.5m (Lane) +2.5m (lateral width) +2.25m (Sidewalk), the total width of the deck is 16.5m.
- The base of the main bridge is the pile foundation of the abutment, the bridge adopts the column pier, the foundation is the independent pile foundation, and the abutment is the u type abutment, pile foundation.

- The pier structure is two-limb thin-walled column pier, the maximum pier height 59m, transition pier using pile-column structure, horizontal set 3 column, column top set high and low cover beam, bridge foundation using bored cast-in-place pile.

160. Some of the impacts of bridge construction could be:

- Some rubber trees and natural forest on the road segment will be removed.
- Large extent of soil erosion might occur due to construction activities. Restoration of road sides with suitable berms to avoid land slide due to erosion in the design and EMP.
- Construction materials falling into river and affecting receptors.
- Water quantity (HFL, LFL) to estimate river water diversion for bridge pillars.
- Biodiversity details for road segment, tunnel and Nanting bridge.
- Nanting river basin on fish migration details.
- Disposal of large quantity of muck generation from tunnel and its disposal.

3.5.2. Output 2: Integrated Urban Environment Infrastructures in Qingshuihe border area improved

161. The component includes:

(i) Qingshuihe water supply system of 20,000 t/d capacity with 32.0 km water transmission line and 28.1 km water distribution line;

(ii) Qingshuihe wastewater treatment plant of 10,000 t/d capacity with 28.1 km sewer piping network;

(iii) MSW management system of 6 MSW collection stations with toilet in Mengding and a 27 t/d transfer station and two collection stations with capacities of 7 t/d and 8 t/d in Qingshuihe as well as the MSW handling equipment for both towns;

(iv) Qingshuihe River rehabilitation for flood and pollution control of 3.43km and Nanpa River rehabilitation of 1 km;

(v) One of each electric charging station in Mengding and Qingshuihe and purchase of 6 new energy buses.

3.5.2.1 Qingshuihe Border Area Water Supply System

Summary: Water Supply Project in Mengding Qingshuihe River Port Area

GPS	**N $23^0$31.5'34" E$99^0$07'015"**	**GPS**	**N$23^0$30.2'44" E$98^0$54.2'44"**
Water Reservoir	**20 km from Nangti Nature Reserve**	**Water Treatment Plant**	**Water treatment plan with a capacity of 20,000 m^3/d**
Source Location	**Water source is Nangun River which is 25 km away**		
Type of trees cut	**900 Rubber Trees, 1800 shrubs**	**Water transmission and distribution pipes**	**32 km transmission pipe lines, 28.1 km distribution pipe line**
Environmental Issues	**Water resources assessment using long term hydrological data series, Water allocation and sustainability of the water sources, Agricultural land, odor, sludge disposal system, quality of waste water disposal**		

Construction Content and Scale:

162. The project requires: Water intake project, raw water transmission project, water treatment plant project and water transport and distribution project. The recent water supply is from Nangun River. Long-term water supply uses Yunjing Reservoir. Water intake project: a new water intake low dam is constructed, long-term water intake achieves dual-pipe water transmission, the recent construction is in accordance with the water transmission scale of 21,000 m^3/d, and the long-term one pipe water transmission volume is ensured 31,500 m^3/d. The total length of the water transmission pipeline is about 31.8 km. One DN700 pipe is recently used for water transmission.

Qingshuihe River Water Plant Size:

163. The Project is located in Qingshuihe River Area of Lincang BECZ. The newly built water plant is located at 1200 m in the southeast of Tuanjie Village, Qingshuihe River, Mengding Town, Gengma Dai and Wa Autonomous County, Lincang City, Yunnan Province and 500 m in the south of S319 provincial highway.

164. A water plant with capacity of 40,000 tons per day will be constructed. The water intake pipeline is estimated to be 21 km long, the water transmission line is 32 km, and the water distribution pipeline is estimated to be 28.1 km. The water intake point is selected on the Nangun River. Location of the water plant is 1.2 km southeast of Tuanjie Village, 500m south of Highway S319. The land to be used is 75 mu. The location of the water treatment plant and planned water distribution pipe network is shown in **Figure 3.18. Figure 3.19** shows the water supply plant location.

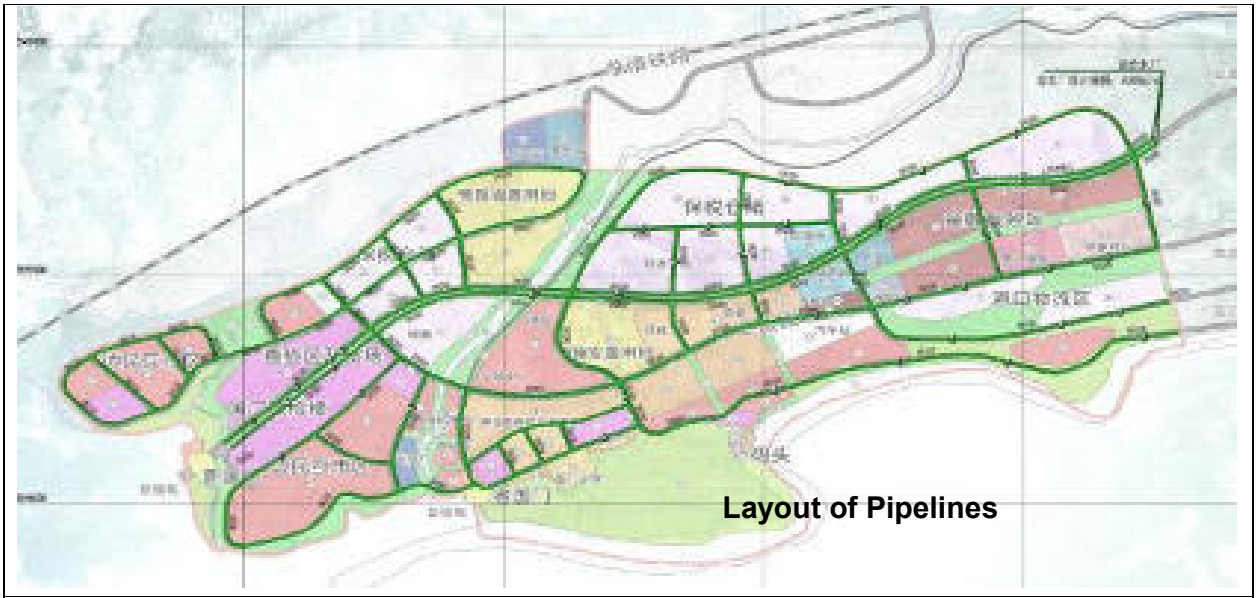


Figure 3.18: Qingshuihe Water Supply System

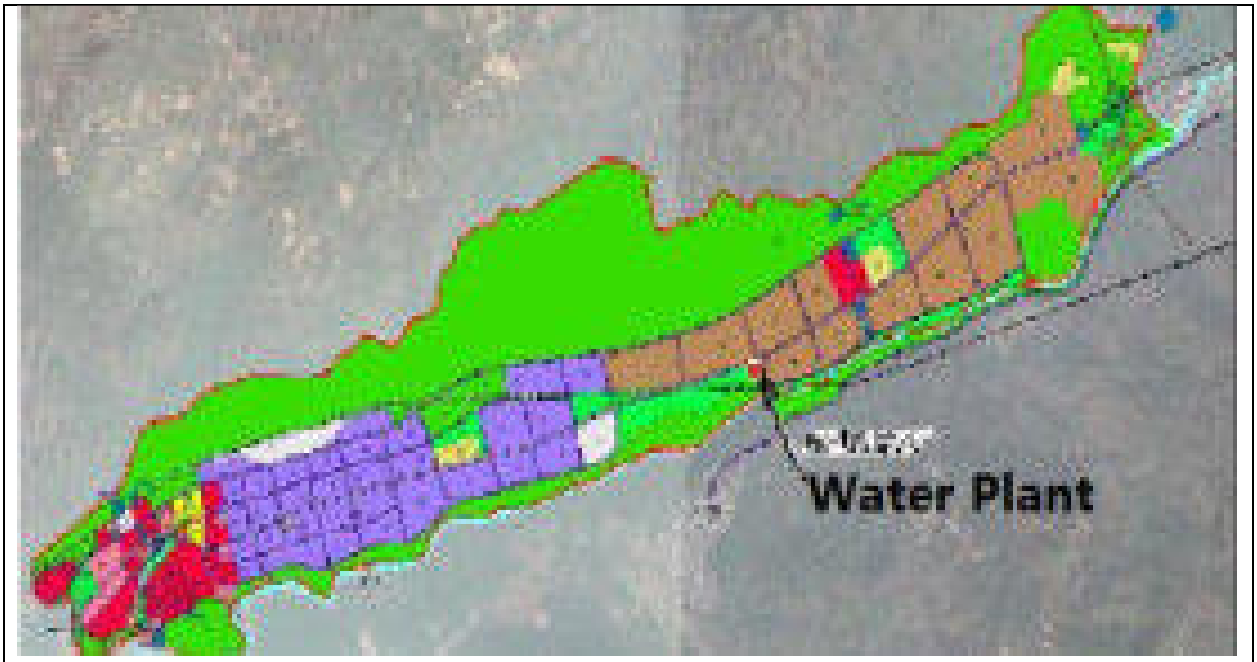


Figure 3.19: Qingshuihe Water Supply Plant

(Source: FSR)

165. According to LBECZ construction plan, Qingshuihe area's daily maximum water consumption is 113,000 m³/d. It is planned to build a new water plant with a water source of Yunjing Reservoir of 150,000 m³/d. In 2020, a new domestic water plant will be constructed with a scale of 20,000 m^3/d. In the long-term 2030, the domestic water plant will be expanded to reach 60,000 m^3/d, and a new industrial water supply plant will be built with a scale of 60,000 m^3/d. The recent planning covers an area of 30 mu. The water distribution pipe network diameter range is DN200-DN700, the total length is 33 km, PE pipe is used and the pressure rating is 1.0M Pa. The plant site is located at 2250 m southeast of Bangui Village, Qingshuihe River Port Area, Mengding Town.

166. The process of "Coagulation + sedimentation +filtration +disinfection process" is adopted for the water treatment in the water plant; the water is transported by gravity from the water plant to the service area. See **Table 3.11** for the detailed Water supply plant details.

Table 3.11: Building Content Schedule for Water Supply Plant in Qingshuihe River Port Area

Name	Construction Content		Remarks
Water intake works	DN500mm raw water pipe with a length of 25km		Raw water is taken from Nangun River; in the long term, multi-source for water intake will be adopted. When utilizing water of Nangun River, it shall be taken from Yunjing Reservoir.
Water treatment plant works	Water distribution Well	1; design scale: 10700m^3/d	Handling capacity of the water plant: 10,000m^3/d in the short term and 20,000m^3/d in the long term
	Pipeline mixer	Two DN800 steel QT-101 helical blade pipeline mixers	
	Flocculation deposit tank	Divided into two groups; the handling capacity of each group is 5350 m^3/d	
	Siphon filtering pool	2 (6 grids); design scale: 535m^3/d	
	Clean water tank	2; design scale: 21000 m^3/d	
	Other buildings	Dosing room, comprehensive building, repair workshop of the warehouse, etc.	
Water diversion and distribution works	The diameter scope of water distribution pipe network is DN100-DN500mm and the total length is 40 km.		The pipe is the ductile cast iron pipe.
Environmental protection engineering	Landscaping of 1000 m^2 and septic tank		

167. The newly built water plant of the Project is located at 1200 m in the southeast of Tuanjie Village, near Qingshuihe River, and 500m in the south of S319 provincial highway. The elevation of this terrain is 700 m, which is higher than the highest point (60 m) of the whole Qingshuihe River area, and completely meetsi the gravity water supply of the whole Qingshuihe River Area and the surrounding areas. The water plant will be built relatively close to the water consumption center. The secondary pollution in water supply pipe network is relatively low and the water use safety of residents is higher.

168. The land for the water treatment plant has rubber trees, is located just next to an existing major road. Number of trees to be cut are 900 rubber trees and 1800 shrub trees. From the plant, the water will be sent 10 km down by a trunk pipeline before the water is distributed to the area. Those pipes will be undergrounded along the existing road, therefore environmental impacts by the construction will be temporary but impacts during the operation will be minimal.

169. The water source is Nangun River which is 25 km away from the water treatment plant. The turbidity is quite high due to heavy soil erosion during rainy days. There is no industrial development in the upstream. Water intake from the river near to existing Mending town water intake structure is about 3 km. Currently, the river water is used for hydropower generation and water supply for Mengding Town. The intake is at upstream of hydropower station.

Demand

170. During 2018 to 2020, short term water demand for raw water transmission, water treatment works and water distribution network is 20,000 m^3/d. During 2021 to 2030, the water supply wil increase to 40,000 m^3/d and the total size of the town water supply to 60,000 m^3/d.

River Water Source for Water Supply

171. There are over 1000 rivers running through Lincang Prefecture, which belong to Nu River system in the east and Lancang River system in the west. Nanting River is the largest river in this region (98°41′～100°14′E, 23°18′～24°20′N), which originates from Boshang Town of Linxiang District, runs through Yun, Yongde, Zhenkang and Gengma Counties, and feeds into Myanmar connecting with the Nu River (Figure 3.22). The total length is 273 km and its catchment area is 8208 km^2 in Lincang Prefecture. Nanting River is the largest and first grade tributary in the left bank of Nu River. It is about 20 km down from Qingshuihe Border Area reaching Gunnong Bridge and connecting with Nu River.

172. **Nanting River**, a Nujiang River Nanting River system (shown in **Figure 3.20**), is the Salween River right bank to join a larger tributary. Nanting River (**Figure 3.21**) stems originated in Linxiang District, Bo Shang Town, Yongquan Village, southwest elevation of 2480 m of Liangshan, since the river flows from north to south After going through the Bo Shang, Lin Xiang, ants heap,; Sheep head rock at the head Road after the water turned to the northeast to southwest Flow through Yun County and Yongde County, blade Mountain, Chonggang and other places in the mountains, out of the valley into Gengma County Meng, Mengding two larger alluvial basin Bazi, Mengding Bazi and then into the Canyon and in Gengma County Meng Shing town of Qingshuihe port out of the country into Burma, down about 20 km rolling in Myanmar into the Salween River county.

173. Total length of the territory of the main stream 268 Km, the total drop of 2080m, with an average drop of about 4m/km, the territory of the basin area of 8097 km^2, to Qingshuihe exit basin area of 8172 km^2.

Figure 3.20: River systems with the catchment area over 20 km^2 in Lincang Prefecture
(Red characters represent the name of county or district, and blue characters represent the river name) (Source: Lincang Runting Water Resources Scientific Services Ltd. Co., LRWRSLC)[21]

[21] Lincang Runting Water Resources Scientific Services Ltd. Co. is responsible for developing the water resources assessment reports for Water Intake Sub-Project from Nangun River, and two bridges across Qingshui River, respectively.

Figure 3.21: Nanting River

174. **South rolling River**, originated in Fu Rong Township Gengma mountains, dense forests within the basin, vegetation lush, abundant rainfall (average annual rainfall greater than 1600 mm), the catchment area of 110.1 km^2, river water sufficient, good water quality, river length 30 km, the natural drop 1515 m, multi-year average flow 4.27 m^3/s, multi-year average runoff depth 1220 mm, the average annual runoff 135 million m^3. According to Gengma County Water Resources Survey Report shows that: the water flow of the most dry 3.87 m^3/s (33.43 Wan m^3/d), the project can meet the requirements for water withdrawals, due to small population living within the river, sparsely cultivated, non-polluting sources, water quality turbidity slightly higher than the rainy season..

Water permits

175. Approval of Lincang Municipal Water Affairs Bureau on the Water Intake Permit Application of Mengding Qingshuihe Port Area Water Supply System (No.6 Document dated April 27, 2018) is attached in **Annexure 10** for reference.

176. Also, a summary from the water allocation resources report in **Appendix 4** in shown in **Table 3.12** below:

Table 3.12 Summary Table of Water Resource Assessment for Construction Project

I. Basic Information	Project Name	Water Supply System in Qingshuihe Port Area, Mengding Town, Gengma County, Lincang Municipality	Project Location	2250m southeast of Bangui Village in Mengding Town, on the sloping field at the north side of the existing China-Myanmar Road: E 98 ° 53'46 ", N 23 ° 30'9" .
	Construction scale	Type I	Sector	Water Resources
	Project Implementing Agency	Lincang Border Economic Cooperation Zone Management Committee	Report Institute and Certificate No.	Lincang Yunting Water Technology Services Co., Ltd. Water Assessment No. 530217093
	Approval Authority	Lincang Municipal Water Affairs Bureau	Water Assessment Approval Authority	Lincang Municipal Water Affairs Bureau

	Water Demand	In Qingshuihe Port Area, the planned annual water intake volume for domestic water consumption is 7.665 million m^3 in the short term, and 22.995m^3 in the long term	Baseline Year	2016
	Feasibility study grade	Grade II	Target Year of the Plan	2020 (short term) 2030 (long term)
II. Control Target	Total water intake control	Short term:7.665 million m^3; Long term: 22.995 million m^3	Total actual water intake and consumption	Short Term Plan Year 7.30 million m^3 Long-term Plan 2299.5m^3
III. Water Intake and Consumption Plan	Approved annual water withdrawals	Short term plan year:7.665 million m^3; Long term target year: 22.995 million m^3		
	Design maximum water intake flow rate (m^3/s)	0.73	Design maximum daily water intake volume (m^3/d)	63000m^3/d
	Water intake location	Yunjing Reservoir: located at Zhedian Village of Mengding Town, geographic location E99 ° 09'21.95", N23 ° 30'4.13" Intake Location: E98 ° 49'40.1 ", N23 ° 29'17.7".	Guarantee Ratio for Water Consumption (%)	95%
	Water Consumption Quota after approval	Short term plan year: 21000m^3/d; long term plan year: 63000m^3/d	Water recycling rate (%)	80 (construction period)
IV. Water Drainage	Approved annual return flow	Annual wastewater generation during short term plan year and long-term plan year is 4.409 million m^3 and 13.559 million m^3	Discharge of Major Pollutants and Concentrations	Predicted major pollutants from domestic wastewater: BOD5 200mg/l, CODcr 300mg/l, TP 4.51mg/l, NH3-N 24.8mg/l
	Location of drainage	Qingshuihe Gengma Development Zone	Drainage arrangement	Discharge into urban wastewater treatment system for treatment to meet Class IB standard of the Pollutant Discharge Standards for Urban Wastewater Treatment Plant (GB18918-2002), before discharge into pollution discharge outlets of river
V. Water Resource and Water Ecology Protection Measures	Engineering measures	The reservoir will release ecological flow at a rate of 10% of the multi-year average flow, i.e. 0.142m^3/s (4.372 million m^3), which will be discharged through the preserved outlet at the dam.		
	Water conservation and management measures	Further improve the water supply pipeline network, increase the diameter of water supply main, adopt new-type material, strengthen monitoring and maintenance of the pipelines, reduce pipeline loss rate.		
	Other non-structural measures	Extensive awareness campaigns on water conservation, demonstration of water saving methods, improve residents' awareness in water conservation. Carry out water tariff reform, conduct scientific and proper allocation of water sources, save water consumption		
Reservoi	Check flood level (m)		922.99	

r Indicators (Yunjing Reservoir)	Design flood level (m)	922.00					
	Normal water level (m)	919.50					
	Dead water level (m)	871.00					
	Total capacity (10,000 m^3)	2035.2					
	Utilizable storage (10,000 m^3)	1688.1					
	Dead storage (10,000 m^3)	93.4					
	Regulation characteristics	Annual regulation					
Short-term plan year Nangun River Water Intake (2020) P=95%, monthly average intake (10,000m^3), in total 7.30 million m^3 (this project)							
January	62	April	60	July	62	October	62
February	56	May	62	August	62	November	60
March	62	June	60	September	60	December	62
Long-term plan year Yunjing Reservoir (2030) P=95%, monthly average intake (10,000m^3), in total 22.955 million m^3 (this project)							
January	195.3	April	189	July	195.3	October	195.3
February	176.4	May	195.3	August	195.3	November	189
March	195.3	June	189	September	189	December	195.3
Current Water Quality	Class II						
Location of water drainage	Gengma County Qingshuihe Development Zone						
Water Quality Target of Drainage	Class Ⅲ						
River Basin	Nujiang River Basin						

Source: Water Allocation Report 2018

Water Source Selection

177. Raw water of the works is taken from Nangun River; in the long-term, multi-source for water intake will be adopted. When utilizing water of Nangun River, it shall be taken from Yunjing Reservoir.

178. The Nangun River is the unique water resource for replenishing the water for the proposed Qingshuihe Border Area. Nangun River is the first grade tributary of Nanting River. It was assigned as the water resources protection area from the waterhead to the proposed Yunjing Reservoir (**Figure 3.22**). For the downreaches, it was allocated as the development and utilization zone for agriculture and industry.

179. Nangun River originates from Gengma Mountain of Furong Village that has dense forest, lush vegetation and abundant rainfall (the average annual rainfall is more than 1600 mm). The catchment area is 110.1 km^2. The water amount in rivers is adequate and the water quality is good. The river length is 30 km and the natural head is 1515 m. The average flow of years is 4.27m^3/s, the average runoff depth of years is 1220 mm and the average total runoff amount of years is 135,000,000m^3. As shown in Water Resource Investigation Report in Gengma County: the lowest flow of the water source is 3.87 m^3/s (334,300m^3/d), which can completely meet the requirement of the planning on water intake quantity. There is a small resident population, rare cultivated land and no pollution in Nanwa River and Nangun River watersheds. The river water is clear throughout the year except that the turbidity of water quality is slightly higher in rainy season. The elevation of water intake point of the water source is about 100m higher than that of the water supply area of planning scope in the short term of Mengding Qingshuihe River Port, so the elevation of the water source point is relevantly proper.

180. The raw water pipe network of the works is designed to be constructed as per short-term plan, which has a diameter of DN 500mm; the water intake pipe network of Yunjing Reservoir is designed to be added as per long-term plan, which has a diameter of DN 500mm. The length of raw water pipe in the short term is 25 km.

Figure 3.22: Location of proposed water supply site for Qingshuihe Border Area along Nangun River within the Nanting River Catchment (Source: Lincang Runting Water Resources Scientific Services Ltd. Co., LRWRSLC))

181. Yunjing Reservoir has a total storage capacity of 20,352,000 m^3 and a capacity of 16,881,000 m^3. Total water demand in the project area is 3215.49 Million m^3, the reservoir water supply 3215.49m^3, can solve the planning level Mengding 803951 people town water supply of Mengding Town Guan Village, Nuo Emei Village, Xinzhai Village, Hexi Village, Jingxin Village, Shaha Village, Hanhong Village, Hehai Village, Xiacheng Village, Xiaba Village, Mangmei Village, Qiushan Village, Baishing Village Qingshuihe Village. A total of 14 village committees, 38,819 population, 15,186 large livestock, 30,372 poultry of small livestock and irrigation water for 83,500 mu of cultivated land is used.

182. Yunjing reservoir has a barrage, spillway, diversion and diversion tunnel. Barrage dam high 88m, spillway and diversion tunnel axial length were 372.00 m, 552.50 m. Reservoir irrigation canal control elevation is 831.50m, the overall layout of the proposed irrigation canal length 52.7km. The total length of 16.0 km, the left main pipe length 23.6 km, the right main pipe length is 13.1 km, the

south socks river branch pipe length is 9.62 km and the south bottom river branch pipe length is 5.7 km.

183. Recent water supply for the South River, the total water supply for water 44.78 million m^3/year, the required water for urban water supply. The amount of water is 5.475 million m^3/year (the original water leakage and the water consumption by the water plant by 5% of the total design scale, diurnal variation coefficient of 1.4), the surplus water volume 39,305,000 m^3/year, water supply available water to meet the needs of urban water supply raw water.

184. **Yunjing Reservoir Overview**

- South Rolling River is located in the mountainous area, as a shallow river, the water level changes in a large range, the flood water level soars with more water deposit.
- The project water point: South River, Yun King Reservoir.
- The long-term water supply source is Yunjing Reservoir, and the total water supply of water supply source is 27,242,700 m^3/year. The urban water supply department for the original water volume of 17,689,000 m^3/year (the original water leakage and the water consumption by the water plant by 5% of the total design scale. Daily variation coefficient of 1.3), the surplus water 9553700 m^3/year, the water supply to meet the needs of urban water supply
- Qingshuihe Port Economic Zone In 2020, the urban water supply source will be South Rolling River; Yunjing Reservoir will be the source of water with Nanting River as a backup emergency water.
- Recent water supply for the South River, the total water supply for water 44.78 million m^3/year, the required water for urban water supply.
- Water abstraction project: One new low-dike intake structure for river banks will be built with a water intake of 21,000 m^3/d. Long-term Yunjing Reservoir water, water size of 63,000 m^3/d.
- Raw water transfer project: The new water pipeline DN700, pipe length 32km, the pipe is made of cast iron pipe, steel pipe, Pressure rating 2.5 MPa.
- Qingshuihe water treatment plant project: the recent 20,000 m^3/d, long-term 60,000 m^3/d. The recent acquisition of 30 acres, long-term reserve 40 mu.
- Water distribution project: water distribution network diameter range of DN200-DN700, the total length of 33km, pipe access to PE pipe, Pressure level 1.0MPa.
- The water plant is located north of the planning area, the water source is Yunjing Reservoir, with a scale of 8,000 cubic meters/day and an area of 0.8 hectares.
- The terrain of water intake to the project is high elevation, thereby requiring no water pumping due to displacement of water through gravity.

185. **Nangunhe Reservoir:** Nanting River is the planning boundary of Qingshuihe Port Economic Zone, which is near the water area and rich in water, but both sides have many villages and market towns are scattered and water quality is unstable and easily contaminated. Nanting River is a port economy and district water is used for domestic use only as an emergency backup water. Nanting River water environment functional zoning is done for agricultural water, industrial water, part of the river for the fish sanctuary, with the strengthening of national environmental protection, Nantinghe water quality protection and stability is set to improve, considering the Nanting River water as a long-term industrial water plant. The impending Jingjing Reservoir to be built is located in the upper

reaches of Nangu River. Its main purpose is to solve the problems of Mengding Township and 14 village committees Qingshuihe Area) domestic water, and livestock water, farmland irrigation water. Rolling south water is rich in water quality is better, both sides of the river are densely covered with vegetation and are far away from the residential area. Water sources are not easily contaminated. Therefore, Nangunhe Reservoir and Yunjing Reservoir are more suitable for such uses.

3.5.2.2 Qingshuihe Wastewater Treatment plant and Supporting Projects in Mengding Qingshuihe Area

Summary of Sewage Treatment Plant and Supporting Projects in Mengding Qingshuihe River Port Area

GPS	**N 23.49493^0 E 98.844385^0**	**Location**	**Site 2 (New area that has agriculture)**
Land Area	**37.2 mu**	**Total Building Area**	**WWTP with capacity of 10,000m^3/d. Land area: 2.38 ha.**
Pipelines	**Sewage pipe network diameter is DN400-DN800, and the total length is 28.1 km**	**Type of trees cut**	**1030 Rubber trees and agricultural crops**
Environmental Issues	**Conduct water quality modelling to assess the impacts of water quality after discharging the effluent into Qingshuihe river and Nanpa river, trees, agricultural land lost, sludge disposal plan, odor. Length of sewage lines, gravity disposal, green belt development**		

186. The Qingshuihe town does not have a systematic wastewater collection and treatment system. The urban wastewater is simply collected with or without treatment and discharged into the nearby river system, causing environmental pollution to the surface water system. The project will establish a new wastewater collection and treatment system to meet the environmental regulation requirements, which is a very critical project component for the border area development. Based on the demand analysis, the capacity of the wastewater treatment system is 10,000 m^3/d and the planned future expansion capacity is 35,000 m^3/d. The discharge standard for the treated water is Class IB in according to PRC design code, and the water will be discharged into Qingshuihe for landscaping development.

Construction Content and Scale:

187. Wastewater Treatment Plant (WWTP) Site – Due to the limited useable land in Qingshuihe, the WWTP site was selected in the upstream of Qingshuihe River based on the alternative study result. The proposed site is shown in **Figure 3.23** and the plant layout diagram is shown in **Figure 3.24**. The site is at the downwind direction of the town, which is desirable but at higher elevation due to the restriction of the available land. A pump station will be included in the project to transmit the wastewater from the Qingshui town to the WWTP. The land currently covered by rubber trees and agricultural land is located in the border facility area and away from the International boundary. Waste water to be pumped up to bring to the WWTP in some areas due to lower elevation.

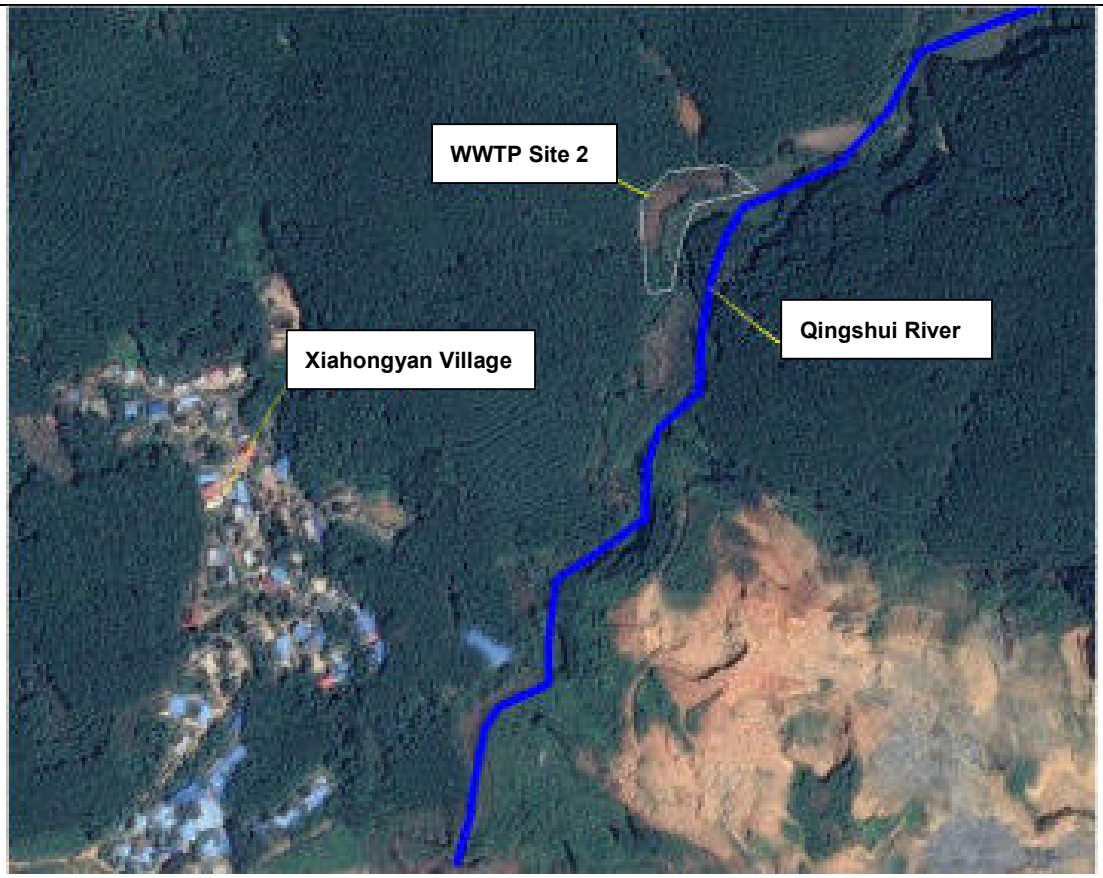


Figure 3.23: WWTP Plant site

(Source: FSR)

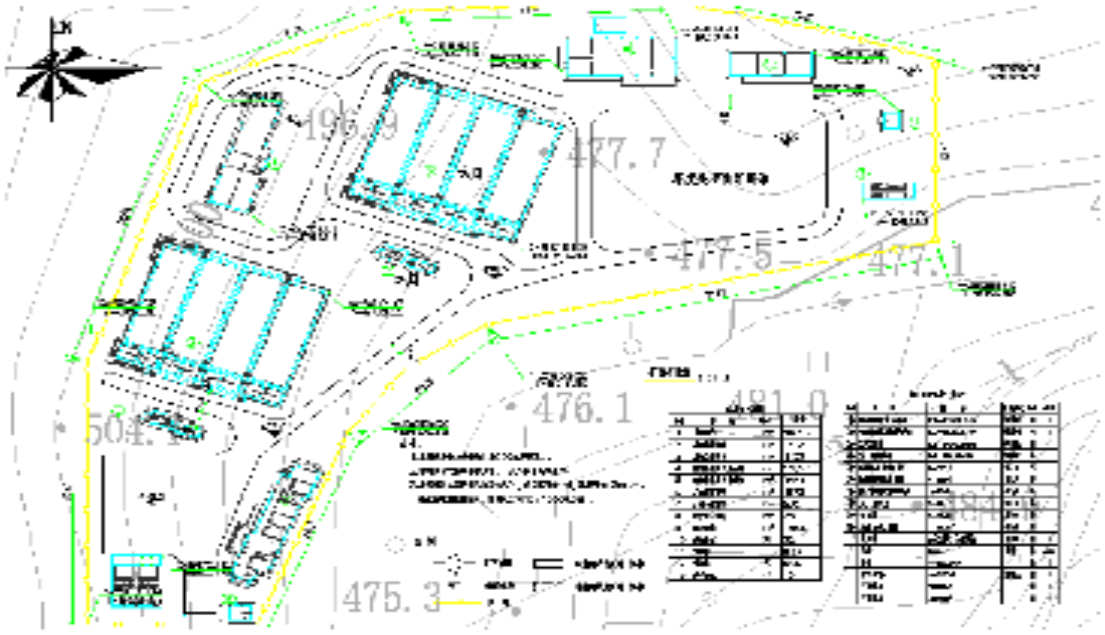


Figure 3.24: WWTP Treatment Plant Site (2)

(Source: FSR)

188. Sewage treatment plant project and supporting sewage pipeline network project; sewage treatment plant project scale: the total scale is 20,000 m3/d, the project is planned once and implemented in phases, and the recent implementation scale is 10,000 m3/d with a total floor area of 37.2 mu. The scope of the recently implemented sewage pipe network diameter is DN400-DN800, and the total length is 16.5 km. The sewage pressure pipeline adopts the ball PE sewage pipeline, and the gravity flow sewage pipeline adopts the steel belt reinforced HDPE pipe.

189. Capacity of the WWT to be constructed is of 25,000 tons per day, wastewater collection pipelines are 48.5 km long. The cost for pipelines is CNY 7.99 million; however, total cost of the WWT and the pipelines is CNY 52.09 million. The location of the WWT is on the north bank of Nanting River and east bank of Qingshuihe River. The preliminary engineering design has been conducted and detailed in the FSR.

Layout Plan of Sewage Pipe

190. The overall terrain of Qingshuihe River Port planning area is higher in the north and east as well as lower in the south and west. Nanting River flows through the south edge of the planning area from the east to the west and Qingshuihe River flows through the central part of the planning area from the north to the south. The project design scope is divided into two sewage drainage division areas according to current topographic features and river systems. The overall sewage division area at east of Qingshuihe River is higher in the north and east as well as lower in the south and west. The sewage main trunks drain sewage from the north and east to the south and west. Afterwards, the sewage converges in the intercepting sewer at the east of Qingshuihe River; the overall sewage division area at west of Qingshuihe River is higher in the north and west as well as lower in the south and east. The sewage main trunks drain sewage from the north and west to the south and east. Afterwards, the sewage converges in the intercepting sewer at the west of Qingshuihe River.

191. See Attached **Figure 3.25** for schematic diagram of layout of sewage pipe network of Qingshuihe River area. The water drainage system in Qingshuihe River Area is improved to realize that the coverage rate of the township sewage pipe network is higher than 90% and the sewage collection and treatment ratio is higher than 80%.The sewage of the planning area of Qingshuihe River Area is collected into the sewage treatment plant for treatment by means of the sewage interception pipe network and finally discharged into Nanting River. The total sewage flow of the planning area is 25000m³/d in the short term and 50000 m³/d in the long term. The pipe network is established in one step as per the short- or long-term plan.

- **Pipe Scope and Quantities of Pipe Network**: The pipe diameter distribution of the pipe network of the Works: DN400-DN1000mm. The quantities of the pipe network of the Works: 48.472 km.
- **Design Period, Handling Scale and Process**: The design period of the sewage treatment plant is Short-term: 2016-202 and Long-term: 2021-2030.
- **Handling Scale of the Sewage Treatment Plant**: The area of Sewage Treatment Plant in this Project is 53.5 mu; the designed treatment scale is 25,000 m³/d in short-term and 50,000 m³/d in long-term.
- **Treatment process**: The CASS process is adopted by the water treatment plant of the Project.

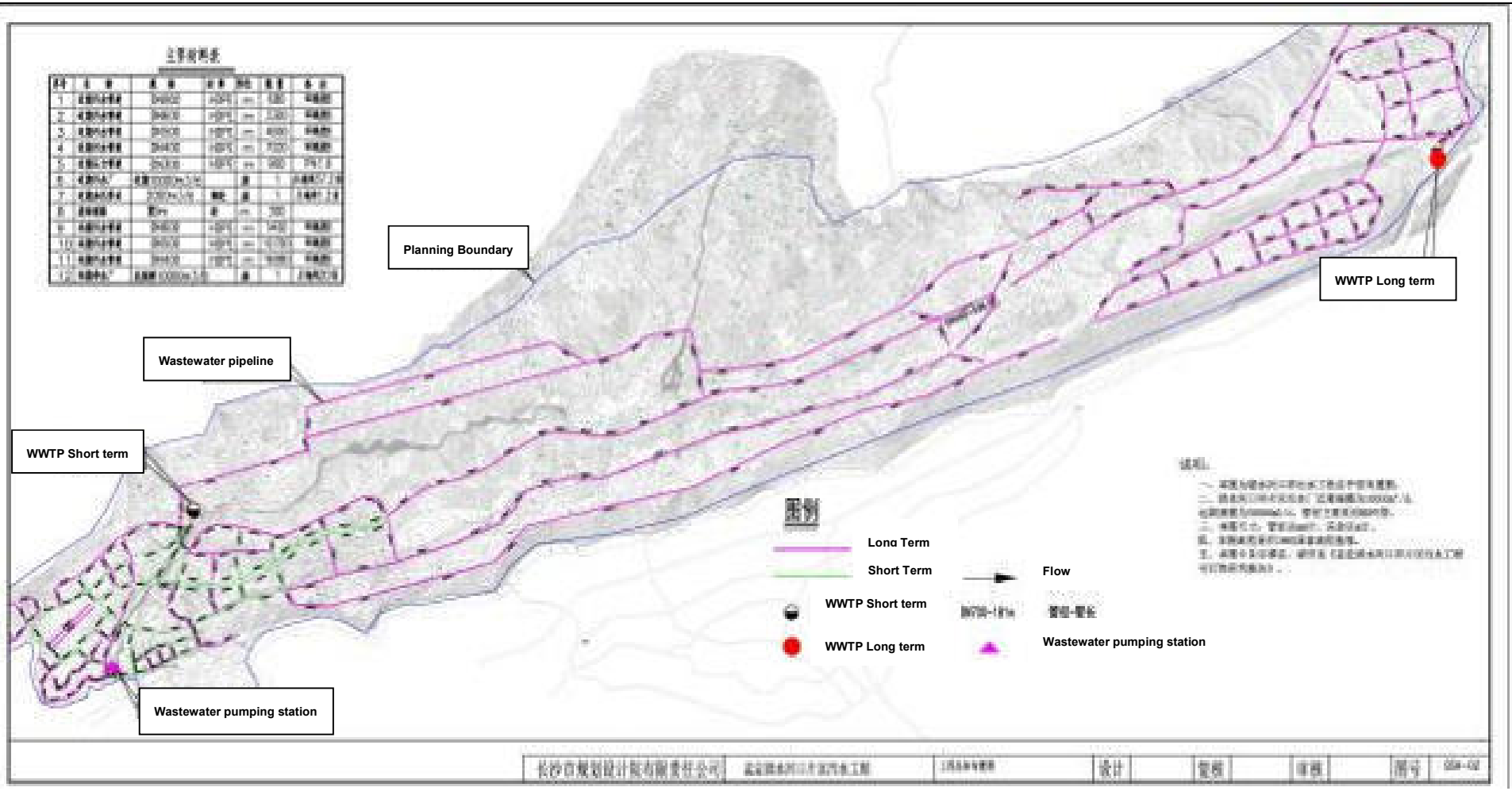


Figure 3.25: Schematic Diagram of Layout of Sewage Pipe Network of Qingshuihe River Area

(Source: FSR)

Designed Effluent Water Quality

192. After the effluent water quality treated in the sewage treatment plant of Qingshuihe River Area reaches B-standard of the Grade I standard as specified in Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002), it is discharged into Nanting River. See **Table 3-13** for the designed effluent water quality:

Table 3-13: Designed Effluent Water Quality of Sewage Treatment Plant in Qingshuihe River Area

Indicator	BOD_5	COD_{cr}	SS	TN	NH_3-N	TP
Values(mg/L)	≤20	≤60	≤20	≤20	≤8 (15)	≤1

* NH_3-N means that the 8mg/L discharge standard shall be executed when the temperature is higher than 12°C while the 15mg/L discharge standard shall be executed when the temperature is lower than 12°C.

193. The summary of the wastewater management system in Qingshuihe, including the wastewater treatment plant and the sewer pipe network as well as the other linked facilities and structures are shown in **Table 3.14**.

Table 3.14: Summary of Qingshuihe Wastewater System

No	Description			Unit	Capacity
1	Design Capacity and Criteria				
	Phase 1 (2020) (m^3/d) =	10,000			
	Phase 2 (2030) (m^3/d) =	35,000			
	Wastewater treatment process = CASS (cyclic activated sludge system)				
	Discharge classification = Class IB				
2	WWTP Site Selection				
	at 500m south of Xiahongyan Village next to Qingshuihe River (EL = 477 m)				
3	WWTP				
	Wastewater process = large grid - small grid - sand settlement tank - grease removal pipe -				
	Anaerobic (A1) - CASS tank - disinfection - discharge/sludge				
	Disinfection - ultraviolet				
	Sludge - dewatering and disposal to landfill				
	Site plan development				
	Area = 24,010 m^2				
	Building area = 4,150 m^2				
	Green area = 13,600 m^2				
	Major structures:				
	Pump room = 13.6m x 13.1m				
	Sand settlement tank = 16.25m x 5.27m				
	Bio treatment tank = 47.0mx39.6 m				
	Compress air room =325 m2				
	Sludge dewater room = 358 m^2				
	Office building = 522 m2				
	Processing equipment			set	1
	Electric equipment			set	1
	Metering and monitoring equipment			set	1
	Automatic control equipment			set	1
	Monitoring and security equipment			set	1
4	Wastewater piping network				

No	Description	Unit	Capacity
	Scope: sewer main, sewer interception, and sewer branches		
	Pipe materials: PE for DN <= 600, Concrete for DN > 600		
	Sewer pipes:		
	DN800 (concrete)	m	200
	DN600 (HDPE)	m	600
	DN500 (HDPE)	m	3400
	DN400 (HDPE)	m	1300
	DN400 pressured sewer (PE, PN 1.0 Mpa)	m	1700
		Subtotal =	7200
	Manhole (1000)	ea	240
	Manhole (1500)	ea	7
PE = Polyethylene pipe, HDPE = high density polyethylene pipe			

(Source: PPTA Consultants)

3.5.1.3 Qingshuihe and Mengding Municipal Solid Waste Management

Summary: Solid Waste Disposal Project in Mengding Area and Qingshuihe River Area (for Garbage Collection)

GPS	**Waste Transfer Station # 1 GPS: N 23.48551^0 E 98.83988^0 (10 m away)**	**Waste disposal site GPS location**	**Mengding county (GPS: N 23^{0}3130 E 99^{0}417).**
Land Area	**Qingshuihe River Port, LBECZ area**	**Total Building Area**	**1685.32m^2**
Type of trees cut	**200 rubber trees cut for solid waste transfer station**	**Other facilities**	**MSW management system of 6 MSW collection stations with toilet in Mengding and a 27 t/d transfer station and two collection stations with capacities of 7 t/d and 8 t/d in Qingshuihe as well as the MSW handling equipment for both towns**
Environmental Issues	**Leachate disposal strategies, Residents around the project sites might be affected by odor, sanitation, water, air, and noise from the collection vehicles. Potential impacts include traffic congestion, threat to public safety, agreements with landfill sites.**		

194. The project will establish MSW collection and transport system in Qingshuihe border area and upgrade the MSW management system in Mengding town. At present, there is no systematic MSW collection and transport system in Qingshuihe and the MSW is collected and disposed by local residents.

Planning and construction content:

195. A new garbage transfer station (including 2 compartments with a capacity of 12m^3, 1 garbage transfer vehicle with 8t, 1 set of garbage compressor, 1 set of lateral displacement device, 1 set of hydraulic system, 1 set of electronic control system, 1 set of spray dust reduction system, 1 set of atomization and deodorization system and 1 set of automatic cleaning machine) will be built in the main urban area and Qingshuihe River area of Mengding Town. The transfer station of

Qingshuihe River Port Trade Zone will increase vehicle parking and sanitation center; 2 new garbage collection points (including garbage room, hook arm box and garbage collection truck with compression equipment, etc.) will be built.

196. Two solid waste stations in the Qingshuihe were visited. The lands are located in the developed border facility areas, and will not have any environmental significance. The wastes will go to a landfill site in Mengding county (GPS: N $23^0$3130 E $99^0$417). Waste Transfer Station # 1 GPS: N 23.48551^0 E 98.83988^0 (10 m away)

SWM System

197. Solid Waste Disposal Project for Mengding Main Urban Area and Qingshuihe River Port Economic Zone is the urban environmental treatment project, which will improve the classified collection system of municipal household garbage and the harmless treatment rate of household garbage, select collection and treatment process scientifically and reasonably and strictly control new pollution to the environment under the guidance of the urban master planning.

198. After collecting the household garbage in the main urban area of Mengding Town and Qingshuihe River Port Economic Zone, the household garbage will be sent to the waste transfer station for centralized disposal (the construction works of household garbage transfer facilities of Gengma County is now under construction. The transfer stations are located at Mengsa Town, Mengyong Town and Mengjian Village respectively, the service of which covers 9 towns and villages) and then sent to the household garbage landfill at Mengding Town. The landfill, at Huishenggai section, Boguang Sub-village, Xiacheng Village, Mengding Town, is 5.0 km from Mengding Town People's Government. The handling scale is 110t/d and the total storage capacity is 680,000m^3. The service population (until 2029) is 165,300.

199. According to setting contents related to garbage collection station specified as per Technical specification for municipal solid waste collecting station (CJJ 179-2012), the collection point mode is adopted for the built area. The quantities of the collection points shall be not less than 1/km^2 (about 565 m service radius).The service radius of the collection points shall confirm to the following provisions:

- For collection by labors, the service radius should be within 0.4 km but not more than 1 km.
- For collection by small motor vehicles, the service radius shall be not more than 2 km.

Main Urban Area in Mengding Town

200. According to regulatory detailed plan for main urban area of Mengding city, the output of household garbage in the main urban area is about 220 t/d at the end of the planning period and about 264 t/d in the peak period.

- As the main urban area of Mengding Town covers an area of about 22 km^2, 11 garbage collection stations are established by combining the Technical specification for municipal solid waste collecting station. The small motor vehicles are adopted for collection in the Project with a service radius of 2000m. The household garbage collection of the main urban area can be covered when the service radius reaches 700m. The collection ability of each garbage collection station is 20t/d.

- 42 garbage collection points are firstly established in main street area with dense population in the built area of the main urban area of Mengding Town.

Qingshuihe River Port Economic Zone

201. Total population is planned to be 15,800 at end of the regulatory detailed plan for Qingshuihe River area of LBECZ. The transfer stations are calculated as:

- As the Qingshuihe River Port Economic Zone covers an area of about 4.23km^2, 2 garbage collection stations are established by combining the Technical Regulation for Household Garbage Collection Station. The Project adopts the small motor vehicles for collection with a service radius of 2000 m. The household garbage collection of the Qingshuihe River Port Economic Zone can be covered when the service radius reaches 1000m.
- The Qingshuihe River Port Economic Zone firstly establishes 8 garbage collection points in densely populated areas of main streets in the constructed zones.

202. The project will build a MSW collection station in Qingshuihe and Mengding as shown in **Figure 3.26**, and two MSW collection stations in the international cooperation area and logistics area each. The project will also build six MSW collection stations in the rural area of Mengding for setting up the MSW collection and transport system. In addition of the construction of MSW transfer station, MSW collection stations, the project will also purchase the MSW handling equipment for the new MSW management system in Qingshuihe and upgrading the MSW management system in Mengding. **Table 3.15** shows the sub-project component details.

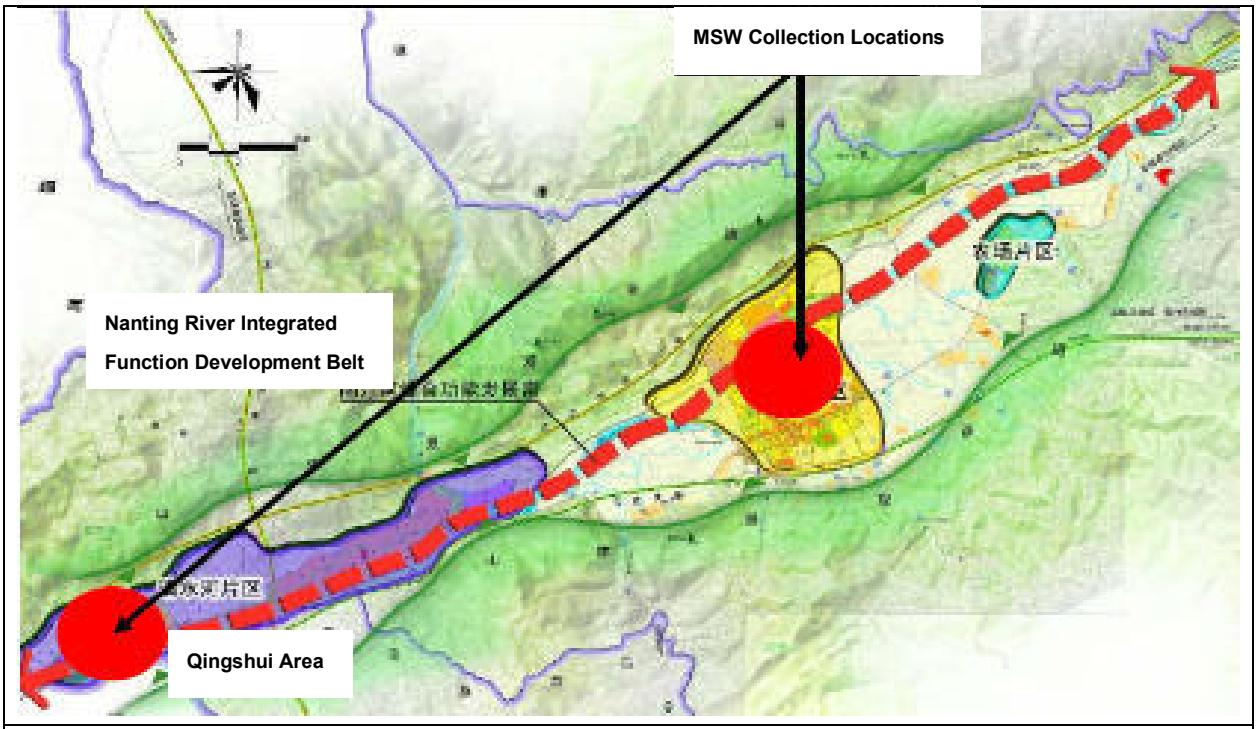


Figure 3.26: Qingshuihe MSW Collection Station Sites

(Source: FSR)

Table 3.15: Summary of Qingshuihe and Mengding MSW Management

No	Name	Capacity	Area (m2)	Qty
1	Design Capacity and Criteria			
	Current design = 76 t/d (population = 174,500)			
	Future capacity = 185 t/d (population = 334,900)			
	Covered area: Qingshuihe and Mengding, including the rural areas			
2	Qingshuihe Border Area MSW Management			
	Transfer station (horizontal compression)	27 t/d	4.44 m	1
	Collection station at logistics area	7 t/d	0.89 mu	1
	Collection station at corporation area	8 t/d	0.54 mu	1
	MSW equipment:			
	8t MSW truck	8		1
	12 m^3 MSW container	12 m^3		2
	8 m^3 MSW swing container	8 m^3		3
	3 t MSW truck with swing arm	3 t		2
3	Mengding MSW Management			
	Scope: rural MSW collection and treatment			
	MSW collection station with toilet		64.8 m2	6
	MSW equipment:			
	Trash bins			2600
	Garbage barrel	240 L		1346
	MSW container	3 m^3		60
	0.3t MSW motor tricycle	0.3 t		59
	1t MSW dump truck	1 t		15
	3t MSW compaction truck	3 t		1
	4t MSW compaction truck	4 t		1
	1t vacuum sewer truck	1 t		1
	5t street sweeping truck	1 t		1

(Source: PPTA Consultants)

203. This component is to build 6 MSW collection stations with Toilets and 2600 collection points (trash cans) in Mengding Town, and 2 MSW collection stations and 280 collection points (trash cans) in Qingshuihe Area. Total cost is estimated to be CNY 16.45 million. Total building area constructed in the Project is 1685.32m^2, which involves the following parts:

a. Construction of the Main Urban Area in Mengding Town:

- 6 garbage collection stations with toilets [22](building area of each station is 129.64 m^2);
- 42 garbage collection points;
- Facilities and general layout for garbage collection and treatment

b. Construction of the Qingshuihe River Port Economic Zone

- 2 garbage collection stations (building area of each station is 129.64 m^2);
- 8 garbage collection points;
- Facilities and general layout for garbage collection and treatment
- **Table 3.16** lists various civil works for MSW collection or transfer stations. Based on the assessment of current situation and needs, considering road conditions, a solid waste collection and transportation plan is developed for Mengding urban center and QPEZ which include two parts as follows:
- MSW collection and transportation equipment for source collection and transportation. Detailed statistics of equipment is listed in **Table 3.17**.

[22] Toilets also include women's facilities at the project sites.

Table 3.16: Contents of construction of MSW collection and transfer stations

No	Contents	Scale (t/d)	Quantity	Area (m^2)	Remarks
1	Compression transfer station	27	1	2963.33	Port trade area and Qingshuihe Village, Bangui Village. The project scope: civil engineering, matched facility and transportation vehicle with two hook-armed boxes and one hook-armed transfer truck.
2	Compression transfer station	21	1	808	Qingshuihe International Production Capacity Cooperation Area. The project scope: civil engineering, matched facility and transportation vehicle with two hook-armed boxes and one hook-armed transfer truck.
3	Collection station	7	1	594	Qingshuihe Transportation and Logistics Park and Banxing Village. The project scope: civil engineering, matched facility and transportation vehicle with three swing-arm boxes and two swing-arm transfer trucks.
4	Waste chamber (with public toilet)		6	64.8	Hanhong Village, Zheha Village, Xiacheng Village, Hehai Village, Xiaba Village, and Nuoe Village

Table 3.17: List of MSW collection and transportation equipment

No.	Equipment	Size	Quantity	Remarks
1	Garbage bin	100-120L	2600	For urban center blocks, commercial blocks - The waste container should be beautiful, hygienic, durable, rainproof and flame-retardant
2	HDPE bin	240L	992	- For residential, commercial street merchants - Specifications are uniform and tightly sealed and anti-corrosive
3	Hook-armed bin	$3m^3$	35	Matching 1t detachable vehicle
4	Three-wheel motorcycle	0.3t	31	For MSW collection
5	Detachable vehicle	1t	9	For sub-urban and rural waste collection
6	Self-loading garbage truck	3t	7	For MSW collection from bins
7	Back-compression vehicle	4t	2	For MSW collection from bins and Waste chamber
8	Fecal suction truck	5t	2	For the collection of sediment from septic tanks and public toilets
9	Road sweeping truck	Maximum cleaning capacity is 70000 ㎡/h, cleaning width is 3200mm	1	For cleaning the road
10	Small sweeping truck	Maximum cleaning capacity is 12000 ㎡/h, cleaning width is 2100mm	2	For cleaning the road and public hall
11	Sprinkler	5t	1	For sprinkling on road
12	Monomer mobile toilet	standard	15	For festival celebrations

Facilities to be put up

204. **Garbage House** (with public toilets): garbage houses usually established in residential areas, business and enterprises, mixed collection capacity about 300kg, with brick mix in township, wider rural application.

205. **Ordinary garbage containers, tick/swing box**: ordinary garbage containers usually established in residential areas, business and enterprises. its capacity range of product sizes, general to 5-20m^3, by region different amount of garbage generated, set containers of different sizes. Finally, the removable garbage vehicle pulls the hook box to the staging point for garbage-compression deodorization.

206. **Extruded Trash Containers**: The extruded garbage container itself is equipped with extruded equipment can be placed in a residential area, business, industry and institution. when a certain amount of garbage is loaded, garbage vehicles will transport it to the processing yard or transfer station.

207. **Garbage cans/Trash Dustbin**: Generally located on either side of the road or at intersections and all types of transport passenger facilities, public facilities, wide farm, social stop near the entrance to the garage, etc., Set at random, from road width limit, and easy for pedestrians throw garbage, belong to fixed point garbage collection. Trash needs larger size of the bin, fitting with the population, garbage where production is large, garbage collection can be used instead of garbage pools, garbage cans, skins without civil construction, and have flexible moveable installation.

208. **Supporting Engineering water source**: using municipal tap water produces water to local water pipe network, day maximum water supply is 4m^3 where: live water consumption: 2m^3/d, water consumption: 0.3m^3/d, road sprinkle water consumption: 1.36m^3/d.

209. **Green water consumption**: 0.55m^3/d single-seat garbage collection station life, live water supply to local water distribution network, maximum daily water supply is 2m^3 where: treated water consumption:1.15m^3/d, water consumption: 0.1m^3/d, road sprinkle water consumption: 0.5m^3/d, green water consumption: 0.25m^3/d.

210. **Drainage** The system will use rain sewage diversion, sewage septic tank treatment back into municipal pipe network, rainwater collection after municipal rain pipe network,

211. **Infiltration Leachate** by pipeline into a drainage pool, flushing and washing of the leachate from the operation of the transfer station, is pollution heavy waste water. Using shipping transport trucks will be regularly sent to Xuanwei landfill leachate system after treatment to meet the target emissions.

Service Population and Landfill waste forecast[23]

212. **Qingshuihe River area:** The permanent population of the Qingshuihe River area is currently 29,034 people, upto 75,305 people; Entry-Exit population approximately 1509 million people, about 41,343 people/d; to a projected 3572 million people, servicing 97,873 people/d.

213. **Mengding Main City**: is responsible for serving current resident population of 133,153 people, Inbound and outbound population about 41,343 person/d, Long term resident population 237,008 people, Entry-Exit population approximately 97,873 person/day.

214. **Mengding Landfill site**: is located in Mengding Zhen Xiacheng cun Bo Guang Group Hui Sheng Change lot. Qingshuihe River area is located in Mengding town West side, distance landfill field approximately 28 km. Total production approximately103t/d, where 76t garbage shipped to Mengding landfill, 27t garbage self handling; 218 t/d,185 t garbage shipped to Mengding landfill plant, and 33 t garbage through self handling. The Qingshuihe River area and the Mengding main town include the rare Hong Kong Village, Chater Village, Xiacheng Village, He Hai Village, Next Dam Village, Waxy village. The Municipal Solid Waste from these localities s eventually transported to Mengding Town landfill for disposal.

215. **Projected MSW sent to Landfill site**: Garbage total production to 103 t/d, where 76t garbage is shipped to Mengding landfill, 27t garbage from self processing. The garbage total output would go upto 218t/d (volume storage of 13.84 million m^3), where 185t (metered capacity 70.69 million m^3) Garbage shipped to Mengding landfill, 33t garbage from self handling in 2029.

3.5.2.4. Qingshuihe River (domestic section) Rehabilitation and Landscaping

Summary: River Regulation and Landscape Works within Qingshuihe River Port

GPS	**GPS N 23.48852^0 E 98.84611^0**	**GPS location**	**About 10 m away and not approachable on foot)**
Land Area	**Clear water channel of 51,923m^2, greening area 66,568 m^2, and permanent foot print of 131,298 m^2**	**Total Building Area**	**Planned river regulation work covers 5 km, which includes: channel improvement, sludge dredging, sewage interception and river landscaping works.**
Type of trees cut	**2000 Rubber Trees, shrub trees 3500**	**Other facilities**	**3.43 km of Qingshuihe River and 1 km of Nanpa River, including engineering measure and biological improvements, and sewage inceptors along the river**
Environmental Issues	**Design for bank embankments, measures for containment of soil erosion, drainage and storm water flow with eco-friendly design, river bed sediment, dredging and disposal, downstream impacts, biodiversity plan, green belt development.**		

216. The project component will rehabilitate two rivers running through the newly developed Qingshuihe border area. The locations of the two rivers are shown in **Figure 3.27**. The Qingshuihe

[23] Forecast data from FSR

River is a seasonal river with flooding risk during the rainy season. The river runs through the exiting urban area to meet Nanting River at the border with Myanmar. Due to lack of systematic wastewater collection and treatment system in Qingshuihe town, some of the domestic wastewater is discharged into the river directly, resulting pollution to the river system. The Nanpa River is another local river running along the border line to meet Qingshuihe River and Nanting River at the border with Myanmar. The river is located in the new border area currently under the development. The river embankments have severe erosions and the area along the river needs to be rehabilitated for use as part of the green open space for the new border area.

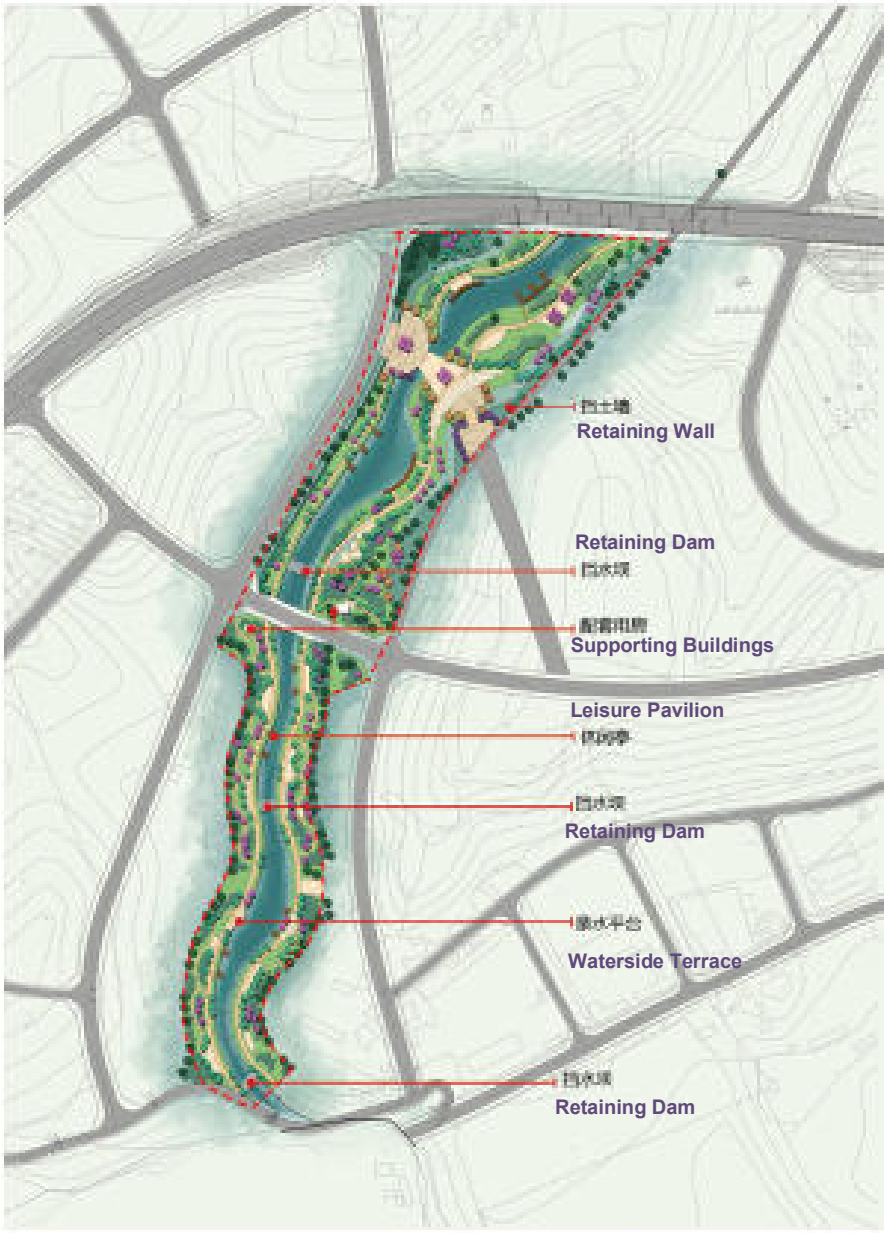


Figure 3.27: Qingshuihe River Rehabilitation Scope

(Source: FSR)

Construction Content and Scale

217. The rehabilitation project would work on landscaping the side banks of the Qingshuihe River, starting from crossing of Nanting River and Qingshuihe River and ending at land for storage of the bonded zone, with a total length of 3.43 km. The construction includes 3.43 km of flood control rehabilitation, embankment, sewage pipelines, and greening of 6.658 million m^2 along the river embankment. Construction of the scenery belt includes alley roads, small squares, lawns, etc. Total cost is estimated to be CNY 52.71 million.

Construction Design for Environmental and natural protection:

218. According to the PRC design code requirements, the design flood for the two rivers is 20 years. The river rehabilitation work will involve the regrading of the river channels, construction of new river embankments using eco-dike scheme for environmental and ecological protection, construction of sewage interception line along the river banks for pollution control, build maintenance service roads along the top of the embankment, and the landscaping development along the rivers.

219. Main construction contents are: river regulation, sludge dredging, sewage interception along the river and river landscape works. Wherein: the scopes of river regulation, sludge dredging and sewage interception along the river are 5.0km, 5.0km and 10.0km respectively. This component is to rehabilitate the Qingshuihe River, from the emerging point with Nanpa River to 5 kilometers upstream. The national Standard for Flood Control (GB 50201-94) for river regulation determines comprehensively project location, population protection and the protected zone measures.

220. The proposed river embankment improvement shall emphasize to preserve the natural river setting and environmental protection. Hardened river embankment shall be avoided. **Figure 3.28** shows the current photograph of the location.

Figure 3.28: Qingshuihe River status before rehabilitation

221. A compound type of river cross section will be adopted and all natural materials will be used for the construction of the river embankment. Based on the alternative study, the stone gabion river embankment will be used to build the eco-dikes. Several typical compound river cross sections are shown in **Figure 3.29** to demonstrate the concept of eco-dike.

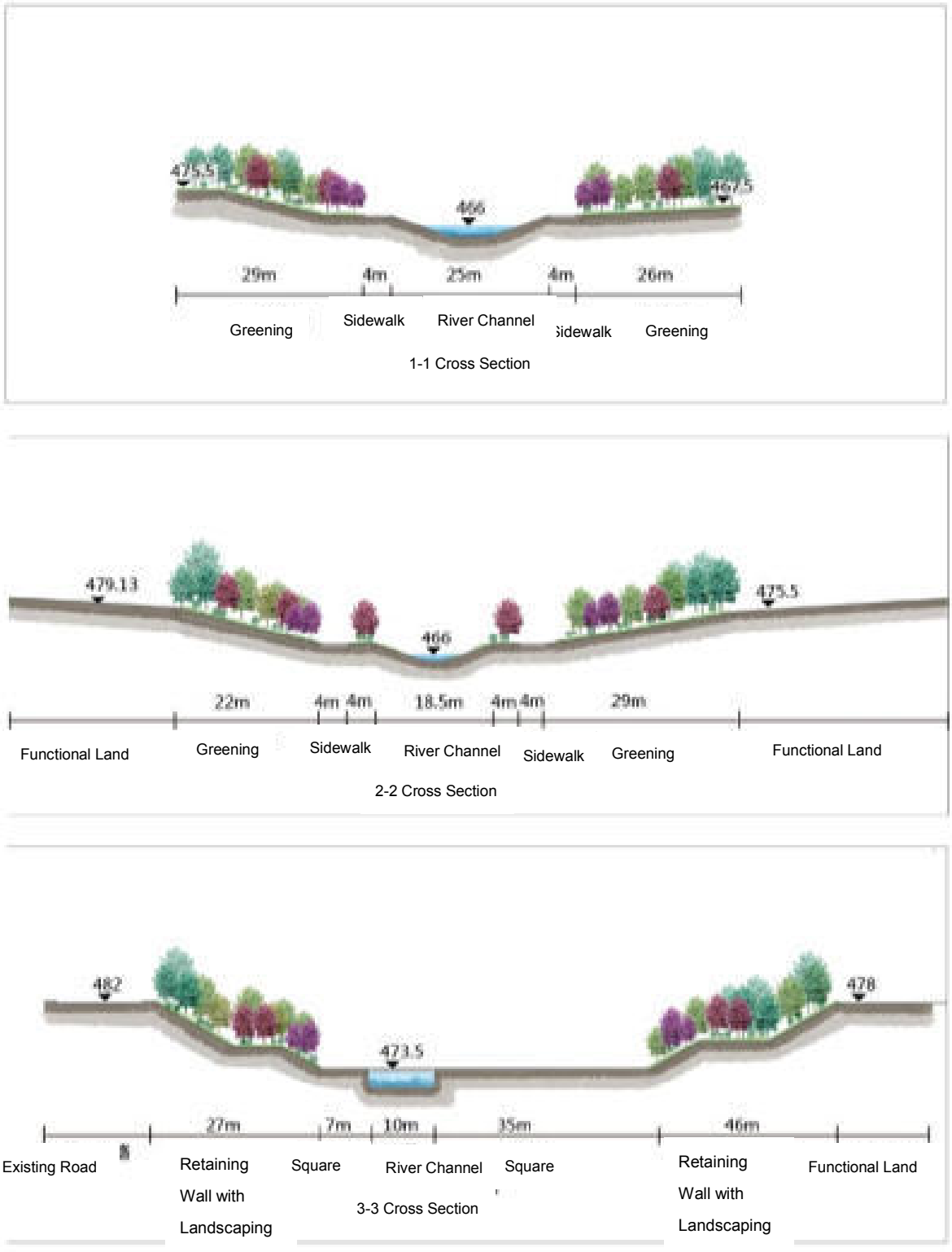


Figure 3.29: Compound Eco-dike Cross Section

(Source: FSR)

222. In order to adopt the concept of recycle and environmental protection, the treated wastewater from the wastewater treatment plant will be discharged into Qingshuihe River for landscaping development use.

223. The summary of the river rehabilitation component is shown in Table 3.18.

Table 3.18: Summary of River Rehabilitation works

No	Description	Type	Length (m)	Remark
1	Scope and Design Criteria			
	Qingshuihe River		3,431	
	Nanpa River		?	
	Design flood = 20 year			
2	River rehabilitation			
	Regrading			
	River bank (compound river cross section)	stone gabion		
	Walk and maintenance path	6 m width		
	Sewage interception (frp pipe with manholes)	DN600 - DN800	?	
	Landscaping		106,733	m^2
	Grey water from WWTP recharge pipe		?	
FRP = fiberglass reinforced plastic				

(Source: PPTA Consultants)

Schedule of Construction:

224. The main investment shall be directed to the flood control and environmental protection, not the city port development. Refer to **Table 3.19** for detailed construction contents of river regulation and landscape works in Qingshuihe River.

Table 3.19: Schedule for Detailed Construction Contents of River Regulation and Landscape Works in Qingshuihe River.

Project Category	Name of Single Project	Content and scale of the Project
Main works	Qingshuihe River regulation	The Qingshuihe River covers an area of 21000m^2 with a length of 5km. Side slope protection will be conducted mainly for both sides of the river.
	Desilting works	The desilting works will be done within 5 km of the Qingshuihe River.
	Green landscape	Total green landscape area along both sides of the Qingshuihe River is 154292m^2.
	Landscape road	The landscape road is mainly made of quartzite and semi-neatly stone pavement with a total paving area of 57103.8 m^2.
	Sewage interception works	Sewage interception will be carried out at both sides within 10km of the Qingshuihe River and the sewage pipe network will be installed to deliver sewage to the sewage treatment plant in Qingshuihe River Port Economic Zone for processing.
Auxiliary works	Bench	It will be set mainly along the landscape road.
	Night light landscape works	It is dominated by road lighting at night with several lawn lamps and accent plant lamps installed.
	Signpost	Road intersection arrangement
Utility	Power supply system	It is introduced from nearby power grid to provide lighting for the Project.
	Water supply system	The irrigation water for greening is provided by Nanpa River, Qingshuihe River and municipal water supply and

Project Category	Name of Single Project		Content and scale of the Project
			domestic water for employees is provided by the municipal water supply system.
Environmental protection engineering	Construction Organization Design Works Stage	Wastewater prevention and treatment	Temporary drainage trench and sedimentation tank will be built.
		Air prevention and treatment	Set watering facilities and provide temporary cover for construction materials and topsoil.
		Noise prevention and control	Construction fence etc.
		Solid waste prevention and treatment	Topsoil pilling area etc.
	Camp Operation period	Wastewater prevention and treatment	1 sedimentation tank
		Solid waste prevention and treatment	Several garbage cans

Ecological Restoration

225. **Current ecological condition**: There is no vegetation distribution as the area near the Qingshuihe River is under construction. The greening design shall be made based on planning positioning and design objective during landscape planning for the Qingshuihe River section. In the upper reaches of the river, restoration of small natural plant communities is a major means for reproducing the original river landscape in full measure and creating a picturesque chapter for ecological cities.

River Bottom Cleaning

226. Serious water and soil loss in upstream of the river and sediment accumulation contribute to accretion of river bed year by year. At the same time, the sludge and garbage at high beach on both sides of the river clean up to the surface at low water level. In addition, the huge amount of polluted bottom sediments in the river will be a great potential source of pollution that is harmful for water quality improvement and ecological restoration.

227. River bottom sediments must be removed for section with river bed accretion while rehabilitation river. River sludge mainly includes sediments, garbage and weeds. The cleaning of sludge at bottom of the river shall be carried out by combining construction of river revetment. The cleaning depth and amount inside Qingshuihe River shall be calculated with different dredging depths as per bottom width, flow rate and longitudinal gradient of the river by the Design institutes.

228. Various facets such as river regulation and sewage interception, consolidate and improve comprehensive regulation effect for the river, increase water capacity of the river to cater to climate change issues, promote flood discharge and water drainage ability and fundamentally eliminate the source of pollution generated by the river.

Road Design

229. According to the regulations of Article 11.3.4 in Code for Design of Levee Project (GB 50286-98), the width of flood-control road on top of the levee and the level 1 levee project shall

meet the requirements for driving on the two-lane road and other levee projects shall satisfy the minimum width for driving on the one-lane road. Ramps or staggered sections shall be set as per a certain distance when top width of the levee is less than 6m. The design content mainly involves the management road for Qingshuihe River that is arranged along one side of the river with a width of 4m. One staggered section will be set at an interval of 300m in compliance with the design specification for highway alignment.

Drainwater/Sewage Interception

230. Water drainage system of rainwater and sewage diversion shall be employed based on the planning. Sewage interception involves area along the Qingshuihe River at both sides of the whole river with a length of 10 km is proposed at this time by installing sewage interception pipes at both sides of the river.

3.5.1.5 New Energy Public Transport Facilities

Summary: Mengding to Qingshuihe Urban Public Transport Facilities

Land Area	**12 mu at Qingshuihe and 10 mu at Mengding**	**Equipment**	**6 new energy buses**
Location	**One of each electric charging station in Mengding and Qingshuihe**	**Facilities**	**Charging station will have 37 fast charging posts and 129 regular charging posts.**
Environmental Issues	**Facility design depicting charging stations and transformers location, Arrangements for storage and disposal of batteries, oils and workshop management. Traffic safety, sustainable public transport management**		

231. To ensure fast development of new energy bus public transportation system, the project will build two electric vehicle charging stations for the public transportation in Mengding and Qingshuihe, respectively.

232. The locations of the two charging stations are shown in **Figure 3.30**. The charging station in Qingshuihe will be located in the planned public transportation center. The total area is about 12 mu, and the station will include 77 regular charging posts and 17 fast charging posts. The charging station in Mengding is located in the city civic center area with a total area of 10 mu which will include 20 fast charging stations and 52 regular charging posts. The station will install 52 regular charging posts and 20 fast charging posts. In addition to the construction of two new electric charging stations, the project will also purchase 6 new energy public transportation buses. The summary of the public transportation facilities is shown in **Table 3.20.**

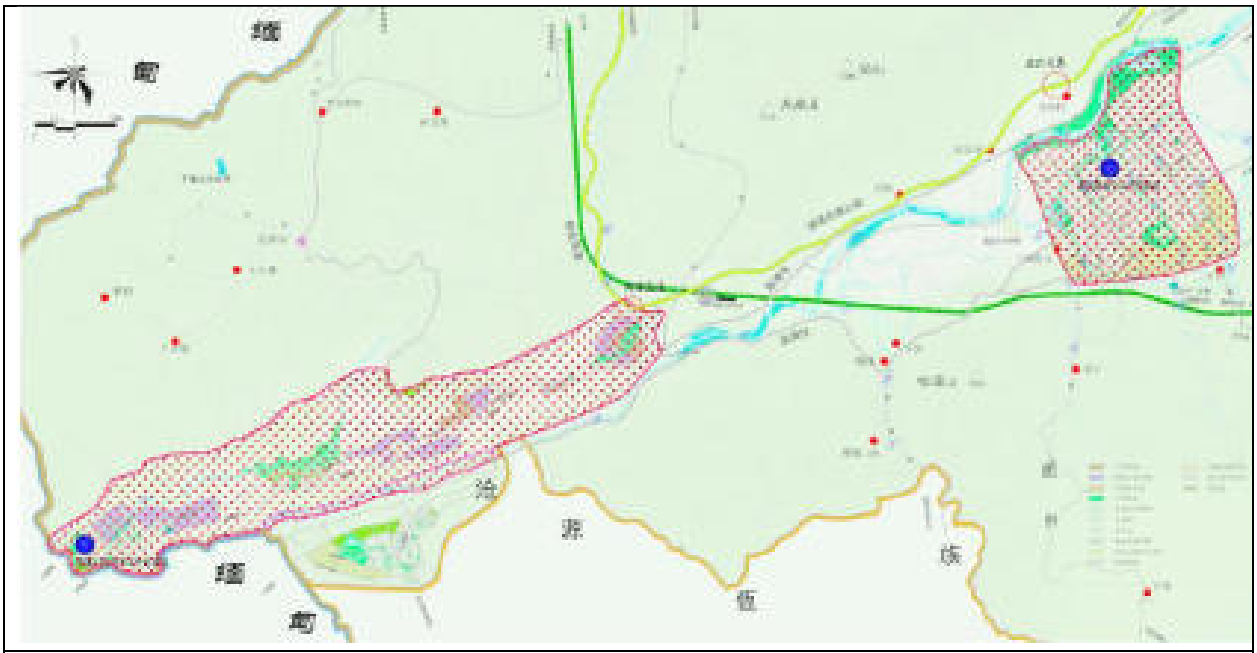


Figure 3.30: Location Map of Two Electric Charging Stations

(Source: FSR)

Table 3.20: Summary of Public Transportation Facilities

No	Name	Unit	Quantity
1	Qingshuihe electric charging station		
	Site development	mu	12
	Fast charging posts	Each	17
	Regular charging posts	Each	77
	Electric and service building	Subtotal =	94
2	Mengding electric charging station		
	Site development	Mu	10
	Fast charging posts	Each	20
	Regular charging posts	Each	52
	Electric and service building	Subtotal =	72
3	New energy bus	Each	6

(Source: PPTA Consultants)

Construction works and scale:

233. The project distribution services range can cover more than 60 square kilometers: City charging station service area of 5 square kilometers; township about 10 square kilometers; 40 km highway etc. The total planning area of the scheme will be 60 square kilometers, This component is to construct a total of 10 charging stations and natural gas refill stations in Mengding, Qingshuihe and Mangka areas. A charging station will have 20 fast charging posts and 50 regular charging posts. The cost for the subproject is CNY 24.22 million.

234. Each charging station has the following features:

- A charging station should be equipped with 20 fast-charging charging poles, piles - Charging station design size: 2.0 × 10 4 kWh/d, the annual charge of 720 × 10 4 kWh. This project selects transformer capacity 2500kVA, a load factor of about 78.02%. production areas within the station.

- Rapid charging device comprising of station pile of DC 500V/200A large DC charger for large vehicles charging 7 kW AC charging station for charging pile of small vehicles.
- 2500 kVA distribution system consists of two dry-type transformers, often for high side using dual, single bus connection mode, Low-side single-bus wiring, while the low-pressure standby power is provided.
- The facility will require workshop for storage of spares and repair material for buses and trucks.
- Water supply from the municipal water supply pipe network would supply water for all domestic and firefighting uses. The sewage will be discharged to nearby municipal pipe network after being collected by the septic tank within the school.

235. **Table 3.21** depicts a schedule for the charging stations.

Table 3.21: Schedule for Construction Content of Each Charging Station

Name	Construction Contents and Scales	
Main body Works	Charging area	It is equipped with 45m^2 charging canopy and 6 charging piles.
Assistance Works	Electric and Service Buildings	Service buildings are provided: station head's office, control room, operation room and restroom in order, with a total floor area of 160m^2. All of them are single-storey buildings.
Shared Works	Water supply	It is supplied by the municipal tap water company and introduced to the project area through the municipal water supply pipe network outside the project to form a ring network around the buildings to offer sufficient water for domestic and firefighting use.
	Drainage	Rainwater and sewage diversion is adopted for pipe network laying within the project area. Rainwater: It is discharged to the rainwater pipe network of nearby roads in an organized way. Sewage: It mainly comes from domestic sewage that will be discharged to nearby municipal pipe network after being collected by the septic tank for processing and finally be delivered to the sewage treatment plant of Mengding Town/Qingshuihe River for treatment.
	Power Supply	The power supply load is level 3 load. The Project introduces 10 KV HV power source from the HV wire out of the station and establishes 1 400kVA box-type substation in the station. LV automatic compensation device is set in the substation, including 10KV dry-type distribution transformer and LV distribution cabinet.
	Fire fighting	19 firefighting equipment are supplied in total: four 4kg portable dry powder fire extinguishers, eleven 8kg portable dry powder fire extinguishers, two 5kg portable CO_2 fire extinguishers and two 35kg wheeled dry powder fire extinguishers.
Environmental protection Works	Wastewater	It is dominated by domestic sewage that will be sent to the municipal sewage pipe network of nearby roads after being treated and up to standard by the septic tank built in the station and finally be delivered to the sewage treatment plant of Mengding Town/Qingshuihe River for processing. The capacity of the septic tank is 3m^3.
	Noise	Common measures for reducing noises such as reasonable layout for absorption.
	Solid Waste	It mainly includes household garbage that is entrusted to the environmental sanitation department of Mengding Town for regular clearing and transportation.
	Other	250m^2 greening

3.5.3 Output 3: Social Infrastructure and Services Improved

236. This component includes

(i) construction of a new Cangyuan Guomen No. 2 Elementary School with a total capacity of 1080 students and total building area of 18,311 m^2;

(ii) upgrade of Qingshuihe Guomen Elementary School with a new classroom building, a new student dormitory and a new cafeteria with a total building area of 7,691 m^2.

(iii) construction of new Zhenkang Sino-Myanmar Friendship Hospital of 500 inpatient beds in Zhenkang with a total building area of 56,009 m^2;

(iv) construction of Qingshuihe Hospital of 100 bed capacity with a total building area of 8,946 m^2; and

3.5.3.1 Cangyuan Guomen No.2 Elementary School

Summary Details: Guomen No. 2 Primary School Construction Project of Cangyuan Va Autonomous County

GPS	**GPS Coordinates: N 23.16766 E 99.26261 Elevation 1270m**	**GPS Nuosai reservoir**	**23.19116 N 99.22663 E**
Total Building Area/ Land Area	**10995.28 m^2 47.13 mu**	**Infrastructure**	**Teaching building, multiple-use building, student dormitory, canteen, sports room, track and field, gymnasium, flag-raising platform, parking lot, etc. and teaching equipment.**
Location	**Cangyuan county**	**Other facilities**	**Discarded sugar mill, Buddhist temple, Mendong river, Reservoir elevation 1682 m, storage 1004 cubic meter**
Environmental Issues	**Vacant plot of land that is divided by a stream joining Mending river and has adjoining housing and shopping areas, comply with the flood prevention code, noise and congestion on roads**		

Construction Area and Design:

237. The project will build a new elementary school in the urban area of Cangyuan county. Based on the demand analysis, the design school capacity will cater to 1080 full time students with 24 classes. The total area of land used of Guomen Second Primary School of Cangyuan Va Autonomous County 47.13 mu, and the total building area is 13,193 m^2, including two student dormitories with a building area of 3644.0m^2, one teaching building with a building area of 5627.55m^2, one comprehensive building with a building area of 5075.0m^2 and the canteen and playground with a building area of 3884.4m^2. Garbage station and guard room for 80.0m^2. The total area of the project is 31418.12 sqm (about 47.13 mu). Cost estimate of the school is CNY 70.98 million.

238. The School project is located in Cangyuan County, East Secondary Road, west and north of the Planning road, south of the Landscape River, the entire land is irregular quadrilateral land. The proposed site location is relatively flat. The soil layer distribution is relatively stable, and there are no other unfavorable geological conditions. The School has about 1080 students and 50 staff. The general site plan of the school is shown in **Figure 3.31**

Figure 3.31: Cangyuan Guomen No 2 Elementary School Plan

(Source: FSR)

239. The design of the school will be in accordance with Yunnan Green Building Standards (DBJ53/T-49-2015) with the one start green building classification, and considerations will be given for energy conservation and environmental protection for building layout, materials and equipment selection, etc. The combined solar and heat pump hot water system will be adopted for the dormitory design for energy conservation and green development.

240. The summary of the school construction details is shown in **Table 3.22**.

Table 3.22: Summary of Cangyuan Elementary Schools

No	Description				
1	Design criteria and innovation				
	Cangyuan Guomen No 2 Elementary School capacity =		1080	students	
	Green building design - Yunnan green building 1 star standard				
	Energy conservation - combined solar and heat pump hot water system				
2	Cangyuan Guomen No 2 Elementary School	Unit	Quantity	Type	Storey/Height
	Teaching building 1	m^2	2,814		5
	Teaching building 2	m^2	2,814		5
	General building	m^2	5,075		5
	Student dormitory 1	m^2	1,822		5
	Student dormitory 2	m^2	1,822		5

No	Description				
	Cafeteria and gymnasium	m^2	3,884		3
	Security room and garbage room	m^2	80		1
		Sub total =	18,311		
	Site development	m^2	31,059		

(Source: PPTA Consultants)

School Site Design

241. The school campus is divided into three major functional areas, teaching, sports and living areas. The teaching and living areas are located in the north half of the campus, and the sports facilities are location the south half of the campus. Three major regions are easily and relatively independent of each other. The main areas of the campus are easy to connect with each other and relatively independent. The teaching area, the living area and the sports district are close to each other, so that the three functional areas show the most reasonable triangular arrangement, and the walking route to each functional area is shrunk to the shortest, without interfering with each other. The student canteen is located between the living area and the teaching district by the middle position, can shorten the traffic streamline.

242. The major buildings include two teaching buildings of four stories with all classrooms, one general building of five stories with labs, library, computer rooms, teacher offices, conference rooms, etc. The teaching buildings and the general building are connected with corridors for better functional operations. In the living area, there are two student dormitories of 5 stories, and each of the dormitory room will have 6 beds. In the sports area, the gymnasium will serve as both indoor sports facilities and the cafeteria. The first floor of the gymnasium will be used as the cafeteria. In the outdoor sports area, a track field, basketball courts and other sports facilities will be constructed.

243. The **teaching area** is located at the front of the campus, near the entrance square of the campus, showing the school's architectural style fully. The complex building is located on the axis of the entrance square, connecting with the teaching building, making it convenient for the administrative office staff to connect with the teaching building, and also reduce the interference of other social people in the campus. The layout of the sports area between the teaching area and the living quarters, on the one hand, can facilitate the physical education activities, on the other hand, to students after school life provides a convenient venue, while the outside natural landscape map to the campus.

244. The **living area** is set up relatively independently. This program has a clear **road traffic** system. Road system to connect the various functional areas, planning ideas, the core area of the block only to consider pedestrian traffic. **Figure 3.32** shows the location of the plot at which the school building is proposed.

Figure 3.32: Construction site for Cangyuan Guomen Primary School

Situation Analysis

245. There are complete water supply and drainage networks on municipal roads around the present site and the municipal drainage system provides connectivity to the entire system of rain and sewage diversion at the school. The school will have connectivity to all public utilities for electricity, water, sewage, drainage and solid waste. Chemistry Laboratory effluent will be collected separately by school staff and disposed of to the leachate plant for the county.

Earthwork

246. The levels of the construction site and the surrounding road site are nearly the same and the balance spoil could be adjusted in the river embankment. This reduces the earthwork excavation as far as possible to fill the low area.

River inside school premises:

247. The proposed school site is located in a vacant plot of land that is divided by a stream (**Figure 3.33**) and has adjoining housing and shopping areas. Dormitory and school will be on the left bank while the play fields etc. will be on the right side. A flooding happened in the project area 30-40 years ago in the project area. Impact from the industrial port and nearby factories is nil as they are closed down.

Figure 3.33: River passing through middle of the construction site for Cangyuan Guomen Primary School

248. The upstream water in the river is controlled by the upstream Nuosai Water reservoir (**Figure 3.34**). The downstream of the school to which this tributary river drains into is the Mendong River **Figure 3.35**) at 1270 m elevation that is about 400 m lower in elevation than the reservoir (1682 m elevation). There has been no flooding in the last 10 years in the river according to flooding data for Mendong river and according to data available with the Water Resouces Bureau, the school will be free of flooding.

Figure 3.34: Nuosai Reservoir Upstream

Figure 3.35: Mendong River

Water Supply source

249. The project water supplied by the municipal body according to the water quality requirements are divided into production and living water supply, fire water supply two parts. Fire-fighting water supply indoor and outdoor hydrant, spray and other water, the rest of the water from the living water supply system. Water supply and firefighting water supply from municipal water supply is in line per water quality index requirements in line with the national drinking water hygiene standards. Municipal Water supply network on municipal roads around the venue, pipe diameter is DN 300, the supply to the site of water pressure is not less than 0.20 MPa.

Drainage System

250. The project adopts rain-sewage shunt drainage system.

Rainwater System

251. The design uses the gravity rainwater pipe net system, the rainwater through the rainwater fights, the rainwater ditch, the rainwater mouth collects the back row to the site rainwater pipe. According to the terrain condition fragment area nearby discharges the municipal rainwater pipeline into drainage system.

Sewage system

252. After reducing the green water for irrigation, water for living and the total water requirement is 177.21 m^3/day (displacement calculated by 100%). The total construction area of this project is less than 3 million m^2. Domestic sewage through septic tank back to the outdoor sewer network, eventually discharged into municipal sewage pipe network.

Firefighting

253. The total map combines the existing roads and new design fire lanes in the base to form an annular fire-fighting lane, and designs fire-fighting heights at the entrances and exits of the building,

fire-fighting lanes wide 4.0 meters, turning radii are no less than 9 meters to meet the requirements of the relevant specifications. The water supply of the wet automatic sprinkler system is supplied by the fire pool and the automatic spraying pump provided the basement, and the roof fire water tank and the fire-fighting regulator are shared with the indoor hydrant system. Fire extinguisher configuration: According to the Building Fire extinguisher Configuration Design Code (GB50140-2005), each building would be equipped with ammonium phosphate dry powder fire extinguisher.

Energy Saving measures

254. To save water and energy, the following water-saving measures are proposed:

- The building is intended to use the current water-saving sanitary ware, using automatic open and limited time flushing devices and hand-washing faucet, water supply appliances, valves and faucets with good sealing performance and reliable quality.
- Control of living water distribution point pipe network pressure is not more than 0.20Mpa.
- Hot water heat source uses solar panels and air source heat pump, the use of green energy.
- Hot water pipe to have appropriate insulation measures to reduce energy waste.
- Fire pool, living tank, hot water tank and roof fire water tank are all set up overflow alarm to prevent water supply overflow for a long time.

Power Supply

255. 10 kV high voltage power supply: 10kv/0.4 kv. Power distribution room to be located in the basement, the total installed capacity of the transformer is 630kVA. Standby Power is used when a return to the mains fault, the diesel generator as a standby power supply to meet the fire load and two load of power supply needs.

3.5.3.2 Qingshuihe Guomen Elementary School Expansion

Summary: Building area 1360m^2; construction mainly includes canteen, student dormitory.

GPS	**GPS Coordinates: N 23.4822^0 E 98.84075^0**	**Total Building Area**	**One teaching building area of 3,168 m2, one student dormitory with the building area of 3,343 m^2 and one canteen with the building area of 1,180 m^2**
Location	**Qingshuihe Cross-border Point**	**Facilities**	**Student dormitory, canteen, sports field and basketball field. School area is 30 mu**
Environmental Issues	**Demolished material to be disposed of at two demolished material disposal sites finalised by local government, connectivity to new sewage system, construction in holiday season, student health and safety**		

256. The project will upgrade the existing Qingshuihe Guomen Elementary School with the new teaching building, student dormitory and student cafeteria. Based on the demand analysis, the school capacity has to be expanded for 1080 full time students with 24 classes. The existing school facilities are not adequate to accommodate the demands, and many local students, especially Myanmar immigrated students could not attend the school due to the limited capacity.

Construction Scale and works:

257. This is an expansion of a current primary school inside the existing school land in the urban developed area. Planned enrollment is 1350 students, including 2 pre-school classes. Total area is 16200m^2. Construction includes: student dormitory, canteen, sports field and basketball field. The border primary school in Qingshuihe River covers an area of 3,722.62 m^2. This plan is designed for a general primary school scale of 12 classes (450 students). This design includes one teaching building with a building area of 3,168 m^2, one student dormitory with a building area of 3,343 m^2 and one canteen with a building area of 1,180.00 m^2.

258. The school is located in the downtown area of Qingshuihe of about 30 mu, and the total building area is 7,691m^2. The current construction works mainly include the boys' dormitory, the girls' dormitory, the canteen, a 200 m athletic field, the badminton court, the basketball court, the hoist platform and the parking lot. The cost of the sub-project is CNY 36.52 million. The general site plan of the school is shown in **Figure 3.36**.

Figure 3.36: General Plan of Qingshuihe Guomen Elementary School Expansion

(Source: FSR)

Teaching Building

259. The new teaching building will be a 5-story reinforced concrete structure with about 20 classrooms.

Dormitory Building

260. The building area: 3,168 square meters, a 5-story concrete structure with the dormitory rooms in second to fifth floors and the activity center located in the first floor. The main layout of the dormitory is a single corridor layout, the internal function set for the bedroom, the guest lounge, as well as the duty room, underground set isolation layer. Standard layer height 3.9 meters, indoor and outdoor high difference 0.45 meters, building total height 19.95 meters.

Canteen

261. The building area: 1,180 square meters, two story building with the main dining room on the second floor and kitchen in the first floor. The internal function is set to entrance hall, dining room, teachers ' dining room, and the kitchen is equipped with isolation interlayer. Standard layer Height 5 meters, indoor and outdoor height difference 0.45 meters, building total height ten meters.

262. The summary of the school construction details is shown in **Tables 3.23** and **3.24**.

263. **Table 3.23: Summary of Qingshuihe Elementary Schools**

No	Description				
1	Design criteria and innovation				
	Qingshuihe Guomen Elementary School capacity =		1080	students	
	Green building design - Yunnan green building 1 star standard				
	Energy conservation - combined solar and heat pump hot water system				
2	Qingshuihe Guomen Elementary School Upgrade (existing building)	Unit	Quantity	Type	Storey/Height
	New classroom building	m^2	3,168	RC	5/18.45m
	New student dormitory	m^2	3,343	RC	5/18.45m
	New cafeteria: area	m^2	1,180	RC	2/8.4m
		Sub total =	7,691		
	Site development	m^2	20,125		

(Source: PPTA Consultants)

Table 3.24: Other features of the building area at Qingshuihe Guomen Elementary School

Item		Remarks
Utility	Water supply and drainage system (The drainage system is diversion of rain and sewage) and power supply system	
	Ordinary firefighting system	
	Internal road	
Environmental protection engineering	Waste gas control	Install oil fume purifier in the canteen;
	Waste Containers	Several waste containers and 2 garbage collection boxes
	Septic tank	1 ($45m^3$)
	Chemistry Lab Effluent	Collected separately and deposited at leachate plant weekly basis
	Oil separation tank	1 ($7m^3$), at the northeast corner of the canteen
	Landscaping	Landscaping area: $1000m^2$

264. Figure 3.37 and Figure 3.38 shows the various locations in the school where the construction will occur.

Figure 3.37: Guomen Primary School construction area in LBECZ.

Figure 3.38: Guomen Primary School construction area in LBECZ.

Site Engineering

Geology of site

265. The site topography is relatively gentle with no steep slopes, no landslides, debris flows, wall collapse, goaf, ground subsidence or any other adverse geologic effects at the proposed site.

Topography

266. The original height difference of the existing land is small, according to the site topographical site treatment for gradient slope, the surrounding road system is adequate.

Earthquake fortification class degree

267. Seismic fortification Intensity is 8 degrees, the basic seismic acceleration value is 0.30g. There is no liquefied soil in the depth range of 20m, and the problem of earthquake liquefaction is not considered.

Green Standards

268. The design of the school will be in accordance with Yunnan Green Building Standards (DBJ53/T-49-2015) with the one start green building classification, and considerations will be given for energy conservation and environmental protection for building layout, materials and equipment selection, etc. The combined solar and heat pump hot water system will be adopted for the dormitory design for energy conservation and green development.

Demolition

269. Demolishing of canteen and old dormitory to be done during vacation period. The demolished material to be disposed of at two demolished material disposal sites finalised by Local government (Location details provided by LBCEZ).

Utility connectivity

270. Connectivity to all public utilities confirmed. However, the wastewater which is currently being disposed of into the river, will then go the WWTP proposed in project. There are complete water supply and drainage networks on municipal roads around the present site. The municipal drainage system is a system of rain and sewage diversion. Currently, the sewage exit pipes go into the Nanting River which will be discontinued.

Water supply Method

271. The project water according to the water quality requirements are divided into production and living water supply, and fire water supply.

- Fire-fighting water supply outdoor hydrant water, the rest of the water from the living water supply system.
- Living water supply and fire fighting water supply for municipal water supply, water quality index requirements in line with the national drinking water hygiene standards.
- Municipal Water supply network on municipal roads around the venue, pipe diameter is DN300, the supply to the site of water pressure is not less than 0.20MPa from the site around the different municipal access to the water mains 1 root DN150 water mains, in the site into a ring layout, pipe diameter of the DN150, Supply the production and living water supply and outdoor fire water supply to the floor and below each building in the project.

Sewerage system

272. Total water consumption for this project 49.06 m^3/day (displacement is calculated by 100%). The total construction area of this project is less than 3 million m^2. This project does not need to be set up in the water treatment station but rather the domestic sewage septic tank can pump back to outdoor sewage pipe network.

Rainwater System

273. The design uses the gravity rainwater pipe net system, the rainwater collected through site rainwater pipes, discharges downstream into original rainwater pipeline.

Fire fighting:

274. Outdoor hydrant water supply pipe network and living water supply, from the site around the different municipal water supply network to introduce 2 DN 150 water pipes in the site ring layout and outdoor fire hydrant. The outdoor fire hydrant spacing is not greater than 120m. Fire extinguisher configuration: Building equipped with ammonium phosphate dry powder fire extinguisher.

Energy Saving measures

275. To save energy and water, the following water-saving measures are proposed:

- The building is intended to use the current water-saving sanitary ware, using automatic open and limited time flushing devices and hand-washing faucet, appliances, valves and faucets with good sealing performance and reliable quality.
- Control of living water distribution point pipe network pressure is not more than 0.20Mpa.
- Hot water heat source using solar panels and air source heat pump, the use of green energy.
- Hot water pipe to have appropriate insulation measures to reduce energy waste.
- Fire pool, living tank, hot water tank and roof fire water tank are all set up overflow alarm to prevent water supply overflow for a long time.

Power supply

276. Mains supply to the school will be the 10 kV high voltage power supply. According to the power supply radius and load capacity, set the 10 kV/0.4 kV power distribution room (to be located in the basement), the total installed capacity of the transformer is 400 kVA. Transformer with a load rate of about 75%, variable distribution room low-voltage use radial or trunk-type power supply to each individual building and basement power supply, fire load using dedicated circuit power supply, low-voltage system grounding type. Standby Power: According to transformer capacity from estimation of a diesel generating set with an output power of 100 kW to be located in a suitable position in the building.

3.5.3.3 Zhenkang Sino-Myanmar Friendship Hospital

Summary: Hospital including a Class 2A general hospital with 499 inpatient beds, and a building area of 44,588.46 m^2, and medical equipment and device.

GPS	**GPS Coordinates: N 23^{0}44'45.0 E 98^{0}50'16.6**	**Land Area**	**Project covers an area of 40 Mu (60000 ㎡), Total building area 56,009 ㎡, where floor area 41,409 ㎡, basement size 14,600 ㎡**
Location	**Zhenkang County**	**Total Building Area**	**56,009 m^2**
Type of trees cut	**None**	**Other facilities**	**Class 2A general hospital with 500 inpatient beds, medical equipment and devices.**
Environmental Issues	**Power transmission line is passing above the project site, solid waste, medical waste, water supply, storage and transfer locations onsite, drainage of storm water. Associated facilities include Fenquing Land fill site for solid Waste and Zhenkang Medical waste treatment facility.**		

Construction works and scale:

277. The project will build the new Zhenkang Sino-Myanmar Friendship Hospital to replace the existing Zhenkang Country Hospital. The existing hospital will be relocated to the new hospital with expanded capacity and upgraded services. The total construction land is 60,000m^2 and the total building area is about 56,009 m^2. The plan is a 499-bed hospital, and this design includes the outpatient emergency treatment building, inpatient department, canteen, administrative building, medical technology building, medical waste room and other supporting facilities. The project includes 500 beds and 800 medical staff, management staff and logistics staff.

278. Sino-Burmese Friendship Hospital is located in the north of Zhenkang County Planning area, the project land is more regular and rectangular. The terrain is basically flat, the interior height difference is small, all sides are in the planning City Road. The construction site is divided into two functional blocks, the southwest part of the block as the medical area, and the northeast corner as the logistic area.

279. This site is located in Lincang City Zhenkang County. The project covers an area of Mu (60,000 ㎡), Total building area 56,009 ㎡, where floor area 41,409 ㎡, basement size 14,600 ㎡. The hospital and the general site plan are shown in **Figure 3.39** and **Figure 3.40** respectively. **Figure 3.41A** and **3.41B** shows some locational pictures.

Figure 3.39: Zhenkang Sino-Myanmar Friendship Hospital Rending

Figure 3.40: Zhenkang Sino-Myanmar Friendship Hospital Plan

(Source: FSR)

Figure 3.41A. Zhenkang Hospital site

Figure 3.41B: Adjoining Chinese Medicine hospital

280. The scheme gradually forms a modern hospital with 499 Bed General Hospital emergency Building, inpatient department, canteen, Administrative building, medical technology building, medical waste room and other ancillary facilities.

281. The project water according to the water quality requirements are divided into production and living water supply, fire water supply two parts. Fire-fighting water supply indoor and outdoor hydrant, spray and other water, the rest of the water from the living water supply system. There are complete water supply and drainage networks on municipal roads around the present site. The municipal drainage system is a system of rain and sewage diversion.

282. This component is to construct a general hospital: three buildings are to be constructed, one five-story building for outpatients and ER, one five-story building for laboratories and offices, and one nine-story building for inpatients. There are also some small buildings such as a diner and laundry house, a house for infectious patients, a psychiatry house, medical waste house, etc. There are 499 beds in the hospital as planned. Total cost estimate of the hospital is CNY 350.6 million, including CNY 124.2 million for equipment procurement. **Table 3.25** gives the summary components for the project.

Table 3.25: Summary of Hospitals in Zhenkang and Qingshuihe

No	Description			
1	Design criteria and innovation			
	Zhenkang Sino-Myanmar Friendship Hospital = 499 beds			
	Green building design - Yunnan green building 1 star standard			
	Energy conservation - combined solar and heat pump hot water system			
Name		Number	Unit	Notes
Total land Area		60000	m^2	
Total construction area of hospital		56009	m^2	
Underground Construction Area		14600	m^2	1 storey
Area	Parking area	10621	m^2	
	Peace Room	800	m^2	
	Underground Equipment Room	808	m^2	
	Water pumping station, distribution room	300	m^2	
	Air Defense Area	2071	m^2	
Hospital Floor Building		41409	m^2	
Area	Outpatient, emergency, office complex building	9130	m^2	5 Storey Office 1660 m^2

No	Description				
	Medical Technology building (including clean and dirty room)	12025	m^2	5 storey
	Inpatient Building	16254	m^2	9 Storey
	Oxygen Production Room	240	m^2	
	Dining Room Laundry	1660	m^2	
	Hospital Infectious Disease Room	900	m^2	
	Psychiatric medicine	900	m^2	
	Hospital waste room, medical sewage treatment station	300	m^2	
Green area		22500	m^2	
Services Building		4000	m^2	1 storey
Building footprint		11250	m^2	
Road area		11825	m^2	
Floor Area		13495	m^2	
Stadium Area		900	m^2	
Parking		499	A	
which	Parking Space	7	A	
	Parking spaces on the ground	365	A	
	Underground Parking	127	A	

(Source: PPTA Consultants)

Geological Survey

283. The site topography is relatively gentle with no steep slopes, no landslides, debris flow, collapse, goaf and ground subsidence or any other adverse geologic effects at the proposed site.

Topography

284. The original height difference of the existing land is large, according to the site topography trend site treatment for gradient slopes, the surrounding road system is perfect.

Seismic design of building electrical and mechanical engineering

285. Seismic fortification Intensity is 8 degrees, the basic seismic acceleration value is 0.20g. There is no liquefied soil in the depth range of 20m, and the problem of earthquake liquefaction is not considered. Seismic design of building electrical and mechanical Engineering basis code for seismic design of building electrical and mechanical Engineering GB50981-2014. Transformer installation should conform to GB50981-2014 Section 7.4.1 section of the seismic provisions. Diesel generators should be installed in accordance with the GB50981-2014. Distribution Box (cabinet) installation should also conform to GB50981-2014 Section 7.4.4 section of the seismic provisions.

Parking space

286. The whole hospital will have a total of parking 499 vehicles, of which the underground civil air defense and war combined with garage parking spaces are 365 and the rest for the ground parking spaces. The entrance of the underground car park is in front of the emergency and inpatient department.

Water supply Method

287. Each access from the north and south sides of the site to the water pipe on each connection 1 root DN 200 water pipe, in the site into a ring layout, pipe diameter is DN200, supply the production and living water supply and outdoor fire water supply to the floor and below of each building in the project.

Sewerage system

288. Removal of green water for irrigation, water for living and total in water 335.5m^3/day, the displacement is calculated by 90% for water supply, and is 301.95m^3/ day. As this project is a general hospital project, sewage wastewater is not suitable as the water source, and the use of the nature is not suitable for medium water. Waste water – underground facility to be developed for hospital wastewater standards compliance to GB 18466-2005 standards.

289. For general waste water, it will be treated by sewage treatment facility at hospital and discharge to reach standard.

290. For special hospital wastewater (which may contain poisonous chemicals or radioactive material), the hospital will have specific treatment of hospital wastewater. Treatment of hospital wastewater is different from standard wastewater treatment; there is a potential risk for contamination from specific compounds that normally are not addressed by the standard WWTP (e.g. hormones, antibiotics, pharmaceuticals).

Rainwater

291. The design uses the gravity rainwater pipe net system, the rainwater through the site rainwater pipenet and discharges to the nearby ground on southwest side municipal rainwater pipeline.

Fire Safety

292. According to the code of building fire protection, the number of fires in this plot is 1 time, the outdoor maximum water hydrant is 40 l/s, and the fire duration is 3h. Outdoor fire hydrant water supply system, to meet the most adverse point of outdoor hydrant water supply pressure is not less than 0.10 Mpa requirements (based on the water supply and hydraulic pressure by the municipal water supply network guarantee). Local block maximum indoor fire water consumption is 30l/s, fire duration 3h. The indoor fire hydrant water supply system adopts the temporary high-pressure water supply system. Fire pool, water pump station set up in the basement, Fire pool storage 432 m^3 fire water. The fire tank is set on the roof of the tallest building in the plot, the effective water capacity of the fire water tank 36 m^3. The water tank is provided with a fire-fighting pressurization and stabilizing device, which provides fire fighting water to the indoor fire hydrant system by special fire water supply pipe. Emergency operations, fire tunnels around the building settings, Fire Road link throughout the hospital area.

Greening and Landscape design

293. The plant landscape design follows the below listed principles:

- The plant landscape is mainly composed of lawn and tall trees, with a partial consideration of the multi-level landscape combined with irrigation, ground and grass.
- Tree species selection to the principle of suitable trees, mainly selected local tree species, and focus on the combination of fast-growing trees and slow-living tree species, emphasizing the recent and long-term green effects and characteristics of landscape space formation.

Energy Saving measures

294. To save energy and water, the following water-saving measures are proposed:

- The building is intended to use the current water-saving sanitary ware, using automatic open and limited time flushing devices and hand-washing faucet, appliances, valves and faucets with good sealing performance and reliable quality.
- control of living water distribution point pipe network pressure is not more than 0.20Mpa.
- Hot water heat source using solar panels and air source heat pump, the use of green energy.
- Hot water pipe to have appropriate insulation measures to reduce energy waste.
- Fire pool, living tank, hot water tank and roof fire water tank with an overflow alarm to prevent water supply.
- The total distribution box is set in the load center to shorten the cable laying path.
- The three-phase load is balanced and the load unbalance rate is less than 15%.
- Set up local compensation in lighting fixtures to improve power factor.
- The illumination value in the library and the corresponding illumination power density value are strictly according to the requirements of architectural Lighting design Standard (GB50034-2013).
- Light Source: With high efficiency straight tube fluorescent lamp (T5 tube) and energy-saving lamp mainly, under the condition of meeting glare limit, choose luminaire with high efficiency and open type direct illumination lamp within the building to make full use of natural light, lighting lamps grouping, zoning, in situ control. The pedestrian street lamp uses the intelligent control, the staircase illumination uses the infrared induction switch control.
- reasonable selection of cable, wire section, line laying path, reduce distribution line loss.

Power supply

295. The mains supply for the project has two 10 kV high voltage power supply. According to the power supply radius and load capacity, set the 10kv/0.4 kv Power Distribution room (to be located in the basement), the total installed capacity of the transformer is1600 kVA. The transformer belt load rate is approximately 88%, the variable distribution room low pressure uses the radial or the trunk type power supply way respectively to each individual building and the basement power supply, the fire-fighting load uses the special circuit power supply, the Low-voltage system earthing type. Standby Power: the diesel generator as standby power supply to meet the fire load.

Medical waste

296. Each county will construct its own medical waste treatment facility as planned during the 13th Five Year Plan of Lincang. Following the principle of nearby centralized disposal of medical waste, it is agreed to include Yun County, Fengqing County, Yongde County and Zhenkang County into the service coverage scope of Liying Medical Waste Treatment Center in Fengqing County. Accordingly, in order to facilitate the improvement of the capacity in coordinated disposal of medical waste in the municipality, LBECZ and LMG have agreed to implement the construction of Liying Medical Waste Treatment Center in Fengqing County to accommodate all medical waste that will be generated in the county in future.

297. Unlicensed entities shall not undertake collection, storage, transport and disposal of medical

waste. Specific agreements will be made with providers of the service in Qingshuihe. Letters of approval of the above is attached **in Annexure 8.B**.

3.5.3.4 Qingshuihe Hospital

Summary: A border hospital in Qingshuihe Border-crossing Economic Zone.

GPS	**GPS N 23.48852^0 98.84611^0 E (10 m away from location)**	**Facilities**	**Class 2A general hospital with 100 inpatient beds and medical equipment and devices**
Land Area	**17.55 mu**	**Total Building Area**	**14,400 m^2, above ground area is 8946 m2 and the underground area is 4,800 m^2**
Location	**Qingshuihe Cross-border Point**	**Trees cutting**	**1650 approx. rubber trees**
Environmental Issues	**solid waste, medical waste, water supply, storage and transfer locations onsite, drainage of storm water, tree cutting, green belt development**		

Construction works and scale:

298. Qingshuihe River Hospital, having 17.55mu land for construction of 100 beds housed by three buildings- the outpatient building, the residential building and the logistics building. The total building area of the Qingshuihe River Hospital Project is 14,400 m^2, in which the aboveground area is 9,600 m^2 and the underground area is 4,800 m^2. There are 43 over-ground parking places and 27 underground parking places. The cost for the subproject is CNY 112.39 million.

299. The project will build the new Qingshuihe Hospital next to Qingshuihe urban area. The location of the new hospital is shown in **Figure 3.42**. Based on the demand analysis, the new hospital is designed to have a capacity of 100 inpatient beds. The hospital site occupies about 22,265 m^2 and the total building area is about 8,946 m^2. About 1650 rubber trees will be cut and result in environmental degradation of the area

Figure 3.42: Qingshuihe Hospital Site Plan

(Source: FSR)

300. Based on the functional requirements, the hospital site plan is organized into the following areas:

- **Medical building** – The building is a 4-story building with outpatient medical unit, medical and technical unit, emergency unit, surgery, and maternity.
- **Infectious disease building** – The building is a 2-story structure with respiratory infection unit and digest infection unit. The two units are specially designed to treat local infectious diseases such dengue, malaria, etc.
- **Administration building** – the building is a 3-story structure for administration, offices, cafeteria, and other service facilities.
- **Service facilities** – the building to host all service units such as mechanical and electrical rooms, medical equipment, security, etc.

301. **Table 3.26** details the project construction components.

Table 3.26: Summary of Qingshuihe Hospital Construction details

No	Description			Unit	Quantity
1	Design criteria and innovation				
	Qingshuihe Hospital = 100 beds				
	Green building design - Yunnan green building 1 star standard				
	Energy conservation - combined solar and heat pump hot water system				
2	Qingshuihe Hospital	Unit	Quantity	Type	Story/Height
a	Main works				
	Medical building	m^2	5,725	RC	4/15.15m
	Infectious disease building	m^2	2,480	RC	2/8.00m
	Administration building	m^2	608	RC	3/12.45m
	Service buildings and facilities	m^2	132	Masonry	1
		subtotal =	8,946		
	Site development	m^2	22,266		
b	Utility	Open parking places, underground parking lot, power supply and water supply and drainage system, fire fighting, communication, ventilation, cable television and safety alarm system and internal roads etc.			
c	Environmental protection engineering	Oil separation tank (1 with a capacity of $6m^3/d$), septic tank (9 with total volume not less than $239m^3$), heavy metal wastewater treatment system (1 set with a capacity of $1.5m^3/d$), medical sewage treatment station (1 with a capacity of $140m^3/d$), sludge treatment facilities, garbage collection room (3) and temporary storage room for medical solid wastes (1) and greening works etc.			

(Source: PPTA Consultants and FSRs)

302. The Project establishes complete facilities of water supply and drainage, electricity, smart equipment, fire fighting, road and sanitation and attaches great importance to optimization design of the comprehensive pipe network. The facility will be connected to all municipal utility facilities such as roads, power, water supply, wastewater, solid wastes transfer stations which will be set up in the LBECZ. Underground laying and one-step construction will be adopted to avoid waste due to repeated construction, facilities management and maintenance and satisfy the requirements for long-term development (refer to **Table 3.27** for schedule of main infrastructures).

Table 3.27: Schedule for Main Infrastructures of Qingshuihe River Port Hospital

S/N	Name	Main Components
1	Internal road	The traffic system of the Project is built by relying on the municipal roads at east and west side of the project area. Each exit of the project area is connected with the municipal roads to achieve smooth traffic flow. The internal road is divided into carriageway and pavement. The route of pavement is designed by combining landscape and the carriageway is arranged along the peripheral road to achieve road circulation and separation with the pavement.
2	Water supply and drainage System	Domestic water supply system: The water source comes from the urban municipal water supply pipe network that mainly provides water for two quarters, i.e. the hospital and staff quarter and the convalesce quarter in lower unit. The domestic water supply pipe and the outdoor fire fighting water supply pipe are combined for use. Fire water supply system: ① Outdoor fire hydrant: It employs the low-pressure system and is directly supplied with water by outdoor domestic water supply pipe in the block. ② Indoor fire hydrant: The set system is temporary high-pressure fire fighting system with 18m^3 fire fighting water tank and one set of pressurization equipment for the air pressure tank on the roof and 220m^3 fire pool in the underground garage. Medical wastewater treatment facilities: The Project is equipped with buried sewage treatment facilities that are located in east green belt of the project area. Water drainage system: The Project is supplied with complete drainage system with diversion of rainwater and sewage. Heavy metal wastewater from the dentistry and wastewater from the laboratory will be collected and pre-treated by special drainage pipe network, then discharged to the municipal sewage pipe network of China-Myanmar Thoroughfare after being processed by oil separation tank and septic tank with wastewater containing bacterium, catering wastewater from the canteen and domestic wastewater to up to standards and finally be sent to the Nanting River after being treated to be up to standard in the sewage treatment plant of Qingshuihe River Port. Rainwater will enter the municipal rainwater pipe network after being collected through the outdoor rainwater pipe (trench).
3	Power Supply	Municipal power supply is adopted for this Project. The power is accessed from the municipal system to underground power transformation & distribution station (with an area of about of 120m^2) the hospital building to serve the project area. 1) Load grade: All equipment such as precision medical equipment for rooms such as ICU, delivery room, baby room, clean room for hematology ward, hemodialysis room, operation department, CT scan room, accelerator machine room, treatment room, blood matching room, incubator, refrigerator, thermostat and elevator room lighting, emergency lighting, fire elevator and fire water pump for high-rise residence in the hospital that belongs to fire electrical equipment uses level 2 load and others adopt the level 3 load. 2) Power supply, voltage and standby power supply: The power supply is accessed from urban 10Kv power supply HV grid with HV power supply all the way; emergency power supply is provided by the auto-start diesel generator set with a voltage grade of 380V/220V; power supply for fire fighting equipment adopts the dual-power terminal switch mode, i.e. normal power supply municipal power at ordinary times and power supply by diesel generator through auto-switch for fire fighting or power cut. 3) Power supply facilities: The dry-type transformer (one in use and one for standby), HV distribution cabinet, LV distribution cabinet and auto-start diesel generator set are adopted. All equipment are arranged in the underground distribution room and the generator room.
4	Smart equipment	Smart systems of the Project include the telephone system and the cable television system etc.
5	HVAC facilities	Central air conditioning is utilized to satisfy various needs of function and temperature for each room, equipped with tertiary air filtration and smoke channel. Energy is power supplied and liquid gas and power are provided for the canteen.
6	Firefighting Equipment	The Project establishes indoor, outdoor fire hydrant system and automatic sprinkling fire extinguishing system that are composed of fire pool, fire hydrant pump, roof water tank, ring-type fire fighting pipe network, fire hydrant box and fire pump adapter. The auto sprinkling fire extinguishing system will be built as per level I danger.

S/N	Name	Main Components
		18m^3 fire fighting water tank is set on the roof and 220m^3 fire pool is set in basement of the hospital building.
7	Sanitation facility	There is 1 garbage collection room in the Project area. It is located in ingress/egress of the project area to collect general solid wastes as per classification that will be regularly cleared and transported by the environmental sanitation department for processing; 1 temporary storage room for medical solid wastes is provided. It is situated in northern side of the emergency ingress/egress with obvious warning sign and will be disinfected and cleaned periodically. The solid wastes will be entrusted to a qualified unit for regular clear, transportation and processing.

Geological Survey report

- The site topography is relatively gentle with no steep slopes, no landslide, debris flow, collapse, goaf and ground subsidence or any other adverse geologic effects at the proposed site.
- According to the unified standard for reliability design of engineering structures GB50153-2008 3.2.1, the project structural safety level for emergency building, medical technology building and inpatient building, the structural importance factor is 1.1. The security level of the logistics building which is two levels, the structural importance factor is 1.0.
- According to the classification standard for seismic fortification of building works, the provisions of the GB50223-2008, emergency buildings, technical buildings, residential buildings are classified as the main fortification category (category B), logistics building for the standard fortification category is C.

Topography

303. The original height difference of existing land is large, according to the site topography trend site treatment for gradient slopes, the surrounding road system is perfect.

Seismic design of building electrical and mechanical engineering

304. There is no liquefied soil in the depth range of 20m, and the problem of earthquake liquefaction is not considered. Seismic fortification Intensity is 8 degrees, the basic seismic acceleration value is 0.20g, and the third group of design groupings. The seismic design of building electrical and mechanical Engineering basis code for seismic design of building electrical and mechanical Engineering GB50981-2014. The transformer installation should conform to GB50981-2014 Section 7.4.1 section of the seismic provisions. Diesel generators should be installed in accordance with the GB50981-2014. The Distribution Box (cabinet) installation should also conform to GB50981-2014 Section 7.4.4 section of the seismic provisions.

Water supply Method

305. Each access from the north and south sides of the site to the water pipe on each connection 1 root DN 200 water pipe, in the site into a ring layout, pipe diameter is DN200, Supply the production and living water supply and outdoor fire water supply to the floor and below each building in the project.

Sewerage system

306. After removing green water for irrigation, water for living and total in water 335.5m^3/ Day, the displacement is calculated by the 90% for water supply which is 301.95m^3/ day. As this project is a

general hospital project, sewage wastewater is not suitable as the water source, so this project does not set up a water treatment station.

307. For general waste water, it will be treated by sewage treatment facility at hospital and discharge to reach standard.

308. For special hospital wastewater (which may contain poisonous chemicals or radioactive material), the hospital will have specific treatment of hospital wastewater. Treatment of hospital wastewater is different from standard wastewater treatment; there is a potential risk for contamination from specific compounds that normally are not addressed by the standard WWTP (e.g. hormones, antibiotics, pharmaceuticals).

Rainwater

309. The design uses the gravity rainwater pipe net system, the rainwater through the rainwater bucket, the rainwater ditch, the rainwater mouth collects the back row to the site rainwater pipe NET, according to the terrain condition fragment area nearby discharges to the ground southwest side municipal Rainwater pipeline.

Fire Safety

310. According to the Code of Building fire protection, the number of fires in this plot is 1 times, the outdoor maximum water hydrant is 40 l/s, and the fire duration is 3h. Outdoor fire hydrant water supply system, that is, to meet the most adverse point of outdoor hydrant water supply pressure is not less than 0.10 Mpa requirements, the water supply and hydraulic pressure by the municipal water supply network guarantee. Local block maximum indoor fire water consumption is 30l/s, fire duration 3h. The indoor fire hydrant water supply system adopts the temporary high-pressure water supply system. Fire pool, water pump station set up in the basement, Fire pool storage 432 m^3 fire water. The fire tank is set on the roof of the tallest building in the plot, the effective water capacity of the fire water tank 36 m^3. The water tank is provided with a fire-fighting pressurization and stabilizing device, which provides fire fighting water to the indoor fire hydrant system by special fire water supply pipe. Emergency operations, fire tunnels around the building settings and fire road link throughout the hospital area.

Power supply

311. The mains supply the construction project two back 10kV high voltage power supply. According to the power supply radius and load capacity, set the 10kv/0.4kv Power Distribution room (to be located in the basement), the total installed capacity of the transformer is1600kVA. The transformer belt load rate is approximately 88%, the variable distribution room low pressure uses the radial or the trunk type power supply way respectively to each individual building and the basement power supply, the fire-fighting load uses the special circuit power supply, the Low-voltage system earthing type All is the TN department, some medical places use IT System. Standby Power: the diesel generator as standby power supply to meet the fire load.

Parking

312. The hospital has a total of parking for 499 vehicles, of which the underground Civil air defense and war combined with garage parking spaces are 365 while the rest for the ground parking spaces. The entrance of the underground car park is in front of the emergency and inpatient department.

Greening and Landscape design

313. The plant landscape design is based upon the following principles:

- The plant landscape is mainly composed of lawn and tall trees, with a partial consideration of the multi-level landscape combined with irrigation, ground and grass.
- Tree species selection to the principle of suitable trees, mainly selected local tree species, and focus on the combination of fast-growing trees and slow-living tree species, emphasizing the recent and long-term green effects and characteristics of landscape space formation.

Energy Saving measures

314. To save energy and water, the following water-saving measures are proposed:

- The building is intended to use the current water-saving sanitary ware, using automatic open and limited time flushing devices and hand-washing faucet, appliances, valves and faucets with good sealing performance and reliable quality.
- Control of living water distribution point pipe network pressure is not more than 0.20Mpa.
- Hot water heat source using solar panels and air source heat pump, the use of green energy.
- Hot water pipe to have appropriate insulation measures to reduce energy waste.
- Fire pool, living tank, hot water tank and roof fire water tank are all set up overflow alarm to prevent water supply overflow for a long time.
- The total distribution box is set in the load center to shorten the cable laying path.
- Three-phase load is balanced and the load unbalance rate is less than 15%.
- Set up local compensation in lighting fixtures to improve power factor.
- The illumination value in the library and the corresponding illumination power density value are strictly according to the requirements of architectural Lighting design Standard (GB50034-2013).
- Light Source: With high efficiency straight tube fluorescent lamp (T5 tube) and energy-saving lamp mainly, under the condition of meeting glare limit, choose luminaire with high efficiency and open type direct illumination lamp.
- Building to make full use of natural light, lighting lamps grouping, zoning, and in situ control. The pedestrian street lamp uses the intelligent control; the staircase illumination uses the infrared induction switch control.
- Reasonable selection of cable, wire section, line laying path, reduce distribution line loss.

Labor Capacity and Working System

315. The Project is provided with 100 hospital beds and 100 staff that will include 86 medical personnel, 8 management personnel and 6 personnel for administration and logistics.

Medical waste

316. As per regulations, each county will construct its own medical waste treatment facility as planned during the 13th Five Year Plan of Lincang. Starting from March 20th, 2018, all counties (district) shall stop the implementation of the transitional plan for disposal of medical waste, the infectious and injurious medical waste generated by all kinds of medical and health institutions in the municipality shall be transferred to Lincang Municipal Medical Waste Centralized Disposal Center for collection and disposal. Unlicensed entities shall not undertake collection, storage, transport and disposal of medical waste. Specific agreements will be made with providers of the service in Qingshuihe.

317. Letters of approval of the above is attached in **Annexure 8.C**.

3.5.4 Output 4: Institutional Capacity Development

318. This component includes project implementation management and support, monitoring on environmental, resettlement, social and ethnic minority, training and study tours, and technical assistance on border trade and logistics improvement, teacher training, healthcare service and hospital management, RCI development and capacity building etc.

319. This component will provide technical assistance to EA/IAs for the project implementation support and the improvement of the management capacity of the EA/IA. The intention of the component is that ADB will not only help on the construction of the project, but also help to improve management capacity on new technology application, management skills, introduction of new concepts and approaches, and technical assistance in project management.

320. One of the contents in the capacity development is to provide project management and project implementation support. A project implementation consultant team will be engaged to assist the PMO on the project implementation to ensure that the project is implemented according to ADB policy and procedure requirements including procurement, contract management, environmental, social safeguard and resettlement, financial management and disbursement.

321. The second part of the capacity development component is the training and study tours for the management staffs in EA/PMO and IAs. The training program may include ADB project implementation policy and procedures, technical training related to the project design and construction, etc. The study tours may include domestic and oversea visits for the project related cities and to learn the advanced technology and management methods.

322. Table 9.2 lists Environment Management Plan and monitoring related trainings to be held for awareness of the PIUs, the construction staff and the stakeholders. These trainings will be conducted during the course of project construction, post construction and operations.

323. The third part of the component will be the technical assistance and studies to help the project implementation. The technical assistance may include the special studies related to the project components and provide contributions to make fully use of the constructed project. Based on the project design and current understanding of the project, the following technical assistance programs listed in **Table 3.28** below.

Table 3.28: Summary of Capacity Development Program

No	Description
1	Project and contract management
2	Environmental, resettlement, social and minority plan implementation and monitoring
3	Border trade and logistics capacity building
4	Teacher training and curriculum development
5	TVET planning and development
6	Healthcare service and hospital operation and management improvement
7	RCI development and capacity building

(Source: PPTA Consultants)

3.5.5 Linked Facilities

324. The project has been assessed to consist of seven linked facilities. There are no associated facilities[24] in the project:

- Solid Waste Management Sites:
  - The entire solid waste collected from LBECZ would be transported to Mengding Municipal Solid Waste site for its disposal.
  - The solid waste from the hospital site would be transported to the Fenqing Solid Waste Management site.
- Medical Waste Management Sites:
  - Lincang Jinsheng Medical Waste Disposal Company, the medical waste handling agency appointed by Lincang government will transfer the medical waste collected from Qingshuihe hospital would be transported to Lincang Municipal Medical Waste Centralized Disposal Center.
  - The medical waste from the Zhenkang hospital site to the under construction Liying Medical Waste Treatment Center in Fengquing city. Lincang
- Traffic tunnel to be constructed as on the road connecting to the China Myanmar Avenue to the Mangka border. China-Myanmar Avenue that connects to this tunnel and road is not an associated facility.
- China Myanmar Avenue (Phase I and II) are under expansion by the government and will be completed by December 2018.
- Water Supply Downstream facility: Electrical hydropower plant draws water supply from water reservoir at the base of Nanting Nature Reserve along with Mengding town and also supplies the water supply water to the Mengding water supply company. No upstream facility is connected upstream to this sub-project. The water intake permit for the water supply for LBECZ is attached as Annexure 10. The water supply agreement between the hydropower and water supply company is attached as Annexure 8.D.

325. Table 3.29 provides information on Solid Waste Production Amount and Treatment Methods during the Project Operation.

3.5.5.1 Domestic solid waste landfill of Mengding Township Gengma County

326. The Solid waste landfill is located at Huishenggai Section, Boguang Unit, Xiacheng Village, Mengding Township. The main project contents include a Domestic Waste Landfill Site with the disposal capacity at 110 ton/day. The total storage capacity is 680,000 m^3. The service lifetime is estimated in 15 years (2029); a composite anti-seepage method, which combines the single-layer HDPE film and GCL, is adopted. HDPE film with thickness at 2.0 mm is used on the bottom, while the film with thickness at 1.5mm is used on the slope.

327. A leachate treatment station with treatment capacity at 75 ton/day is also included. Two-

[24] According to ADB's SPS 2009, the associated facilities that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

stage disc-type reverse osmosis (DTRO) and Concentration Reinfusion Treatment Process Craft are used. The total volume of the adjusting pool is 7500 m3, and the quality of the effluent is required to meet national standard of the “Contamination Control Standard for Domestic Waste Landfills” (GB16889-2008).

328. A domestic waste transfer station with daily treatment capacity of 40 tons, and two collection stations with daily collection scale of 10 tons, are proposed to be built at the main field of Mengding Farmland and the intersection of Dawanjiang and Zhenqing Secondary road respectively. They will be equipped with some domestic waste collection container and transporting vehicles.

329. The civil construction was kicked off on January 12, 2015. Currently, components including landfill main dam, section dams, slopes, earthworks in reservoir areas, groundwater inversions in reservoir areas, adjusting pools, management houses, mechanical repair workshops, leachate treatment stations, weighbridge rooms, approach roads, etc. have been completed. At present, the main parts of the project has been completed, accepted and put into operation. The service area of landfill covers Mengding State-owned Farmland and 10 villages of Mengding township, including Chengguan Village, Nuoe Village, Xinzhai Village, Hexi Village, Jingxin Village, Zheha Village, Hanhong Village, Hehai Village, Xiacheng Village, and Xiaba Village.

330. The landfill is designated to dispose the domestic waste generated from the service area above, excluding the construction waste, industrial waste, and special waste, especially the dangerous waste. At present, the landfill is targeted to serve 60,528 people. This number is estimated to reach 165,274 by 2029.

331. After collecting the household garbage in the main urban area of Mengding Town and Qingshuihe River Port Economic Zone, the household garbage is sent to the waste transfer station for centralized disposal (the construction works of household garbage transfer facilities of Gengma County is now under construction. The transfer stations are located at Mengsa Town, Mengyong Town and Mengjian Village respectively, the service of which covers totally 9 towns and villages) and then sent to the household garbage landfill at Mengding Town. The landfill, at Huishenggai section, Boguang Sub-village, Xiacheng Village, Mengding Town, is 5.0km from Mengding Town People’s Government. The handling scale is 110t/d and the total storage capacity is 680,000m3. The service population (until 2029) is 165,300.

332. **Figure 3.43** and **Figure 3.44** show the Mengding Land fill site and leachate treatment facility.

Figure 3.43: Landfill facility at Mengding Landfill site

Figure 3.44: Leachate facility at Mengding Landfill site

333. Sludge generated in the sewage treatment station of the Hospital of Qingshuihe River Port should be transported to the Landfill at Mengding Town for dumping after drying (i.e., the water content is less than 60%), and the grating slags and settling sand should be uniformly collected and sent to the landfill.

334. **Annexure 8.E** provides the basis of charging for solid waste disposal user fees in Mengding.

3.5.5.2 Fenquing Solid Waste Management site.

335. Sludge generated in the sewage treatment station of the China-Myanmar Friendship Hospital of Zhenkang County should be transported to the landfill for dumping after drying (i.e., the

water content is less than 60%), and the grating slags and settling sand should be uniformly collected and sent to the landfill.

336. The Zhengkang landfill (see **Figure 3.45** below) was put into use in 2010. The designed treatment capacity is 49 tons per day, with 13 years service life, the treatment method is landfill disposal. The landfill site is a controlled site that only handles solid waste from settlements and no medical or hazardous waste is accepted at this site as per Provincial regulations.

Figure 3.45: Landfill site at Zhenkang City

3.5.5.3 Lincang Medical Waste Centralised Collection Center

337. The Lincang Municipal Medical Waste Centralized Disposal Center has been relocated and has been technologically upgraded and made operational to handle treatment of 5 tons of infectious and injurious medical waste per day. The Lincang Jinsheng Medical Waste Disposal Company has acquired the operation license for medical waste centralized disposal by the Lincang Government.

338. The following order from Lincang Government states that “Starting from March 20th, 2018, all

counties (district) shall stop the implementation of the transitional[25] plan for disposal of medical waste, the infectious and injurious medical waste generated by all kinds of medical and health institutions in the municipality shall be transferred to Lincang Municipal Medical Waste Centralized Disposal Center for collection and disposal. Unlicensed entities shall not undertake collection, storage, transport and disposal of medical waste".

339. All medical solid waste of the hospital will be handed over to a medical waste disposal company of Lincang City with relevant qualification for bio-safety disposal at regular intervals. Sludge generated in their sewage treatment stations should be first provided with drying and disinfection treatment by lime to reduce the water content to below 60% and transported with household garbage to the landfill for dumping. Sludge containing heavy metals and waste active carbon absorbents should be collected to be handed over to a unit with relevant qualification for disposal. Sludge must have effective disinfection treatment up to the control and disposal requirement stated in Article 4.3 of Discharge Standard of Water Pollutants for Medical Organization (GB18466－2005), and stored in the temporary sludge storage tanks in the hospitals to have drying and disinfection treatment by lime to reduce the water content to below 60% before being handed over together with household garbage to a unit with relevant qualification for disposal The temporary sludge storage tanks should be designed to meet the temporary storage requirements of sludge according to Standard for Pollution Control on Hazardous Waste Storage (GB18597-2001).

3.5.5.4 Liying Medical Waste Treatment Center at Fenquing City

340. Zhenkang medical waste will be collected and will be sent to the Liying medical waste treatment center in Fengqing County treatment in Fengqing County which is under expansion/construction[26]. These facilities will be created as specialised medical waste facility disposing hospital medical waste as per PRC regulations.

341. Following the principle of nearby centralized disposal of medical waste, it is agreed to include Yun County, Fengqing County, Yongde County and Zhenkang County into the service coverage scope of Liying Medical Waste Treatment Center in Fengqing County.

Table 3.29: Table of Solid Wastes Production Amount and Treatment Methods during the Project Operation

Source	Name of Solid Waste	Output (t/a)	Handling Measures
Road facilities	Household waste:	Small amount	Set trash cans along the route which are collected and sent by sanitation workers
Frontier Trading Market for Border People	Commodity packaging wastes	626	Recycle the recyclable wastes. Unrecyclable wastes should be processed by environmental sanitation department.
International Capacity Cooperation Area at	Warehousing garbage	200	To be processed in accordance with relevant requirements. Recycle the abandoned packing materials.
	Household waste	18.25	To be processed by environmental sanitation department through collecting.

[25] Current facilities used for medical waste will discontinue once the new facility is operational.

[26] Current facilities used for medical waste will discontinue once the new facility is operational.

Source	Name of Solid Waste	Output (t/a)	Handling Measures
Qingshuihe River			
Qingshuihe River Port Water Supply Plant	Sludge	365	Slime will be sent to and filled in landfill.
	Household waste	8.03	To be processed by environmental sanitation department through collecting.
Sewage Treatment Plant in Qingshuihe River Area	Sludge	456. 25	To be dried (moisture content being lower than 60%), sent to and filled in the landfill at Mengding Town.
	Grid slags and sand setting	18.25	To be sent to landfill through collecting.
	Household waste	7.3	To be processed by environmental sanitation department through collecting.
Charging station	Household waste	54.75	To be processed by environmental sanitation department through collecting.
Hospital of Qingshuihe River Port	Household waste	36.5	To be processed by environmental sanitation department through collecting.
	Canteen swill	94.9	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	0.6	To be processed by qualified unit through collecting.
	Medical wastes	29.2	The medical solid wastes shall be temporarily stored in medical waste storage room through collecting and shall be carried out regular harmless treatment by qualified medical wastes treatment company.
	Sludge of sewage treatment facilities	21.83	To be dried and sterilized with lime until the moisture content is below 60% and to be collected, sent to and filled in landfill together with household garbage.
	Heavy metal sludge and abandoned activated carbon absorbent	1	To be processed by qualified unit through collecting
China-Myanmar Friendship Hospital of Zhenkang County	Household waste	328.5	To be processed by environmental sanitation department through collecting.
	Canteen swill	593.1	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	3.75	To be processed by qualified unit through collecting.
	Medical wastes	912.5	The medical solid wastes shall be temporarily stored in medical waste storage room through collecting and shall be carried out regular harmless treatment by qualified medical wastes treatment company.
	Sludge of sewage treatment facilities	81.09	To be dried and sterilized with lime until the moisture content is below 60% and to be collected, sent to and filled in landfill together with household garbage.
	Heavy metal sludge and abandoned activated carbon absorbent	1.33	To be processed by qualified unit through collecting
Guomen Primary School in Qingshuihe River	Household waste	64.26	To be processed by environmental sanitation department through collecting.
	Canteen swill	5.4	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	0.3	To be processed by qualified unit through collecting.
Changyuang 2nd Guomen Primary School	Household waste	152.55	To be processed by environmental sanitation department through collecting.
	Canteen swill	12.82	To be sold to local pig farms for comprehensive utilization

Source	Name of Solid Waste	Output (t/a)	Handling Measures
			through collecting
	Grease in oil separation tank	0.71	To be processed by qualified unit through collecting.

3.5.5.5 Highway Tunnel

342. The project is a two-grade highway that would require construction of tunnel to make easier driving conditions. The tunnel would have 2x1.5m (overhaul path and sidewalk)+2x3.5m(side width)+2x 3.5m(carriageway)=15m, pavement two-way horizontal slope 2.0%, building clearance height of 5.0m, net width 15.0m. There are houses on top of the tunnel for which the design of tunnel, information on residents and structures on the tunnel etc. would be required.

Figure 3.46: 633 m long proposed Tunnel (design)

(Source: FSR)

343. Table 3.30 provides the investment required for the tunnel which would require demolition of one small portion of building. Table 3.31 provides the tunnel specifications.

Table 3.30: Project details for the road connecting the highway to the tunnel and the Nanting River Bridge

Number	Indicator name	Unit	Number	Notes
	I. BASIC indicators			
1-1	Highway Grade	Level	Secondary	
1-2	Design speed	Km/h	60	
1-3	Occupy Land	Acres	72.58	
1-4	Demolition of buildings	M^2	68	
	Ii. Route			
2-1	Total route length	Km	1.866	
2-2	Route growth factor		1.002	

Number	Indicator name		Unit	Number	Notes
2-3	Minimum radius of circular curve		M	2000	
2-4	Maximum longitudinal slope		%/Secretariat	4.857/1	
	Iii. roadbed and Pavement				
3-1	Subgrade width		M	16.5	Road width 12m
3-2	Amount of earthwork		$1000m^3$	279.85	
3-3	Average number of earthwork per kilometer		$1000m^3$	316.931	
3-4	Protection Engineering	Subgrade Protection	$100m^3$	21.588	
		Slope protection	$1000m^2$	35.93	
3-5	Drainage works		$100m^3$	16.116	
3-6	Pavement Engineering		$1000m^2$	9.701	
	Iv. Bridges, culverts				
4-1	Design Load Level			Highways - I level	
4-2	Standard width of bridge deck		M	1x16.5	
4-3	Bridge	Bridge	m/ seat	350/1	
		The bridge occupies the route total length	%	18.76	
	V. Tunnels		m/ Road	633/1	
	Vi. Route Cross				
6-1	Plane Cross		Secretariat	2	
	Vii. facilities and other works along the line				
7-1	Safety facilities		Km	1.866	
	Viii. Environmental Protection				
8-1	Environmental greening		Km	1.866	
	IX. Investment Estimates				
9-1	Total amount of investment estimate		Million	27863.3258	
9-2	Average Cost per kilometer		Million	14932.114	

Table 3.31 Tunnel main Specification table

No.	Project	Technical Specifications
	Tunnel Scheme	Banqui Tunnel
1	Road level	Highway Level Two
2	Design speed	60km/h
3	Tunnel Construction Clearance Height	5.0m
4	NET width of tunnel construction clearance	2x1.5 (overhaul path and sidewalk) +2x2.5(side width)+2x3.5(carriageway)=15m
5	Longitudinal slope of road surface	-2.735,-0.41
6	Road slopes	2.0%(bidirectional)
7	Basic seismic fortification Intensity	9 degrees
	Tunnel Length	633 m
	Starting and ending pile no	k0+239~k0+872
	Lighting mode	Combination Lamps
	Ventilation mode	Mechanical ventilation
	Building gauge (width x high) (m)	15.0x5.0

Spoil from tunnel

344. The spoils from the tunnel will be used for the earthwork required at the road sides and near the bridge for developing the road connectivity to the Bridge to the tune of 279,850 m^3. Any shortage of earth spoils for road sides and developing the green belt area would be made good by importing material from other spoil dumping area inside LBECZ.

Green belt development

345. The green belt to be developed along the road and the tunnel would about 1.886 km. Slope protection of about 35930 m^3 would need to be done near the tunnel to ensure the soil erosion due to the rain etc. is controlled.

Receptors above project area

346. **Figure 3.47** shows the location of tunnel and the houses about 40 m from the top of the tunnel. These houses shall be disturbed during construction due to cutting and forming of the tunnel as proposed. The people living there may have to be temporarily shifted to allow for safety reasons incase cracks appear in the structure or some portion subsides due to rain or ground sinking.

347. One building of size 68 m^2 may need to be demolished as a safety precaution.

Figure 3.47: Tunnel alignment and houses on top (about 40 m above)

3.5.5.6 China Myanmar Avenue (Phase I and II)

348. **Figure 3.48 and Figure 3.49** show the China Myanmar Avenue to which this tunnel connects. However, since the traffic on this is road is not entirely dependent on the tunnel or vice versa, there is no associated facility linkage to the project.

349. China Myanmar Highway of Phase I and Phase II are expected to complete within 28th December, 2018.

Figure 3.48: China-Burma Road (first phase) starting point

Figure 3.49: China-Burma Road (Phase I) Qingshuihe River bridge

(Source: FSR)

3.5.5.7 Hydropower project

350. It is proposed that the water supply for the Qingshuihe River Port shall be made from the current Nangun River which also supplies water to Mengding Town and the private electrical hydropower plant. The river water sharing arrangements shall be made and shall be adhered as part loan requirements.

351. **Figure 3.50** shows the water diversion structure and **Figure 3.51** shows the water reservoir from where the current water supply is being undertaken for Mengding town and hydropower plant. **Annexure 8.D** provides the agreement between the Hydropower company, the water supply company and the Provincial government.

352. Approval of Lincang Municipal Water Affairs Bureau on the Water Intake Permit Application of Mengding Qingshuihe Port Area Water Supply System (No.6 Document, April 27, 2018) has been granted conjointly with the power station. The details are attached in **Annexure 10**.

Figure 3.50: Water diversion barrage for Mengding town and electrical hydropower project

Figure 3.51: Water reservoir for Mengding town water supply and electrical hydropower project

4.0 DESCRIPTION OF ENVIRONMENT (BASELINE DATA)

4.1 Physical Environment

Geographic Location

353. Lincang is located in the southwestern part of Yunnan province and is a prefecture-level city in Yunnan province, between east longitude 98° 40 -100° 34 and northern latitude 23° 05 -25° 02 between the east of Lincang city and Puer City, the west is adjacent to Baoshan, the north and Dali Bai Autonomous Prefecture, the southern border with Burma, to the brink of the Lancang River. There are 23 nationalities such as Han, Dai, WA, Lahu, Brown, Lincang, Yi and Jing which is one of the birthplace of Dai Culture, WA Cultural gathering place, the world tea native land, the national famous Walnut Township, but also Kunming to Burma Yangon land route, It is also known as the Southern Silk Road, Southwest Silk Tea Trail. Lincang Municipal Hengduan Shan Mountains, the South extension part of the western Yunnan Longitudinal Gorge, the territory of the old Bieshan, Bongmar mountains. The middle of the terrain is high, surrounded by low, and from northeast to southwest gradually tilt. The highest point in the territory of 3,429 meters above sea level Yongde snow-capped mountains, the lowest altitude of 450 meters of Mengding Qingshuihe River, the relative height difference of 2,979 meters.

354. Situated in southwest Lincang City, Yunnan Province, Gengma County is located between the east longitude of 98°48′~99°54′ and northern latitude of 23°20′~24°02′. It borders Lincang City and Shuangjiang County in the east, Cangyuan County in the south, Zhenkang County and Yongde County in the north across the Nanting River as well as Myanmar in the west Gengma County is 719 km away from Kunming, the Capital City of Yunnan Province and is 146km away from People's Government of Lincang. North-south width and east-west length across the whole territory is 42 km and 90 km. The perimeter of the County is 410.4 km with a border line of 47.35 km. The national territorial area is 3,837km^2 with 92.4% mountainous area and 7.6% plain.

355. The Project is located at west end of Gengma County, southwest frontier of China. The terrain in northeast region of Gengma County is higher than that in southwest region with the northeast-southwest degradation in an echeloning order. In northeast area, peaks are towering and steep. The terrain in the central area is broad with slopes while in west area is slightly narrow. Most plains belong to hilly plain. The highest point in this area is located in the snow mountain at the junction of eastern Gengma and Shuangjiang County with the altitude of 3,323 m. The lowest point is located at the confluence of Nanting River and Qingshuihe River with the altitude of 450m. The dominant terrain in surveying area is mountain land with a small amount of intermountain basins. The peak is an extension of Laobie Mountain chains, one of the tributary of Nu Mountain.

356. Situated in southwest of Yunnan Province, Mengding Town is located between the east longitude of 98°53′~99°15′ and northern latitude of 23°27′~23°40′. It borders on Mengjian Village of Gengma County, Gengma Town and Hepai Village in the east, Mangka Town of Cangyuan County in the south, Grūm of Myanmar in the west as well as Muchang Village of Zhenkang County in the north. The Project is located at Mengding Qingshuihe River Port. Qingshuihe River Port is 83 km away from the county. See geographic location of the Project in **Figure 4.1**.

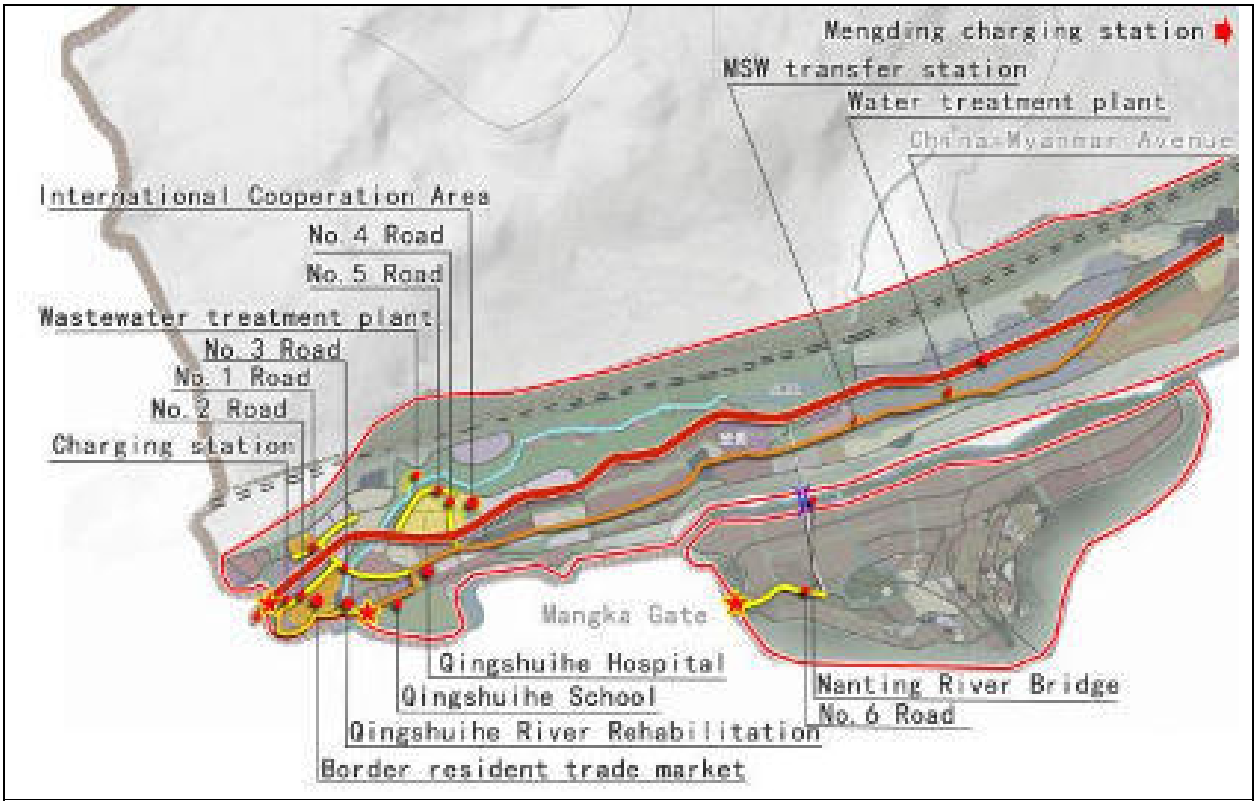


Figure 4.1: Qingshiuhe River port area (ADB funded sub-project sites)

(Source: PMO, FSR)

357. Mengding Town of Gengma County is located at middle and lower part of mountainous incision region of Hengduan Mountain Range in West Yunnan and is situated at alluvial plain of broad valley of Nanting River and low-heat valley. Most of mountains and rivers line run from northeast-southwest. The terrain decreases in an echeloning order from northeast-southwest. All the peaks in the area belong to Laobie Mountain chains, one of the tributary of Nu Mountain. The mountain is towering and steep in northeast region while the terrain in southwest region is broad and sloping, just like a cone. The average altitude is 511m. The altitude of Fairy Mountain, the highest peak, is 1,694m. The lowest position is located at the confluence of Qingshiuhe River and Nanting River with the altitude of 450m and belongs to low-altitude alluvial plain and low-heat valley.

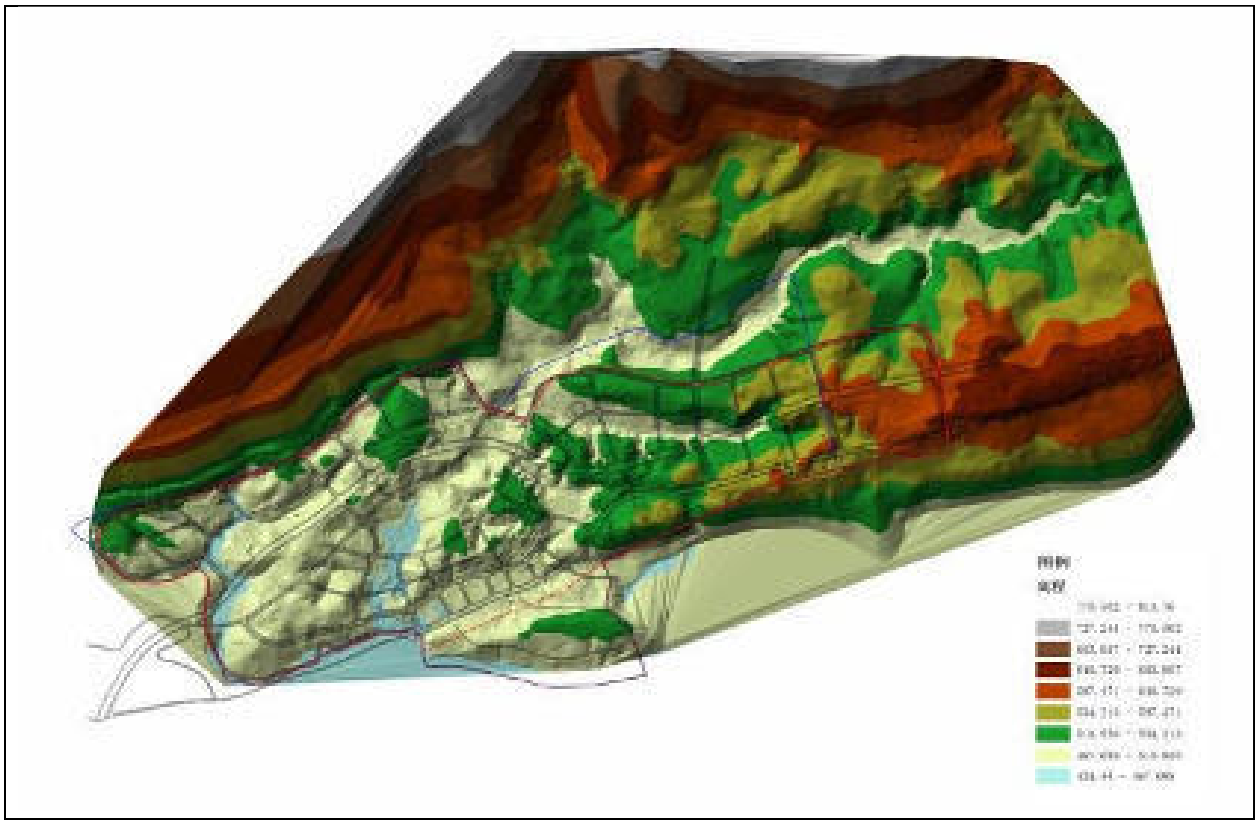
4.1.1. Topography, Geology and Soil

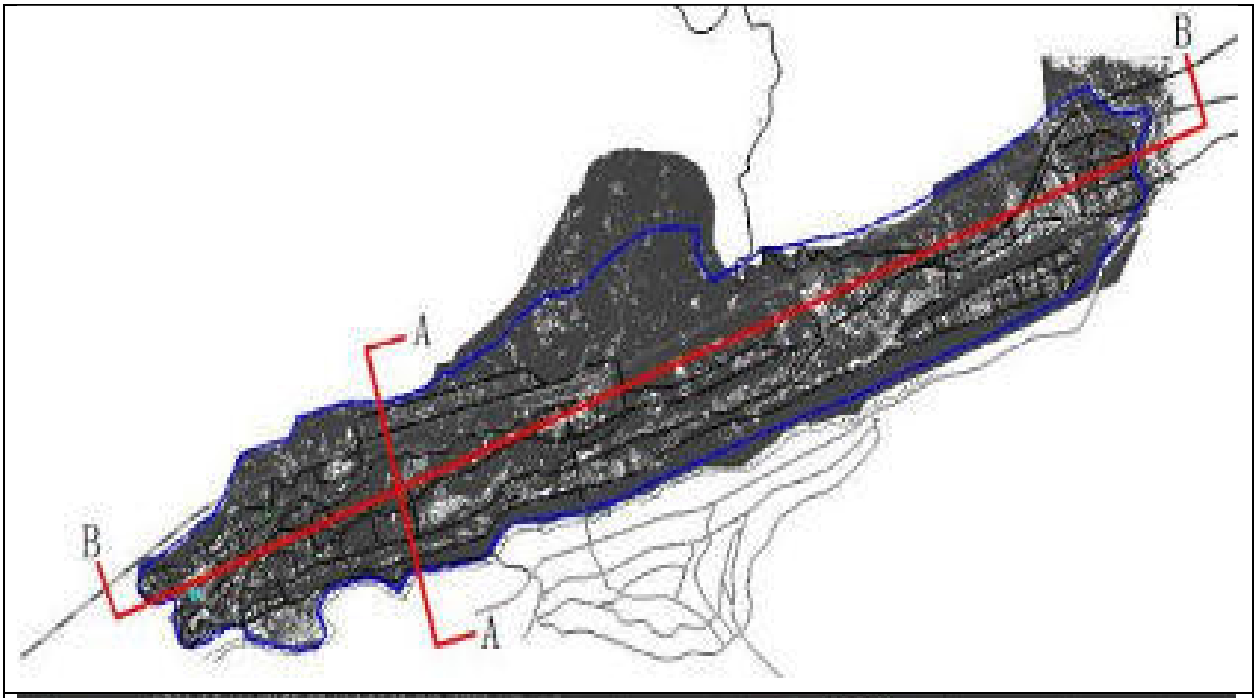
Topography

358. Qingshiuhe port area topography is complex - the area has gully vertical and horizontal landscape, rubber forest trees plantations. Qingshiuhe, the South Pa River Longitudinal Planning Area, the lowest place is the South Ting River and Qingshiuhe Rendezvous having elevation of 450 m. The difference in maximum elevation and minimum elevation of the project area is nearly 200 m. Some sections have a very steep slope. The road design makes full use of the present terrain to make the road longitudinal slope balanced and coordinates with the present terrain

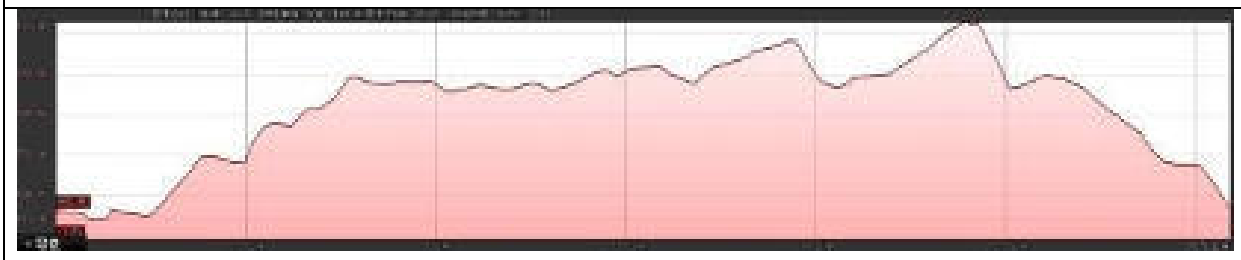
features, the site planning could fill the amount of excavation as far as possible to a suitable elevation conducive to the proposed construction and sustainable development of the area.

359. **Figure 4.2** shows the elevation of the LBECZ area above MASL. It also depicts the land anatomy in two sections A-A and B-B for the area.





Section A-A



Section B-B

Figure 4.2: Elevation Plan for LBECZ site

Source: FSR Reports 2018

Geology

360. The cover layer of the project area is the fourth series red and residual layer, the thickness of the flood layer is generally small, mainly distributed in the Gully and river valley and its lower order, and the residual slope is distributed in the slope, uneven thickness distribution, and more contain the original rock fragments; The underlying bedrock is mainly Permian (P), Triassic (T), lithology is dominated by sedimentary rocks and volcanic rocks.

361. The location of tectonic structure in assessment area is situated at Gangdise-Nyenchen Tanglha fold system--Changning-Menglian fold belt--Lincang-Menghai virgation and Mengsheng-Donghui virgation-Nanla-Ximeng virgation. Meridional structural belt in West Yunnan has complex geological structure according to geomechanics. The assessment area is basically located between Lancang River Fault-Nanting River Fault. The faults with larger scale from west to east in assessment area are as follows: Nanting River Fault, Dazhai-Yunyang Fault, Nantianmen Fault, Sanjian Mountain Fault, Mengsa-Mangang Mountain Fault and Lancang River Fault. Dominated by those faults, the assessment area is under significant influence. Folds are developing in this area. Derived faults include north-east faults and south-west faults. Among them, Nanting River Fault dominates the area.

362. Nanting River Fault (F1) is located at east of assessment area. Qingshuihe River flows out of the area from southwest end toward northeast area passing through Mengding Plain, northwest edge of Mengjian Plain, Dajunsai and Damengpo with the total length being larger than 200km in large scale. The fault is in the shape of a straight line on a flat surface from northeast to southwest (about 45°). The strata of fault include Devonian, Carboniferous, Permian, Triassic and Jurassic strata. As for the direction, discontinuous and old strata will generally thrust over new strata. Along fault belt, the strata are seriously broken with folds and recrystallization and generate fault conglomerate, mylonite, structural lenticle and fault gouge. The width of crushed zone is generally 100-300m. It is above 500m across at its widest point.

Soils

363. There are 10 soil types, 19 subclasses, 72 soil genera and 348 species in Lincang. With the influences by terrain, climate, vegetation and human activities, the soil has a regular vertical and zonal distribution characteristic. From low altitude to high altitude, the soils are distributed as the laterite, latosol red soil, red soil, yellow soil, yellow brown soil, and subalpine meadow soil. The laterite occurs in the elevation less than 800 m, the latosol red soil between 800 ~ 1300 m, red soil between 1300 ~ 2100 m, yellow soil between 2100 ~ 2400 m, yellow brown soil between 2400 ~ 300 m, and subalpine meadow soil between 3000 ~ 3504.

4.1.2. Climate and Meteorological conditions

364. Since it is located on the Tropic of Cancer, Gengma County belongs to south subtropical monsoon climate with hot weather, annual average temperature of 18.8^{0}C, lowest average monthly temperature of 11.6^{0}C, highest average monthly temperature of 23.3^{0}C and sunshine duration of 2142.6 h. The annual average precipitation is 1321.1 mm. The rainy season of this area lasts from May to October which will cover 86.6% annual precipitation. The duration of frost-free season is 320d. The annual average sunshine duration is 2196.1h and gross radiation intensity is 133.58 kcal/cm^2. The annual average wind speed is 0.91 m/s and wind from the southwest is the predominant wind direction.

365. **Zhenkang County** has a subtropical low latitude mountain monsoon climate. Its main climate is characterized by relatively warm weather in most areas, abundant sunshine, short frost period, indistinct four seasons, abundant rainfall, distinct wet and dry seasons and significant

three-dimensional climate. The highest temperature in Zhenkang County is 36.3°C, and the minimum temperature is minus 1.8°C. The average temperature over the years is 18.7°C and the rainfall is 1625.4mm (of which, the rainfall from May to October accounts for 87% of the annual rainfall). The evaporation is 1501.3mm. The sunshine duration over the years is 1989 hours. The percentage of sunshine is 44%. The average atmospheric pressure over the years is 893.3 hp, the wind speed is 1.1 m/s, the sunny days are 150 days, and the rainy days are 215 days. The number of frost days is small, i.e. averaging only 8 days per year with light frost.

366. **Cangyuan Va Autonomous County** has a subtropical low latitude mountain monsoon climate with an annual average temperature of 17.2 degrees, an annual extreme maximum temperature of 34.6 degrees, a minimum temperature of -1.3 degrees, a frost-free period of 290 days, an average annual rainfall of 1,425 to 1,595 millimeters and annual sunshine hours of 2,115 hours. There are five months with more than 200 hours of sunshine per month.

367. Since the project location belongs to subtropical mountainous monsoon climate, the area possesses distinct rainy season (duration: May-October, precipitation: 1200~2000mm) and dry season (duration: November-April, precipitation: 100~200mm). Because of the obvious difference of three-dimensional climate, the weather in intermountain basin and river valley area is humid and hot with the highest temperature being above 40^0C while the weather in mountainous area is mild and cool with the temperature within 30^0C. The annual average temperature is 18.8~20.1^0C.

368. **Mengding**: The edge zone is a famous subtropical scenic area in Yunnan province, one of the three Dai dams in Yunnan (Xishuangbanna, Ruili, and Mengding). Mengding town has a typical stereo type climate- a mountain having four seasons with, the Tropic of Cancer across the entire territory, forming a typical northern tropical humid climate type. Annual average temperature 21.7, no frost year-round, year of sunshine 2112.3 hours, sunshine percentage 48 %, annual total accumulated temperature 7861.2, effective temperature 3541.2; annual average rainfall 1600mm, Rainy season (5-10) Monthly rainfall accounts for annual rainfall 88%; winter and Spring foggy, Foggy Day 89.9 Day, average humidity 20.7%, relative humidity 75-80%, has natural Greenhouse. Under the influence of the Northwest dry air and southwest warm and humid airflow, the formation of Mengding region spring and autumn warm, summer and autumn long, rain and heat in the same season, abundant rainfall, summer without heat, winter without cold, sunshine sufficient, heat source rich, wet and humid obvious subtropical climate. A different type of climate allows a variety of vegetation types and brings favorable conditions for the development of large agricultural production in Mengding.

369. **Project Location:** The project is located in Mengding Town, Gengma County with a straight line distance of about 53 km. The Mengding Town is located in the low valley area near the Tropic of Cancer with a high temperature, longer sunshine time, no frost all the year round. It is typical subtropical monsoon climate with annual average temperature of 21.7 °C, the hottest month (June) temperature of 25.8 °C, the coldest month (January) temperature of 14.3 °C, annual accumulated temperature of 7861.2 °C; annual sunshine time of 2094.8 hours, sunshine rate of 48%; average annual rainfall of 1600 mm, rainfall in the rainy season (May to October) accounting for 88% of the annual rainfall; annual fog days of 89.9 days, annual average humidity of 20.7%, relative humidity of

80% and annual evaporation of 1602 mm. West wind is the perennial predominant wind direction and southwest wind is the secondary predominant wind direction.

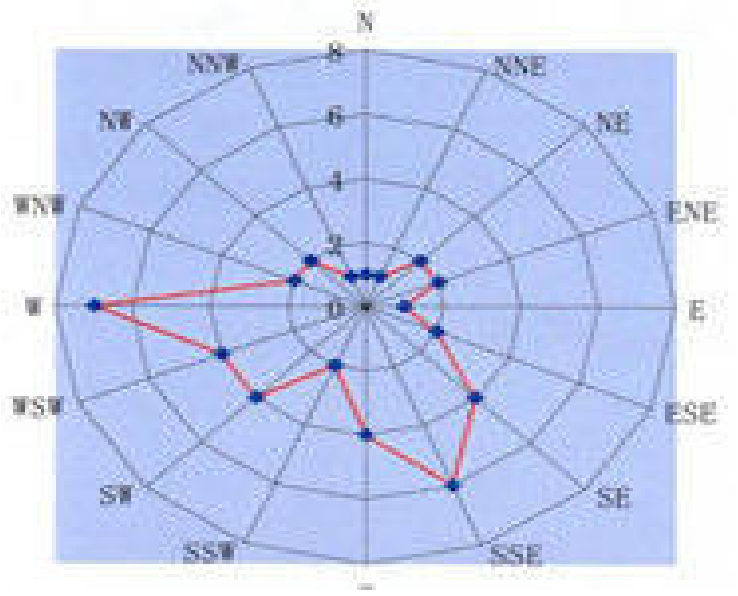


Figure 4.3: Average Wind Rose Diagram in the Project Area

Source: DEIA report 2018

370. Figure 4.3 above shows the average wind rose diagram. Accordingly, the buildings will be designed for wind load design basic wind pressure (50 recurrence period): Wo=0.30kn/m^2, ground roughness: Class B.

Temperature

371. The monthly variation of annual average temperature in the local area is shown in **Table 4.1**. The monthly variation curve of annual average temperature is shown in Figure 4.4. It can be seen from the data of monthly variation of annual average temperature that the average temperature reached the highest in June (24.59ºC) while the average temperature reached the lowest in February (13.07ºC) and the average temperature of the year was 20.28º C.

Table 4.1: Monthly Variation of Annual Average Temperature

Month	January	February	March	April	May	June	July	August	September	October	November	December
Temperature (ºC)	13.46	13.07	15.74	20.21	22.11	24.59	23.91	23.87	24.20	23.56	21.46	16.78

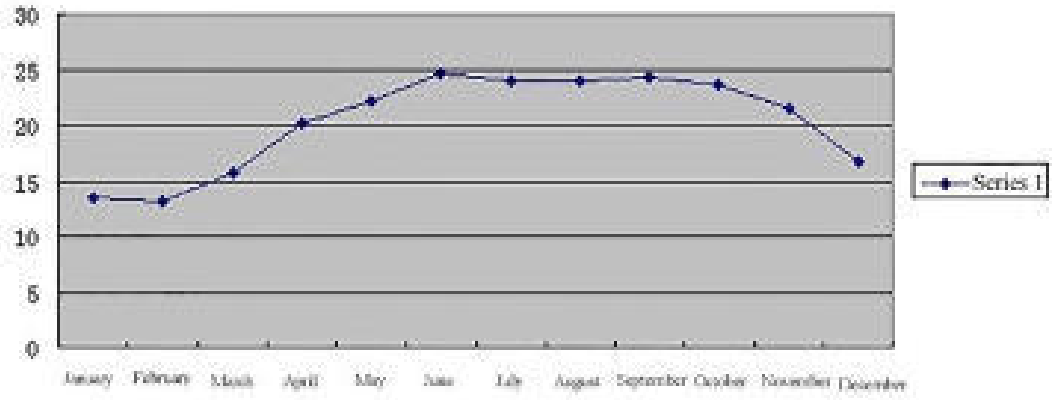


Figure 4.4: Monthly Variation Curve of Annual Average Temperature

Source: DEIA report 2018

Wind Speed

Monthly Variation of the Average Wind Speed

372. The variation of monthly average wind speed varies with months and daily variation of seasonal average wind speed per hour is shown in **Table 4.2**. The variation curve of monthly average wind speed is shown in **Figure 4.5**.

Table 4.2: Monthly Variation of Annual Average Wind Speed

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed (m/s)	0.61	0.47	1.06	0.96	1.40	1.27	0.98	0.90	0.97	0.88	0.79	0.61

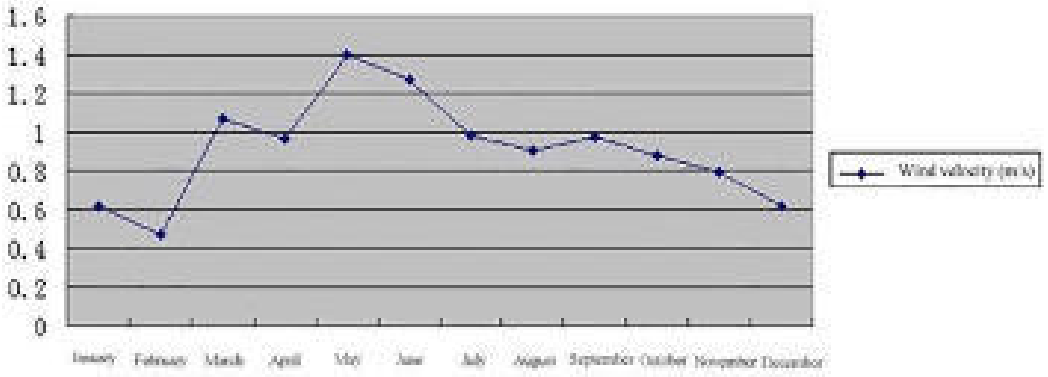


Figure 4.5: Monthly Variation Curve of Average Wind Speed

Source: DEIA report 2018

373. In accordance with monthly mean wind speed statistics, the highest average wind speed appeared in May (1.40m/s) while the lowest average wind speed appeared in February (0.47 m/s) and the annual average wind speed is 0.91 m/s in Gengma County. Daily variation of average wind speed per hour at each season refers to **Table 4.3**. Daily variation of average wind speed per hour at each season refers to **Figure 4.6**.

Table 4.3: Daily Variation of Average Wind Speed per Hour at Each Season

Hour (s) / Wind Speed (m/s)	02	08	14	20
Spring	0.63	1.55	2.99	2.4
Summer	0.67	1.26	2.12	1.96
Autumn	0.61	1.2	1.97	1.78
Winter	0.40	1.67	3.08	2.57

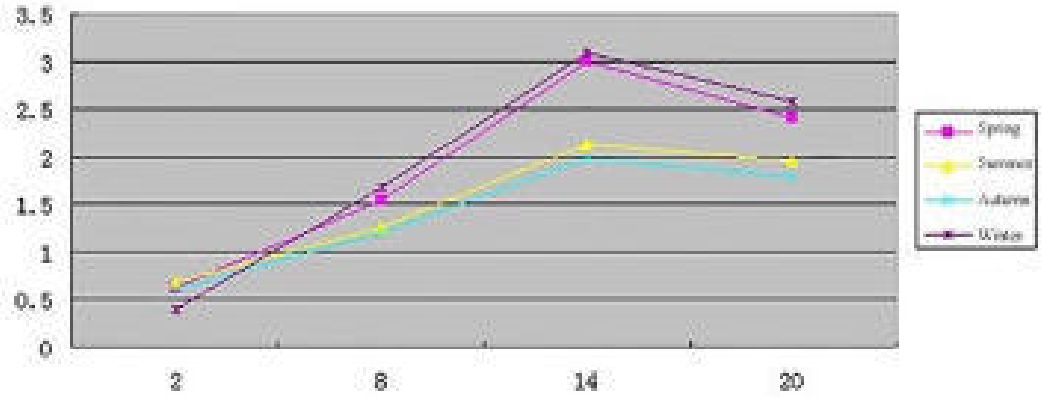


Figure 4.6: Daily Variation of Average Wind Speed per Hour at Each Season

Source: DEIA report 2018

374. From the statistical data of monthly average wind speed per hour at each season, the wind speed of assessment area is high in afternoon and low in morning to sunrise, and the wind speed in winter, spring and summer is higher than that in autumn.

Wind Direction and Wind Frequency

375. Monthly, seasonal and long-term average variation of wind frequency at each direction refers to **Table 4.4**. From the statistical data of monthly, seasonal and annual average variation of wind frequency, the predominant wind direction is W- WSW and the angle of wind direction is 22.5°, and the frequency of occurrence of such wind is 15.03%. The largest wind direction (W) frequency is 8.84% and the calm wind frequency is 16.92%; from seasonal distribution, the most frequent wind direction in spring is calm wind (C: 21.47%); the most frequent wind direction in summer is west wind with relatively high frequency (11.41%); the most frequent wind direction in autumn is calm wind (C: 9.89%); the most frequent wind direction in winter is calm wind (C: 27.78%). There is no obvious seasonal variation in wind direction frequency. Rose Diagram for Monthly, Seasonal and Annual Wind Frequency see **Figure 4.7**.

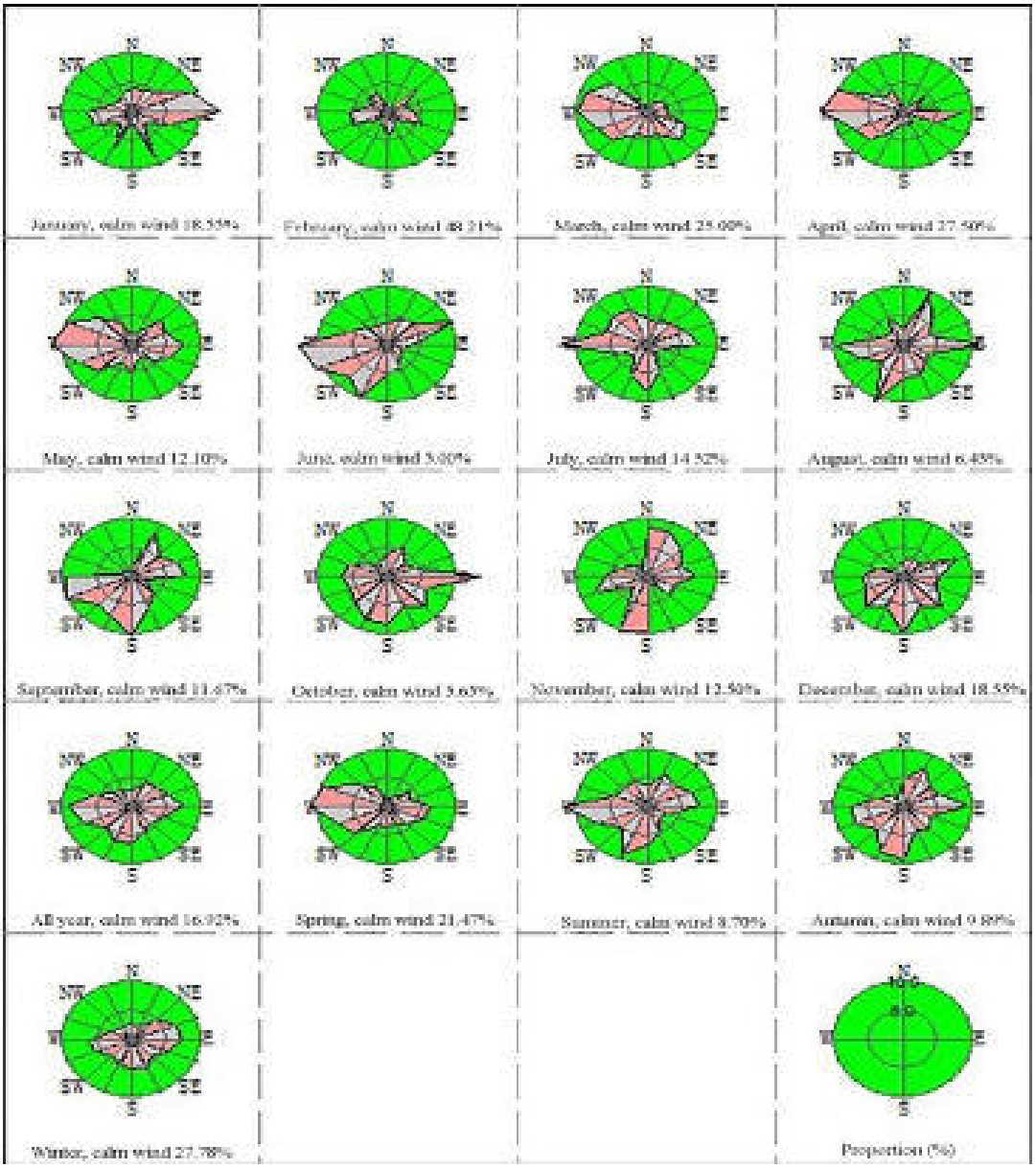


Figure 4.7: Rose Diagram for Monthly, Seasonal and Annual Wind Frequency in 2015

Source: DEIA report 2018

376. Monthly, seasonal and long-term average variation of wind frequency at each direction refers to **Table 4.5**. From the statistical data of monthly, seasonal and annual average variation of wind speed in 2015, the annual average wind speed is 0.91m/s. The wind speed is relatively high in spring and the seasonal average wind speed is 1.14 m/s. The winter has the lowest wind speed of 0.57 m/s.

Table 4.4: Monthly, Seasonal and Annual Average Variation (%) of Wind Frequency in 2015

Wind Frequency (%)\ Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	C
January	4.03	4.03	4.84	8.87	12.1	5.65	2.42	8.06	1.61	6.45	2.42	5.65	6.45	3.23	2.42	3.23	18.55
February	0.89	0	6.25	2.68	3.57	5.36	1.79	2.68	4.46	1.79	1.79	5.36	5.36	2.68	3.57	3.57	48.21
March	0.81	1.61	2.42	3.23	2.42	5.65	6.45	4.03	4.03	4.03	6.45	7.26	9.68	8.87	6.45	1.61	25
April	0.83	0.83	4.17	1.67	8.33	5	0.83	2.5	1.67	3.33	6.67	7.5	11.67	10	3.33	4.17	27.5
May	1.61	2.42	5.65	4.84	7.26	5.65	4.03	2.42	4.84	3.23	6.45	8.06	11.29	9.68	6.45	4.03	12.1
June	3.33	5	5	10	3.33	2.5	2.5	4.17	5	10	7.5	10.83	12.5	5.83	4.17	3.33	5
July	4.03	4.03	4.84	5.65	7.26	2.42	1.61	4.84	8.06	5.65	2.42	4.03	12.1	5.65	6.45	6.45	14.52
August	2.42	9.68	5.65	4.03	11.3	4.03	4.03	5.65	5.65	10.48	4.03	6.45	9.68	3.23	2.42	4.84	6.45
September	1.67	8.33	5	6.67	7.5	1.67	4.17	5.83	10	7.5	6.67	10	9.17	1.67	1.67	0.83	11.67
October	4.03	5.65	3.23	4.03	12.9	5.65	7.26	5.65	8.06	8.06	6.45	5.65	6.45	5.65	3.23	2.42	5.65
November	8.33	8.33	6.67	5	6.67	4.17	4.17	0.83	9.17	10	2.5	7.5	5.83	4.17	2.5	1.67	12.5
December	3.23	3.23	3.23	8.06	4.84	4.84	7.26	5.65	9.68	5.65	7.26	5.65	5.65	4.03	1.61	1.61	18.55
Spring	1.09	1.63	4.08	3.26	5.98	5.43	3.8	2.99	3.53	3.53	6.52	7.61	10.87	9.51	5.43	3.26	21.47
Summer	3.26	6.25	5.16	6.52	7.34	2.99	2.72	4.89	6.25	8.7	4.62	7.07	11.41	4.89	4.35	4.89	8.7
Autumn	4.67	7.42	4.95	5.22	9.07	3.85	5.22	4.12	9.07	8.52	5.22	7.69	7.14	3.85	2.47	1.65	9.89
Winter	2.78	2.5	4.72	6.67	6.94	5.28	3.89	5.56	5.28	4.72	3.89	5.56	5.83	3.33	2.5	2.78	27.78
Full Year	2.95	4.45	4.73	5.41	7.33	4.38	3.9	4.38	6.03	6.37	5.07	6.99	8.84	5.41	3.7	3.15	16.92

Table 4.5: Monthly, Seasonal and Annual Average Variation (m/s) of Wind Speed in 2015

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Average
January	1.12	1	0.57	0.61	0.68	0.61	1.3	0.61	0.4	0.63	0.6	0.81	0.95	1.03	0.67	0.8	0.61
February	0.4	0	1.2	0.73	0.5	0.62	0.65	0.87	0.74	0.8	1.15	0.77	0.77	1.47	1.2	1.38	0.47
March	0.3	1.1	1.13	1.1	1	0.93	1.21	1.1	1.38	2.88	1.14	1.37	1.73	1.64	1.39	1.85	1.06
April	0.6	1	1.22	1.3	0.83	0.5	0.3	0.8	0.95	1.48	1.05	1.86	1.64	1.82	1.9	1.2	0.96
May	1.55	2.1	1.11	0.95	1.32	1.87	0.68	0.57	1.3	1.3	1.39	1.81	2.31	2.21	1.28	1.9	1.4
June	0.88	1.18	0.68	1.08	1.05	0.47	0.63	0.84	1.28	1.28	1.49	2.06	2.07	1.11	1.08	1.3	1.27
July	1.12	1.78	0.65	1.04	1.26	1.03	0.7	1.33	1.23	0.94	0.57	1.06	1.12	1.61	1.35	0.89	0.98

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Average
August	0.8	1.02	1.13	1.06	0.86	0.68	1.38	1.11	1.01	0.77	1.16	0.76	0.9	1.2	1.33	0.92	0.9
September	1.2	1.37	0.9	1.11	1.03	1.8	1.16	1.27	1	1.13	0.91	1.04	1.1	0.9	0.95	0.9	0.97
October	1.1	1.06	0.98	0.94	0.93	0.96	0.98	0.71	1.1	0.74	0.9	0.89	0.85	1.1	1.2	0.57	0.88
November	1.01	0.92	0.69	0.9	0.99	0.74	0.72	1.6	1.07	0.79	1.13	0.76	1.21	0.92	0.6	0.9	0.79
December	0.98	0.83	0.95	0.65	0.7	0.55	0.9	0.76	0.82	0.81	0.53	0.64	0.86	0.86	0.85	0.5	0.61
Full Year	1.01	1.17	0.92	0.92	0.93	0.87	0.97	0.92	1.05	1.04	1.03	1.23	1.4	1.48	1.22	1.11	0.91
Spring	1	1.58	1.15	1.06	1.05	1.13	0.96	0.87	1.28	1.96	1.19	1.68	1.9	1.89	1.45	1.6	1.14
Summer	0.96	1.23	0.84	1.07	1.02	0.72	1.02	1.11	1.18	1	1.23	1.47	1.4	1.33	1.26	0.99	1.05
Autumn	1.06	1.12	0.82	1	0.97	1	0.96	1.03	1.05	0.87	0.94	0.91	1.05	1.01	0.94	0.73	0.88
Winter	0.99	0.92	0.92	0.64	0.66	0.59	0.95	0.7	0.75	0.72	0.64	0.74	0.87	1.07	0.94	0.97	0.57

4.1.3 Water Resources

377. Mengding town is rich in water resources, with the river flow of 218 cubic meters per second. There is a total of 3.843 billion cubic meters of water resources available in Mengding, of which 648 million cubic meters of groundwater, surface water volume 1.891 billion cubic meters, there are 2 reservoirs (Mount Clam small type reservoir and dry local dam small Type II reservoir).

River System

378. There are 15 rivers flowing in Mengding Town, including 14 primary tributary (Nanting River, Gulao River, Nanzhuang River, Nanwang River, Nanwen River, Heling River, Nandi River, Nangun River, Nanwa River, Moya River, Xiaohei River, Nanpeng River, Nanpa River and Qingshuihe River) and 1 secondary tributary with the total cross-boundary flow of 218m^3/s. Nanting River, the main river, belongs to the primary tributary of Nujiang River system. The ravine streams on both sides are flowing into Nanting River in dendritic shape from mountainous area through basin.

379. Within the scope of the project planning area and the surrounding water resources are rich, the area has the Qingshuihe River, the South Pareto River, the south has the Lincang inside the larger river system South Ting Rivers. The main river is the South Ting River, which belongs to the tributaries of the Nujiang water system, and the Gou on both sides, are branched from the mountain Basin to the South Ting River.

380. The Guomen Second Primary School of Cangyuan Va Autonomous County (located in Cangyuan Va Autonomous County) and China-Myanmar Friendship Hospital of Zhenkang County (located in the north of Zhenkang County Planning District), the remaining subprojects are located in the Qingshuihe River Port Area, Mengding Town. The main surface water bodies in the area are Qingshuihe River and Nanting River.

Qingshuihe River Area

381. There are 15 rivers flowing in Mengding Town, including 14 primary tributary (Nanting River, Gulao River, Nanzhuang River, Nanwang River, Nanwen River, Heling River, Nandi River, Nangun River, Nanwa River, Moya River, Xiaohei River, Nanpeng River, Nanpa River and Qingshuihe River) and 1 secondary tributary with the total cross-boundary flow of 218 m^3/s. Nanting River, the main river, belongs to the primary tributary of Nujiang River system. The ravine streams on both sides are flowing into Nanting River in dendritic shape from mountainous area through the basin.

382. Nanting River: belonging to the primary tributary of Nujiang River system, it originates from Liang Mountain (altitude: 2480m) in southwest Yongquan Village, Boshang Town, Linxiang District. The river flows across 6 counties from east to west and flows out of the area from Qingshuihe River Port of Mengding Town, Gengma County. It is the largest international river in Lincang. Its main stream within the border possesses the total length of 264 km, total drop of 2090 m, annual average flow rate of 353 m^3/s, drainage area of 8097 square kilometers, 8 imported tributaries, annual total runoff volume of 731,800 m^3 and annual sediment discharge of 586,000 m^3.

383. Qingshuihe River: belonging to Nujiang River drainage basin, Qingshuihe River is a primary tributary of Nanting River on the right bank of downstream and originates from Gonglaoshu Shan of southeast Sandui Shan of Myanmar. The drainage basin of Qingshuihe River covers China and Myanmar. Within China, it involves 4 administrative villages in Mengding Town, Gengma County, Lincang City with the catchment area of 77.8 km^2 (0.9 km^2 catchment area in Myanmar), river length of 20km, river fall of 1360m, average gradient of 43.0% and drainage density of 0.77.

Cangyuan County

384. Cangyuan County is rich in water resources. There are 84 large and small rivers across the entire territory. The total amount of water resources is 4.35 billion m^3, and the theoretical reserve of hydroenergy is 317,000 kilowatts and can be developed and used for 180,000 kilowatts. The large rivers in the territory include Nangun River, Xinya River, Nanban River, Xiaohei River, Dangpa River, Lameng River, Hemeng River, Mengdong River and Yong'an River, which belong to the Nu River and the Salween River systems respectively. There are seven rivers with a runoff area of more than 100 square kilometers.

385. The Mengdong River is the secondary tributary of the Lancang River system. It originates from the Yangbaiyakou belt along the China-Myanmar border. It runs from south to north and extends from the southwest to the northeast. The river is 8 to 14 meters wide. The rivers are gentle, and the flow changes obviously along with the rainy season. The total length is 38km. It is the main surface water system in the eastern part of Cangyuan, with the development of the upstream secondary deep valley. The water system is distributed in dendrites centered on the Cangyuan County. The main tributaries include Muchang River, Nuozhang River, Kongjiao River, Minliang River and Menglai River. The total runoff area is 455.65 km^2.

Zhenkang County

386. The most recent surface water in the project area is the Nanpeng River, which is about 3.0 km away from the north of the project. Nanpeng River is the largest tributary of the Nanting River system in the Nu River basin. The river valley is narrow, and the river fall is concentrated. The river channel is 98.3 km long. The nature fall is 1169 m, the average slope of the main channel is 1.32%, the drainage area is 2368.8 km^2, the average annual rainfall is 1514.5mm, the total annual rainfall is 3.59 billion m^3 and the annual runoff is 19.8m^3.

4.1.4 Seismicity

387. According to China's seismic parameters zoning map, GB18306-2015, the proposed seismic fortification intensity is 8, and the design of the basic seismic acceleration value is 0.30g. The proposed site category for the Ⅱ category, according to China's seismic parameters Zoning map "GB18306-2015", the seismic response spectrum characteristics of the periodic value of 0.45s. The site soil type is medium soft soil, the site soil category is the Ⅱ class ground.

4.1.5 Landform and Physiognomy

Master Plan

388. Construction site and location project is located in the Mengding Qingshuihe River port Economic Zone, located in the east south of the new frontier. The current situation is mainly land

and small fields, a residential area, the status of the current port areas, including the frontier inspection and quarantine of the river and the armed police, customs and other border departments, as well as relying on the development of port to form part of the current construction of concentrated areas for commercial and logistics, service rooms, residential land.

389. Project construction area and land ownership land nature for urban construction sites, project land of 320.44 acres, has been hoarded. In line with the national policy for land supply, in line with the Mengding Town Qingshuihe Port construction master plan, in line with the new round of land use overall planning and construction site layout. **Figure 4.2** depicts the project area in the master plan area of LBECZ.

General master plan layout principles

- From the perspective of harmonious coexistence between human and environment, fully consider the rational layout of the function in the land, the scientific and reasonable organization of traffic, the natural and human nature of the environment.
- Combined with the conditions of land use and surrounding environment, to create a reasonable and comfortable environment, fully embodies the harmony between the building and environment design principles.
- Make full and reasonable use of land, environment and established infrastructure and municipal facilities to conserve land.
- Conforms to the Mengding main urban area and the Qingshuihe port Economic Zone City overall plan request.

390. Conditions of public facilities

- **Traffic**: The project construction site is located in the Mengding Qingshuihe River port, located in the new country on the south side of the east, the current entry into the town only a two-way two lanes 12 meters wide two-meter road, freight and passenger transport through the road between Burma, into the Mengding Town area.
- **Water supply**: The project's water supply can be connected to the city's existing facilities, water, water quality can guarantee the water demand of this project.
- **Power supply**: The project's water supply can be connected to the city power supply system, improve the appropriate facilities to ensure electricity.
- **Communications**: The broadband, wireless communications are within the scope of telecommunications coverage, can fully meet the project requirements.
- **land** expropriation and demolition conditions: The project construction land, currently an open space, does not need demolition. This plot conforms to the National land use request, conforms to the Mengding town land use. The construction plan, the perimeter boundary is clear and undisputed. The site does not have the tomb relic, or any critical pipeline facility. The land requisition condition is good.
- **Construction site** is located in the Mengding town Qingshuihe Port: The construction site is relatively independent, can organize the closed construction and will not cause threat to surrounding community’s residents and the environment impact will not be incontrollable. Construction water use can be connected to the nearest, waste water after treatment and the waste water can be discharged to the nearest county government drainage system.

- **Site evaluation**: the project site is in line with urban planning requirements, meets project location conditions, sets up convenient transportation and livelihoods and sustains border trade.

4.2 Ecological environment (Terrestrial and Aquatic)

4.2.1 Biological Resources of Lincang

391. According to the data from Lincang Prefecture Forestry Bureau, the area of forests is 1,405 thousand hectares, accounting for 59.31% of the area of land territory. In addition to 197 thousand hectares of timber land in agriculture fields, the coverage reaches 67.8% to the total area of land territory. Of them, the area of non-commercial forest (NCF) is 475 thousand hectares (33.8 % of the total area of forests), including 348.9 thousand hectares of national level, 120.6 of provincial level and 5.12 hectares of county level.

392. The wildlife resources are abundant in Lincang. It is one of the most biologically diverse regions in China. The main vegetation communities include: tropical rain forest, tropical monsoon rain forest, evergreen broad-leaved forest, evergreen broadleaf mixed forest, evergreen broadleaf deciduous mixed forest, warm thermal coniferous forest, Yunnan hemlock forest and other vegetation types. A total of more than 4200 kinds of advanced plants (bryophyte, fern, and seed plants) is recorded. Of them, 32 plant species are included in the national protected wild fauna list. *Taxus yunnanensis, Alcimandra cathcardii, Cycas balansae*, and *Eleutharrhena macrocarpa* are the Grade I of national protected wild fauna. 28 wild plants are the Grade II, such as *Cibotium barometz* and *Alsophila spinulosa*.

393. There are more than 740 species of wild animals recorded within the scope of Lincang Prefecture, including 121 species of mammals, 413 species of birds, 55 species of reptiles, 35 species of amphibians and 85 species of fishes. Among them, 100 species are included in the national protected wild animal list. 21 wild animals are listed as the Grade I of national protected animals, such as Indochinese tiger, Asian elephant, Black gibbons, Green peacock, and 74 wild animals are listed as the Grade II, such as Macaques, Sambar and Silver pheasant. In addition, five animal species are included in the provincial protected animal list, such as Tufted deer, Wolf etc.

4.2.1.1 Nangun National Nature Reserve

394. According to the Scientific Survey Report of Nangun River National Nature Reserve (**NNR**) (2015), a total of 6 orders, 10 families, 30 genus and 45 fish species were recorded. There is no fish species under the national protected fishes list, China Red List[27] of endangered animals, and the list of CITES appendix. Only *Anguilla nebulosa* is under the protected fish of Yunnan Province. Large economic fishes are scarce, which only include *Anguilla nebulosa* and *Bagarius yarrelli*. B. *yarrelli* was recently recorded in 2003. A. *nebulosa* is an occasional species in the reserve, which mainly

[27] The evaluation criteria of China Red List is quite similar with that of IUCN Redlist. The difference is the scale of the evaluation. China Red List mainly focuses on the threatened status within the scope of China, rather than in the global scale as the IUCN Red List. Generally, the category of most species are the same in both Red Lists. In China, only the species under the national protection list can recieve higher legal protection.

distributed in the main stream and tributaries of the lower reaches of Nu River. This fish has the migratory habit from India Sea. There are many small and medium economic fishes, including *Neolissochilus baoshanensis*, *Scaphiodonichthys acanthopterus*, *Clarias fuscus*, *Monopterus albus*, *Channa gachua* and *Mastacembelus armatus*. Meanwhile, four alien fish species are discovered including *Pseudorasbora parva*, *Abbottina rivularis*, *Rhodeus ocellatus* and *Gambusia affinis*, which had the negative impact on the native fish species.

4.2.1.2 Nanting River

395. According to Comprehensive Planning Report of National Aquatic Germplasm Reserve (**NAGR**) in the lower reaches of Nanting River (2013-2033), a total of 5 orders, 9 families and 48 fish species were recorded. The main conservation targets include *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis*. The fish composition is quite similar with that in Lancang River. The dominant fish species belong to Siluriforms, Cobitidae and Barbinae. The majority of fishes in Nanting River are adapted to the torrent, which are benthic and omnivorous fishes except for *Channa gachua*, *Bagarius yarrelli* and *Anguilla nebulosa*.

396. The integrated biodiversity Assessment Tool (IBAT) was accessed to determine the category of documented flora and fauna affecting the project. The description of the Nanting River area and Nangunhe national reserve are attached in **Annexure 9**.

4.2.2 Non-commercial Forests

397. The national non-commercial forest (**NCF**) is only distributed in the project area of Lincang Border Economic Cooperation Zone (LBECZ) in Qingshuihe Border Area. The Zhengkang Sino-Myanmar Hospital is located in the grassland with partial farmland, and Cangyuan Guomen No. 2 Elementary School is located in the waste land of Baitai community of Cangyuan County.

398. In Qingshuihe Border Area, the national non-commercial forests are mainly distributed in the area of New Guomen, and both banks of Nanting River (**Figure 4.8**). The proposed roads closed to the New Guomen would occupy part of national NCF, which is mainly composed of rubber plantation. The proposed Nanting Bridge also occupies part of national NCF, which is mainly composed of the rubber plantation and teak (*Tectona grandis*) plantation. However, the NCF here is not the natural forest, which provides the low conservation values for biodiversity protection.

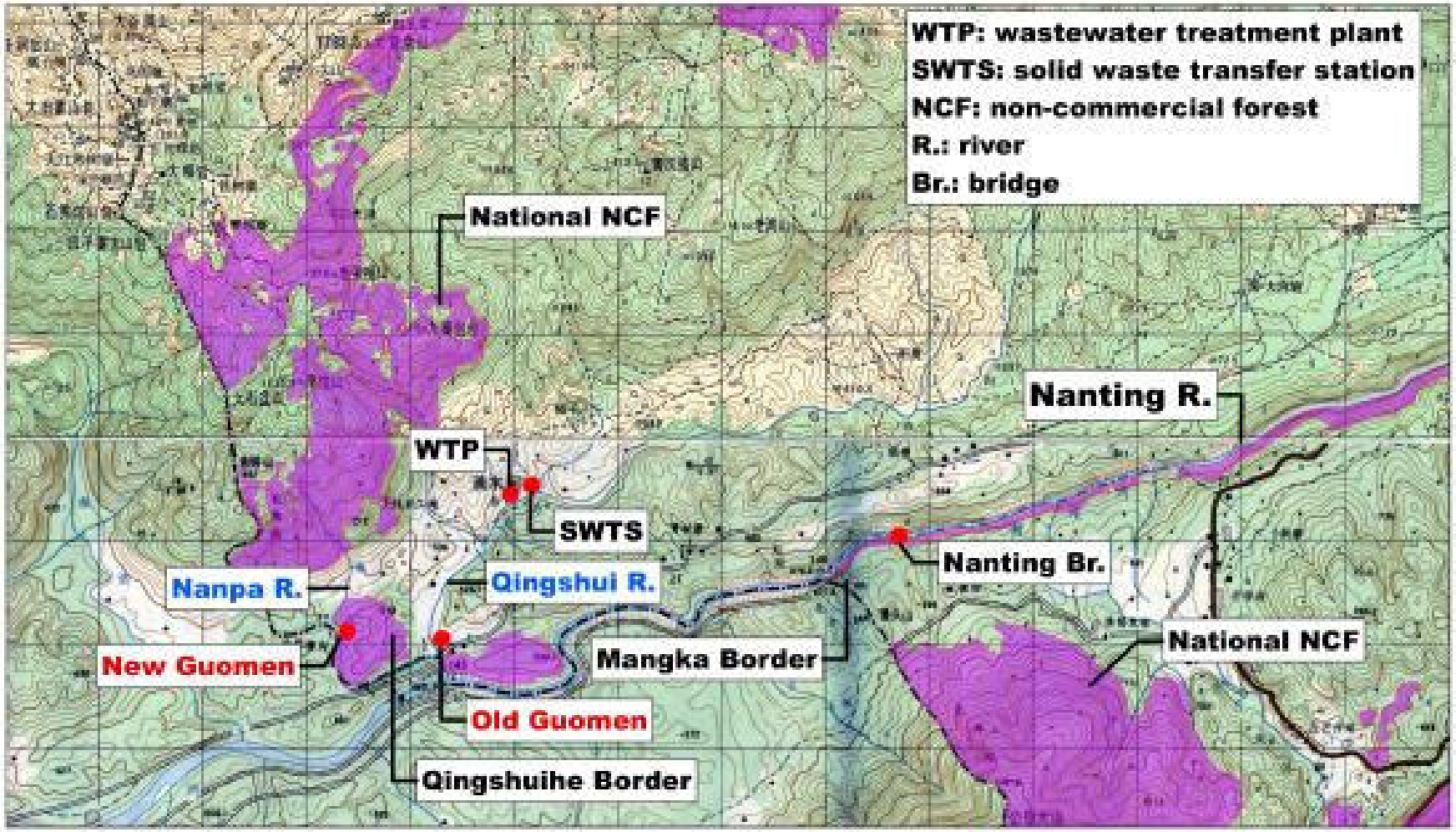


Figure 4.8: Distribution of national non-commercial forests in Qingshuihe Border Area (Source: Lincang Forestry Bureau)

4.2.3 Protection Areas

399. A total of six protection areas were established in Lincang Prefecture, such as Nangun River NNR, Daxueshan NNR, NAGR in lower reaches of Nanting RIver, NAGR in Nanpeng River, Nanpeng River Provincial Nature Reserve (PNR) and Lancang River PNR. The proposed project area is out of these protected areas (**Figure 4.9**). The basic information and spatial relationship of proposed project areas are concluded in **Table 4.6**. All of these reserves are located outside 6 kilometers radius from each sub-project site.

400. Nangun River NNR was established in 1995 and expanded in 2003, which covers 27,649.5 ha in Cangyuan County and 23,237.5 in Gengma County. The total area is 50,887 hectares, including 19,923 ha core zone, 17,335.1 ha buffer zone and 13,628.9 ha experimental zone. The reserve is the second largest distribution range of Asian elephant (*Elephas maximus*) and Indochinese tiger (*Panthera tigris*) in China after Xishuangbannan of Yunnan Province. There are 11 orders, 20 families, 87 genus and 111 mammal species, and 14 order, 36 families and 147 bird species.

401. Daxueshan NNR was established in 2006, which is located in the eastern Yongde County. The total area is 17,541 ha, including 9,276 ha core zone, 3,291 buffer zone and 4,974 ha experimental zone. The main conservation objectives include south Asian tropical mountain ecosystem represented by zhongshan moist evergreen broad-leaved forest, and 64 rare and endemic plant and animal species represented by Hog deer (*Axis porcinus*), Black gibbons (*Nomascus concolor*) (western yunnan subspecies), green peacock (*Pavo muticus*), Chinese yew (*Taxus yunnanensis*), *Alcimandra cathcartii*, etc.

402. NAGR of *Barbodes huangchuchieni* of Nanpeng River was established in 2007, which is located in Zhenkang County. The total area is 750 hectares, including 350 ha core zone and 400 ha experimental zone. Special protection period in core zone is from February 1 to next July 31, in order to protect the copulation and spawn stage of *Barbodes huangchuchieni*. The total length is 30 km including 14 km core zone and 16 km experimental zone. The main conservation objectives include *Barbodes huangchuchieni, Bagarius yarrelli*, *Mastacembelus armatus*, *Anguilla nebulosa*, Eurasian River otter (*Lutra lutra*).

403. NAGR in the lower reaches of Nanting River was established in 2013, which is located in Yongde and Gengma Counties. The total length is 150 km including the main stream and tributaries of Nanting River. The total area is 2200 hectares, including 1200 ha core zone and 1000 ha experimental zone. Special protection period is from March 1 to May 30. The main conservation objectives include *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis*. The proposed Nanting Bridge will be constructed in the down reach of the reserve approximately 6.8 kilometer (**Figure 4.10**).

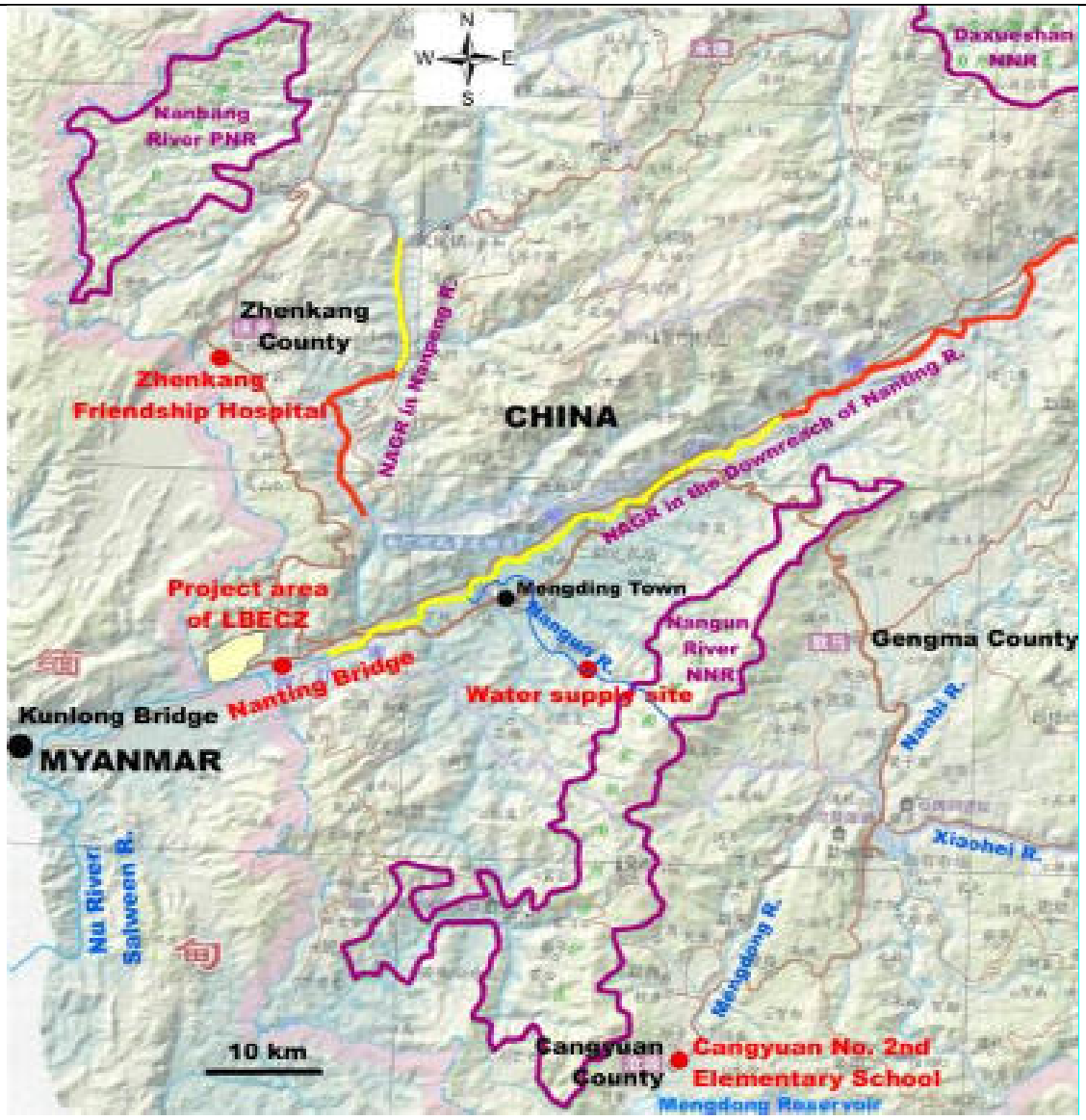


Figure 4.9: Locations of proposed project areas (red characters) and surrounding protection areas (purple characters and polygons) (Source: NAGR in lower reach of Nanting River)

404. Nanpeng River PNR was established in 1999, which is located in Zhenkang and Yongde Counties. This is a forest ecological type reserve in China. It aims to protect sub-tropical monsoon evergreen broadleaf forest, sub-mountain damp evergreen broadleaf forest, and rare and endangered wildlife. The reserve consists of four sections: Zhuwa, Mangbinghouqing, Bodaoshan and Xuezhulin Mountain. 42 animal species and 42 plant species are included in the national protection list. 13 plant species belong to the provincial protection list. A total of 1546 species of wild seed plants were recorded, belonging to 660 genera of 155 families. In the reserve, 3 families are endemic to East Asia, and 6 genera and 451 species are endemic to China. The endemic plant species are higher than the other provincial and national nature reserves in this region, such as Nangun River NNR (Zhang et al., 2010).

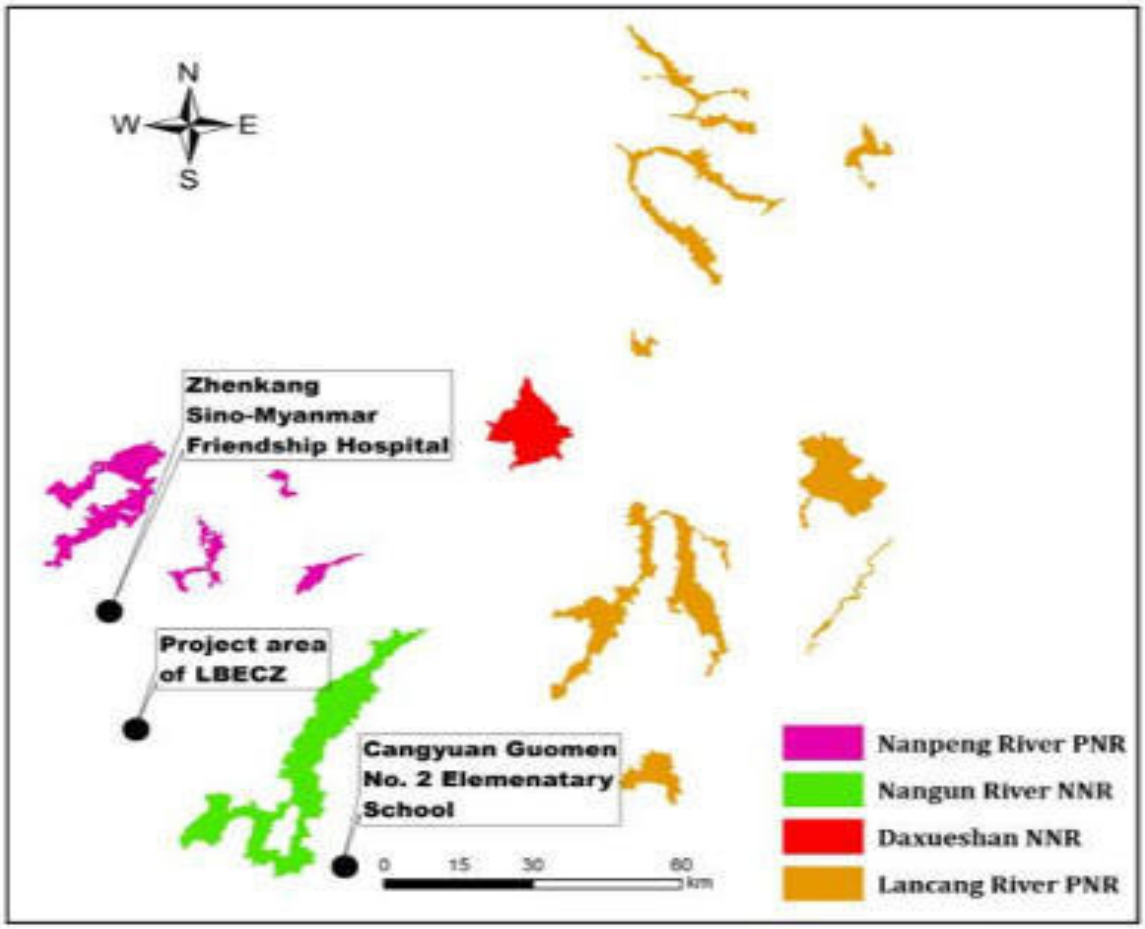


Figure 4.10: Spatial distribution of Nanpeng River PNR, Nangun River NNR, Daxueshan NNR and Lancang River PNR, and the project areas of LBECZ, Zhenkang hospital and Cangyuan elementary school (Source: Lincang Forestry Bureau)

405. Lancang River PNR was established in 1999, which was combined from 5 nature reserves at county/district level including Linxiang District, Fengqing County, Yun County, Shuangjiang County and Gengma County. The total area is 89,504 hectares. It is a forest ecological type reserve in China. There are 136 families, 428 genus and 1051 seed plant species, and 39 orders, 123 families and 742 vertebrate species. The main purpose is to conserve the evergreen broad-leaved forest and the monsoon evergreen broad-leaved forest ecosystems, rare and endangered wildlife such as West Black gibbons (Nomascus concolor) and *Alcimandra cathcartii*, and the wild ancient tea tree community.

Table 4.6: Basic information of six Protection Areas in Lincang Prefecture

Name	Coordinates	Area (ha)	Conservation objectives	Nearest project name	Direct distance (km)
Nanguan River NNR	98°57′32″ ～ 99°26′00″E , 23°09′12″～23°40′08″N	50,887	Rare and endangered wildlife, and their habitats	Water supply location for Qingshuihe Border Area; Cangyuan Guomeng No. 2 Elementary School	7.4 km；7km
Daxueshan NNR	99°41′12″ ～ 98°56′51″E , 24°0′59″～23°30′41″N	17,541	South Asian tropical mountain ecosystem, and rare and endangered wildlife	Project area in Qingshuihe Border Area	>100 km
NAGR of Nanpeng River	98°55′41″～98°59′26″E, 23°37′53″～23°51′47″N	750	*Barbodes huangchuchieni, Bagarius yarrelli*, *Mastacembelus armatus* , *Anguilla nebulosa*, Eurasian River otter, etc.	Banxing Tunnel; Nanting River stream	15 km;8.5 km
NAGR in the lower reaches of Nanting River	99°41′12″ ～ 98°56′51″E , 24°0′59″～23°30′41″N	2,200	*Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis*	Nanting Bridge	6.5 km
Nanpeng River PNR	98°41′ ～ 99°18′E, 23°45′～24°04′N	36,970	Sub-tropical monsoon evergreen broadleaf forest, sub-mountain damp evergreen broadleaf forest, and rare and endangered wildlife	Zhenkang Sino-Myanmar Friendship Hospital	20 km
Lancang River PNR	99°35′15″ ～ 100°09′30″E , 23°11′58″～23°48′50″N	89,504	The evergreen broad-leaved forest and the monsoon evergreen broad-leaved forest ecosystems, rare and endangered wildlife such as West Black gibbons (Nomascus concolor) and *Alcimandra cathcartii*, and the wild ancient tea tree community.	Cangyuan Guomeng No. 2 Elementary School	> 40 km

4.3 Land use Assessment in Project Area

406. The Project is located at Qingshuihe River in Mengding Town, Gengma Dai and Va Autonomous County, Lincang City, Yunnan Province. According to the survey of land use current status of the Project, the total floor area of the Project is 137.84 hm^2 and the main types of land occupation are rubber forest, wasteland, transportation land, etc., where the rubber forest 1s the principal occupation. **Table 4.7** provides the land use status details.

Table 4.7: Land Use status

No	Area	Total Land area	Arable Land	Wood Land area	Garden Area	Water Area	Unused Land	Other Land area
1	Gengma County Area	3,727.23 km^2	42,037 hm^2	212,657 hm^2	9,669 hm^2	3,545 hm^2	6,906 hm^2	7909 hm^2
2	Mengding Town Land area	1,005.87 km^2	22,902.19 hm^2	53,072.77 hm^2	13,315.53 hm^2, Farmland-7,060.89 hm^2		2,447.63 hm^2	Construction land 1,787.99 hm^2
3	Qingshuihe River Committee land area	9.00 km^2		735 hm^2	Cultivated land-108 hm^2			57 hm^2
4	Total Project Area	58.62 hm^2		52.05 hm^2			6.57 hm^2	

407. The present construction scale of Qingshuihe River town is 0.61 km^2. The population of the township is 3000 persons; the percentage of proportion of foreign population is also less.

408. The area has good vegetation and Qingshuihe River, an important river in Yunnan Province flows through the watershed. The current situation is that the area is mainly land and small fields, and residential area. This area includes economic port areas, including the frontier inspection and quarantine of the river and the armed police, customs and other border departments, commercial and logistics, service rooms, and residential land.

Table 4.8: Land Use of LBECZ Area

Land Type		Land Area used in LBECZ in Ha
Agricultural Land	Arable Land	220.1075
	Garden Plot	2,460.6107
	Woodland	674.6035
	Grassland	1.6822
	Others	0.6531
	Total	3,357.6570
Developed Land	Urban & Rural Construction Land	95.1397
	Land Used for Transportation & Conservancy	72.2387
	Others	45.3657
	Total	212.7441
Land Resource Unexploited	Non-developed/identified land resources	3.0947
Total Area		3,573.4958

Source: FSR 2018

4.4 Social Environment

4.4.1 Population

409. Mengding, known as the golden port is a hub connecting Southeast Asia and South Asia, Mengding Qingshuihe Port, has foreign trade volume of nearly 1 billion yuan. The total land area of 1005.87 square kilometers, of which dam area is 100 square kilometers and 34.35 million mu of arable land. Whole town administers 23 villagers committees and 277 villagers groups.

410. Mengding Town has about 100,000 people (excluding farms), of which about 78,000 of the agricultural population, inhabited by the Dai, Han, WA, Jingpo, Deang and other 23 nationalities, ethnic minorities accounted for about 57% of the total population.

411. The town of Dai, Han, Wa, Jingpo, De Ang and other 23 ethnic groups, 50,947 ethnic minorities, accounting for 63% of the total population. Among them, there are 27,717 Dai people, accounting for 34.2% of the total population; 10814 Wa people, accounting for 13.4% of the total population; Deyang 1071 people, accounting for 1.3% of the total population; Jingpo 502, accounting for 0.6% of the total population.

412. According to 2016 National Bureau of Statistics[28], China has an estimated population of 1,339,720,000 inhabitants. Approximately 47,368,000 reside in Yunnan. Over the course of five years (2011-2016), Yunnan's population increased by 1.4 million, with growth occurring mainly in urban areas. According to the provincial census, the ratio of men to women is 51.5:48.5.

413. Age distribution in Yunnan is highlighted below:

- People with 0-14 years of age equal 8.427 million.
- People with 15-64 years of age equal 34.792 million.
- People 65 plus years of age equal 4.149 million.

414. The total number of urban dwelling residents is 20.397 million. The total number of rural residents is 26.971 million.

415. Yunnan is the most ethnically diverse region in China. Ethnic minorities make up 33.6 percent of the province's total population:

- Yi population: 5.02 million (11 percent of provincial total)
- Hani population: 1.63 million (3.55 percent of provincial total)
- Bai population: 1.56 million (3.4 percent of provincial total)
- Dai population: 1.22 million (2.66 percent of provincial total)
- Zhuang population: 1.21 million (2.64 percent of provincial total)
- Miao population: 1.2 million (2.62 percent of provincial total)

[28] National Bureau of Statistics of China. 2016. http://www.stats.gov.cn/english/

416. Yunnan Province is situated in the far southwest corner of the People's Republic of China (PRC). It shares borders with the Lao PDR, Myanmar and Viet Nam. Yunnan is one of the poorest provinces in the PRC, with a per capita gross domestic product of 52% of the national average in 2009. A poverty incidence rate is almost four times the national average.[29]

4.4.2 Migrant laborers

417. Immigration personnel, 2010 entry and exit personnel 231,139 people, to 2013 to 443,146 people, an average annual growth rate of about 17.6%, is expected to 2030 entry and exit staff of 5,987,441 people.

4.5 Economic Development

4.5.1 Economic mineral deposits

418. Mengding possesses abundant mineral resources, including nonferrous metals, like gold, silver, copper and iron and nonmetallic minerals, like silica, limestone and sulphur mine.

419. Mengding has a total distribution of iron, copper, gold, lead and zinc ore, marble and other mineral deposits, including marble, brown net, white marble, Beige series, Anna, wood grain stone, stalactites. The mineral resources up to 1.3 billion cubic meters are found in China and even Asia's first marble Beige series products are sourced from here.

4.5.2 Import Export Trade

420. The main export goods for the Qingshuihe port are steel products (wire, nails, galvanized sheet, etc.), beer, monosodium glutamate, liquefied petroleum gas, etc., of which the iron and steel products export the largest value; The main imported goods are sugarcane, natural oak, Gum, corn, sesame, mung bean, etc.

421. Import and export goods in 2010 stood at 89,249 tons, between 2013 to 210,295 tons, an average annual growth rate of about 23.89%, is expected to 2030 entry and exit cargo of 6,482,442 tons. The recent (2020) import and export cargo 760,619 tons, planning forecast of about 800,000 tons. Forward (2030) Import and export goods 6,482,332 tons, planning forecast of about 6 million tons.

4.5.3 Agriculture

422. Mengding abounds in top-grade rice, soybeans, rubbers, peppers, coffee, watermelons and aquatic products. It enjoys wide varieties of tropical rare plants represented by T*ectona grandis, Mesua ferrea* and *Ochroma lagopus* and it is also the main producing areas of rubber in Yunnan Province and vegetables, melons and fruit and commodity grain base.

423. Area is also rich in teak, iron wood, light wood as a representative of the tropical rare plant varieties, is the main rubber-producing area in Yunnan province.

[29] Asian Development Bank. 2011. *Empowering Women through Rural Infrastructure*. Available online at https://www.adb.org/sites/default/files/publication/29263/empowering-women-rural-infrastructure.pdf

4.5.4. Socio- economic status of the community

424. This project is located in Gengma County Mengding town that consists of Gengma County Township (town), two farm management committees, 1 overseas Chinese admin zone, 82 Village committees and 4 communities, of which, Mengding is a sub-county town and national class-I opening up port. Based on the Gengma County 2016 Annual Statistical Yearbook and other socio-economic data, socio-economc profile of Gengma County, Mengding town and Qingshuihe village are summarised in **Table 4.9**.

Table 4.9: 2016 Socio-Economic Profile of the Project Area

Administrative Zoning	Total area (Km^2)	Arable land (mu)	Total population (CNY10,000)	Agriculture population (CNY 10,000)	Gross agricultural production (CNY 10,000)	Rural per capita arable land (mu)	Rural per capita net income (CNY yuan)
Gengma County	3727.23	630 555	29.63	25.19	233 436	2.51	9267
Mengding Town	1005.87	343,532.85	9.55	7.0	34027	4.91	4861
Qingshuihe Village	9.00	1620.00	0.21	0.21	3182	0.77	7753

Source: Water and Soil Loss report 2018

425. Mengding town to achieve a total production value of 1.798 billion yuan, rural economic total income of 1.338 billion yuan, industrial output value of 894 million yuan, township enterprises Total income of 920 million yuan for the area.

426. In the Mengding Area, fixed assets investment of 7.489 billion yuan, social consumer goods retail total 1.05 billion yuan, urban resident's per capita disposable income of 22212 yuan, farmers per capita net income of 7726 yuan. In 2015, Mengding town completed the production value of 2.488 billion yuan, rural economic total income of 2.126 billion yuan, industrial output value of 1.155 billion yuan, township enterprises; a total income of 1.216 billion yuan, the total retail sales of consumer goods 1.696 billion yuan, resident urban residents per capita disposable income of 30296 yuan, Resident rural residents per capita disposable income stood at 11658 yuan.

Income generation sources

427. In 2013, Mengding Township of rural economic total income of 13.38 Meng Ding town billion, grain planting area of 190,000 mu, grain production reached 30,900 tons. The rubber industry base of 489,000 acres, cutting area of 178,000 acres, daily 5 to 10 tons of production capacity of the plastic label with annual output of 18,700 tons of dry plastic.

428. There are more than 55,000 acres of banana base, the output value of more than 570 million yuan, the characteristics of fruit and vegetable area of 96,000 mu, annual output of more than 100,000 tons, walnut 129,700 mu, bamboo 12,900 mu, sugarcane 45,000 mu, coffee 40,000 mu, green jujube, fruit, carambola, dragon fruits and grapes and other subtropical fruits.

429. A total of 30 rural professional cooperatives, 4 professional and technical association, Mengding Town and a planting base of 300 acres completed the total rural economic income of 2.126 billion yuan.

Rural Industry

430. In 2013, Mengding town will achieve an industrial value of 308 million yuan, industrial output of 894 million yuan agricultural products processing, township Enterprises Total income of 920 million yuan. In 2015, Mengding Town Industrial output value of 1.155 billion yuan, township enterprises total income stood at 1.216 billion yuan.

4.6 Key Health Issues

431. Yunnan province is one of the last remaining areas of People's Republic of China (PRC) with local malaria transmission.[30,31] Yunnan records consistent malaria outbreaks and epidemics.[32,33] Based on national network surveillance data, malaria cases in Yunnan Province accounted for 31.4, 14.0 and 17.3% of the overall cases in 2012, 2013 and 2014 respectively. In 2012, Yunnan's malaria incidence rate was 1.79/10^5 in 2012.[34] Reasons for malaria epidemics in Yunnan Province may include its tropical and subtropical climate, especially in valleys[35,36], and social factors such as the international movement of individuals. In 2010, PRC launched an action plan with the goal of malaria elimination by 2020.[37] Intensive malaria control interventions over the last decade have reduced the prevalence of malaria by 95% in border counties of Yunnan Province.[38,39,40] A recent

[30] http://www.wpro.who.int/china/mediacentre/factsheets/malaria/en/

[31] Zhou S, Li ZJ, Cotter C, Zheng CJ, Zhang Q, Li HZ, et al. Trends of imported malaria in China 2010–2014: analysis of surveillance data. Malar J. 2016;15:39.

[32] Xu J, Liu H. 2012. The challenges of malaria elimination in Yunnan Province, People's Republic of China. Southeast Asian J Trop Med Public Health; 43:819–24.

[33] Xia ZG, Zhang L *et al*. 2014. Lessons from malaria control to elimination: case study in Hainan and Yunnan provinces. Adv Parasitol; 86:47–79.

[34] Yang D, Xu C *et al*. 2017. Spatiotemporal epidemic characteristics and risk factor analysis of malaria in Yunnan Province, China. *BMC Public Health*; 17(1):1-10

[35] Na-Bangchang K, Congpuong K. 2007. Current malaria status and distribution of drug resistance in East and Southeast Asia with special focus to Thailand. *Tohoku J Exp Med*; 211:99–113.

[36] Clements ACA, Barnett AG *et al*. 2009. Space-time variation of malaria incidence in Yunnan province, China. *Malaria Journal;* 8:180

[37] Ministry of Health, People's Republic of China. Malaria elimination action plan 2010–2020 (in Chinese). Beijing: The Ministry; 2010. accessed Jun 25, 2011.

[38] Xia ZG, Feng J, Zhou SS. Malaria situation in the People's Republic of China in 2012 (in Chinese). Chin J Parasitol Parasit Dis. 2013, 31413–418.

[39] Wang RB, Zhang J, Zhang QF. Malaria baseline survey in four special regions of northern Myanmar near China: a cross-sectional study. Malaria Journal. 2014;13:302.

[40] China Office for the tenth Global Fund to fight Malaria: Impact Evaluation of Malaria Control across Chinese-Myanmar Border (in Chinese). Dissemination workshop of China's tenth Global Fund to fight Malaria. Puer, Mar 31, 2014. The Office; 2014.

study showed that in these border counties 85% of malaria cases were imported, and most were transmitted by mobile and migrant populations (MMPs) with apparent infection origin in Myanmar. Malaria cases imported from Myanmar, from the continuous influx of migrants from Myanmar as well as Chinese migrant workers returning from abroad, are a key obstacle for malaria elimination in PRC.[41,42]

432. Other vector-borne and communicable diseases are also important in the project area. These include but are not limited to japanese encephalitis, dengue fever, polio, and sexually transmitted infections.

433. Yunnan is situated along a main drug trafficking route, moving heroin into China from Southeast Asia's opium-producing "Golden Triangle" region.[43] Since the first HIV epidemic in China was identified among people who inject drugs in Yunnan in 1989, Yunnan has been an important HIV area in China.[44] With regards to HIV, while the national HIV prevalence remains low, some provinces, including Yunnan, continue to show a high prevalence, especially among some population groups.[45] In 2014, Yunnan province had 79,915 cases of people living with HIV, ranking first in the country, with 9601 new cases of diagnosed between January and October of that year. 89.5% of such cases were sexually transmitted and there is an increasing trend in HIV incidence among young students, the elderly, men who have sex with men and migrants. Part of the challenge related to the high proportion of mobile populations and the continuous expansion of such populations. According to the Yunnan Provincial Health Planning Commission, the situation of HIV prevention and control in key municipalities and border areas remains sub-optimal.[46]

434. In 2011, national authorities established the 12th five-year National TB Control Programme. The implementation of the integrated control strategies has helped control the burden of PTB, however, a continuous increase of the PTB burden has been observed in Yunnan province.[47]

435. The Maternal Mortality Rate (MMR) in Yunnan is almost twice the national average of 56.2/100 000 live births.[48] In remote mountainous regions, the rate is five times higher.[49] The

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[41] Zhou G, Sun L, Xia R, Duan Y, Xu J, Yang H, et al. Clinical malaria along the China-Myanmar border, Yunnan Province, China, January 2011–August 2012. Emerg Infect Dis. 2014;20:675–8.

[42] Wangdi K, Gatton ML, Kelly GC, Clements A. Cross-border malaria: a major obstacle for malaria elimination. Adv Parasitol. 2015;89:79–107.

[43] Beyrer C, Razak MH *et al*. 2000. Overland heroin trafficking routes and HIV-1 spread in south and south-east Asia. *Aids*; 14(1):75–83

[44] Lu L, Jia M *et al*. 2008. The changing face of HIV in China. *Nature*; 455(7213):609–11.

[45] http://www.unaids.org/sites/default/files/country/documents/CHN_narrative_report_2015.pdf

[46] http://news.ifeng.com/a/20141124/42553464_0.shtml

[47] Huang et al. 2017. Spatial-temporal analysis of pulmonary tuberculosis in the northeast of the Yunnan province, People's Republic of China. *Infectious Diseases of Poverty*; 6:53

[48] Li C. 2001. Health care in rural China: current development and strategic planning. *Chinese Health Econ*; 20:11–13.

national rate of birth in hospitals in 2005 was 79%. In Yunnan, it was approximately 57%.[50] Geographic terrains, particularly in areas where ethnic minority nationalities reside, remain a challenge in reducing 'pregnancy-related deaths'. In remote mountainous regions, access to township level hospitals for delivery remains problematic.[51]

436. A recent study has identified that between 2004 and 2014, Yunnan Province had the highest rate of serious fatal – road traffic accidents (SF-RTAs) as compared to all other provinces in the PRC.[52] Local project area SF-RTA rates are unknown but given this project will increase traffic in the area, this is an important health consideration.

437. A standalone rapid health impact assessment (HIA) is currently being conducted at the project site level to identify social and community health baseline conditions. This information will be used to develop and implement a Public Health Management Plan (PHIA) that would aim to protect both community members and workers involved in this project alike.

4.7 Infrastructure facilities in Project Area

438. The Mengding area is building materials and transport conditions are favorable:

- Stone: Mengding has a number of stone fields to choose from, sufficient reserves of stone, convenient transportation.
- Sand: The area is very rich in sand, South Ting River, widely distributed in the Quaternary alluvial sand layer, its thickness is good, sand quality, and the distance is more than within 6 km.
- Cement: Lincang City has a Gengma County Cement Plant.
- Wood: The northeast Mengding Town has the lumber and the transportation distance is short.
- Water: The present situation of the built-up area of Qingshuihe River is water supply pipe network, the main river of the project area is the south, the South Pa and the Qingshuihe rivers, the water is rich, the project and the life water is not short.
- Power: At Qingshuihe built-up area, power supply is available through power grid.
- Transport conditions: The area is connected to China Myanmar Road, secondary roads and Linqing line and criss-cross rural roads, can use the original road transport.

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[50] Yunnan Provincial Bureau of Statistics, Office of Yunnan Provincial Maternal/Child Commission. 2002. Social Progress of Yunnan: Women and Children's Development in 1990s. Kunming, China: Yunnan Guohao Publishing Company.

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4.6.1 Assets and infrastructure

439. **Table 4.10** lists all existing assets and infrastructure located in vicinity of the sub-project area.

Table 4.10: Assets and Infrastructure within LBECZ area

Location	Assets and Infrastructure						
	Residential	Agriculture	Commercial centers	Industrial units	Schools	Hospitals & health centers	Religious places
International production cooperation area	0	0	0	0	0	0	0
Border resident trading market	0	0	0	0	0	0	0
Solid Waste transfer station	0	0	0	0	0	0	0
River rehabilitation project	0	0	0	0	0	0	0
Electrical charging station	One near the office building of LBECZ, another near the new gate	0	0	0	0	0	0
WTP	0	0	0	0	0	0	0
WWTP	0	0	0	0	0	0	0
Qingshuihe school	Within Qingshuihe village	0	1	0	Existed Qingshuihe school	Near Qingshuihe health canter	0
Qingshuihe hospital	0	0	0	0	0	0	0
Road #1	0	0	0	0	0	0	0
Road #2	0	0	0	0	0	0	0
Road #3	0	0	0	0	0	0	0
Road #4	0	0	0	0	0	0	0
Road #5	0	0	0	0	0	0	0
Road #6	0	0	0	0	0	0	0

Source: Social Assessment 2018

4.6.2 Road network

440. In Mengding area, apart from the main road, many roads are not paved and have no matching drainage system. The road network in the planned area has poor connectivity and road conditions. Due to lack of public green space and leisure space, the city lacks livability. Except one pedestrian zone square, the town is rarely open to the public leisure space.

441. The current port planning area adopts network and annular road network system, the whole road system is divided into four levels: Burma Avenue, Main trunk, Gan road, and slip road. Considering the limitation of land use conditions and the actual situation of traffic flow in the port planning area, the road red line in the port planning area is controlled by the 12~43m China-Myanmar Avenue. China-Myanmar Avenue is the main road linking the port and Myanmar, taking into account the size of the port and the traffic flow in the port area, the road red Line is 43m. The main road provides links between the areas within the organization area, considering the traffic flow

of the port, the main roads in the area have a ring-and-mesh layout structure, which is divided into Nancong and North Cond, which is divided into the East region and western, and the Gan Road Red Line is 24m. The Slip is mainly the road within the area, which mainly undertakes the transportation links among the functional areas. The branch line in the Port Planning area is 18m. The 12 m Road is mainly the road within the area, which mainly undertakes the transportation links among the functional areas. The road red line in the port Planning area is 12m.

Traffic Facilities Status

442. Zhen Qing (Gengma zhenxing Bridge to Qingshuihe) two-level road for the current access to the main channel of the Qingshuihe River area, mainly bear the demand for transit trucks, the west side of the route to China Mengding Qingshuihe River Port, East joint Mengding Meng Line, road subgrade width 12m, two-lane road, design speed 60km/h. The observed traffic volume over the years is shown in the following **Table 4.11**.

Table 4.11: Calendar year traffic unit: Car/Day

Year	Passenger	Bus	Minivan	Medium Goods Vehicle	Big Truck	Towed trailer	Absolute	Fold the Count
2012	5674	277	1079	7391	1566	1159	11096	17355
2013	5707	156	1210	1503	2495	150	11221	17441
2014	6785	232	1386	1144	3174	198	12919	20351
2015	8583	342	1656	1414	3413	418	15825	24365
2016	8814	312	1790	1565	3322	279	16082	24223

443. Entry-Exit modes of transport, 57,769 vehicles for entry and exit in 2010, up to 149,447 in 2013, an average annual growth of about 26.8%, and 6,693,551 vehicles for entry to 2030. In the near future (2020), 621,836 vehicles were planned to forecast 600,000 vehicles. In year 2030, planning forecast of about 6,693,551 vehicles.

4.6.3 Archaeologically important sites/Tourist Resources

444. Gengma County has Gengma South Ting River Provincial Scenic Area, Lancang River Basin Nature Reserve, Mengding Dam, Gandong Port, Gengma Total Buddhist temple, Jinggo White Pagoda etc.

445. Mengding Dam: Mengding Dam is an alluvial meander basin which has been eroded and piled up by the South Ting River since Fourth century, surrounded by hills, the south of the north from the northeast to the southwest and across the dam area. It is situated near Tropic of Cancer and has a typical subtropical monsoon climate with long sunshine and is perennially frost-free.

446. Gandong Port: The port is situated in Gengma County.

447. Buddhist Temple: the only total Buddhist temple preserved in this county, is the center of the Gengma Dai Buddhist activities in the past 200 years, and also the Holy Land of Buddhist believers both inside and outside the city. There are 130 monks residing there.

448. Jinggo White Pagoda: Founded in the Qing Dynasty Gianlong. The Gengma earthquake caused the Baita to destroy the upper part, leaving only the base, the Baita, which was rebuilt in 1992. The tower is hexagonal, symbolizing the height of the Buddha's main tower 30.3 m. The tower is surrounded by a cluster of six sides with two layers of shrines under the main tower.

449. The Qingshuihe port is more of a trading port and does not have any tourism or landscape resources for tourists sightseeing.

4.8 Baseline Data for Study Area

450. The baseline data collection for the trading port located at Lincang is divided into following sections:

- Physical Resources Assessment
    - Air, Water, Noise, Soil
- Hydrology Assessment
- Land use
    - GIS mapping
- Ecological
    - Terrestrial Habitats
    - River Habitats
    - Aquatic fauna

451. Among the subprojects of the Infrastructure Construction and Comprehensive Development Project of Yunnan Lincang Border Economic Cooperation Zone evaluated at this time, Guomen Second Primary School of Cangyuan Va Autonomous County is located in Cangyuan Va Autonomous County, China-Myanmar Friendship Hospital of Zhenkang County is located in the north of Zhenkang County Planning District, and the remaining subprojects are located in the Qingshuihe River Area.

452. ADB's SPS requires projects to apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group's Environmental, Health and Safety Guidelines (EHS).[53] The comparison of PRC Standards and World Bank EHS guidelines 2007 has been discussed in **Annexure 1B**. Similarly, if there no equivalent EHS standards[54], equivalent international standards must be followed

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

[54] Pollution Prevention: During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.[7] These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in this document.

[7] World Bank Group, 2007. Environmental, Health, and Safety General Guidelines. Washington, DC.

453. The current status of environmental quality in the project area and Qingshuihe River Area are monitored, and the other two project areas use existing monitoring data for evaluation. On May 24-30, 2017, the Employer entrusted Yunnan Haochen Environmental Protection Technology Co., Ltd. with the monitoring works for atmosphere, surface water and environmental noise in the project area.

454. Details of monitoring sites on the map are shown in **Figure 4.11**. Monitoring contents and results are as follows:

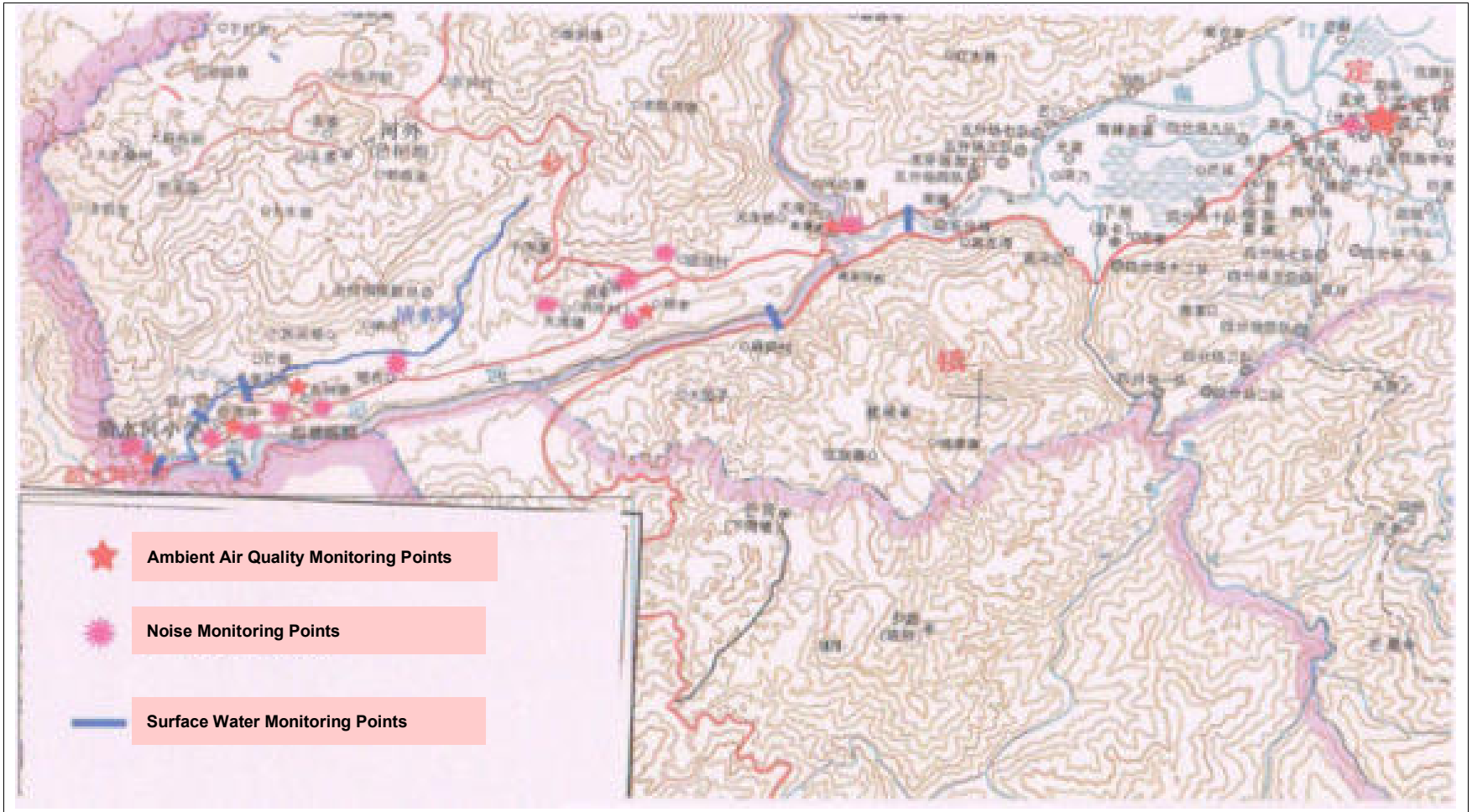


Figure 4.11: Baseline Monitoring site locations for EIA

Source: DEIA Report

4.7.1 Ambient Air quality Baseline

455. The concentration of TSP, PM_{10}, SO_2 and NO_x in assessment area must meet the requirements of Ambient Air Quality Standard (GB3095-2012) as shown in **Table 4.13**. The ambient Air quality Standards (GB3095) that conform to level two standards is listed below:

Table 4.13: Ambient air quality standards (mg/m³)

Pollutant Name		$S0_2$	TSP	NO_2	CO	PM_{10}	$PM_{2.5}$
Concentration limit	Average	0.06	0.20	0.04	—	0.07	0.035
	Daily average	0.15	0.30	0.08	4.0	0.15	0.075
	1 h Average	0.05	—	0.20	10.0	—	—

The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

4.7.1.1 Current Status Monitoring Data of Qingshuihe River Area

456. Testing parameters:

- Monitoring sites: Mengding Town, Qingshuihe River Port, Shuanglongjing, Banxing, Qingshu Village and Dawanjiang.
- Monitoring factors: TSP, PM_{10}, SO_2, NO_x, CO, ammonia and hydrogen sulfide.
- Monitoring frequency: continuous monitoring for 7 days. Average daily provided concentration of TSP, PM_{10}. Average daily & hourly provided concentration of SO_2, NO_x and CO. Provided hourly data of ammonia and hydrogen sulfide.
- Sampling time: May 24, 2017-May 30, 2017.
- Monitoring results and assessment (as above).

457. See monitoring and assessment results of ambient air quality current status in **Table 4.14**.

Table 4.14: List of Ambient Air Quality Monitoring and Assessment Results

Unit: mg/m3

Monitoring Site	Monitored Items		Concentration Range	Standard values*	Evaluation Results
Mengding Town	NOx	Daily Mean Value	0.025-0.036	0.10	Reach the standard
		Hourly Mean Value	0.023-0.040	0.25	Reach the standard
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.014-0.025	0.50	Reach the standard
	TSP	Daily Mean Value	0.113-0.155	0.3	Reach the standard
	PM10	Daily Mean Value	0.080-0.101	0.15	Reach the standard
Qingshuihe River Port	NOx	Daily Mean Value	0.027-0.038	0.10	Reach the standard
		Hourly Mean Value	0.025-0.038	0.25	Reach the standard
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.012-0.026	0.50	Reach the standard
	TSP	Daily Mean Value	0.086-0.118	0.3	Reach the standard
	PM10	Daily Mean Value	0.061-0.083	0.15	Reach the standard
	CO	Hourly Mean Value	0.6-1.3	10	Reach the standard
		Daily Mean Value	0.9-1.1	4	Reach the standard
	Ammonia	Primary	0.02-0.04	0.20	Reach the standard
	Hydrogen sulfide	Primary	0.003-0.009	0.01	Reach the standard
Shuanglongjing	NOx	Daily Mean Value	0.025-0.036	0.10	Reach the standard
		Hourly Mean Value	0.024-0.042	0.25	Reach the standard

Monitoring Site	Monitored Items		Concentration Range	Standard values*	Evaluation Results
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.014-0.024	0.50	Reach the standard
	TSP	Daily Mean Value	0.094-0.120	0.3	Reach the standard
	PM10	Daily Mean Value	0.076-0.087	0.15	Reach the standard
	CO	Hourly Mean Value	0.4-0.9	10	Reach the standard
		Daily Mean Value	0.4-0.6	4	Reach the standard
Banxing	NOx	Daily Mean Value	0.025-0.040	0.10	Reach the standard
		Hourly Mean Value	0.022-0.044	0.25	Reach the standard
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.014-0.024	0.50	Reach the standard
	TSP	Daily Mean Value	0.089-0.108	0.3	Reach the standard
	PM10	Daily Mean Value	0.052-0.070	0.15	Reach the standard
	CO	Hourly Mean Value	0.4-0.9	10	Reach the standard
		Daily Mean Value	0.4-0.7	4	Reach the standard
Qingshu Village	NOx	Daily Mean Value	0.026-0.040	0.10	Reach the standard
		Hourly Mean Value	0.021-0.043	0.25	Reach the standard
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.014-0.025	0.50	Reach the standard
	TSP	Daily Mean Value	0.096-0.125	0.3	Reach the standard
	PM10	Daily Mean Value	0.067-0.086	0.15	Reach the standard
	CO	Hourly Mean Value	0.6-1.1	10	Reach the standard
		Daily Mean Value	0.6-0.8	4	Reach the standard
Dawanjiang	NOx	Daily Mean Value	0.027-0.036	0.10	Reach the standard
		Hourly Mean Value	0.027-0.045	0.25	Reach the standard
	SO2	Daily Mean Value	0.017-0.020	0.15	Reach the standard
		Hourly Mean Value	0.014-0.025	0.50	Reach the standard
	TSP	Daily Mean Value	0.080-0.100	0.3	Reach the standard
	PM10	Daily Mean Value	0.046-0.068	0.15	Reach the standard
	CO	Hourly Mean Value	0.4-0.8	10	Reach the standard
		Daily Mean Value	0.4-0.6	4	Reach the standard

Source: DEIA 2017

* The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

458. According to the monitoring data as shown in the table, the concentration of TSP, PM10, SO_2, NO_x, CO in assessment area has to meet the requirements of Grade II standard of Ambient Air Quality Standard (GB3095-2012). The concentration of ammonia and hydrogen sulfide has been subject to the maximum allowable concentrations of hazardous substances in atmosphere in the residential areas listed in Table 1 of the Hygiene Standard Design of Industrial Firms (TJ36-79). Therefore, the region possesses good quality of ambient air.

4.7.1.2 Monitoring Data of China-Myanmar Friendship Hospital of Zhenkang County

459. The status monitoring data of ambient air quality of the China-Myanmar Friendship Hospital of Zhenkang County is quoted from the status monitoring data in the area of Traditional Chinese Medicine Hospital Construction Project of Zhenkang County on January 13-15, 2016.

- Monitoring Point Distribution No.1 monitoring point - Xiaochanggou, No. 2 monitoring point - Baiyan Village;
- Monitoring Factor: TSP, PM_{10}, NO_2 and SO_2, total 4 items.
- Monitoring Results and Assessment

460. See **Table 4.15** for monitoring and assessment results.

Table 4.15: Ambient Air Monitoring Results Unit: mg/m^3

Monitoring Point	Monitor Item	Concentration Range		Standard Value *		Single Factor Pollution Index		Exceeding-Standard Rate	
		Hourly Value	Daily Mean Value	Hourly Value	Daily Mean Value	Hourly Value	Daily Mean Value	Hourly Value	Daily Mean Value
Xiaochanggou	TSP	/	0.077~0.083	/	0.3	/	0.26~0.28	/	0
	PM_{10}	/	0.038~0.042	/	0.15	/	0.25~0.28	/	0
	NO_2	0.02~0.028	0.02~0.023	0.2	0.08	0.1~0.14	0.25~0.35	0	0
	SO_2	0.023~0.04	0.029~0.036	0.5	0.15	0.04~0.06	0.19~0.24	0	0
Baiyan Village	TSP	/	0.075~0.087	/	0.3	/	0.25~0.29	/	0
	PM_{10}	/	0.036~0.043	/	0.15	/	0.24~0.29	/	0
	NO_2	0.019~0.029	0.02~0.021	0.2	0.08	0.09~0.36	0.24~0.36	0	0
	SO_2	0.025~0.037	0.028~0.033	0.5	0.15	0.014	0.19~0.22	0	0

* The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

461. According to assessment results, in Xiaochanggou and Baiyan Village, the daily average values of TP and PM_{10} and daily average values and hourly values of NO_2 and SO_2 all meet the requirements of Class II assessment criterion in *Ambient Air Quality Standard* (GB3095-2012); therefore, the ambient air quality in the project area is good.

4.7.1.3 Monitoring Data of the Guomen Second Primary School of Cangyuan Va Autonomous County

462. The Guomen Second Primary School of Cangyuan Va Autonomous County is located in the Mengdong Town in Cangyuan Va Autonomous County; the current status assessment of ambient air quality is quoted from the relevant monitoring data in the 2017 County Eco-environmental Quality Report of Cangyuan County, Lincang City, Yunnan Province.

- Monitoring point: Mengdong Reservoir in Cangyuan County
- Monitoring factor: PM10, NO_2 and SO_2, total 3 items;
- Monitoring time: November 14, 2017 - November 18, 2017
- Monitoring results and assessment

463. See **Table 4.16** for monitoring and assessment results.

Table 4.16: Ambient Air Monitoring Results Unit: mg/m^3

Monitoring Point	Monitor Item	Concentration Range	Standard Value *	Exceeding-Standard Rate
		Daily Mean Value	Daily Mean Value	Daily Mean Value
Mengdong Reservoir in Cangyuan County	PM_{10}	0.037-0.040	0.15	0
	NO_2	0.004-0.006	0.08	0
	SO_2	0.004-0.005	0.15	0

*The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

464. According to monitoring results, the ambient air quality in the project area can meet the requirements for Class II criterion in *Ambient Air Quality Standard* (GB3095-2012).

4.7.2. Noise Assessment (Inventory of noise sources and levels)

465. The noise measurements in assessment area must meet the requirements of Class 2 standard of Environmental Quality Standard for Noise (GB 3096-2008) Supplemental Notification,

for general evaluation object execution on both sides of urban trunk line (4 Class area standards), and school classrooms, hospital wards, nursing homes and special hotels (2 Class area standards (Table 4.17 below):

Table 4.17: Urban Area noise standard (DB) *

Category	Night	Night
2 class	60	50
4 class	70	55

* The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

466. Noise limit of construction site (GB12523-) are listed in Table 4.18 below.

Table 4.18: Noise limit for construction site (DB)*

Construction Stage	Daylight Between	Night Between
Construction stage of earthwork	75	55
Structure Construction Stage	70	55
Decoration Construction Stage	65	55

* The comparisons of PRC standards and the World Bank EHS standards provided in Annexure 1B.

4.7.2.1 Acoustic Environment Quality Status in Qingshuihe River Area

Testing Parameters

- Monitoring Sites: The monitoring sites in the assessment are: Mengding Town, Qingshuihe River Port, Guomen Primary School, Shuanglongjing, Qingshu Village, Bangui, Dawantang, Banxing Village, Banxing, Tuanjie Village, Dawanjiang and the site of proposed hospital.
- Monitoring Frequency: Continuous monitoring for 2 days. The monitoring will be performed once respectively in daytime and at night.
- Monitoring Results and Assessment: According to the inspection report, Class 2 standard of Environmental Quality Standard for Noise (GB3096-2008) is adopted as assessment method.
- Sampling time: May 27, 2017-May 28, 2017.

467. See details of monitoring results in **Table 4.19**.

Table 4.19: List of Monitoring Results of Acoustic Environment Quality

Unit: dB (A)

Test Location	27 May 2017		28 May, 2017	
	Daytime	Night	Daytime	Night
Mengding Town	53.4	40.0	53.5	40.9
Qingshuihe River Port	51.0	40.5	52.9	39.9
Guomen Primary School	50.6	40.3	53.5	40.0
Shuanglongjing	51.7	41.8	52.7	41.8
Qingshu Village	52.7	41.9	53.2	40.2
Bangui	52.5	41.7	52.7	40.6
Dawantang	54.2	40.4	53.2	41.0
Banxing Village	53.5	40.3	53.0	45.7
Banxing	52.0	43.9	53.4	42.1
Tuanjie Village	52.9	40.7	53.7	43.2
Dawanjiang	53.0	41.1	53.6	42.1
Site of proposed hospital	52.3	41.2	53.6	42.3
Standard values: 60 dB (A) in daytime, 50 dB (A) at night				

Source: DEIA 2017

468. According to the monitoring results, the quality of acoustic environment status for sensitive

spots in project area in daytime and at night has to meet the Class 2 standard of Environmental Quality Standard for Noise (GB3096-2008). Therefore, the project area possesses good acoustic environmental quality of sensitive spots.

4.7.2.2 Acoustic Environment Quality Status of Zhenkang China-Burma Friendship Hospital

469. The Zhenkang China-Myanmar Friendship Hospital is located in the Nansan Industrial Park Zhenkang County in Zhenkang County, and there are no industrial and mining enterprises around the site, as well as the environmental sensitive points within the scope of assessment. The acoustic environment quality status is relatively good.

4.7.2.3 Acoustic Environment Quality Status of Guomen Second Primary School of Cangyuan Va Autonomous County

470. At present, the site for proposed Guomen Second Primary School of Cangyuan Va Autonomous County is vacant, there are neighboring residential areas and Gengcang Class-II road around the site, and the monitoring is not carried out for the acoustic environment quality status of the project site in this assessment. The monitoring data of acoustic environment quality status in the project area refers to the noise monitoring data in the Cangyuan County Traditional Chinese Medicine & Va Medicine Hospital Outpatient and Inpatient Medical Technology Comprehensive Building Construction Project, which has basically the same external environment compared with that of Guomen Second Primary School of Cangyuan Va Autonomous County Construction Project; therefore, the noise monitoring data shown in Table 4.20 can be quoted.

Table 4.20: List of Monitoring Results of Acoustic Environment Quality Unit: dB (A)

Test Location	10/29/2017	
	Day time	Night time
1#	52.3	46.8
2#	56.3	47.1
3#	53.2	47.5
4#	51.2	47.5
Standard values: 60 dB (A) in daytime, 50 dB (A) at night		

471. According to monitoring results, the acoustic environment quality at daytime and at night in the project area can satisfy the Class 2 criterion in the Environmental Quality Standards for Noise (GB3096-2008), and the acoustic environment quality at the sensitive points in the project area is relatively good.

4.7.3.4 Vibration Ambient Quality

Traffic

472. Automobile exhaust emission Standard adoption: The emission limits and measurement methods of exhaust pollutants from automotive compression ignition engines (GB17691-2001) and light vehicle pollutant emission limits and measurement methods (GB18352.2-2001) as shown below in **Table 4.21**.

Table 4.21: Automotive Emission Standards

Project Category		**CO**	**NO_2**
Standard Value (G. car)	Small Type	2.2	0.5
	Medium Type	4.0	0.6

473. The main construction of this road engineering is mainly mechanical construction, transportation and earth-rock excavation process that will produce some dust, smoke, road pollution.

After the end of the construction period, the impact on the surrounding environment will have a short-term impact on the smaller, generally only in the vicinity of the road, the degree of light.

474. Road traffic vibration is caused by the vibration of the vehicles on the road which mainly depends largely on the road structure and geological conditions. When the vibration is propagating on the ground, its vibration intensity decays with distance faster. In general, road traffic 30m from the location on the roadside will not have much vibration impact. The vibration impact would be less pronounced and safe upto 50m from roadside.

475. The road construction uses high-grade asphalt pavement design, which can ensure proper road roughness which can effectively reduce the impact of traffic vibration.

Pile construction

476. Before construction, the building unit should fully understand the vibration of the project, select the construction machinery with small vibration and consider the vibration-proof device. In the construction of engineering personnel to improve the understanding of vibration and shorten the operation of construction machinery operating time.

477. The construction method of pile foundation engineering is to adopt the sinking pipe perfusion machine pile, which has no vibration, so it will not produce large vibration effect. The foundation vibration caused by the foundation improvement project is mainly sand and soil tamping operation, and the construction equipment is tamping equipment such as vibratory hammer. The vibration caused by heavy vehicles is affected by the vibration caused by the rollers and diesel engines. According to the Environmental Impact Assessment Handbook, the vibration of construction machinery is shown in the **Table 4.22** below.

Table 4.22: Vibration level of construction machinery (Unit: DB)

Equipment	5 m	10 m	20 m	30 m
Vibrating Hammer	75	67	48	44
Roller	58	53	50	48
Diesel engine	62	58	54	51

478. As shown in the above table, the vibration effect of the construction machinery is transmitted to the source at 10m distance thereby meeting the urban regional environmental vibration standards.

4.7.3. Surface Water Environmental Quality

479. The Surface Water Environmental quality standards (GB3838-2002) are used for class III water standards. **Table 4.23** gives the surface water quality standards.

Table 4.23: Surface water quality standards (mg) *

Pollutant Name Protection Target	PH	COD	Ammonia Nitrogen	Petroleum Products	TP	TN
GB3838 - 2002 Ⅲ class	6 ~ 9	20	1.0	0.05	0.2	1.0

*** EHS guidelines only have drinking water standards

480. The Pollutant Discharge Standard: The comprehensive effluent standard (GB8978-1996) 3 class standard is shown in **Table 4.24** below. The sewage discharged into urban sewer water quality standard (CJ3082-1999), 2 class standard shown in **Table 4.25** below:

Table 4.24: Sewage Comprehensive Discharge standard (MG)*

Category	COD	BOD	SS	Petroleum Products
3 class	500	300	400	30

** EHS guidelines only have drinking water standards

Table 4.25: Sewage discharged into urban sewer water quality standard (MG)*

Class	Ammonia Nitrogen	Phosphate
2 class	35	8

** EHS guidelines only have drinking water standards

4.7.3.1 Surface Water Environment Quality Status in Qingshuihe River Area

481. In this assessment project, most of the subprojects are located in the Qingshuihe River Area, and the surrounding surface water bodies are mainly the Qingshuihe River and Nanting River.

482. Testing Parameters:

- Monitoring Sites: 500m upriver from Nanting River bridge, 1500m downriver from Nanting River bridge, 500m upriver of Qingshuihe River, 500m downriver of Qingshuihe River, 500m upriver of Nanting River at the confluence of Qingshuihe River and Nanting River, 50m downriver of Nanting River at the confluence of Qingshuihe River and Nanting River.
- Monitoring Factors: 12 indexes of PH, BOD5, CODcr, TP, TN, SS, NH3-N, petroleum, sulfide, volatile phenol, fecal coliforms and flow rate;
- Monitoring Time: a continuous monitoring for 3 days with 1 composite sample each day
- Monitoring Results and Assessment as above.

483. According to surface water monitoring and assessment results in **Table 4.26**, the monitoring indexes of Nanting River and Qingshuihe River have met the Class III water quality standard in Environmental Quality Standards for Surface Water (GB3838-2002). Therefore, the project area possesses good environmental quality of surface water.

Table 4.26: List of Surface Water Monitoring and Assessment Results

Unit: mg/L

Items / Location/time		pH (non-dimensional)	COD_{cr}	BOD_5	TN	NH_3-N	TP	Petroleum	SS	Sulfide	Volatile phenol	Fecal coliforms (Nr./L)
500m upriver from Nanting River bridge	2017.5.27	6.67	15	2.1	0.76	0.307	0.09	0.03	121	0.005L	3×10^{-4}L	<2
	2017.5.28	6.98	14	2.6	0.63	0.275	0.10	0.03	111	0.005L	3×10^{-4}L	<2
	2017.5.29	6.83	12	2.4	0.74	0.238	0.08	0.02	113	0.005L	3×10^{-4}L	<2
	Maximum single index	0.02	0.75	0.65	0.76	0.307	0.5	0.6	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard
1500m downriver from Nanting River bridge	2017.5.27	6.69	13	2.2	0.72	0.345	0.10	0.03	138	0.005L	3×10^{-4}L	<2
	2017.5.28	7.11	14	2.5	0.68	0.185	0.15	0.02	132	0.005L	3×10^{-4}L	<2
	2017.5.29	6.84	14	2.6	0.64	0.259	0.11	0.02	144	0.005L	3×10^{-4}L	<2
	Maximum single index	0.055	0.7	0.65	0.72	0.345	0.75	0.6	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard
500m upriver of Qingshuihe River	2017.5.27	7.52	16	2.7	0.68	0.318	0.097	0.04	14	0.005L	3×10^{-4}L	<2
	2017.5.28	7.94	15	2.5	0.71	0.387	0.12	0.04	20	0.005L	3×10^{-4}L	<2
	2017.5.29	7.66	13	2.4	0.63	0.419	0.14	0.04	23	0.005L	3×10^{-4}L	<2
	Maximum single index	0.47	0.8	0.675	0.71	0.419	0.7	0.8	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard
500m downriver	2017.5.27	8.13	17	2.8	0.83	0.233	0.08	0.04	6	0.005L	3×10^{-4}L	<2
	2017.5.28	8.19	16	2.6	0.76	0.291	0.04	0.04	10	0.005L	3×10^{-4}L	<2

Items / Location/time		pH (non-dimensional)	COD_{cr}	BOD_5	TN	NH_3-N	TP	Petroleum	SS	Sulfide	Volatile phenol	Fecal coliforms (Nr./L)
of Qingshuihe River	2017.5.29	8.14	15	2.5	0.80	0.259	0.06	0.04	14	0.005L	3×10^{-4}L	<2
	Maximum single index	0.595	0.85	0.7	0.83	0.291	0.4	0.8	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard
500m upriver of Nanting River at the confluence of Qingshuihe River and Nanting River	2017.5.27	7.46	15	2.4	0.76	0.233	0.09	0.03	119	0.005L	3×10^{-4}L	<2
	2017.5.28	7.48	14	2.3	0.73	0.281	0.08	0.03	122	0.005L	3×10^{-4}L	<2
	2017.5.29	7.51	13	2.2	0.74	0.217	0.09	0.03	129	0.005L	3×10^{-4}L	<2
	Maximum single index	0.255	0.75	0.6	0.76	0.281	0.45	0.6	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard
50m downriver of Nanting River at the confluence of Qingshuihe River and Nanting River	2017.5.27	7.62	16	2.5	0.60	0.339	0.10	0.02	135	0.005L	3×10^{-4}L	<2
	2017.5.28	7.58	13	2.3	0.63	0.371	0.14	0.02	142	0.005L	3×10^{-4}L	<2
	2017.5.29	7.64	14	2.4	0.61	0.323	0.11	0.01	145	0.005L	3×10^{-4}L	<2
	Maximum single index	0.32	0.8	0.625	0.63	0.371	0.7	0.4	/	<1	<1	<1
	Standard values	6-9	≤20	≤4	≤1.0	≤1.0	≤0.2	≤0.05	/	≤0.2	≤0.005	≤10000
	Status	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	Reach the standard	/	Reach the standard	Reach the standard	Reach the standard

4.7.3.2 Surface Water Environment Quality Status of China-Myanmar Friendship Hospital of Zhenkang County Project

484. The main surface water body in the project area is the Nansan River in the north about 2.5km. The Nansan River is a tributary of the Nanpeng River, and the Nanpeng River is a 2nd order tributary of the Nanting River which is the primary tributary of the Salween River Basin. The Class Ⅳ water quality criterion in Environmental Quality Standards for Surface Water (GB3838－2002) is executed for the Nansan River.

485. According to Function Division of Surface Water Environment in Yunnan Province (2010-2020), the water environmental function of the Nanpeng River (source - entrance to Nanting River) includes the industrial water and agricultural water, which are subject to the Class IV criterion; according to principle that the water quality criterion of the tributary is not lower than that of the mainstream, the Class Ⅳ water quality criterion in Environmental Quality Standards for Surface Water (GB3838－2002) is executed for the Nansan River.

486. In this EIA, the surface water status monitoring is not carried out, and the monitoring data in the Environmental Impact Report for Overall Planning of Zhenkang Border Characteristic Industrial Park about two monitoring points is quoted, i.e., at a distance 100m of the upstream of No.2 road with wastewater discharge of Zhenkang County to Nansan River and before entry of Zhenkang County wastewater discharged into Nansan River into sinkhole. See **Table 4.27** for monitoring results.

Table 4.27: Surface Water Status Monitoring Results Unit: mg/L

Monitoring Point Position	At a Distance 100m of the Upstream of No.2 Road with Wastewater Discharge of Zhenkang County to Nansan River			Before Entry of Zhenkang County Wastewater Discharged into Nansan River into Sinkhole			Standard *	Status:
Date / Item	March 17	March 18	March 19	March 17	March 18	March 19	6～9	/
pH (Non-dimensional)	7.4	7.43	7.52	7.94	7.89	7.92	≤ 30	Benchmark reaching
Chemical Oxygen Demand	18	18	18	17	17	17	≤ 6	Benchmark reaching
Biochemical Oxygen Demand	3	3	3	3	3	3	≤ 1.5	Benchmark reaching
Ammonia Nitrogen	0.97	0.96	0.97	0.82	0.79	0.79	≤ 0.3	Benchmark reaching
TP	0.19	0.19	0.18	0.18	0.18	0.17	/	Benchmark reaching
SS	200	210	180	22	25	20	≤ 0.5	/
Petroleum	0.012	0.015	0.014	0.013	0.014	0.012	≤ 1.5	Benchmark reaching
Fluoride	0.07	0.08	0.08	0.08	0.08	0.09	≤ 0.05	Benchmark reaching
Lead	＜0.0021	＜ 0.0011	＜ 0.001	＜ 0.0011	＜ 0.0011	＜ 0.0011	≤ 1.0	Benchmark reaching
Copper	＜0.001	＜ 0.001	＜ 0.001	＜ 0.001	＜ 0.001	＜ 0.001	≤ 1.0	Benchmark reaching
Zinc	＜0.05	＜0.05	＜0.05	＜0.05	＜0.05	＜0.05	≤ 0.005	Benchmark reaching
Cadmium	＜0.0001	＜ 0.0001	＜ 0.0001	＜ 0.0001	＜ 0.0001	＜ 0.0001	≤ 0.1	Benchmark reaching

Monitoring Point Position	At a Distance 100m of the Upstream of No.2 Road with Wastewater Discharge of Zhenkang County to Nansan River			Before Entry of Zhenkang County Wastewater Discharged into Nansan River into Sinkhole			Standard *	Status:
Arsenic	0.0061	0.0057	0.0053	0.0058	0.0060	0.0055	≤ 0.05	Benchmark reaching
Hexavalent Chromium	＜0.004	＜ 0.0047	＜ 0.004	＜ 0.004	＜ 0.004	＜ 0.004	6～9	Benchmark reaching

* EHS guidelines only have drinking water standards

487. According to monitoring data, the items monitored, i.e., pH, BOD_5, COD, total nitrogen, total phosphorus, petroleum, fluoride, lead, copper, zinc, cadmium, arsenic, hexavalent chrome, all satisfy the Class IV water quality criterion in the *Environmental Quality Standards for Surface Water* (GB3838－2002).

4.7.3.3: Surface Water Environment Quality Status of Guomen Second Primary School Project in Cangyuan Va Autonomous County

488. The main river in the project area is Mengdong River. According to *Function Division of Surface Water Environment in Yunnan Province* (2010-2020), the water environment function of the Mengdong River (source-entrance to Nanbi River) includes the agricultural water and landscaping water, and the Class Ⅳ water quality criterion in *Environmental Quality Standards for Surface Water* (GB3838－2002) is executed.

489. In this EIA, the monitoring is not carried out for the water environment quality status of the Mengdong River, and the monitoring and assessment results of water environment quality status in Mengdong River are quoted from the monitoring and assessment results of the *Mengdong River in the Environmental Impact Assessment Report of Cangyuan County 600t/a Mild Aromatic Chinese Spirits Factory Construction Project.*

490. From July 24, 2016 to July 26, 2016, the Yunnan Huanlv Detect Technology Co., Ltd. conducted the detections on the water environment quality of the Mengdong River. The monitoring results are shown in **Table 4.28**.

Table 4.28: Mengdong River Surface Water Monitoring and Analysis Results

Item		Ph	COD/(mg/L)	BOD_5(mg/L)	NH_3-N(mg/L)	TP(mg/L)	SS (mg/L)
At a distance of 500m (Mengdong River) along the upstream at the convergence of Paliangxiao River and Mengdong River	7/24/2016	7.62	12	2.3	0.035	0.04	36
	7/25/2016	7.59	14	2.5	0.037	0.03	38
	7/26/2016	7.54	16	2.7	0.034	0.05	36
	Mean Value	7.58	14	2.5	0.035	0.04	36.67
Class Ⅳ Water Quality Criterion		6~9	≤ 30	≤ 6	≤ 1.5	≤ 0.3	——
Status:		Benchmark reaching	Benchmark reaching	Benchmark reaching	Benchmark reaching	Benchmark reaching	
At a distance of 100m along the upstream of	7/24/2016	7.12	24	4.3	0.054	0.05	26
	7/25/2016	7.09	25	4.6	0.056	0.06	26
	7/26/2016	7.13	27	5.1	0.052	0.04	27

Item		Ph	COD/(mg/L)	BOD_5(mg/L)	NH_3-N(mg/L)	TP(mg/L)	SS (mg/L)
discharge point of Cangyuan County Sewage Treatment Plant into Mengdong River	Mean Value	7.11	25.3	4.67	0.054	0.05	26.3
Class Ⅳ Water Quality Criterion		6~9	≤ 30	≤ 6	≤ 1.5	≤ 0.3	——
Status:		Benchmark reaching	Benchmark reaching	Benchmark reaching	Benchmark reaching	Benchmark reaching	

491. The Guomen Second Primary School Project is located in the west of the Mengdong River in the Cangyuan Va Autonomous County. The status monitoring points are all located at the downstream of the project; from the project river reach to the monitoring point, the farmlands and slopes are mainly distributed on both banks of the river, and there are no industrial wastewater and large domestic sewage; consequently, the water quality of the river remains basically unchanged. Therefore, the monitoring results of the monitoring points listed in **Table 4.28** can represent the water quality of the Mengdong River in the project section.

492. According to monitoring results, the indexes of various pollutants in the water of the Mengdong River can satisfy the Class IV water quality criterion in the *Environmental Quality Standards for Surface Water* (GB3838-2002), and the environmental quality of surface water is good.

4.7.4 Hydrology and Hydrogeology

4.7.4.1 Current Status and Assessment of Underground Water Environmental Quality

Regional Hydrogeological Conditions

493. The underground water in project area belongs to pore water in loose strata and distributes around Nanting River and the outlets of tributaries. Aquifers include Q 4el+dl, Q4al+pl and Q4col. The lithology involves conglomerate, sandstone, siltstone and clay rock. Because of the large variable thickness of aquifer, the water-bearing capability varies widely and obviously with seasons. The pore water mainly derives from atmospheric precipitation with partial surface water, fissure water and karstic water.

494. The underground water generally flows to river valley and is discharged into rivers in undercurrent and seepage. Pore water in loose strata of assessment area mainly distributes in the quaternary basin along Nanting River with medium-strong water yield property. Chemical type of water is dominated by HCO_3-Ca·Mg water.

Current Status of Underground Water

495. According to survey, there is no groundwater spouting spring point in the project area in the Qingshuihe River Area, so the groundwater monitoring cannot be carried out in the EIA, and the assessment is not carried out for the status of groundwater this time.

According to construction nature of Guomen Second Primary School of Cangyuan Va Autonomous County Project and China-Myanmar Friendship Hospital of Zhenkang County Project, the assessment for groundwater may not be carried out for the above two projects; therefore, the assessment and analysis are not carried out for the groundwater status in the areas of above-mentioned two projects this time.

4.7.5 Water and Soil Loss

496. According to national water and soil loss type division, since the project area is located at southwest soil-stone mountainous area, the soil erosion belongs to water erosion. The allowable value of water and soil loss is 500t/ km^2. Based on the Announcement No. 2 [2006] of Ministry of Water Resources-Notice on Regionalization of National Key Regions for Water and Soil Conservation, Gengma County, the project area, has been listed in national key regions for soil and water conservation. Based on the Notice of the People's Government of Yunnan Province on Regionalization of Key Regions for Water and Soil Conservation (YZF [2007] No. 165), Gengma County, the project area, belongs to key regions for soil and water conservation in Yunnan Province.

497. The causes of water and soil loss are both natural and human factors. The Natural factors include strong wind, rainfall, geomorphology, soil and vegetation, etc. while the human factors mainly refers to the increase of population and the impact of the production and operation activities which are not in accordance with the scientific laws on water and soil loss. Among these factors, the strong wind and rainfall are the main factors of water and soil loss during the construction period.

4.7.1 Current water and soil loss at Gengma County[55]

498. According to the Yunnan Province 2015 Soil Erosion Survey Report (Yunnan Water Conservancy and Hydropower Research Institute), the total land area of Gengma County is 3727.23 km^2, in which, area of micro erosion is 2461.82 km^2, accounting for 66.05%; area of soil erosion is 1265.41 km^2, accounting for 33.95%. Among the area of soil erosion: area of mild erosion is 657.30 km^2, accounting for 51.94%; area of moderate erosion is 231.36 km^2, accounting for 18.28%; area of strong erosion is 108.14 km^2, accounting for 8.55%; area of very strong erosion is 165.02 km^2, accounting for 13.04%; area of intensive erosion is 103.59 km^2, accounting for 8.19%.

Table 4.29: Soil Erosion in Gengma County unit: km^2

Area	Land area	Micro erosion	Soil Erosion					
			Subtotal	Mild	Moderate	Strong	Very strong	Intensive
Gengma County	3727.23	2461.82	1265.41	657.30	231.36	108.14	165.02	103.59

[55] Data from Water and Soil Report 2018

499. According to the categorization in the Categorization and Classification Standard for Soil Erosion (SL 190-2007), the project is located in the southwest earth-rock mountain region where soil erosion type is mainly water erosion, allowable soil loss is 500t/km^2.a.

4.7.5.2 Water and soil loss in the project area

500. The project will require occupation of land, including forest land, grassland, transport land, mild slope cropland, water area and water conservancy facilities land. The soil erosion modulus of different land types are taken from the Categorization and Classification Standard for Soil Erosion (SL 190-2007), the weighted average by area is the current water and soil loss intensity of the project area, which is micro erosion, the current average soil erosion modulus of the project area is 266.73t/km^2.a., the REF value of current soil erosion modulus is detailed in **Table 4.30**.

Table 4.30: Native Soil Erosion Modulus

Estimates by different areas		The total area (hm^2)	Original Land Composition and Area		Soil erosion modulus (t / $km^2 \cdot a$)	Average soil erosion modulus (t / $km^2 \cdot a$)	Remarks
			Composition of Land	Area (hm^2)			
Water Supply in Mending Qingshuihe Port Area	Water intake	0.04	Waters and water conservancy facilities	0.04	200	200.00	Micro-degree erosion
	Raw water conveyance	7.68	Forest land	3.42	300	866.67	Mild erosion
			Land Transportation	2.68	450		
			Slope cropland	1.58	2800		
	WTP	2.40	Forest land	2.40	300	300.00	Micro-degree erosion
	Water distribution networks	4.28	Forest land	0.42	300	415.65	Micro-degree erosion
			Construction land	0.24	100		
			Land Transportation	3.62	450		
	Temporary site of pipeline construction	23.17	Forest land	4.36	300	400.73	Micro-degree erosion
			Grass land	1.28	400		
			Construction land	1.21	100		
			Land Transportation	16.32	450		
WWTP and associated works	WWTP	2.48	Forest land	2.48	300	300.00	Micro-degree erosion
	Wastewater pipelines	2.63	Land Transportation	2.63	450	450.00	Micro-degree erosion
	Temporary site of pipeline construction	5.66	Construction land	1.48	100	358.48	Micro-degree erosion
			Land Transportation	4.18	450		
Solid waste management	Buildings and Structures	0.09	Forest land	0.05	300	211.11	Micro-degree erosion
			Construction land	0.04	100		
	Roads and hardened areas	0.17	Forest land	0.17	300	300.00	Micro-degree erosion
	Greening areas	0.18	Forest land	0.18	300	300.00	Micro-degree erosion
Qingshuihe River Rehabilitation	Flood Control	2.44	Waters and water conservancy facilities	2.44	200	300.00	Micro-degree erosion
	Wastewater Interception	2.00	Forest land	0.66	300	364.00	Micro-degree erosion
			Grass land	0.26	400		
			Land Transportation	0.84	450		
			Waters and water conservancy facilities	0.24	200		
	Ecological	8.23	Forest land	2.15	300	311.48	Micro-degree

Estimates by different areas		The total area (hm^2)	Original Land Composition and Area		Soil erosion modulus (t / $km^2 \cdot a$)	Average soil erosion modulus (t / $km^2 \cdot a$)	Remarks
			Composition of Land	Area (hm^2)			
	rehabilitation		Grass land	2.40	400		erosion
			Land Transportation	0.89	450		
			Waters and water conservancy facilities	2.79	200		
Urban public transport infrastructure	Buildings and Structures	1.27	Forest land	0.26	300	947.64	Mild erosion
			Construction land	0.50	100		
			Transportation	0.15	450		
			Slope cropland	0.36	2800		
	Roads and hardened area	4.61	Forest land	0.22	300	605.53	Mild erosion
			Grass land	0.92	400		
			Construction land	2.30	100		
			Transportation	0.43	450		
			Slope cropland	0.74	2800		
	Greening areas	0.72	Forest land	0.22	300	400.00	Mild erosion
			Grass land	0.12	400		
			Construction land	0.26	100		
			Transportation	0.08	450		
			Slope cropland	0.04	2800		
Total		**68.05**		**68.05**		**420.14**	**Micro-degree erosion**

4.7.6 Ecological Resources in Project Areas

Approach

501. The baseline studies have been based on the collection and review of available data and maps, interviews of local stakeholders (namelist as the Appendix 1), and field studies to observe habitats, flora and fauna in project sites. The field works were conducted four times, in December 2017, and January, March and April 2018.

4.7.6.1 Flora

502. There is no plant species under the national and provincial key protected plants in the project areas.

a Arbor species

503. The arbors mainly include *Hevea brasiliensis*, *Artocarpus heterophyllus*, *Tectona grandis*, *Ficus altissima*, *Ficus microcarpa*, *Ficus auriculata*, *Ailanthus altissima* and *Alstonia scholaris* etc.

b Textile plants

504. Textile plants include *Boehmeris macrophylla*, *Broussonetia kazinoki*, *Thysanolaena maxima*, *Abelmoschus manihot* etc.

c Herbaceous plants

505. Herbaceous plants include *Digitaria sanguinalis*, *Cynodon doctylon*, *Zoysia japonica*, *Microstegium vegans*, *Panicum notatum*, *Filipendula palmata*, *Paspalum conjugatum* and *Lonicera japonica* etc.

d Ferns

506. Including *Pteris nervosa*, *Matteuccia struthiopteris*, *Acrostichum aureum*, *Cyclosorus parasiticus* etc.

e Bryophyte

507. Bryophyte include aquatic communities such as Plagiomnium spp. and Thuidium spp., Geophytia such as Taxiphyllum spp. and Brachythecium spp., Epixylophytia such as Bazzania spp., Leucobryum spp., and Barbella spp. etc.

f Medical plants

508. *Artificial medical plant*. *Amomum villosum* is wildly planted under the rubber plantation in the project areas. Wild medical herbaceous plants: *Arthraxon hispidus*, *Pleione yunnanensis*, *Ageratum conyzoides*, *Clerodendrum bungei* and *Tithonia diversifolia* etc. Medical arbor plants. *Bothrocaryum controversum* and *Alstonia scholaris*.

g Exotic invasive plant

509. *Eupatorium odoratum* originates in Central America, which was imported in Thailand in 1920 as a spiceberry species. This was found in the south of Yunnan Province in 1934. Its reproduction capacity is very strong. The plant is recognized as a globally invasive plant with high competition.

4.7.6.2 Typical Vegetation Assemblages

510. Five vegetation assemblages were found in the project areas, including timberland, shrubland, grassland, farmland including garden land, and the wetland vegetation.

a Timberland

511. Only two artificial forests were found in the project area of LBECZ: rubber (*Hevea brasiliensis) plantation* and *teak (Tectona grandis) plantation.* The former forest includes plantation of *Artocarpus heterophyllus*, *Coffea Arabica*, *Musa nana*, and *Amomum villosum etc.* The herbaceous plants include *Eupatorium odoratum*, *Cyclosorus parasiticus*, *Cyrtococcum patens*, *Paspalum conjugatum*, *Pueraria lobata* and *Ageratum conyzoides* etc. *Tectona grandis* plantations are distributed in two small areas: one is located in the left bank of Qingshuihe River with the area less than 200 m^2, and the other one is located in the right hill of proposed Nanting Bridge.

512. Natural *Dendrocalamus semiscandens* forest. This bamboo forests are mainly distributed in the slope foots and valleys of hills, and the riverside areas, which generally present small patches or bands of sporadic distribution.

b Shrubland

513. The shrubland is mainly divided into two communities: *Psilopeganum sinense* shrubland and *Homonoia riparia* shrubland. Both of them are mainly distributed in the open areas of valley, forest edge, and river banks. The *Psilopeganum sinense* shrubland has the auxiliary plant species such as *Bauhinia variegate* and *Bischofia polycarpa*, and the herbaceous plant species such as *Microstegium vegans*, *Tithonia diversifolia* and *Eupatoyium odoratum*. The *Homonoia riparia* shrubland is mainly distributed along the river bank. It has the auxiliary plant species such as *Litsea lancifolia*, *Ficus pyriformis* and *Flemingia fluminalis*, and the herbaceous plant species such as *Hippochaete romosissimum*, *Saccharum spontaueum* and *Brainia insignis*.

c Grassland

514. The grassland presents as a small patch, which is not a typical habitat in project areas. It is mainly distributes in the low slopes and valleys. Two grassland communities were found: *Microstegium vegans* and *M. vimineum* community, and *Eupatoyium odoratum* community. The *Microstegium vegans* and *M. vimineum* community mainly consisted of *Thysanolaena maxima* and *Pogonatherum crinitum*, and the few shrub species such as *Rhus chinensis*, *R. corchorifolius*, and *Ficus cyrtophylla*. The *Eupatoyium odoratum* community mainly consisted of *Thysanolaena maxima*, *Imperata cylindrical*, *Hedyotis hirta* and *Ageratum conyzoides*, and the shrub species such as Rhus chinensis, *Trema tomentosa* and *Vernonia volkameriaefolia*.

d Farmland including garden land

515. Farmland only distributed in project area of proposed Zhenkang Sino-Myanmar Friendship Hospital, which mainly plants the sugar cane (*Saccharum officinarum*). The garden land mainly distributed along the Qingshuihe River, and the slope foots and valleys. The plant species include the common fruits and vegetables, such as pepper, kidney bean, soybean and tomato etc.

e Wetland vegetation

516. Wetland vegetation is found in rivers, mostly in small areas. The main communities were *Alternanthera sessilis*, *Polygonum hydropiper*, *Arundo donax*, *Arthraxon Beauv*, and *Paspalum longifolium* community.

4.7.6.3 Terrestrial Fauna

517. 129 terrestrial fauna species were identified in the project areas. The number of nationally protected animals is relatively small given the extensive human occupation. These comprise two bird species, one amphibian and two reptiles. Five of these species are Common buzzard (*Buteo buteo*), Great coucal (*Centropus sinensis*), Tiger frog (*Hoplobatrachus rugulosus*), Asian water monitor (*Varanus salvator*), and Tokay gecko (*Gekko gecko*). Only the Asian water monitor falls under the Grade I of national protection animals. The others are Grade II.

a Birds

518. Some 10 orders, 24 families and 111 bird species are believed to exist in the project areas (**Table 4.31**). According to the residential types, 84 species are residential birds, 18 winters, 6 summers and 3 migratory birds. According to the functional guilds, 85 birds are insectivores, 11 species are carnivores, 10 species are frugivores and 5 species are granivores. 30 bird species and 9 species are under the list of Sino-Japan, and Sino-Australia bilateral conservation agreement on migratory birds and their habitats, respectively.

519. The general bird species include Great Tit, Yellow-cheeked Tit, Tree Sparrow, White-rumped Munia, Chestnut-vented Nuthatch, Common Magpie, Burmese Shrike, Long-tailed Shrike, Rusty-cheeked Scimitar Babbler, Rufous-necked Scimitar Babbler, White-browed Laughing thrush, Rusty-capped Fulvetta, Grey-cheeked Fulvetta, Common Tailorbird, Franklin's Prinia, Common Tailorbird, Franklin's Prinia, Grey-headed Canary Flycatcher, White-throated Fantail and Yellow-bellied Fantail.

520. Only two bird species are under the national protection list: Common buzzard (*Buteo buteo*) and Great coucal (*Centropus sinensis*). The former one is also listed in appendix II of CITES, and the latter is recognized as the vulnerable species in China RedList.

Table 4.31: The bird species list in the project areas of LBECZ of Yunnan Province

Number	Scientific name	NPL	SJ	SA	CITES	Residential type	Functional guild	IUCN Red List
1	*Butorides striatus*		√			R	C	-
2	*Bubulcus ibis*		√	√	Ⅲ	R	I	-
3	*Egretta garzetta*				Ⅲ	R	I	-
4	*Nycticorax nycticorax*		√			S	C	-
5	*Tadorna ferruginea*		√			W	C	-
6	*Anas crecca*		√		Ⅲ	W	F	-
7	*Buteo buteo*	Ⅱ	√		Ⅱ	W	C	-
8	*Francolinus pintadeanus*					R	I	-
9	*Phasianus colchicus*					R	F	-
10	*Streptopelia orientalis*		√			R	G	-
11	*Streptopelia chinensis*					R	G	-
12	*Oenopopelia tranquebarica*					R	G	-
13	*Cuculus micropterus*					R	I	-
14	*Cuculus merulinus*					S	I	-
15	*Centropus sinensis*	Ⅱ				R	C	-
16	*Hirundapus caudacutus*		√	√		R	I	-
17	*Apus pacificus*		√	√		S	I	-
18	*Apus affinis*		√			R	I	-
19	*Alcedo atthis*		√			R	I	-
20	*Halcyon smyrnensis*					R	I	-
21	*Megalaima virens*					R	I	-
22	*Megalaima franklinii*					R	I	-
23	*Megalaima asiatica*					R	I	-
24	*Picumnus innominatus*					R	I	-
25	*Picoides major*					R	I	-
26	*Picoides canicapillus*					R	I	-
27	*Blythipicus pyrrhotis*					R	I	-
28	*Hirundo rustica*		√	√		R	I	-
29	*Hirundo daurica*		√			R	I	-
30	*Hirundo striolata*			√		R	I	-
31	*Motacilla flava*		√	√		W	I	-
32	*Motacilla cinerea*			√		W	I	-
33	*Motacilla alba*		√	√		R	I	-

Number	Scientific name	NPL	SJ	SA	CITES	Residential type	Functional guild	IUCN Red List
34	*Anthus trivialis*					R	I	-
35	*Anthus roseatus*					R	I	-
36	*Pericrocotus divaricatus*		√			W	I	-
37	*Pericrocotus ethologus*					R	I	-
38	*Pericrocotus brevirostris*					S	I	-
39	*Pericrocotus flammeus*					R	I	-
40	*Pycnonotus jocosus*					R	F	-
41	*Pycnonotus xanthorrhous*					R	F	-
42	*Pycnonotus cafer*					R	F	-
43	*Pycnonotus aurigaster*					R	F	-
44	*Hypsipetes mcclellandii*					R	F	-
45	*Hypsipetes madagascariensis*					R	F	-
46	*Lanius cristatus*		√			W	I	-
47	*Lanius collurioides*					R	I	-
48	*Lanius schach*					R	I	-
49	*Lanius tephronotus*					R	I	-
50	*Oriolus chinensis*		√			R	I	-
51	*Dicrurus macrocercus*					R	I	-
52	*Dicrurus leucophaeus*					S	I	-
53	*Urocissa erythrorhyncha*					R	G	-
54	*Pica pica*					R	F	-
55	*Dendrocitta formosae*					R	F	-
56	*Corvus splendens*					R	I	-
57	*Corvus macrorhynchos*					R	I	-
58	*Corvus corone*					W	I	-
59	*Luscinia calliope*		√			W	I	-
60	*Luscinia svecica*					W	I	-
61	*Luscinia cyane*		√			M	I	-
62	*Tarsiger cyanurus*		√			W	I	-
63	*Copsychus saularis*					R	I	-
64	*Phoenicurus frontalis*					R	I	-
65	*Phoenicurus auroreus*		√			W	I	-
66	*Rhyacornis fuliginosus*					R	I	-
67	*Pomatorhinus erythrocnemis*					R	I	-
68	*Pomatorhinus ruficollis*					R	I	-
69	*Garrulax sannio*					R	I	-
70	*Alcippe dubia*					R	I	-
71	*Alcippe morrisonia*					R	I	-
72	*Tesia castaneocoronata*					R	I	-
73	*Cettia fortipes*					R	I	-
74	*Cettia robustipes*					R	I	-
75	*Phylloscopus affinis*					W	I	-
76	*Phylloscopus fuscatus*					W	I	-
77	*Phylloscopus pulcher*					R	I	-
78	*Phylloscopus inornatus*		√			M	I	-
79	*Phylloscopus proregulus*		√			W	I	-
80	*Phylloscopus borealis*		√	√		W	I	-
81	*Phylloscopus reguloides*					R	I	-
82	*Seicercus castaniceps*					R	I	-
83	*Seicercus burkii*					R	I	-
84	*Seicercus xanthoschistos*					R	I	-
85	*Abroscopus superciliaris*					R	I	-
86	*Abroscopus schisticeps*					R	I	-

Number	Scientific name	NPL	SJ	SA	CITES	Residential type	Functional guild	IUCN Red List
87	*Orthotomus sutorius*					R	I	-
88	*Prinia hodgsonii*					R	I	-
89	*Prinia rufescens*					R	I	-
90	*Prinia polychroa*					R	I	-
91	*Prinia atrogularis*					R	I	-
92	*Ficedula parva*		√			M	I	-
93	*Ficedula strophiata*					S	I	-
94	*Muscicapa thalassina*					R	I	-
95	*Culicicapa ceylonensis*					R	I	-
96	*Rhipidura albicollis*					R	I	-
97	*Rhipidura hypoxantha*					R	I	-
98	*Parus major*					R	I	-
99	*Parus spilonotus*					R	I	-
100	*Aegithalos caudatus*					R	I	-
101	*Aegithalos iouschistos*					R	I	-
102	*Sitta nagaensis*					R	I	-
103	*Zosterops japonica*		√			R	I	-
104	*Zosterops palpebrosa*					R	I	-
105	*Passer montanus*					R	G	-
106	*Lonchura striata*					R	G	-
107	*Lonchura punctulata*					R	G	-
108	*Carduelis ambigua*					R	G	-
109	*Carpodacus erythrinus*		√			R	G	-
110	*Emberiza spodocephala*		√			W	G	-
111	*Emberiza pusilla*		√			W	G	-

NPL: national protection list, SJ: Sino-Japan bilateral conservation agreement on migratory birds and their habitats, SA: Sino-Australia bilateral conservation agreement on migratory birds and their habitats.
Residential type: S = summers, W = winters, M = migratory birds, R = resident birds
Functional guild: I= insectivore; F = frugivore; G =granivore; C =carnivore.

b Mammals

521. The mammal list was concluded from the interviews with the local managers. Six general mammal species of 3 orders and 4 families were identified in the project areas: *Mus musculus*, *Apodemus draco*, *Callosciurus erythraeus*, *Mustela sibirica*, *Arctonyx collaris*, *Scotophilus kuhlii*, and *Pipistrellus abramus* (**Table 4.32**).

522. Only *Arctonyx collaris* is recognized as the vulnerable species by China RedList, which is an omnivore animal and widely distributes across whole of China. The *Scotophilus kuhlii* and *Pipistrellus abramus* are common small bats in east Asia, even they were not observed during the scientific survey period of Nangun River NNR.

Table 4.32: The mammal list in the project areas of LBECZ of Yunnan Province

Scientific name	China RedList	NPL	Sources	IUCN Redlist
CHIROPTERA				
Vespertilionidae				
Scotophilus kuhlii	LC	-	L	-
Pipistrellus abramus	LC	-	L	-
CARNIVORA				
Mustelidae				
Mustela sibirica	NT	-	O	-
Arctonyx collaris	VU	-	O	-
RODENTIA				
Muridae				

Mus musculus		-	O	-
Apodemus draco	LC	-	O	-
Sciuridae				
Callosciurus erythraeus	LC	-	O	-

IUCN RedList: LC = least concern, NT = near threatened, VU = vulnerable.
Sources: L = literatures, O = observed during the scientific survey period of Nangun River NNR.
NPL = National Protected List

c Amphibian and Reptiles

523. A total of 3 families and 5 species were identified (**Table 3.3**), such as *Hoplobatrachus rugulosus*, *Occidozyga martensii*, *Fejervarya limnocharis*, *Microhyla heymonsi* and *Polypedates leucomystax*. All of them generally distribute in the low hilly land, valleys, ponds, riverside and rice fields.

524. The *Hoplobatrachus rugulosus* is Grade II of the national protected animals, which widely distributes in Middle and South China. It is an endemic species in China and also recognized as the vulnerable species by China RedList. With the illegal harvesting for food and degradation of their habitats, the population number is rapidly decreased.

525. A total of 7 families and 7 reptile species were identified (**Table 4.33**), such as *Pelodiscus sinensis*, *Elaphe porphyracea*, *Sphenomorphus maculatus*, *Ophiophagus hannah* and *Trimeresurus stejnegeri*. However, the *Varanus salvator* and *Gekko gecko* may occur in the project areas.

526. According to the local records in Forestry Station of Mengding Town, the *Varanus salvator* was ever rescued in Qingshuihe Border Area. This lizard often lives in the mountain stream. It is Grade I of national protected animals, and listed in the Appendix II of CITES.

527. The *Gekko gecko* is Grade II of national protected animals, which is mainly distributed in Southeast and South Asia. The gecko prefers inhabiting the rock crevices, caves, or tree holes in the rocks or wilderness, living in the woods, open spaces, mountains, deserts, and houses. The *Ophiophagus hannah* is listed in the Yunnan provincial protected animals and the appendix II of CITES, and recognized as the vulnerable species in China RedList.

Table 4.33: The list of amphibian and reptiles in project area

Scientific name	Distribution	Elevation (m)	NPL	China-RL	CITES	IUCN-RL
AMPHIBIAN						
Dicroglossidae						
Occidozyga martensii	South China	10～1000		NT		LC
Hoplobatraclrus rugulosus	Middle and south China	20～1120	Ⅱ	VU		LC
Fejervarya limnocharis	General	10～1400		LC		DD
Rhacophoridae						
Polypedates megacephalus	General	80～1600		LC		LC
Microhylidae						
Microhyla heymonsi	Middle and south China	70～1515		LC		LC
REPTILES						
Trionychidae						
Pelodiscus sinensis	General	＜1000		VU		VU
Gekkonidae						
Gekko gecko	South China	300～1300	Ⅱ	EN		
Varanidae						
Varanus salvator	South China		Ⅰ	CR	Ⅱ	LC

Scientific name	Distribution	Elevation (m)	NPL	China-RL	CITES	IUCN-RL
Scincidae						
Sphenomorphus maculata	Southwest China	450～1300		LC		
Colubridae						
Elaphe porphyracea	General	200～2400		LC		
Elapidae						
Ophiophagus hannah	General	300～1800	P	EN	Ⅱ	VU
Viperinae						
Trimeresurus stejnegeri	General	150～2200		LC		LC

NPL: national protection list. RL: RedList
IUCN RedList and China RedList: LC = least concern, NT = near threatened, VU = vulnerable, CR = critically endangered, EN = endangered, DD = data deficiency

4.7.6.4 Fish resources

a Fish Composition

528. 48 endemic fish species of four orders and 11 families were identified in project areas (**Table 4.34**), which is consistent with the fish composition in NAGR of lower reaches of Nanting River. The fish list was concluded from the literatures (Zhou et al., 2016a and 2016 b) and the scientific survey reports of Nanting River NNR (Tang et al., 2015) and Lancang River PNR (Wang et al., 2010). There is no fish species under the national protected animals and the appendix of CITES.

529. Sorted by species absolute number, Cyprinidae, Cobitidae and Sisoridae were ranked in the top 3 families. Sorted by the fauna presence value, Anguillidae, Channidae, Mastacembelidae, Cobitidae, Synbranchidae and Sisoridae were ranked in the top 5 families.

530. Four fish species were identified as the conservation objectives: *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis* in Nanting River system. Their distribution is presented in **Figure 4.14**. The *Balitora nantingensis* and *Neonoemacheilus mengdingensis* are the two unique species only distributed in Nanting River, the *Anguilla nebulosa* is the unique species in Nanting River and Irrawaddy River, and the *Neolissochilus baoshanensis* is the unique species in Yunan Province. The *Anguilla nebulosa* is an occasional species, which can migrate from India Sea. However, the biological information of this species is quite scarce.

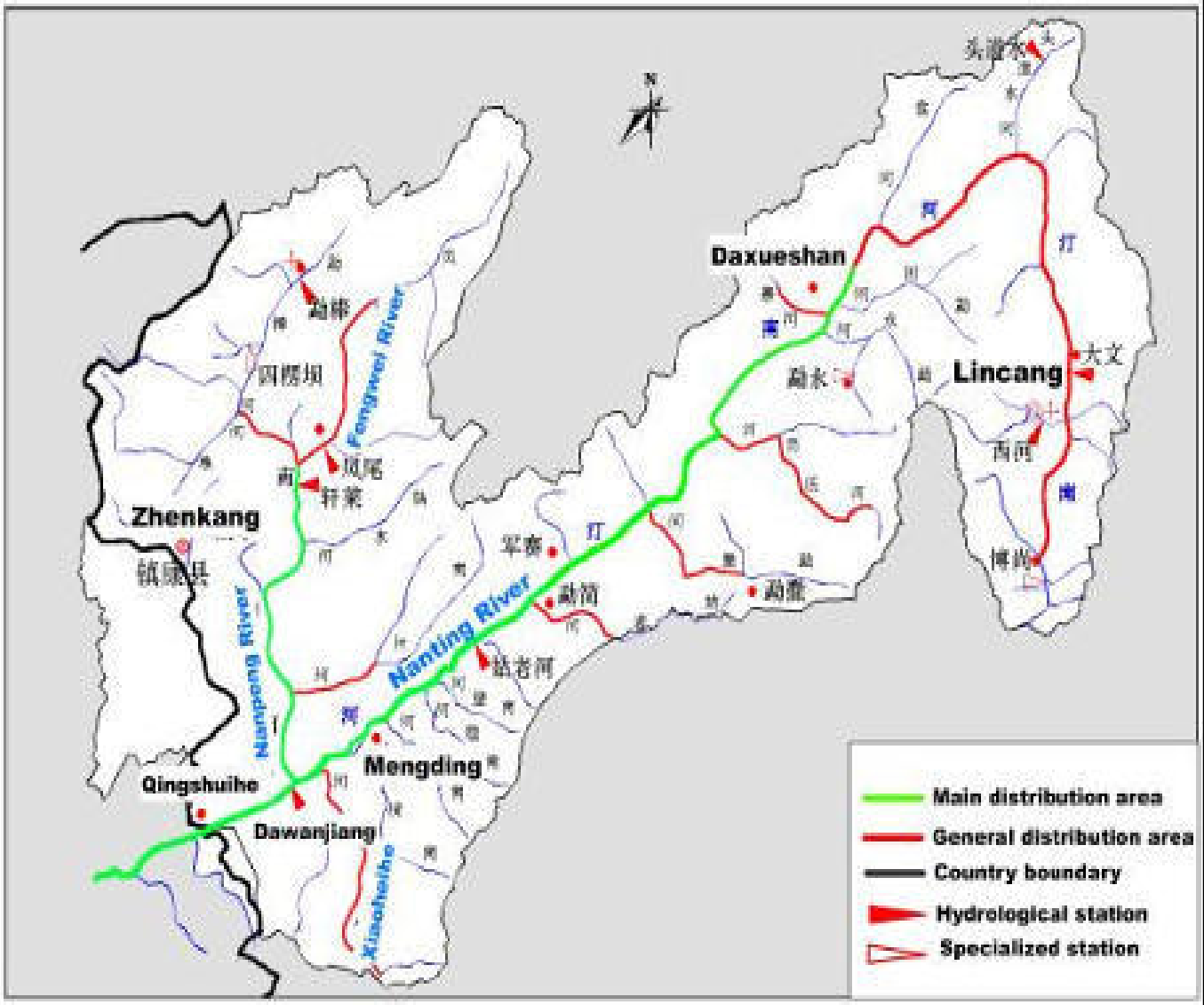


Figure 4.12: Distribution of four conservation targets: *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis* in Nanting River system
(Source: Master plan of NAGR in lower reach of Nanting River (2013-2020))

Table 4.34: Fish resources in four nature reserves in Lincang Prefecture

Number	Scientific name	Nangun	Nanpeng	Nanting	Lancang	Endemic	IUCN-RL
Ⅰ	**ANGUILLIFORMES**						
1	**Anguillidae**						
1)	*Anguilla nebulosa*	1	1	1			NT
Ⅱ	**CYPRINIFORMES**						
2	**Botiidae**						
2)	*Botia histrionica*			1			
3)	*Sinibotia longiventralis*				1	E_L	
4)	*Syncrossus beauforti*				1		
5)	*Ambastaia nigrolineata*				1	E_L	
3	**Cobitidae**						

Number	Scientific name	Nangun	Nanpeng	Nanting	Lancang	Endemic	IUCN-RL
6)	*Lepidocephalichthys berdmorei*	1	1	1			
7)	*Misgurnus anguillicaudatus*	1	1	1	1		
4	**Balitoridae**						
8)	*Vanmanenia* sp.				1		
9)	*Balitora lancangjiangensis*				1		
10)	*Balitora nantingensis*			1		E_2E_3	
11)	*Hemimyzon elongatus*				1	E_L	
12)	*Hemimyzon nujiangensis*		1	1		E_N	
13)	*Hemimyzon pengi*				1	E_L	
14)	*Hemimyzon zhangi*				1	E_L	
15)	*Balitoropsis yunnanensis*				1	E_L	
5	**Nemacheilidae**						
16)	*Neonoemacheilus mengdingensis*	1	1	1		G	
17)	*Homatula anguillioides*				1		
18)	*Homatula pycnolepis*		1	1		E_2	
19)	*Pteronemacheilus meridionalis*	1	1	1			
20)	*Physoschistura shuangjiangensis*	1			1		
21)	*Schistura bucculenta*		1		1		
22)	*Schistura cryptofasciata*			1			
23)	*Schistura disparizona*	1	1			$E_1E_2E_3$	
24)	*Schistura fasciolata*				1		
25)	*Schistura kengtungensis*	1	1	1	1		
26)	*Schistura latifasciata*	1	1		1		
27)	*Schistura longa*		1	1		E_N	
28)	*Schistura nandingensis*		1			E_2E_3	
29)	*Schistura poculi*	1	1	1	1		
30)	*Schistura prolixifasciata*	1				E_1	
6	**Cyprindae**						
	Danioninae						
31)	*Danio browni*	1	1	1			
32)	*Danio shanensis*			1			
33)	*Danio chrysotaeniatus*				1	E_L	
34)	*Raiamas guttatus*	1	1	1	1		
35)	*Barilius caudiocellatus*	1	1	1	1		
36)	*Barilius pulchellus*				1		
37)	*Aspidoparia morar*	1	1	1		G	
38)	*Opsariichthys bidens*				1		
	Gobioninae						
39)	*Hemibarbus maculatus*				1		
	Barbinae						
40)	*Tor laterivittatus*				1	E_L	
41)	*Tor sinensis*				1	E_L	
42)	*Tor tambra*	1	1	1	1		
43)	*Tor hemispinus*			1			
44)	*Puntius sophore*		1				
45)	*Puntius ticto*	1	1				
46)	*Onychostoma gerlachi*			1	1		
47)	*Scaphiodonichthys acanthopterus*	1	1	1	1		
48)	*Poropuntius huangchuchieni*				1		
49)	*Poropuntius opisthopterus*		1	1		E_N	
50)	*Percocypris pingi retrodorslis*		1		1		
51)	*Neolissochilus baoshanensis*	1	1	1			DD
52)	*Placocheilus cryptonemus*			1			
	Labeoninae						

Number	Scientific name	Nangun	Nanpeng	Nanting	Lancang	Endemic	IUCN-RL
53)	*Bangana* sp.						
54)	*Bangana lippa*				1	E_L	
55)	*Bangana yunnanensis*				1	E_L	
56)	*Bangana zhui*				1		
57)	*Akrokolioplax bicornis*			1			
58)	*Labeo pierrei*				1		
59)	*Crossocheilus burmanicus*		1				
60)	*Garra mirofronits*				1	E_L	DD
61)	*Garra nujiangensis*	1	1			E_N	DD
62)	*Garra salweenica*	1	1	1			
63)	Schizothoracinae						
64)	*Schizothorax lissolabiatus*				1		
65)	*Schizothorax nukiangensis*		1	1		E_N	DD
66)	*Schizothorax paoshanensis*			1			
67)	*Schizothorax gongshanensis*			1			
68)	*Schizothorax yunnanensis yunnanensis*				1	E_L	
	Cyprininae						
69)	*Carassius auratus*		1	1	1		
Ⅲ	**SILURIFORMES**						
7	**Clariidae**						
70)	*Clarias fuscus*	1	1	1	1		
8	**Schilbidae**						
71)	*Clupisoma longianalis*				1	E_L	
72)	*Clupisoma sinense*				1	E_L	
9	**Sisoridae**						
73)	*Bagarius bagarius*				1		
74)	*Bagarius yarrelli*	1	1	1	1		
75)	*Glyptothorax burmanicus*	1	1	1		E_N	NT
76)	*Glyptothorax zanaensis*			1			
77)	*Creteuchiloglanis gongshanensis*			1			
78)	*Creteuchiloglanis macropterus*			1			
79)	*Glyptothorax fucatus*	1	1			E_1E_3	
80)	*Glyptothorax fuscus*				1	E_L	
81)	*Glyptothorax laosensis*				1		
82)	*Glyptothorax macromaculatus*				1	E_L	
83)	*Glyptothorax ngapang*	1	1	1			
84)	*Glyptothorax trilineatus*	1	1	1			
85)	*Glyptothorax longinema*	1	1	1	1		
86)	*Pseudecheneis paucipunctatus*	1				E_1	
87)	*Pseudecheneis longipectoralis*		1	1		E_N	
88)	*Pseudecheneis sulcatoides*				1	E_L	
89)	*Gagata dolichnema*			1			
90)	*Pseudexostoma yunnanensis*			1			
91)	*Oreoglanis jingdongensis*				1	E_L	
92)	*Oreoglanis immaculatus*	1		1		E_1	
93)	*Oreoglanis setiger*				1	E_L	DD
Ⅳ	**BELONIFORMES**						
10	**Adrianichthyidae**						
94)	*Oryzias sinensis*				1		
Ⅴ	**SYNBRANCHIFORMES**						
11	**Synbranchidae**						
95)	*Monopterus albus*	1	1	1	1		
12	**Mastacembelidae**						

Number	Scientific name	Nangun	Nanpeng	Nanting	Lancang	Endemic	IUCN-RL
96)	*Mastacembelus armatus*	1	1	1	1		
Ⅵ	**PERCIFORMES**						
13	**Channidae**						
97)	*Channa gachua*	1	1	1	1		
98)	*Channa striata*			1			
Total		**33**	**41**	**48**	**54**		

Mg: monotypic genus, E_I: endemic species occurred in Lanchang River, E_N: endemic species occurred in Nu River, E_1: endemic species occurred in Nanguan River NNR, E_2: Endemic species occurred in National Aquatic Germplasm Reserve of Nanpeng River, E_3: Endemic species occurred in National Aquatic Germplasm Reserve in the lower reaches of Nanting River. DD: Data Deficient

b Fish habitats

531. The majority of fishes in Nanting River are the benthic fishes, especially preferring to live in the fast torrent. This is associated with the natural environmental conditions, such as high river bed slope, fast flowing, shallow water, and lack of opening water and still water along the stream of Nanting River. The minor fish species including *Channa gachua*, *Bagarius yarrelli* and *Anguilla nebulosa* are carnivores. The others are omnivores and their food type is relatively simple.

532. According to the anatomy of the fish gonads, the fishes that live in this area are mainly the type of disposable oviposit, and the development of germ cells in the ovary is basically synchronous. In the only few reports on the proliferation of fish in Nu River, the fish breeding season in this area is mainly concentrated from April to June. First began to breed in the basin is the small fishes of Cobitidae, Homalopteridae and Cyprinidae. With the start of the rainy season and river runoff increase, many large and medium-sized fish migrate from downreaches for breeding in Nanting River.

533. There are a dozen of wetlands with variant size distributed from Daxueshan to Junsai along river course of Nanting River (**Figure 4.12**), where is approximately 15 kilometers in the upper reach of proposed Nanting Bridge. The aquatic vegetation provides good spawning habitats for fishes producing the adhesive eggs, and also provides good foraging and shelter habitats. In addition, partial river course such as Nanpeng, Mafengcun, Mangka and Mangbing, provide the typical spawning habitats for fishes producing drifting eggs, due to the fast runoff and intensive whirlpools.

534. The river course from Banxing Village (23° 30′ 41″ N, 98° 56′ 50″ E) to the lower reach becomes narrow. The runoff is fast and the whirlpools is abundant. These provide good habitats for spawning by fish laying floating-eggs. The main species include fishes of Barbinae, Cotitidae, and Botiidae and so on. However, there is only the migratory path for 2.7 kilometer in the upper reach and 1.0 kilometer in the lower reach of proposed Nanting Bridge. The spawning site is disturbed approximately 2.7 kilometer in the upper reach of bridge.

535. The fish harvest has an obvious seasonal change in Nanting River, which is concentrated in April, May and June. With the rainy season going, the fishes migrate from the downreaches of Nu River for spawning in Nanting River, including Barbinae, *Bagarius yarrelli* and Clarias fuscus. Through interviews with the local people along Nanting River, there are groups of fishes concentrate for spawning in the shoals in the flood season of each year.

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

536. To establish a responsible, improved and educated implementation of civilized construction, standardize construction behavior and creating a good working environment are some of the goals for the project. The construction must not inconvenience the public and must strictly abide by the safety regulations. To strictly implement the relevant laws and regulations of environmental protection, LBECZ will take necessary environmental protection measures during construction period:

- high altitude removal of soil and cleaning of garbage, is strictly forbidden as it will lead to extreme dust pollution.
- prohibited incineration of garbage, asphalt, linoleum, rubber and other easy to produce toxic and harmful soot and odor gas substances.
- construction of roads/foundation to be phased at any time to reduce road dust.
- Restrict collection of garbage in living areas by designating transfer stations.
- no toxic waste or waste residue directly discharged.
- no toxic and harmful waste for earthwork backfill, pollution of groundwater.
- Ensure cleaner wastewater discharge into the sewage pipe after two sedimentation tank/proper sedimentation.
- strengthen the education of construction personnel, provide environmental protection awareness.

5.1 Environment Impacts and Mitigation Measures

537. This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental interventions and physical cultural resources in the project's area of influence. In quantitative terms to the extent possible; this section also identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; examines global, trans boundary, and cumulative impacts as appropriate.

538. During site visits, the officials and consultants made numerous observations and held discussions with PMO and local communities which would be helpful for project design (summarized below):

(xi) noted location of proper access roads, laydown area for materials to be used by the construction companies to use without disturbing the adjoining land area for working and minimizing utilization of populated areas,
(xii) proper discussion on avoidance of underground existing pipes for water, heating, sewage etc. at these proposed work sites,
(xiii) discussions on ensuring right of way for construction vehicles and provide traffic safety during construction to local residents living adjoining these project sites (specially near two schools),
(xiv) traffic caused by construction of new buildings/expansion projects by use of concrete, dump trucks etc. transporting materials inside two school premises;
(xv) discussed traffic safety for children and their parents during operations of school in normal work hours (for Qingshuihe Guomen School),
(xvi) review the distances of these project sites from non-sensitive biodiversity areas and cultural heritage sites to ensure minimal impact,
(xvii) dust and noise emissions from the construction subprojects and their impacts on two school

children and apartment dwellers adjoining the sub-project areas,
(xviii) noises from any surroundings areas during construction and operations,
(xix) review the impact of project activities on associated facilities to the project, and
(xx) Determine the offset required for carbon sequestration and increase in emission due to reduction of carbon sink, increase in vehicular emissions, construction project and operations of schools, hospitals, WTP, WWTP, SWM, trade and production activities. Review options to reduce climate change vulnerability for each sub-projects.

539. The team along with officials conducted public consultations twice during the course of project with the public residing in these subproject areas to sensitize them about project activities, their impacts and get their suggestions.

5.2 Environment problems due to project location and design

540. All project components such as buildings, bridges, roads shall be designed in compliance with relevant the PRC's design standards and codes for energy-efficient, safe buildings, or in compliance with World Bank's EHS guidelines 2007 standards, which apply in-case where the PRC's standards are less stringent.

541. Potential adverse environment impacts associated with LBECZ has been avoided or minimized through careful site selection. The LBECZ is sited away from major settlements, whenever possible, to account for future urban expansion. Thick vegetation areas are avoided wherever possible; however, it does include some plantations of rubber trees and agricultural areas etc. on community land. The physical damage to any crops in the area during the construction phase of the project will be compensated at the time of damage as per PRC norms.

542. **Green Building and Energy Efficiency**: The building design must include green building and energy efficiency features. The design must lead to introduction of other energy efficiency elements (heat meters; heat insulation that meets the requirements on PRC's Energy Efficiency Regulations; use of solar energy, LED lighting; glazed windows) etc.

543. **Linked facilities**: The Project Management Office (PMO) must confirm from concerned authorities of various linked facilities such as landfills to accept solid waste, medical wastes, power, water supply, wastewater facilities to each of the project components on their ability to deliver required services and without interruptions. Any existing underground utilities such as power cables, sewage drainage, water pipelines etc. for local area that can be disconnected during construction will be designed accordingly. Section 3.5.5 discusses the linked facilities in detail.

544. **Construction in Populated areas**: The Project Implementation Unit (PIU) and the Construction contractor must ensure that proper design be considered so that the proposed infrastructure becomes coherent, and complies to national and international health and safety norms. During the construction phases of complex projects (with multiple construction sites) known risks include those associated with increased traffic (injury and mortality rates) and mobile/migrant workers (vector-borne, communicable diseases). These risks need to be elevated as priority as they represent significant burdens on countries, community members and individuals and have demonstrated importance for Yunnan. These risks will be identified in the HIA report.

545. **Restoration**: Associated impacts on any area adjoining the two schools for building inside its premises used for construction material storage and workmen temporary camp will be restricted to the

construction phase and will be temporary in nature. After construction is complete, these areas within the premises will be repaired.

546. **Climate Change**: All facilities shall be properly sited to minimize the risk of scouring that may result from increased intensity of precipitation as a result of climate change. Green belt tree plantation and reforestation measures must be adequate to ensure net GHG Emission reduction from project activities. CVRA, attached as **Appendix 3** to this EIA, lists possible options to reduce climate change risk involved due to project construction and operation activities.

5.3 Environmental Impacts Associated with Pre-Construction Stage

5.3.1 Acquisition/Clearance of rubber plantation/agricultural and other lands

547. The land occupation of the project is mainly rubber forest, which causes loss of agricultural land of the surrounding residents. At least one household will need to be relocated which will be covered in the Resettlement Plan for the project. Following measures will have to be taken prior to the project activities:

- Ensure existing drainage facilities are maintained in working condition,
- Protect /preserve topsoil and reinstate after construction is completed, and
- Repair /reinstate damaged green area etc. after construction is completed.
- Restore green cover through plantation of trees in green belts around project areas that are local and non-invasive in nature.

5.3.2 Impacts on Temporary Use of Land

548. The mobilization of construction equipment and construction materials will require space for storage and parking of construction vehicles and equipment, construction material storage yards, disposal sites, and labor camps for human resource to avoid environmental impact and public inconvenience. These locations must comply with the local laws and regulations and need approval from authorities to utilize these facilities (access roads, telecommunication, and pipe borne water supply). It is important that selection of temporary lands does not infringe upon adjoining residential areas, water bodies, natural flow paths, access roads to health, cultural amenities and schools in the area.

549. Thus, following measures will have to be taken prior to the project activities:

- Avoid farming season wherever possible in the planning of project activities,
- Protect /preserve topsoil for reinstatement after construction is completed,
- Repair /reinstate damaged bunds, animal passes etc. before construction is started, and
- Compensation for loss of home garden, agricultural production etc.

550. Removal of trees should be minimized during preparation of construction area, access road and other facilities. The existing vegetation including rubber trees will be cleared (33 trees per mu of land to be procured) at each project component. Once the construction activities are completed, it is expected that the green belt development would lead to natural regeneration of vegetation in the area. In addition, for landscaping the seedlings of the native species found in these habitats can be planted once the construction work of sub-components is completed, to enhance the structure and floristic composition of the habitats found in the LBECZ. Since most of the birds, small mammals, reptiles and amphibians cohabitate with the humans in the area, the replantation will restore the habitats for them in the area.

5.3.3 Aesthetic and visual environment

551. Every effort will be made to design and construct all the manmade structures in this project to blend with the surrounding environment. It is located in the hilly area with greatly fluctuating terrain. The high-filled and deeply-excavated highway subgrade will seriously damage the surface vegetation in the land acquisition area and form a bare land in great contrast with ambient environment of construction site as well as blocks people's line of vision. More seriously, due to the complete destruction of surface vegetation and the disturbance of the soil in the project area, water and soil loss will easily form in loose and bare slope surface in the rainy season, resulting in an increase of soil erosion modulus and an impact on downstream vegetation and water. Therefore, the regional landscape environmental quality will be affected. In the dry season, the loose surface will easily form dust when there is wind and there are moving vehicles. When the dust covers the surface of the vegetation outside the construction site the beauty of the surrounding landscape will be greatly reduced. In accordance with the survey of environmental status, along the proposed highway the area is mostly rural landscape. The arrival of a large number of construction machineries and constructors will add an unharmonious landscape development.

552. The construction of the bridge will change the landscape of the area. Based on the results of the survey of water environment, the proposed construction of highway and bridge will have a great influence on the landscape along the route. Thus, the establishment of the LBECZ will affect the present and future aesthetic value of the sites selected.

5.3.4 Risk of natural Disasters

553. The project will not cause or increase the risk of any natural disasters. No serious earthquake occurred in the area of the project. On November 6th, 1988, there were 7.6-magnitude and 7.2-magnitude earthquakes in Lancang Lahu Autonomous County and at the border of Gengma County and Cangyuan County respectively, which caused a slight impact on Mengding. According to the " Seismic Zoning Map of China" (GB 18306-2015) and "China Seismic Intensity Scale" (GB/T 17742-2008)，the seismic intensity in the area of the project is VII degrees[56], Peak ground acceleration (PGA) is 0.30g, and the response spectra is 0.45s.

5.4 Environmental Problems Associated with Construction Stage

Degree of Potential Impacts

554. In general, the degree of impact of LBECZ is determined by the quality or uniqueness of the existing environment along the proposed area. The quality of the existing environment is influenced by several factors:

- **The uniqueness of the resources -** Proposed LBECZ is reviewed for species or community types that are uncommon or in decline in the region or country. The environmental review evaluates whether the resource possesses a feature that would make it unique, such as its size, species diversity, or whether the resource plays a special role in the surrounding landscape.
- **The threat of future disturbance -** The resource is compared to surrounding land uses that may affect the quality of the resource over time. Considerations include whether the current and likely future land uses may threaten some aspect of the resource or whether the resource is valued by the adjacent community and therefore, likely to be preserved.
- **The degree of disturbance that already exists -** The significance of prior disturbance can be evaluated by determining how close the place resembles pre-settlement conditions.

[56] The China seismic intensity scale (CSIS) is a national standard in the People's Republic of China used to measure seismic intensity. Similar to EMS-92 on which CSIS drew reference, seismic impacts are classified into 12 degrees of intensity, or liedu (literally "degrees of violence") in Roman numerals from I for insensible to XII for landscape reshaping.

Duration of potential impacts

555. The construction of a LBECZ involves both long-term and temporary impacts. Long-term impacts would exist as long as the LBECZ is in place; and includes imposition of land use restrictions, loss of vegetation and concern on air, water, noise and soil pollution impacts due to establishment of residential/commercial/industrial activities. However, temporary impact of LBECZ on local community would be minimised by proper mitigation of impacts of construction in the project area.

556. Main construction activities inside the LBECZ are:

- Vegetation clearance
- Laydown areas for construction material storage
- Foundation excavation and concreting
- Logistics and dumping of spoil materials
- Office sheds, storage
- Contractor's camp, yard and workshop
- Waste disposal
- Tree replantation and green belt development

557. The project activities during construction phase will involve clearing of rubber trees wherever required, excavation for civil works and erection related to buildings, roads, yard layout and underground power, sewer, water distribution lines. It will involve excavation and civil works for buildings, open areas, roads and culverts, and lay down areas. During the operation phase, most of the construction phase impacts will get stabilized and the impacts will be restricted only to the operation and maintenance of the project, as well as noise and pollution due to border trading port operations.

558. The impacts on the environment from various activities of the project can be categorized as follows:

- Impact on Physical Resources
  - Impact on Topography
  - Impact on Climate
- Impact on Environmental Resources
  - Impact on Air Quality
  - Impact on Noise Levels
  - Impact on Surface Water Quality
  - Impact on Ground Water Quality
  - Impact on Soils and Geology
- Impact on Ecological Resources
  - Terrestrial Ecology
  - Wildlife
  - Aquatic Ecology
- Impact on Human Environment
  - Health and Safety
  - Agriculture
  - Socio-economics
  - Resettlement and Rehabilitation
  - Cultural sites
  - Traffic and Transport
  - Interference with other utilities and traffic
- Waste Disposal

- Solid waste disposal
- Liquid waste disposal.
- Hazardous Waste disposal

559. The impacts of the project activities on various environmental attributes are discussed in subsequent sections. The following activities shall form an integral component in the planning stage before commencement of construction activity by the construction contractor.

5.4.1 Impact on Physical Resources

Impact on Topography

560. During the construction of the project components, the most prominent impact on the surface topography will be due to the excavation for foundations, removing of the trees (if any) and erection of buildings. The impact will be irreversible as the present feature of the sites as well as the land use will change due to construction of new buildings, roads, bridges, tunnel etc.

561. The construction phase involves site preparation, clearing of existing vegetation and some earthworks for leveling the surface. These activities may cause some negative impacts such as:

- Change in Landscape: vegetation clearance, biodiversity;
- Emission of Dust, wastewater
- Associated noise; and
- Improper management of construction debris and solid waste may pose risk to the local community.

562. No topographical changes are envisaged during the operation phase.

Impacts to the land and vegetation

563. The construction activities would involve the usage of approximately 37.57ha m^2 [57]area around the locations of each project subcomponent. Clearing of vegetation, excavating, filling, compacting, leveling and other related activities are envisaged during construction phase. Large scale soil erosion, siltation, blockage/restriction of natural drainage patterns leading to soil degradation and water logging/localized flooding could occur in the area. The impact of water and soil erosion of project construction activities is assessed in Water and Soil Conservation Report (**Appendix 2**).

564. Hence, proper construction practices in the form of the usage of minimal areas required for constructions, provision of drainage systems-with silt traps where necessary, non-obstruction of existing drainage paths/flow in water bodies-with culverts provided where necessary-and restoration of the affected area as much as possible after the construction phase will be adopted as impact mitigation measures. In addition, these measures need to be put in place prior to the rainy season in the area and regular monitoring and maintenance activities need to be carried out during the construction period.

565. Therefore, provisions will be made for relatively uninterrupted drainage, in the form of culverts, animal passes or other measures having capacity to drain all water from rains, flooding at locations where water logging could occur during construction and operational stages. Regular monitoring and maintenance of existing culverts in the area will also be done to mitigate the adverse impacts associated with water logging/flooding in the area.

[57] By land use nature, the project will require permanent land use of 22.63 hm^2 and temporary land occupation of 45.42 hm^2.

Impact on Climate

566. The proposed LBECZ area has predominantly rubber plantations and agricultural lands. About 47,324 rubber trees, 5300 shrubs besides grasslands will be cleared due to implementation of project activities. The Climate Risk and Variability Assessment (CRVA) report has been attached as **Appendix 3** which deals in detail about potential impact to climate change due to project construction.

567. The project activities will modeled to estimate the approximate carbon di-oxide increase due to the proposed project activities:

- Reduction of carbon sink - due to removal of rubber trees and vegetation by 80.5% LBECZ area which is covered by sub-projects funded by ADB project. There is no vegetation removal for Cangyuan which is an area allocated for construction earlier and Zhenkang area which has agricultural area.
- Increase in vehicular emissions due to increase in traffic after the project is operational in LBECZ area.
- Increase in emissions from construction activities of all sub-activities
- Increase in emission from facilities such as schools, hospitals, etc.
- Increase in emissions from WTP, WWTP, SWM, Land fill sites, medical waste sites.

5.4.2 Impact on Environmental Resources

Impact on Air Quality

568. During the construction phase, the activity would involve excavation for the erection, movement of transporting vehicles carrying the construction materials, spoils etc. along the main haul roads. All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which although will be transitory in nature. Though the emissions are temporary and not expected to contribute significantly to the ambient air quality and will be within prescribed limits for industrial regions by National Ambient Air Quality Standards, necessary measures are to be taken.

569. The air quality in the project area may slightly deteriorate for the time being during construction mostly due to dust emission. Air pollution by way of dust will increase during construction (due to truck/vehicle traffic to the project site, minor construction required, earthwork, development of roads, vehicle traffic on gravel road, etc.). Also, use of construction vehicles and equipment and idling of vehicles carrying construction raw materials add to the emissions. Dust produced will potentially negatively affect the following:

- Local residents/communities and general public at other sub-project locations;
- Construction workers temporary camps, work areas etc.; and
- School attendees (students, teachers at two schools) and adjoining apartment dwellers and other buildings in the vicinity of subprojects.

570. The preparation of road would require the scraping of top soil and compact the same with appropriate type of layers made of soil and grit to handle the vehicular transportation of equipment and accessories. At majority of locations, access road will have to be constructed for movement of heavy vehicles. All these activities would give rise to emission of dust particles thereby affecting air quality marginally at the site which although will be transitory in nature. Proper dust control during construction will be done using mechanical water spray to minimize the dust nuisance. Regular sprinkling of water on open surface and dust emitting grounds should be done regularly until paving is done during dry season and keeping all soil, sand, and aggregate piles covered (whether on the site, or on trucks) to minimize the air pollution during the construction stage. If there is any complain of dust emission from local community, it should be given proper attention.

571. The operation of border trade area, schools will not have any negative impact on the air quality of the region during the operation phase. However, international production center, roads, hospitals, water treatment, waste water treatment facilities, solid waste management will have air emissions that would need to be monitored regularly and maintained as per PRC national laws or IFC's World Bank's EHS guidelines[58]. **Annexure 1B** discusses the comparison in levels of compliance required as per EHS standards

572. According to actual measurement results around the similar construction sites, the concentration of TSP within 20-30m work plane in the site can be up to 200-300mg/m^3, mainly affecting the construction personnel; the concentration of TSP at a distance of over 50m is 1.5-3.0mg/m^3, the main range of influence is in the downwind direction, and the Class II criterion in Table 2 of Comprehensive Emission Standard of Air Pollutants (GB16297-1996) may be reached generally at a distance of 150m in the downwind direction, i.e. 1.0 mg/m^3.

573. The annual average wind speed in project area is 0.91 m/s. The weather is arid during dry season, so dust pollution is easy to be generated.

574. Since the engineering construction requires a large-scale land and total duration of 31 months, the generation of dust concentrates mainly on earlier-stage foundation construction and construction among 31 months as well as has an influence on the range of 50m outside construction site and 300m of downwind direction.

Impact on Noise Levels

575. **Noise Source Intensity**: Commonly-used machinery and equipment for construction are: excavator, bulldozer, loader, static pressure pile driver, etc. The main noise sources at each construction stage and the sound level value at 1 m are shown in **Table 5.1**.

Table 5.1: Noise Source Strength of Main Construction Machinery

Construction Stage	Sound Source	Noise Source Intensity dB(A)
Earthwork Phase	Excavator	89
	Bulldozer	89
	Loader	85
Structure Phase	Static Pressure Pile Driver	99
	Electric saw	94
	Electric welding machine	89
	Air compressor	79
	Medium weight carrier	74
Decoration Stage	Electric Drill	95
	Electric hammer	90
	Light weight carrier	69

576. During the construction phase, the major sources of noise pollution are movement of vehicles transporting the construction material and equipment within and outside the construction site. Most of the access roads along the location are wide enough and can be used to bring construction material without obstructing the neighborhood roads. The major work of the construction is expected to be carried out during the day time at schools however the movement of trucks and concreting may happen

[58] They will need to follow IFC/World Bank EHS guidelines if National laws are less stringent.

in the night to avoid congestion in the area in the day time. The residents living nearby will be exposed to noise generated during day and night during the construction phase. At other places, the number of residents are far away and therefore the impact of noise will be limited. **Table 5.2** gives predicted values[59] at different types of equipment.

Table 5.2: Noise Values at Different Distances from the Main Sound Source dB (A)

Name of Equipment:	1m	5m	10m	20m	40m	50m	100m	150m
Bulldozer	86	72	66	60	54	52	46	42
Loader	90	76	70	64	58	56	50	46
Excavator	84	70	64	58	52	50	44	40
Truck	92	78	72	66	60	58	52	48
Crane	82	68	62	59	56	54	52	50
Electric Saw	84	70	64	61	58	56	54	52
Transport Vehicle	84	70	64	61	58	56	54	52
Superposition Value	95.91	81.91	75.91	70.58	65.68	63.55	59.83	57.37

Analysis of Impact of Construction Noise on Sensitive Receptors

577. Protected targets within evaluation scope are Shuanglongjing, Qingshu Village, Bangui, Tuanjie Village, Dawanjiang, etc. In accordance with **Table 5.2**, after noise of project construction equipment is attenuated by distance the predicted results of sensitive targets are shown in Table 5.3.

Table 5.3: List of Noise Predicted Results for Sensitive Targets during Construction Period

Monitoring Point Position	Involving Sections	Distance from Road Center Line (m)	Contribution Value	Background Value	Predicted Value	Executive Standard	Commenting
Shuanglongjing	No.1 Road	20	70.58	52.7	70.65	60 in daytime, 50 in night	Exceed the standard

578. According to **Table 5.3**, the project construction process has a great influence on the peripheral sensitive targets. Shuanglongjing and Tuanjie Village are close to the project and the noise predicted results are excessive in daytime and night while for the rest points the results are excessive in night. Thus noise reduction measures shall be taken.

579. Construction works may cause objectionable noise nuisance to workers, and most importantly, the students or teachers at this Qingshiuhe school and the local community living in vicinity of the proposed Cangyan Guomen School. Night-time construction traffic and related offloading can also generate night-time noise and related impacts. Noise-related impacts include health effects such as annoyance in the general population and learning impairment in school children related to day-time noise exposure, and sleep disturbance related to nigh-time noise exposure. According to World Health Organization (WHO) guidance, to avoid sleep disturbance at night, sound pressure levels at the outside

[59] The predicted value of daytime boundary outside the 20m can meet the GB12523-2011 Emission Standard of Environment Noise for Boundary of Construction Site in the earthwork phase; the predicted value of daytime boundary outside the 40m can meet the GB 12523-2011 Emission Standard of Environment Noise for Boundary of Construction Site in the construction phase; and the predicted value of daytime boundary outside the 20m can meet GB12523-2011 Emission Standard of Environment Noise for Boundary of Construction Site in the decoration phase.

facades of the living space should not exceed 45 dB $L_{Aeq,8\text{-}hr}$ and 60dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB(A). To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB $L_{Aeq,16\text{-}hr}$ for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB $L_{Aeq,16\text{-}hr}$. Qingshuihe village near the proposed hospital and border trading market, the Qingshuihe school authority and students as well as residents near Cangyuan School must be notified in writing on the date of commencement of construction work at least one month in advance. Following measures will help to keep noise and vibration in acceptable level during construction phase:

- Contractor shall equip their heavy construction equipment and plants with exhaust silencers to limit the engine noise not to exceed 75 db (A) (diggers, compacters/rollers, and loaders) and regularly maintain all construction vehicles and machinery to be a low-noise mechanical equipment.
- Construction time shall be arranged reasonably. LBECZ area has many construction sites, except for engineering required, construction is strictly prohibited at 12:00 ~ 14:00, 22:00 ~ 6:00 (the next day). At the same time construction progress shall be arranged reasonably to slow down the effect of noise on the acoustic environment in adjacent residential area. If there is a special need for continuous operation, it shall be reported to the local environmental protection agency to be approved and announced to nearby residents.
- The Construction Contractor shall designate specially-assigned person to regularly maintain equipment and shall use various types of machinery in strict accordance with the norms.
- Temporary measures to block around the project shall be taken. Noise barriers may be installed by the Construction contractor to ensure residents and schools (students and teachers) are not inconvenienced.
- PRC Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011) standards currently establish a maximum environmental noise goal for residential receptors during the daytime and night time. World Bank EHS guidelines 2007 for noise limits will apply if they are more stringent than the PRC's noise standards.
- Vehicles in the construction site shall choose right time and route for transport and the site shall be far away from the sensitive points such as residential areas. The vehicle shall be driven at lower speed, no tooting, when it enters the site.
- Environmental propagation and education shall be strengthened; construction director shall be organized for training; relevant national environmental laws and regulations shall be learned to enhance environmental awareness.

580. During the operation phase of the project, the ambient noise level meets the World Bank EHS guidelines for residential areas (55 dB(A) during daytime and 45 dB(A) during night time). At these two locations (Qingshuihe village and school and Cangyuan), during normal school hours, noise from play grounds may also disturb some residents, but the nearby residents have been consulted prior to the start of construction.

Impact on Surface Water Quality

581. The construction and operation of the infrastructure especially roads will not have any major impact on the surface and ground water quality in the area. Contamination of water bodies, if any in that area, may result due to spilling of construction materials and surface runoff from the construction site adjoining the water body. There may be an increase in the turbidity levels temporarily where the surface runoff during construction meets the drainage of the area. This can be avoided by careful selection of the raw material and waste material storage at the construction site.

582. Proposed activities will create temporary impacts to the existing drainage system in the area including in earthen and line drains. Thus, it will create temporary inundation closer to the above locations during rainy season. Stagnation of water will create direct impact on public health. Thus, incorporation of following measures will minimize anticipated impact due to obstruction of natural flow paths and existing drainage:

- Provisions of temporary drainage facilities to the particular locations if existing drains are obstructed due to construction activities.
- Maintenance of all drainage paths by avoiding blockages at all times.
- Contractor should minimize excavation of drainage systems in the project affected area.
- If any village, school, community living is situated in immediate vicinity of the waterbody/river, adequate reinforcement of embankment will be done to ensure no surface runoff gets discharged into the waterbody/river.

583. Contamination of water bodies may result due to spilling of construction materials and surface runoff from the construction site joining the water body. There may be an increase in the turbidity levels temporarily where the surface runoff during construction meets the water body. This can be avoided by careful selection of the construction sites and the access route so that the surface runoff does not meet the water body.

584. Removal of rubber trees and shrub vegetation and leveling of land are the main activities during the preparation of site for project components and these materials could be added to the stream segments during the flooding period. In addition, the soil erosion as well as sedimentation to the surface water bodies could take place during rainy period. The expected impacts from soil erosion could be very low due to the presence of flat topography. Also, all the activities would exist only until the completion of the construction period.

585. Proposed project construction activities may cause temporary impacts to the existing drainage system in the area including natural flow paths, earth and line drains. Stagnation of water will also create temporary breeding sites to mosquitoes, which may have direct impact on public health. Thus, incorporation of following measures will minimize anticipated impact due to obstruction of natural flow paths and existing drainage:

- Provisions of temporary drainage facilities to the particular locations if existing drains are obstructed due to construction activities.
- Maintenance of all drainage paths by avoiding blockages at all times.
- Contractor should minimize excavation of beds of any streams, irrigation systems, and other water resources available in the project affected area.

586. At the LBECZ, Construction contractor shall locate the temporary day-time facilities such as drinking water, toilet/sanitary facilities by constructing temporary soak pits for toilets and garbage collection which will be away from any water body. No water well will be located within minimum 100 m of a toilet facility. There will be 960 constructors in the normal construction period while 1570 during peak construction period. However, their accommodations are not within the project area. Domestic water of the constructors is mainly for hand washing. Counting as 10L/(person·d), the need for domestic water of the constructors is 2 m^3/d; to calculate the sewage amount as 80% of the water usage, the sewage generation is 1.6 m^3/d. After sedimentation, the domestic sewage will be used back to the construction process and will be used for spraying and de-dusting.

587. Other possible contaminants during the rainy period are mainly from anthropogenic activities. The created wastewater is planned to be collected and transported to the available existing water treatment plant for treatment of waste water.

588. The total length of drains in the works is about 8290m. 40 temporary sedimentation tanks are adopted for the sedimentation of surface runoff. The surface runoff will be used for watering in construction site after settled. And the rest will be discharged into nearby channels.

Influence of Bridge Construction on River

589. On the Mangka border connecting road, a bridge spanning Nanting River is built in the K0+882-K1+232 section; the main bridge is a double-tower, three-span cable-stayed bridge, with a span arrangement of 70m+140m+70m. The bridge design has twin-tower three-span cable-stayed bridge that uses the prefabricated pre-stressed concrete T-beam with a 2×30m span and a total length of bridge girder of 350m. The two piers need to be set up on the river banks. The technology of cast-in-place bored pile is utilized for construction of bridge girders and piers, and installing a steel casing cofferdam to avoid spillage is used during construction. During the drilling perfusion of pile foundation for the pier, embedment of steel casing is normally adopted. The steel casing functions for fixing of pile position and guiding of drilling as well as for protection of boreholes to prevent soil layer collapse at the boreholes.

590. The drilling slurry for foundation of construction of bridge girder cast-in-place bored pile is generally prepared by use of water, clay and additives in a suitable mix ratio. The additives generally include the CMC, FCI, nitro humic sodium carbonate, sodium carbonate, PHP, barite fine powder and such fiber materials as pulp, dry sawdust, asbestos, etc. During drilling and pile perfusion, the potential pollutants which have the greatest impact on water are cavings and slurry for encasing wall. The cavings wastewater produced during construction will impact directly on water quality of Nanting River if the wastewater is discharged into river with improper treatment. During the foundation construction of the major bridge crossing Nanting River, construction processes like cofferdam sinking and implantation will disturb water and bottom mud so as to increase SS concentration and impact on water quality. Analysis of the increase of SS concentration on water quality is as follows:

- The drilling is carried out in the cofferdam and isolated from the surface water body, thereby not impacting on the river water quality during operations.
- Cofferdam sinking and implantation will disturb water and bottom mud, leading to a small amount of bottom mud suspension. Suspended bottom mud will increase sediment concentration and turbidity degree in a certain range owing to factors like flow expansion. During the removal of construction cofferdam, slurry and wastewater in cofferdam which will be discharged into rivers will also increase SS concentration in a short time. According to actuality monitoring, the water in Nanting River is in good quality. The monitoring indexes of water have met the Class III water quality standard in Environmental Quality Standards for Surface Water (GB3838-2002). Therefore, suspended bottom mud will not lead to hazardous substances pollution to water. Meanwhile, the influencing time and range of cofferdam construction on water quality is limited. Those pollution factors will be eliminated with the completion of construction.
- Drainage from cofferdam and rainfall which will have impact on water quality. During construction in dry seasons, drainage of foundation pit is mainly of leakage water while during flood season, drainage of foundation pit is mainly of rainfall. Drainage of cofferdam foundation pit has little impact on SS concentration.
- Based on analogy and analysis on monitoring data of several similar cofferdam drainage, the maximum increment of SS resulted from the Project is estimated as 250 mg/L with the range of influence being 150 m of downstream.

591. Based on analysis above, bridge construction crossing Nanting River will have minimum adverse impact on river, especially the wastewater from the river foundations and cavings, which will increase the concentration of suspended solids in Nanting River.

Impact on Ground Water Quality

592. Ground water pollution can take place, if chemical substances and oily waste get leached by precipitation of water and percolate to the ground water table. For schools/buildings/roads/urban infrastructure construction activity, no chemical substance or oil is used hence there is no impact on ground water quality. The silt discharge from the earth work around water bodies, oil, grease and fuel release from the construction vehicles/equipment and spoil from construction and other construction related activities such as raw sewerage from worker accommodation sites will mix with runoff water. This situation will increase during the rainy season and have a critical impact on surface and ground water. Thus, following measures will be required in order to prevent deterioration of water from the construction and construction related activities:

- All construction vehicles and equipment should be maintained in proper conditions without any leakages,
- Contractors shall use silt traps and erosion control measures where the construction is carried out in close proximity to the water bodies to avoid entering of cement particles, rock, rubbles and waste water to the surrounding drains,
- Construction activities requiring digging should be preferably done in the dry season,
- Waste oil should be collected properly and disposed to the approved location.

593. The impact on groundwater during construction of the Project is mainly reflected in the impact of construction of bridge girder pile foundation of No.3 road and Mangka Border. In these two projects, two bridge girders are built, and there are no grand and small bridges. Pumping and drainage of groundwater is required during bridge pile foundation construction. But the groundwater in general river is closely related to surface water; the amount of groundwater will not change much and generally the water level can be recovered by stopping water pumping and drainage. The main pollutant of drilling slurry and waste residue of bridge pile foundation is suspended solids (SS). Most of the pollutants can be discharged through the pumping and drainage process; and hence pumping and drainage of slurry waste water and waste residue shall be done properly in the construction; and then sedimentation tank treatment shall be set; after dried the waste residue shall be transported to the low-lying areas in Qingshuihe River area as backfill. This will reduce filling engineering to develop land leveling in Qingshuihe River Area in the future and reduce ground water pollution impacts.

Impact on Soil and Geology

594. Project activities including excavation, cut and fill operations, removal of trees and green cover vegetation etc., will enhance the soil erosion during rainy season. Excavation activity and land clearance in the erosion prone areas have to be minimized by conducting site selection. Leveling and stabilization of Project subcomponent construction sites will be done after completion of construction activity, which will avoid increased acceleration of surface runoff and damage to the topsoil. The impact associated due to excessive erosion and other civil works can be avoided or minimized by following mitigation measures:

- Maximum effort should be taken to minimize removal of trees and green cover vegetation. Green belt formation around sub-project to be designed to take care of slope failure and gully erosion.
- Minimize obstruction or destruction to natural drainage pattern of the surrounding area.
- Proper treatment of clearing and filling areas against flow acceleration.
- Turfing work should be taken after completion of construction around the LBECZ.
- Contractors shall restrict cut and fill operation around sharp/deep slope areas.

- Piling activities will be restricted to non-rainy season; otherwise the piled materials will spread all over the area and contaminate close by water bodies.
- Top soil (2-3 cm from the top of the soil), which is removed during construction from the cultivated lands must be stored separately for future utilization of near foundations.

Water and Soli Loss Impact

595. The impacts of the construction project on water and soil loss mainly take place in the construction period where the damage of the original geomorphic vegetation and the discharge of abandoned spoil, the abandoned stone and the abandoned slag frequently occur. The soil and water conservation function of the original geomorphic vegetation in the project area will be rapidly reduced or lost, which will provide a large number of loose deposits that is easily washed out by water for the occurrence and development of water and soil loss.

596. A proper drainage system shall be established in order to prevent water and soil loss. When the construction is completed and after all projects enter into the normal operation period, geology and geomorphology will no longer be affected and the impact of water and soil loss is over.

597. With respect to the construction characteristics of the project, the environmental impact assessment has proposed the following ecological protection measures:

- Strengthen environmental protection education for construction teams, standardize the behaviors of construction personnel, protect the environment, protect the plants and trees around the construction site, and do not arbitrarily destroy plants outside the construction belt;
- Strictly divide the scope of construction in phases if the ground is sloping. Minimize temporary storage of loose soil and maximize temporary floor area in the premises to ensure smooth construction. Strictly limit the scope of constructors and construction machinery activities;
- Refill soil excavated for the construction with plans and refill the surface soil to surface layer as far as possible;
- Avoid the construction of civil engineering during the rainy season and reduce water and soil loss;
- Establish a perfect drainage system to prevent water and soil loss.

5.4.3 Impact on Ecological Resources

Impacts on Terrestrial Habitats and Plants

598. According to the Biodiversity Report in **Appendix 2,** there is no plant species under the national and provincial key protected plants in the project areas. Further, the project will require large scale vegetation clearing and therefore impact on local flora is significant. The number of standing trees observed within the project impact area includes 47,324 rubber trees and 5300 shrub trees. These will be removed during the construction period. In addition, rubber trees which form a dense cover will be removed.

599. In the project sites, the detailed information of the current land covers and the land uses after project completion are presented as **Table 5.4**. Most of the land currently comprises rubber plantations, shrub land, grassland and unused land. No rare plants were found in the project area, and those plants are widespread and common. The total project area is 123.9 hectares and its vegetation ratio is 79.6%. The area of 98.7 hectares with vegetation comprises 51.5 hectares of rubber plantation (52.2%), 45.8 hectares of shrub (46.4%) and 1.35 hectares of grassland (1.4%). Of them, the grassland include different types, such as clearing land for international cooperation area, unused land for Qingshuihe Guomen Elementary School and Electronic charging stations, garden field for water treatment plant, and mixed habitat types for river rehabilitation (including grassland, shrub, garden fields, river beaches and so on). The current land covers are almost artificial landscapes, which have low contribution to the

biodiversity conservation. Therefore, the impact should be very limited.

600. In addition, the layout of water transmission pipes would temporarily destroy the surface vegetation, especially at the beginning section. For the later section, the layout will be consistent with the existing road network. The impact will significant during construction but the recovery period would be very short once the construction is complete.

Table 5.4: Basic land cover and construction information of different project components (unit: m^2)

Project components	Area of land occupation	Construction area	Construction base area	Area of green belt	% of greening rate	Number of trees cutting[a]	Original vegetation composition		
							Rubber	Grassland	Shrub
Cross-border capacity improved									
Border resident trade market	213,629	107,454	190,788	22,841	10.69%	6,110	123,427	90,202	
International cooperation area*	355,267	171,633	284,178	71,089	20.01%	9,124	184,313	170,954	
No. 1 Road	48,851	21,596	20,881	3,523	7.21%	3,720	21,596		
No. 2 Road	53,226	18,912	15,548	4,000	7.52%	118	14,189		
No. 3 Road	111,775	30,240	24,386	4,536	4.06%	13,398	30,240		
No. 4 Road	53,853	15,456	12,577	1,990	3.70%	3,987	11,594		
No. 5 Road	78,625	22,920	19,051	4,780	6.08%	3,995	17,197		
No. 6 Road	12,467	6,273	6,273	0	0.00%	1,092	6,273		
Social infrastructure and service improved									
Cangyuan Guomen No. 2 Elementary School	31,059	18,231	20,224	9,318	30.00%			31,059	
Qingshuihe Guomen Elementary School Upgrade*		7,691	1,847					7,691	
Zhenkang Sino-Myanmar Friendship Hospital**	60,000	56,009	37,500	22,500	37.50%			60,000	
Qingshuihe Hospital	22,266	8,946	16,032	6,234	28.00%	1,650	22,266		
Mengding electric charging station*	8,000	8,000	8,000					8,000	
Qingshuihe electric charging station*	6,670	6,670	6,670					6,670	
Integrated urban environmental infrastructure improved									
Water treatment plant	24,000	1,290	3,800	15,000	62.50%	900, 1800[b]	12,000		12,000
Wastewater treatment plant***	24,010	1,422	5,170	13,600	56.64%	1,030	18,667	3,333	
Solid waste transfer station	3,768	514	2,447	805	21.36%	200	1,480		1,480
Solid waste collection station	594	162	230	134	22.56%			954	
Qingshuihe River Rehabilitation****	131,298	0	13,226	66,568	50.70%	2000, 3500[b]	51,923	79,375	
Total	**1239,358**	**503,419**	**688,828**	**246,918**	**19.92%**	**47324, 5300[b]**	**515,165**	**458,238**	**13,480**

*grassland refers to the clearance land; ** grassland includes partial farmland; ***grassland refers to the garden field; ****grassland refers to the mixed habitats, such as timber land, garden field, shrub land and grassland. [a]: refers to the number of rubbers to be cut; [b]: refers to the number of shrubs to be cut.

Construction area refers to the area of the constructed buildings including the area of different floors, and the construction base area include the flat area of constructed buildings in addition to the area of roads and parking areas. Source: Biodiversity Report 2018

601. There is no ecologically sensitive area/protected forest area such as national wildlife park, bird sanctuary in the proposed sub-project locations. The removal of herbaceous vegetation from the soil and loosening of the top soil generally causes soil erosion. However, such impacts would be primarily confined to the project site during initial periods of the construction phase and would be minimized through adoption of mitigation measures like water sprinkling and green belt formation, paving and surface treatment etc. during construction and maintaining them during the operations period.

Removal of Trees

602. **Table 5.5** gives the number of trees that are found within the area.

Table 5.5: Details of trees to be cut in Project Area

No	Project Component Name	Tree Details			
		Type	Number	Type	Number
1	International production capacity cooperation zone	Rubber	9,124	-	-
2	Border trade market	Rubber	6,110	-	-
3	Planned 1# Road	Rubber	3,720	-	-
4	Planned 2# Road	Rubber	118	-	-
5	Planned 3# Road	Rubber	13,398	-	-
6	Planned 4# Road	Rubber	3,987	-	-
7	Planned 5# Road	Rubber	3,995	-	-
8	Planned 6# Road	Rubber	1,092	-	-
9	WTP	Rubber	900	shrub	1,800
10	WWTP	Rubber	1,030	-	-
11	Solid Waste transfer station	Rubber	200	-	-
12	River rehabilitation project	Rubber	2,000	shrub	3,500
13	Qingshuihe electric charging station	None	0	-	-
14	Mengding electric charging station	-	0		
15	Cangyuan Guomen No. 2 Elementary School	-	0		
16	Qingshuihe Guomen Elementary School Upgrade	-	0		
17	Zhenkang Sino-Myanmar Friendship Hospital	-	0		
18	Qingshuihe Hospital	Rubber	1,650		
		Total	**47,324**	-	**5,300**

603. The initial construction works involving land clearance, cutting, filling, and leveling may cause loss of vegetation. This will have an irreversible impact. Clearing of plantations/agricultural lands is involved and therefore appropriate amount for compensation for plantations and lands will be paid directly to the owners.

604. Generally, if forest/commercial trees are to be cut within areas belonging to forest /wildlife department, an amount of compensation as agreed with such institutions will be paid for the replantation of an equivalent area at a suitable location. The afforestation plan of Gengma County in 2018 was issued on March 17, 2018. The total area of afforestation is 80,000 mu (15 mu equals to one hectare), including 50,000 mu of nut plantation, 20,000 mu of commercial forest and 10,000 mu of precious timber forest. Of them, 9,000 mu of afforestation will happen in Mengding Town, where is the location of project area of LBECZ. This is the critical measure to compensate the carbon emission due to the cutting of rubber plantation. Thereafter the forest department would look after the trees, and be responsible for replacing any trees that die in the first 5 years of planting, until these get established in planting area. It is highly recommended to establish a tree replanting programme which should be undertaken e.g. where two trees will be planted when a single tree is cut. The Construction contractor would be responsible for replantation of trees cut from the construction area in the Green belt area around all subproject areas as per design requirements listed in the FSRs. **Annexure 8.F** gives the

Afforestation details for Gengma County.

5.4.4 Impact on Terrestrial Ecology

Fauna

605. Migratory paths of small mammals and reptiles may be affected due to construction activities. However, noise, vibration and emission from construction vehicles, digging of foundations and working of equipment will occur during construction and pre-construction stages in temporary manner. The impacts related to above activities are temporary and can be mitigated through following measures:

- Strict attention on worker force regarding disturbance to surrounding habitats, flora and fauna including hunting of animals and fishing in water bodies.
- Selection of approved locations for material storage yards and day-time labor camps away from the environmental sensitive areas.
- Avoid entering of construction waste (cement particles, rock, rubbles and waste water) and sanitary waste to the surrounding water bodies.
- Restore any road underpasses for fauna to pass and avoid road kills during construction and operations.

606. Regarding the terrestrial fauna, five species are under national protected animals and two are recognized as 'Vulnerable' species by the IUCN RedList. Comparing with the world population estimate and population size in the project area, and their geographical distribution ranges, two nationally protected animal species including Tiger frog and Gekko gecko have low conservation values, and the other five species including three protected animals such as Common buzzard, Great coucal and Asian water monitor, and two near threatened animals such as Chinese softshell turtle and King cobra have medium conservation values, but not significant (**Table 5.6**).

Table 5.6: Overall impact of project activities on the Terrestrial species with conservation values

Scientific name	NPL	IUCN-RL	Main distribution site of project area	Overall impact of project activities
BIRDS				
Buteo buteo	Ⅱ	-	LBECZ	Medium
Centropus sinensis	Ⅱ	-	LBECZ	Medium
AMPHIBIAN				
Hoplobatraclrus rugulosus	Ⅱ	-	LBECZ	Low
Fejervarya limnocharis		DD		Low
REPTILES				
Pelodiscus sinensis	-	VU	Qingshuihe, Nanting River	Medium
Gekko gecko	Ⅱ	-	LBECZ	Low
Varanus salvator	Ⅰ	-	Qingshuihe	Medium
Ophiophagus hannah	P*	VU	LBECZ	Medium

*P: Yunnan Provincial protection animal.

EN: endangered, VU: vulnerable, NT: near-threatened, DD: data deficient.

Green Belt Development

607. Plant configuration with native tree species with appropriate density in both high and low mode forming levels of sense, rich in color, mainly with evergreen trees as the background. The trees and flower shrubs planted should remain evergreen during all four season while the three seasons would have flowers. Tree/shrub planting configuration would be according to the different functions of the park in the form of outdoor space and greening requirements such as bush ratio, evergreen and deciduous

ratio, so that the green space has a level and ideal green effect. Care should be taken that only local native species of plants and vegetation should be planted thereby avoiding any invasive species in the area.

Effect on Local Road Network

608. Iron bars, concrete materials, piling equipment, etc. will be transported through the local road network to the project site. Transporting of large quantities of materials using heavy vehicles could exceed the carrying capacity of the road. This would lead to physical damages to local road network. Thus, it will be necessary to obtain consent from the road/highway authorities to use local/national highway roads prior to transportation.

609. The Construction contractor should properly maintain all road sections, install road signs warning of children crossing etc. which will be utilized for the construction related activities. The Construction contractor will ensure free and safe access roads to each buildings-schools, hospital, trade center etc. and install appropriate road safety signs as necessary in the area.

Disposal of Debris

610. Because of construction related activities, inert spoil and debris will be generated during the construction stage. Improper disposal of the debris will have an impact on the surrounding ecology, public health, and scenic beauty. Following measures will minimize the impacts associated with disposal of debris:

- Spoil materials (soil, sand, rock etc.) generated from construction activities shall be used wherever possible for site levelling, back - filling etc. Any dismantled and demolished structural materials, if any, should be dumped in accordance to government norms.
- Preparation of Disposal Management Plan for the project and selection of the disposal site by excluding locations, which are closer to residential, commercial and public sensitive areas, is necessary by the Construction contractor. Prior approval should be obtained for linked facilities such as dumping grounds/land fill sites from relevant local authorities.

611. Dumped materials will interfere with the drainage pattern of the area, any water bodies, agricultural lands, marshlands and down slope or any environmental sensitive areas if not planned properly.

612. During operation phase, there is no requirement for disposal of debris.

5.4.5 Impact on Aquatic Ecology

Aquatic Fauna

613. The majority of fishes in Nanting River are the benthic fishes, especially preferring to live in the fast torrent. 48 endemic fish species of four orders and 11 families were identified in project areas. There is no fish species under the national protected animals and the appendix of CITES. For fishes, there is no protected species in national and provincial level found in the project area. However, there are two species recognized as near threatened by IUCN Redlist including *Anguilla nebulosi* and *Bagarius yarrelli*, and three species as data deficient such as *Neollissochilus baoshanensis*, *Garra salweenica* and *Schiothorax nukiangensis*.

614. The *Garra salweenica* and *Schizothorax nukiangensis* are mainly distributed in the middle and upper reaches of Nu River, in the northwest of Yunnan Province. Nanting River is not the concentration distribution area. Their conservation values are assigned as medium. The other three fish species including *Neolissochilus baoshanensis*, *Bagarius yarrelli* and *Anguilla nebulosi*, in addition to *Balitora nantingensis* (was not assessed by IUCN with the lack of information), have the high conservation

values (**Table 5.7**). The location of proposed Nanting Bridge is important fish migratory path. For the river system, the river course of proposed Nanting Bridge has the relatively medium conservation value. The river course in the vicinity of proposed Nanting Bridge is the important migration pathway of migratory fishes from Salween River and India Sea, but not important spawning sites for fished laying floating-eggs. The survey report in the vicinity of proposed Nanting Bridge is presented as the Appendix B of biodiversity report for reference.

Table 5.7: Overall impact of project activities on the aquatic species with conservation values

Scientific name	NPL	IUCN-RL	Main distribution site of project area	Overall impact of project activities
FISHES				
Anguilla nebulosa	-	NT	Nanting River	Medium
Neolissochilus baoshanensis	-	DD	Nanting River	Medium
Garra salweenica	-	DD	Nanting River	Low
Schizothorax nukiangensis	-	DD	Nanting River	Low
Bagarius yarrelli	-	NT	Nanting River	Medium

NT: near-threatened, DD: data deficient.

615. Illegal fishing by labor causes harmful effect on fish; the noise and vibration of the bridge during the construction period will have a certain degree of impact on the ecology of fishes in the 1 km reach from upstream and downstream of the construction site. With limited impact on habitat of fish due to the building of the bridge pier in the river which will not obstruct riverway and at the end of the construction period, the impact will gradually decrease.

616. There will be an impact on hardness of water, pH and its transparency etc., due to pollution of the water body by engineering wastes. These changes will lead to changes of species and biomass in plankton and benthos in the water and usually some types of pollution tolerant organisms will increase, which will lead to changes in primary productivity in the water. In this case, usually fishes having a high requirement of water quality will decrease while other fishes with strong tolerance of pollution, especially the proportion of some exotic species will increase.

617. During the construction of bridge and river embankment, the cement, lime and sandy soil will enter into the river, which will form sediment precipitation: the original pebbles will be filled with engineering waste residue, resulting in river bed reconstruction without sufficient source of sediments. While the river bed is an important biological habitat of the riparian zone. The bottom of the river bed is relatively gentle and difficult to form a slow flow area, which will make some fishes keen on inhabiting in flowing water rather than turbulent flow and fishes in the gap loss part of their habitat. Changes in water quality will affect the composition, biomass and primary productivity of plankton. The eutrophication of waters in the assessment area is often aggravated by the large number of multiplication of algae. Algal blooms will consume large amounts of nutrients in water bodies and cause oxygen deficit in water, which will indirectly affect other aquatic organisms and may also block fish gills, resulting in fish's death by suffocation.

618. According to the on-site investigation, there are no relatively concentrated spawning ground, feeding ground and wintering ground of fish at the bridge across Nanting River. Therefore, there is no direct effect on the spawning, reproduction etc. During underwater operation in large-scale construction period of the bridge, stirring water and sediment of river bed will destroy the habitat of fish in partial scope and drive fishes, keeping fish away from the construction site. Fish will choose water to migrate to other places and the impact of the project on fish is limited to the construction area. So it does not affect the protection of fish species resources. After the completion of the project, the water in the basin is still abundant and the water quality will quickly return to the original situation. If appropriate protection

measures of fish are taken the original fish resources and their living environment will not be changed too much and the species and quantity of fish in this basin will not be affected obviously.

Disturbance of riparian habitat and fisheries habitat:

619. Generally, the high runoff velocity with the staggered rocks provide important spawning site for fish laying floating-eggs. The slow runoff velocity with the extensive shallow river beach provide the critical spawning site for the fish laying sticky demersal eggs.

- From Junsai to Mengding (southwards) (**Figure 4.8**), there are 27 tributaries entering into Nanting River. The number of river beaches with area of over 10 hectares exceeds 43 sites, which provide good foraging habitats and spawning habitats for fish laying sticky demersal eggs.

- From Junsai to Daxueshan (northwards) (**Figure 4.8**), there are plenty of shallow shoals with swift currents. These provide good spawning habitats for fished laying sticky demersal eggs. The known concentration sites include the estuaries of Hedigang River and Kaisa River. The species mainly include the small fishes of Cotitidae, Homalopteridae and Sisoridae. They are also the traditional harvesting sites of the local farmers.

- From Mengding to the Sino-Myanmar boundary (**Figure 5.1**), the river course of Nanting River becomes narrow and spans approximately 15 km with swift current. This combining with the large stones in the river bed, create a plenty of whirlpools for fish laying floating-eggs.

620. The site survey was conducted in a total length of 9.6 kilometers' river course (**between Site 1 and Site 6 in Figure 5.2**), including 1.0 kilometer in the down reach and 8.6 kilometers in the upper reach of proposed Nanting Bridge. The potential spawning site for fish laying floating-eggs is identified, which is located over 2.7 kilometers (**in the upper reach of Site 4 in Figure 5.2**) in upper reach of proposed Nanting Bridge (**Site 2 in Figure 5.2**). The total length of river course with potential spawning area is 5.9 kilometers (**between Site 4 and Site 6 in Figure 5.2**). Details refer to the Appendix B in Biodiversity Report.

621. It was reported that *Anguilla nebulosa* has the long-distance migration from India Ocean. In addition, a plenty of fishes such as Barbinae, *Bagarius yarrelli*, and *Clarias fuscus*, migrate from Salween River for breeding in Nanting River. Nanting River feeds into Salween River in the location of Gunnong Bridge of Myanmar, where is about 30 km in the west of proposed Nanting Bridge (**Figure 5.1**). **Table 5.8** gives details about the fish affected.

Table 5.8: The fish species with conservation values migrate through and breed in the vicinity of proposed Nanting Bridge

Species	Migration period	Breeding period	Distance to Nanting Bridge
Neolissochilus baoshanensis	+		
Anguilla nebulosa	+		
Bagarius yarrelli	+		
Balitora nantingensis	+	+	>2.7 kilometers in the upper reach
Garra salweenica	+	+	>2.7 kilometers in the upper reach
Schizothorax nukiangensis	-	-	-

Figure 5.1: Spatial locations of proposed Nanting Bridget and boundary of NAGR of Lower Reaches of Nanting River, approximately 6.8 kilometres apart

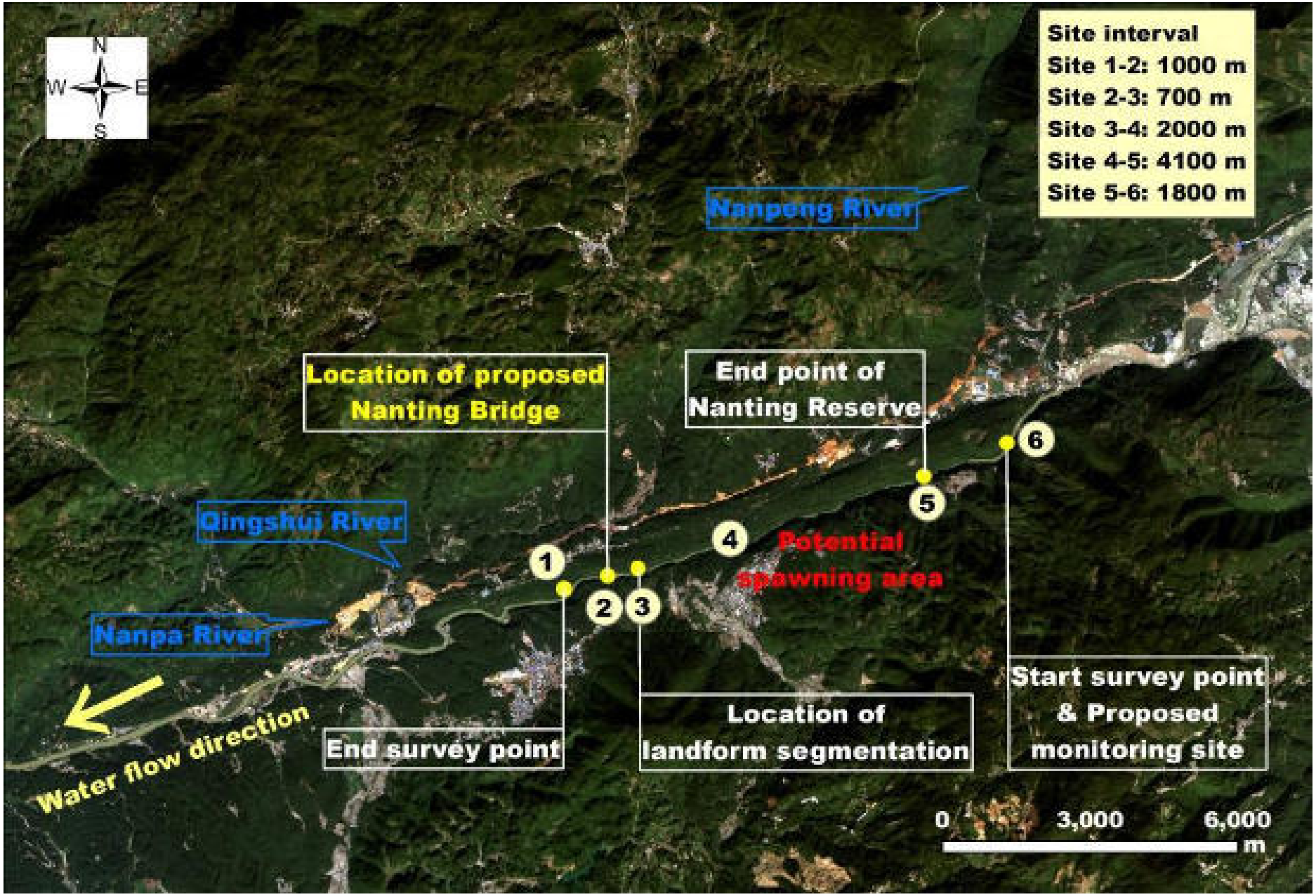


Figure 5.2 Locations of survey points in the vicinity of proposed Nanting Bridge on April 24 2018. The section between site 4 and site 6 is the potential spawning area for fish laying floating-egges.

Alteration of river bottom and sediment transport

622. The construction of bridge and the river embankment rehabilitation will affect river bottom and sediment transport as serving a barrier for waves and river currents. Although some local disruption to the river channel bed can be expected as a result of construction.

623. The following activities include improving site access, site preparation, material disposal, site dewatering, and restoration after completion of activity.

- During construction, noise and vibration from piling, excavations and river bed cleaning, would have temporary impacts on the fish. Considering the closure of part of the rivers of Qingshuihe River (river rehabilitation), Nanpa River (river rehabilitation) and Nangun River (construction of water intake infrastructure), the impacts would be more severe. In particular, the river rehabilitation project of Qingshuihe River will last for 24 months.

- The bridge construction company has to avoid any oil/fuel dripping from boats. The operator should conduct regular maintenance and repairs of the boats, a feature that is beyond scope of this EIA. However, any accidental oil spill from equipment such as cranes etc. would badly impact the riverine mammals, fish and other aquatic organisms. It is not anticipated that bridge construction activities will significantly interfere with navigation of boats, fishing vessels in particular in the Nanting River. Appropriate measures should be taken not to interfere with boat navigation. Qingshuihe River has no such facility due to irregular water flows.

- Due to the nature of the proposed bridge, no significant level of sediment trapping in its vicinity is envisaged as there will be no permanent structure inside the river. However, a possibility exists for sediment accumulation where temporary structures such as temporary coffer dams on either side of the river bank will be erected to support the embankment and avoid spillage of wastewater into the Nanting river. The chances that an accumulated sediment extends towards either of the coffer dams, forming a sediment barrier which could lead to sand accretion and affecting the migration, spawning and breeding areas for fish in the river is minimal.

5.4.6 Impact on Human Environment

Worker and Community Health and Safety - Construction

624. Given the diverse number of contractors that will likely be involved in the construction phase of this project, it is going to be important for the project to envision how contractor performance and conformance to mitigation measures will be ensured. During construction, the EA and the PIUs through the construction company will engage in public consultations and EMP trainings (listed in **Table 9.2**) to improve worker and community members' knowledge, attitudes and practices on health and safety.

Community Health

625. The project will ensure to adopt internationally and nationally adopted safety regulations during the construction of various sub-project near schools, houses, neighboring community etc.:

- Health and safety issues due to construction activities will be an issue for workers, community, students, teachers and others. Accident can occur during earth cutting, casting, construction works and installation of heavy machinery if care is not taken in their operation.
- The whole work site will have to be fenced off and marked, so as to prevent the access of local community, in particular residents and children in the vicinity of construction sites. When land clearing is complete, the work area is finished, and facilities are in place, all of the above impacts and risks will be neutralized

626. Risks to community health and safety (CHS) and occupational health and safety (OHS) are highest during the construction stage as project activities can affect various environmental, social and behavioral determinants of health. Risks to CHS and OHS can be inter-related, as interactions between construction workers and local community members are unavoidable.

627. The construction phase will require an estimated workforce of 960 to 1570 workers during peak construction periods. A number of unskilled workers are expected to be recruited from outside the project area. This can include workers coming from other provinces within China as well as from across the border in Myanmar. Yunnan province is one of the last remaining areas of the PRC with local malaria transmission. Identified sources are mobile populations. Therefore, construction workers coming from Myanmar and/or other parts of PRC can be infected with malaria parasites (with or without symptoms), as well as other vector-borne (e.g. dengue), vaccine-preventable (e.g. polio, measles) or other communicable diseases, bring such pathogens into the project area. This increases the risk of onward transmission to fellow workers as well as the local population. Furthermore, workers risk infection as vector-borne and other infectious diseases are important for the project area. When workers return back to their home communities, during rotations, leave or after construction works are concluded this can lead to further spread of such communicable diseases.

628. Another well-defined risk associated with construction phases of projects is the spread of sexually transmitted infections (STIs). This is inter-related as local baseline conditions can hold risk to the incoming workforce and vice versa. The risk during this phase increases as workers spend longer time away from their families during this time, there is heightened disposable income, and there is a new opportunity for income generation amongst local populations. There is little reliable information known about the baseline burden of STIs, including HIV/AIDS in the project area. However, given the area is rural, with a larger population of ethnic minorities, the likelihood of local community members having insufficient knowledge, attitudes and practices related to prevention, testing and treatment associated with communicable diseases should be expected.

629. The increase in construction traffic, especially of heavy goods vehicles, along the road local networks will affect road safety and the risk of road traffic accidents and injuries. This risk is higher for pedestrians and cyclists and near vulnerable receptors such as schools and other social services. Community health and safety mitigations will be outlined clearly in the Traffic Management Chapter of the EMP and at minimum will include details for: engaging with local villages and communes along transportation corridors with traffic safety awareness campaigns, imposing speed limitations with zero tolerance clauses in the worker codes of conduct for non-compliance, traffic signs on entry and exit points of the construction site, signs inside villages of caution with the transportation machinery.

630. Construction traffic and construction works on the various sites will generate noise. Construction-related day-time noise, especially near Qingshiuhe school, can cause learning impairment in schoolchildren, as well as annoyance and other health effects in the general population around the various construction sites. Night-time noise associated with night-time construction traffic and offloading can cause sleep disturbance. This is also discussed under Analysis of Impact of Construction Noise on Sensitive Receptors.

631. The construction workforce, as well as the likely additional influx of camp followers and job seekers looking to explore emerging economic opportunities, can put pressure and strain existing social and health services, and housing, and affect the availability and quality of such services. The entire construction workforce of up to 1570 workers is set to rely on Qingshuihe Health Center for health services. It is not known if this health center can provide adequate services for the incoming workforce.

The rapid standalone HIA will attempt to assess the capacity of this health center for providing workforce health services.

632. Mitigation measures can address community health and safety risks and impacts associate with increased air pollution, noise and traffic during the construction phase. To avoid straining Qingshuihe Health Center with the additional population under its care, strengthening the health staff of the center and/or establishing occupational health services as well as medical facilities within worker camps will be required.

Occupational health and Safety

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

634. The contractors will also implement precautions to protect the health and safety of construction workers. The occupational health and safety risks will be managed by applying measures in the following order of preference: avoiding, controlling, minimizing hazards, and providing adequate protective equipment. All workers will undergo a site induction/orientation that will highlight expectations on minimizing impacts to the physical and social environment. There will be an on-site and off-site code of conduct established that will outline roles, responsibilities and consequences for non-compliance. Prior to construction, the Environmental Management Plan will be finalized to include the following components:

a. Public Health Management Plan
b. Waste and Hazardous Material Management
c. Worker accommodation Management (if there are workers' camps)
d. Traffic Safety Management component during construction
e. Dust, Noise and Vibration Management
f. Occupational Health and Safety Management

635. In addition, each contractor's Site Specific Environmental Management and Supervision Plan will include measures for health and safety for personnel. The plan will be submitted to the PIU/PMO for review and appraisal and will include the following provisions for health and safety:

- **Personal protection**. Provide personal protection equipment (PPE) appropriate to the job, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations, for workers.
- **Worker Accommodation Plan** which will conform to International worker accommodation standards to prevent health, safety, security and environmental risks to workers and community members alike.
- **Emergency Preparedness and Response**. An emergency response plan to take actions on accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events will be prepared, and submitted to the PIU for review and appraisal. A fully equipped first-aid base in each construction site will be provided.
- **Records Management**. A Records Management System will be established to document occupational accidents, diseases, and incidents, that: (a) includes a tracking system to ensure that incidents are followed-up; (b) can easily retrieve records; and (c) can be used during compliance monitoring and audits. The system will be backed up on at least one external hard drive to protect records against loss or damage.

- **Safety communication**. Ensure that safety, rescue and industrial health matters are given a high degree of publicity to all persons regularly or occasionally on the site. Posters drawing attention to site safety, rescue and industrial health regulations will be made or obtained from the appropriate sources and will be displayed prominently in relevant areas of the site.
- **Training, awareness and competence**. Train all construction workers in basic sanitation and health care issues, general health and safety matters, and on the specific hazards of their work. Specific awareness raising, training and behavior change communication on malaria, dengue, STIs, including HIV, and other communicable diseases will be undertaken.

636. In collaboration with local health services, construction workers can be screened and treated for infectious diseases such as malaria, dengue, sexually transmitted infections upon recruitment and before leaving to their home communities. Periodic examinations by occupational health physicians should be available to all construction workers for screening, early diagnosis and treatment of occupational diseases and key infectious diseases.

637. Specific mitigation measures can include (i) conducting regular information, education and communication (IEC) campaigns addressed to all site staff and labor (including truck drivers and delivery crews) and the immediate local communities concerning project risks and impacts, and appropriate preventative behaviors with respect to STIs, including HIV, malaria, dengue and other vector-borne diseases, vaccine-preventable diseases, tuberculosis and other infectious diseases; (ii) Developing peer educator program for workers and providing work time for peer educator's activities; (iii) Distributing condoms to project workers and educating them regarding use; and (iv) Contractually requiring project transportation contractors to provide HIV/AIDS education programs, condom distribution, and case finding/treatment of curable STIs during required medical exams for truckers; and (v) Providing support for a Voluntary Counseling and Treatment (VCT) program at the local hospital, based on needs.

638. A project standalone rapid health impact assessment (HIA) is being undertaken and will further detail mitigation and enhancement approaches and measures.

Requirement of labor

639. During the construction stage manpower ranging from 20 to 300 will be required during normal functions while peak construction activities will require 60-500 workers depending on the type of facility under construction. The available skilled and unskilled labor required for construction activities will be hired both outside and locally. Contractors will make efforts to recruit legal workers or use legal hiring schemes. The labor camps for unskilled persons from outside may be required to be set up on the project site as well as outside in villages. Skilled workers will be brought in from outside, which may be limited to 40-50 individuals. These skilled workers coming from outside will be lodged in rented accommodation in Mengding town. Sufficient quantity of drinking water available and toilet/ sanitation facilities will be provided at the construction site. Adequate accommodation standards for worker health and safety will be ensured, according to national and international[60] standards and guidance. **Table 5.9** below gives the estimated labor requirement during various stages of construction phase and **Table 5.10** gives the facilities for labor camps.

[60] International guidance on accommodation standards to ensure worker health and safety is provided in International Finance Corporation and European Bank for Reconstruction and Development. 2009. Worker Accommodation Process and Standards: A Guidance Note by IFC and EBRD. Washington, DC: World Bank. http://www.ebrd.com/downloads/about/history/workers.pdf (retrieved on 16 November 2017).

Table 5.9: Estimated Labor Requirement during Construction Phase Activities

No	Project Component Name	Normal Period	Peak Period
1	International production cooperation area	300	500
2	Border resident trading market	200	300
3	Planned 1# Road	40	70
4	Planned 2# Road	35	60
5	Planned 3# Road	80	120
6	Planned 4# Road	35	60
7	Planned 5# Road	35	60
8	Planned 6# Road	35	60
9	WTP	50	80
10	WWTP	50	80
11	Solid Waste transfer station	20	40
12	River rehabilitation project	60	100
13	Electrical charging station	20	40
	Total	960	1,570

Source: LBECZ DEIA report 2018 for Lincang LBECZ Project

Table 5.10 Facilities for Labor Camps during construction

No.	Project Component	No of camps	Distance from site	Toilets * (approximate)	Drinking water	Cooking fuel	Transportation facility	Health Facility
1	International production cooperation area	1200m^2	Located in the project area	3-4	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center
2	Border resident trading market	800m^2	Located in the project area	2	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center
3	Planned 1# Road	Share one camps, 1,000 square meters	Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
4	Planned 2# Road		Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
5	Planned 3# Road		Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
6	Planned 4# Road	Share one camps, 1,000 square meters	Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
7	Planned 5# Road		Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
8	Planned 6# Road	One camps, 1,000 square meters	Located in the project area	1	Bottled pure drinking water	Liquefied natural gas	Car + Walk	Qingshuihe Health Center
9	Nanting Bridge	Two camps, 1,000 square meter	Located one on each side of river,	2 on each side =4	Bottled pure drinking water	Liquefied natural gas	Car	Qingshuihe Health Center
10	WTP	200 square meters	Located in the project area	21	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center

No.	Project Component	No of camps	Distance from site	Toilets * (approximate)	Drinking water	Cooking fuel	Transportation facility	Health Facility
11	WWTP	200 square meters	Located in the project area	2	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center
12	Solid Waste transfer station	0	100meters	2	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center
13	River rehabilitation project	0	20meters	2	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center
14	Electrical charging stations (2)	0	400meters	2	Bottled pure drinking water	Liquefied natural gas	walk	Qingshuihe Health Center

* Toilets also include women's facilities at the project sites.

640. About 50-100 workers would be required during the operation of Lincang Border Economic Border Cooperation Zone Project.

Sanitation Hazard & Drinking Water

641. The health of the project personnel, construction workers and laborers at the site could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. The project activities shall make higher demand on the local utilities and service facilities particularly construction and drinking water, health and sanitary facilities.

Emergency response during construction

642. The Construction contractor must train its project personnel, construction workers and laborers, staff and local community to have knowledge of sufficient emergency response systems put in place. Fire safety management training and mock drill should be practiced periodically and emergency equipment and facilities like fire extinguisher/water hose, first aid etc. must be available to manage fire hazard or any medical emergency. An Emergency Response Program will be prepared by Contraction Company in consultation with Environment Supervision consultants of the PIUs.

Receptors in Study Area

643. This section provides distances of the various components from various receptors. **Table 5.11** to **5.12** below provides information about various project features from the LBECZ site.

Table 5.11: Summary of Sensitive Receptors

No	Subproject component Location	Distance from Subproject component in meters								No of Structures (within 1 km radius from project			
		Schools	River side	Place of Worship	Houses	Hospital/ Nursing Center	National Reserve/ conservation area	International Boundary	Remarks	Residential	Commercial	Kiosks	Border Posts
1	International production cooperation area	700	95	none	85	850	none	1050		0	0	0	0
2	Border resident trading market	600	100	none	70	650	none	260		0	0	0	0
3	Solid Waste transfer station	1400	20	none	500	1500	none	1400		395	30	14	1
4	River rehabilitation project	700		none	20	600	none	20		432	25	21	2
5	Electrical charging station	1200	500	none	700	1000	none	600		190	3	21	2
6	WTP	6600	700	none	2200	6500	none	3100		0	0	0	0
7	WWTP	1300	20	none	400	1400	none	1300	Pump station is 15 meters away the border line	185	0	5	0
8	Road No.1	600	600	none	450	1600	none	500		0	0	0	0
9	Road No. 2	200	500	none	180	1500	none	240		0	0	0	0
10	Road No. 3	200	0	none	40	600	none	1040		0	0	0	0
11	Road No. 4	700	100	none	140	100	none	580		0	0	0	0
12	Road No. 5	700	100	none	140	800	none	1000		0	0	0	0
13	Road No. 6	none	800	none	20	none	none	5		0	0	0	0

Table 5.12: Communities affected by Various Project Components

Environmental Elements	Communities affected	Projects Involved	Distance and Direction to the Nearest Boundary Line of Road / the Plant Boundary	Number of affected persons	Protection Level
Qingshuihe River Port Area					
Atmosphere and Acoustic Environment	Xiahongyan Village	Sewage Treatment Plant	170m on the west side	120 persons	Grade II standard in GB3095-2012 Ambient Air Quality Standard, Class 1, 2 and 4a standard in GB3096-2008 Environmental Quality Standard for Noise (in which the Class 1 standard shall be implemented by hospitals, the Class 4a standard shall be implemented by the area within 30 m along both sides of the road, and the Class 2 standard shall be implemented the area beyond 30 m.
	Shuanglongjing	No.3 Road	20m on the south and north side	240 persons	
	Qingshuihe River Village	No.3 Road	About 10m on the south side	146 persons	
	Bangui	Mangka Connecting Line	About 20m on the west side	132 persons	
	Qingshu Village	Hospital in Qingshuihe River Port Area	190m to the east side	180 persons	
Surface Water Environment		Nanting River	1,000 m to the south side of the project area		Class III water quality standard in Environmental Quality Standards for Surface Water (GB3838-2002)
		Qingshuihe River	Project area, the river regulation work in this project		
Ecological Environment		LBECZ	The land utilization, farmland vegetation and water and soil loss in the project area.		
Cangyuan County and Zhenkang					
Atmospheric Environment	Manghei	Guomen Primary School of Cangyuan Va Autonomous County	Northwest 1.7km	86	Class II Standard of GB3095-2012 Ambient Air Quality Standard
	Baka Village; Nongsai		1.72km west-northwest	428	
	Mengdong Town		--	--	
	Jingfei		South 2.32km	147	
	Yongdebulan		2.31km south-southeast	132	
	Mangnai		Southeast 1.30km	214	
	Mangbo		Southeast 1.13 km	152	
	Yongdeben		1.13 km east-northeast	421	
	Mangbang		1.18 km north-northeast	185	
	Gongliang		2.02 km north-northwest	385	
	Zhenkang	China-	Northwest 2.1 km	--	

Environmental Elements	Communities affected	Projects Involved	Distance and Direction to the Nearest Boundary Line of Road / the Plant Boundary	Number of affected persons	Protection Level
	County	Myanmar Friendship Hospital of Zhenkang County			
	Xiaochanggou		Northwest 0.9 km	124	
	Yanglongzhai		Northwest 2.05 km	95	
	Baiyan Village		Northeast 2.25 km	849	
Surface Water Environment	Mengdong River	Guomen Second Primary School of Cangyuan Va Autonomous County	North 3.0 km		Class IV in GB3838-2002
	Nanpeng River	China-Myanmar Friendship Hospital of Zhenkang County	East 242m		

Trenches/tunnels for sewers, water supply, drainage, power evacuation lines

644. The power lines, water supply, sewage lines, drainage will be laid underground and along the public in trenches/tunnels. There will be some temporary disturbances and travel inconveniences during the erection of underground facilities which will be managed by the contractors as per the national environmental and safety regulations. However, they will not affect any private properties or houses of the people.

Traffic and Transport

645. During the construction phase, traffic disturbance needs to be minimized by avoiding heavy traffic hours, ensuring proper access roads and avoiding road blockage. Increase in vehicular traffic in the area is likely to be experienced during construction phase; especially at the school buildings because of trucks ferrying in off construction material and carrying waste material from site. Following are the impacts likely to occur due to increased traffic:

(i) Slightly more congestion near the main entrance to the schools.
(ii) Increased number of vehicles on local roads will result in increased wear and tear of local roads thus reducing lifespan of affected roads.
(iii) Decreased road safety and increased risk of road traffic accidents and injuries, especially for pedestrians and cyclists[61] using local roads who will have to exercise more care with increase of vehicular traffic on the said roads.
(iv) There will be an increase of exhaust emission from vehicles, which will pollute local atmospheric air.
(v) During the transportation of heavy and long loads (such as the case with bridge parts, and building parts – mainly trusses and beams etc.), the operator shall follow proper traffic management rules and ensure none of the road receptors are affected negatively.

646. Road layout design includes design for cyclists using some of the upgraded roads. Promoting cycling and ensuring its safety is an important public health measure (increased physical activity) also with additional environmental benefits. The project design should include appropriate and safe cycling infrastructure, whenever feasible. Furthermore, safe and convenient cycling parking should be included in all infrastructures – hospitals, schools, border trade market and international cooperation area.

647. The Construction contractor may have to transport the construction material into the site at night or during least congestion period on the auxiliary roads in order not to inconvenience the road users. So, while this may increase traffic-related night-time noise, the traffic related congestion, road safety and air pollution would be least affected in this case.

648. Slightly more congestion near the main entrance to the two schools could exist at the gates due to limited entry available at the school site until entire construction is complete. The Construction contractor will post traffic managers at all access roads at of the school site and will ensure parking places are not encroached by placing any construction/waste material or parking of construction vehicles. Construction traffic at the school site will be halted during critical periods such as school drop off and pick up times.

649. Considering the impact of project construction on traffic, project will make the following plan:

[61] provision of cycling infrastructure must be included at all sites – hospitals, schools, border trade market and international cooperation area.

a. The project owner, prior to construction begins, will undertake a traffic risk assessment based on baseline road conditions and projected route planning. This risk assessment will inform the safest project related traffic management plan required to mitigate the risk of injuries and fatalities to local community members.
b. The project owner will work with local highways authority and traffic police to carry out road maintenance work, to ensure smooth road during the construction process;
c. Construction units to strengthen traffic safety education for engineering vehicle drivers, Construction vehicles on the designated routes, in the crossing of villages, densely populated areas and near sensitive locations (schools, health centers and other social services) to drive slowly and according to designated speed limits (e.g. 30 km/h);
d. After school, the market, traffic arteries and other densely populated areas to strictly prohibit overloading, avoid overrun vehicles on the road, large tonnage of vehicles in and out of the narrow village road and actively take precautions and measures through the widening reinforcement, watering of berms and erect proper signages for project vehicles;
e. Construction traffic at the school site will not occur during critical periods such as school drop off and pick up times.
f. Not park construction vehicles on roads adjoining to project area.

Energy Conservation considerations in Road construction

650. The construction of road construction project involves the protection of resources along the road, and the route line index and road conditions related to the driving efficiency of vehicles, thus reducing the level of energy consumption. In order to make the road construction projects to protect, economize and utilize resources rationally, the project component must implement the principle of saving energy and protecting resources in the design and the construction process.

651. Some of the measures include: road conditions, including geometric features (longitudinal, curvature, and road width, etc.) and pavement features (flatness), increased access, ease of traffic pressure, traffic conditions mainly refer to the level of road service, including mixed traffic conditions, traffic flow size and dispersion, pedestrian and lateral interference, speed and the improvement of traffic facilities, and so on, this one side of high-speed road fuel consumption is significantly better than other grade roads, empirical research shows that fuel consumption is the function of speed,

Temporary Outage of the Electricity

652. Temporary disconnection of power supply, drinking water, sewer supply may occur during the construction activities. Thus, general public and the community dwellers, who live in the vicinity of the sub-project area, may face inconvenience for short periods of time. Thus, following measures will have to be taken:

- Advance notice to the public about the time and the duration of the utility disruption, and
- Restore the utilities immediately to overcome public inconvenience.

Navigation of aircrafts

653. As the project area does not fall within an air traffic route, there will not be any adverse effects on aircraft navigation. However, an approval will be requested prior to the commencement of construction works from the civil aviation authority.

Interference with Other Utilities and Traffic

654. As per regulations enacted by PRC, it is mandatory for LBECZ to seek clearance prior to construction from telecommunications and wherever necessary from aviation authorities. The LBECZ construction and operation will not affect any telecommunication circuits by causing electrical interference and induced voltage. However digging of area, roads etc. may require physical measures like rerouting of the telecom circuits, conversion of overhead telecom circuits into cables etc. The exact

cost to mitigate the impacts of physical relocation and impact of induction in neighboring telecom circuits would vary from case to case. In general, the system is planned and executed in such a way that adequate clearance is maintained between Project subcomponents, civil aviation and defense installations on the other. There is no airport in the area.

5.4.7 Socio-Economics

655. The project will create temporary employment opportunities for local communities during project construction period and operation phase. Although most of the technical expertise required will be brought from outside skilled technical people in the area will have good opportunities being employed in the project and the capable people will be absorbed in to the operation staff after completion of the project. Manual labor work will be available for both men and women. Such employment opportunities will benefit the households who are dependent on seasonal and fluctuating incomes to enhance their household incomes and living standards. There will also be a limited number of employment opportunities available for local communities during the operation phase such as to work as security guards, sanitary workers etc.

656. Sanitary facilities and other public requirements such as augmenting existing by roads in the vicinity of project site and construction of community center for the village community that fall under social corporate responsibility will be carried out by the project.

Land Acquisition and Resettlement

(Source: Resettlement Plan for the project)

657. Based on the preliminary impact survey [62], the project will affect 4 townships, 10 village/communities; a total of 88 households with 439 people will be affected, including 25 minority households with 109 people, accounting for 24.83% of the total population. 941.14 mu^3 land will be permanently acquired, affecting 87 households with 435 people (including 24 minority households with 105 people), of which, the project will occupy 290.9 mu state-owned land (125 mu state-owned forest land, without affected people; 165.9 mu state-owned construction land, without affected people); 650.24 mu collective land (including 56.11 mu cultivated land, 547.97 mu forest land, 2.03 mu unused land), 87 households with 435 people will be affected. The area of demolished house is 270.9 m^2, 1 household with 4 people, all are ethnic minorities.

658. This project belongs to the public enterprise, and the state-owned land will be obtained by means of allocation, but it needs to pay land usage fee for new construction land to LRB (CNY 10 /m^2). As regards the permanent farmland acquisition compensation is according to Notice on Land Acquisition Compensation Standard for the 15 Prefectures (Municipalities) in Yunnan Province (amended) Issued by Yunnan Provincial Land and Resource forwarded by the Lincang city Land Resources Department（LGTZ [2014] No.195） and Notice on land expropriation compensation scheme of subway and railway issued by people's government of Gengma Dai Wa autonomous county (GZF No.37); The comprehensive compensation fee (including land compensation fee and resettlement subsidy) for Cangyuan is CNY 55,000 /mu, the subproject of Zhenkang hospital is CNY 37,908/mu; the subproject of Mengding port area is CNY 28000-52000 /mu, the compensation fee for young crops is calculated according to the variety and diameter, and the compensation fee for ground attachments will be compensated according to the actual input cost. Compensation for land acquisition (including land

[62] The detailed measurement survey (DMS) will be carried out after the detailed project design.

compensation fee and resettlement subsidy), the compensation fee for young crops and the compensation fee for ground attachments will be fully compensated to the affected people.

659. **Table 5.13** shows the summary of Land and Property acquisition in this regards.

Table 5.13: Summary of Land and Property Acquisition by County

	Type	Details with remarks
1	No. of Townships affected	4
2	No. of Village/communities affected	10
	No. of Households affected	88
	No. of people affected	439
3	Permanent Land Requirements (Mu)	941.14 mu
A	State owned land	290.9 mu
B	Collective Land	650.24 mu
i)	Cultivated Land	56.11 mu
ii)	Forest land (Rubber tree land)	547.97 mu
iii)	Unused land	2.03 mu
4	Private Households Requiring demolition	1
A	Floor Space (m^2)	270.9 m^2
5	Establishments requiring relocation	1 household with 4 persons

Source: Draft Resettlement Plan 2018

Impacts on the Local Communities in the Area

660. The implementation of project activities within the geographical area will be designed to have minimal adverse impacts on the local communities. The preliminary design of the project has avoided any major settlements and structures etc. **Table 5.14** below shows the distance between the settlements and the nearest project component.

Table 5.14: Type of impact of project subcomponents on settlements

No	Project sub-component	Name of the village	Type of Settlement	Distance between settlements and Subproject component (km)	Type of impact	Type of impact mitigation
1	International production cooperation area	Qingshuihe village	Natural village	75m	Noise	Digging, construction of buildings, concreting
2	border resident trading market	Qingshuihe village	Natural village	60m	Noise	Digging, construction of road, berms, concreting
3	Planned 1# Road	Qingshuihe village	Natural village	460m	Noise	Digging, construction of road, berms, concreting
4	Planned 2# Road	Qingshuihe village	Natural village	180m	Noise	Digging, construction of road, berms, concreting
5	Planned 3# Road	Qingshuihe village	Natural village	40m	Noise	Digging, construction of road, berms, concreting
6	Planned 4# Road	Qingshuihe village	Natural village	140m	Noise	Digging, construction of roads, berms,

						concreting
7	Planned 5# Road	Qingshuihe village	Natural village	140m	Noise	Digging, construction of roads, berms, concreting
8	Planned 6# Road	Mangka town	Natural village	20m	Noise	Digging, construction of roads, berms, concreting
9	WTP	Bangui village	Natural village	2200 meters	Noise	Digging, construction of plant, buildings, concreting
10	WWTP	Xiahongyan village	Natural village	400 meters	Noise	Digging, construction of plants, buildings, concreting
11	Qingshuihe hospital	Qingshuihe Village	Natural village	0 meters	Noise	Digging, construction of buildings, concreting
12	Qingshuihe school	Qingshuihe Village	Natural village	0 meters	Noise	Digging, construction of buildings, concreting
13	Solid waste collection points	Qingshuihe Village	Natural village	200 meters	none	Digging, construction of plant, concreting

Source: Social Impact Assessment, March 2018

661. Details for physical resettlement and rehabilitation involved in the project would be available in the Resettlement Plan (RP) for the project.

Loss of Rubber Trees

662. Rubber, bamboo trees are a vital part of the day to day life and the livelihood of people of Yunnan Province. The community makes use of every part of the tree and sells rubber produce from the tree. These include handicrafts, and rubber. As stated earlier, the project requires cutting 47,324 rubber trees and 5,300 shrubs trees including bamboo trees resulting in loss of income to the dependents of the trees. This analysis assumes that a rubber tree generates an annual income of 35 CNY to its owners and would be compensated an estimated CNY 400 per tree based on the average tree life estimation in the RP.

Availability of Employment

663. Projects of this nature generate many employment opportunities for skilled, semi-skilled and unskilled labor during construction and post construction period. Surveys conducted for this study revealed that availability of skilled and semi-skilled labor in Yunnan is limited. It was assumed for this analysis that the project will generate upto 1570 employment opportunities throughout the construction period for people of Lincang Prefecture and 50-100 employment opportunities after commissioning of the LBECZ.

664. Regional infrastructure such as roads are expected to be developed together with the LBECZ for facilitation of trade. These developed infrastructures will have a positive impact on the regional economy due to improved access. Sectors such as employment, trade, production, and agriculture can

be expected to grow. The actual growth in these sectors was not possible to be quantified as information on development plans for Lincang is not available.

Agriculture

665. Permanent and temporary loss of agricultural land occurs due to project subcomponent location in the agricultural field and loss of crop for roads etc. There will be land acquisition for the Project subcomponent. As far as possible, any prime agricultural land will be avoided and substituted with rubber tree plantation land.

666. The planned rehabilitation and development work for the China-Myanmar Avenue that runs along the LBECZ upto border and other access roads under the proposed project will ease the movement of such vehicles and benefit the community at large. The project will not restrict communities' access to and use of these developed roads. However, temporary disturbances and inconveniences to their livelihood activities will be experienced by the communities during project construction period. Access to houses and villages located within the project impact area will not be restricted by the project. Since the existing land use patterns will change near the project area, the areas for agriculture shall also change.

Physical Cultural Sites

667. There are no archaeological, historical, or cultural important sites located in the LBECZ area. The proposed project will not adversely affect any national, social, economic and cultural heritage resources and values in the communities living within the project impact area. The project will not affect any places of religious worship or any monuments of cultural or religious significance located within the project impact area.

5.4.8 Waste Disposal

668. The waste generated at site requires disposal measures and shall be dealt with as per the Waste Management and Handling guidelines in People's Republic of China. Improper disposal of waste can lead to contamination of soil and ground water, which could result in indirect impacts to humans, flora and fauna. The Construction contractor shall undertake the measures listed below to protect and enhance the quality of environment near the construction sites.

669. Construction waste will also consist of construction debris and spoils. Contractor should manage its construction wastes in accordance with the guidance given by the Lincang Environment Protection Bureau (LEPB). Contractor should handle and manage waste generated from the construction site without contamination to natural environment and it will reduce risk to public who stay close to sites, if any. The disposal of wastes from construction sites must be done regularly in a hygienic manner as per PRC regulations.

670. The main source of solid waste during the construction period is excavated soil from the foundations and foundations of the buildings. As all excavated soil will be utilized for back-fill and earthen ramp building, solid wastes will not pose any problem. The abandoned earthwork is mainly produced in the process of earthwork excavation for road and foundations. All the earthwork excavation discards are to be transported to the proper place to concentrate the dumping, and the dumping site will take certain biological protection facilities after the disposal. Generally with abandoned earth-rock must be rammed together to after stacking.

671. Solid waste components during the construction period are simpler, but the large quantity of waste should be timely removal, centralized treatment, and according to different components of different treatment methods:

a. for the stability of construction waste, excavated material such as rubble debris can be stone piled

or backfilled (**Construction Waste**).

b. for waste paint, paint and other ingredients that belong to hazardous waste, can be collected in containers, and handled by qualified agencies to transport, treatment, disposal. (**Hazardous Waste**)
c. perishable ingredients and concentrated waste from a construction personnel camp, must be stored using classified collection methods to handle garbage, leachate and stench as well as toilet waste from affecting the ambient atmosphere. (**Construction Labor waste**).
d. during construction, vehicles transporting bulk building materials are covered with tarpaulin to prevent the material from causing air pollution and spillage on the road causing hazardous driving conditions. (**Construction material**)

Recyclable Solid Waste Disposal

672. The solid waste generation will be collected at the location of the project subcomponent site which may include metal scraps, wooden packing material packaging and crafting material of machines etc. Wooden waste and metal scrap will be collected and disposed of in compliance with applicable regulations and rules. Wastes will be disposed of through Environment Protection License (EPL) vendors who collect such wastes.

Sanitary Waste Disposal at Construction Sites and Labor Camps

673. Lincang Municipal Government maintains a solid waste disposal site in Mengding. The project will use this site for solid waste disposal. No solid waste will be disposed to an unlicensed solid waste disposal site.

674. During the construction of the project, all kinds of constructors are more concentrated and the living garbage generated shall be calculated by 0.2 kg/person/day. The total amount of waste generated during construction is about 40 kg/day, which can be divided into degradable and non-degradable solid waste. If treatment measures against these rubbishes are not taken, these will have a great influence on the surrounding ecological environment and water environment such as river etc. Household garbage generated during construction period shall be entrusted with the local environmental sanitation department to dispose after it is collected.

675. Silt generated in the desilting work of Qingshuihe River channel with desilting volume of about 2000m^3 shall be disposed properly in accordance with requirements of the environmental sanitation department.

676. The labor camps at the site of construction will be temporary in nature, however, the human excreta could be significant to cause contamination of ground water if not managed by the construction company. Those places where most labor will be staying will be near apartments which may use some community or school facilities for solid waste, water and sanitation. Adequate drinking water facilities, sanitary facilities and drainage in the temporary sheds of the construction workers should be provided to avoid the surface water pollution. At the LBECZ, Construction contractor shall locate the temporary day-time facilities such as drinking water, toilet[63]/sanitary facilities by constructing temporary soakpit for toilets[64] and garbage collection which will be away from any water body. Portable toilet with septic tank soak pits will be provided at construction site to facilitate the disposal of sewage generated. No water well will be located within minimum 100 m of a toilet facility.

[63] Toilets can be calculated based on One (1) shared accommodation and one (1) Toilet between 4-5 workers.

[64] Toilets also include women's facilities at the project sites.

677. There should be proper solid waste disposal procedure to enhance sanitation of workers who stay in camps. Thus, possibilities of infecting water borne diseases or vector borne diseases (Parasitic infections) will be eliminated by adopting proper solid waste disposal procedure. Unacceptable solid waste disposal practices such as open dumping of solid waste and poor sanitation facilities will lead to pollution of surrounding environment, contamination of water bodies and increase adverse impact to the general public inhabited in the area. Surrounding of labor camps, garbage disposal sites and material storage yards provide favourable habitats for diseases. Improper dumping of spoil materials and solid wastes may cause environmental degradation of the school area and students, teachers and neighbouring people will face problems like: bad smell, aesthetically unpleasant environment, diseases etc.

678. The total requirement of manpower is not cumulative in nature as most of the activities take place intermittently and the workers tasks will overlap in above mentioned stages and therefore could be common for several activities mentioned above.

679. However, maximum number of persons required at any time by the entire project – both skilled and unskilled is shown in **Table 5.5.** The unskilled labor from the area will be used who will be operating from their homes. The skilled and other technical persons would normally stay at a rented accommodation in nearby town – in this case Lincang town is the nearest and would use the Construction contractor's vehicles for transportation. Usually in one rented accommodation about 8-10 persons can stay in 3-4 bedroom flat/house, about 4-5 accommodations will be rented by the Construction contractor. The rented accommodations will have all amenities such as toilets, washing facilities as well as kitchen and meals facilities. Sufficient quantity of drinking water[65] will be available and toilet/ sanitation[66] facilities will be provided by the Construction contractor of workers rented accommodations.

680. Since Lincang town is completely electrified and has cooking gas connections, no firewood etc. will be used for cooking. Contractor should provide garbage bins at all workers' accommodations. The local municipal body at Lincang collects waste in the town and disposes off in designated disposal areas. Following measures are needed to be performed by Construction contractor to protect and enhance the quality of environment during the construction stage:

- A better way to overcome garbage disposal as mentioned above is by reducing or avoiding the construction of labor camps, thus the selection of majority of skilled and unskilled workers from the project influence area will be a proper measure in this regard.
- Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured. Contractors and workers should obey appropriate means of waste removal and sanitation measures. Adequate number of toilets and bathrooms should be made for the workers, and proper disposal system (septic tank) of sewage waste should be implemented for sanitation purpose and the workers should be aware to use those facilities. Contractor should provide adequate facilities to manage its wastes in accordance with the guidance given by the PRC's regulations.
- Provision of the solid waste disposal, sanitation and sewage facilities at all sites of the construction/labor camps to avoid or minimize health hazards and environmental pollution.
- Contractor should handle and manage waste generated from the construction/labor camps without contamination to natural environment and reduce risk to general public who stay close

[65] 20 liters of water availability per day person (3 litres drinking, 15 lpd per bathing, 10 lpd for cooking) Source; Basic water requirements for human acidities: Meeting Basic Needs, By Peter H. Gleick, Pacific Institute for studies in Development, Oakland CA, USA.

[66] Approx 1.5 toilets for 12-14 persons as per Table 5.31

to sites. Also, Construction contractor should be responsible to enhance the quality of environment.

- Adequate supply of water should be provided to the urinals, toilets and wash rooms of the workers' accommodation. Toilets also include women's facilities at the project sites.
- Contractor should provide garbage bins to all worker's accommodation and construction sites, for dumping wastes regularly in a hygienic manner in the area.

Spoil Disposal

681. According to the water and soil conservation plan, all the earth and stone produced during the construction of the involved projects will be used for site backfilling. The earth and stone between each subproject are internally transported and no spoils are generated. Therefore, no special spoil disposal sites are needed.

Liquid Waste Disposal

682. However, minor wastes such as, waste oil, lubricant, cleaning fluids, paints, degreasers and other similar substances will occur during construction whereas small quantities of waste oil/lubricant will be generated during maintenance works. The disposal of any type of waste oil will be carried out according to the People's Republic of China's waste management regulations. Therefore, any impacts to the environment of study area due this aspect are not expected.

683. Specific areas will be allocated for controlled cleaning and maintenance of vehicles and all wastewater will be collected in soaking pits built to standards within the specific area. This will continue during the full operation period of the project.

Hazardous Waste Disposal

684. During the LBECZ construction, generation of any hazardous waste generation is not expected. However, the Construction contractor will dispose of solid/hazardous waste (if generated at site) at a suitably licensed landfill by transporting the solid/hazardous waste outside of the project area in keeping with the good international practice. No hazardous waste will be disposed to unlicensed hazardous waste disposal sites.

5.5 Environmental impacts associated with operational stage

5.5.1 Air Quality

Road Vehicle Exhaust

685. During the operation, the waste gas mainly comes from vehicle exhaust which contains multiple harmful substances such as CO, NO_x, CO_2, THC and smoke, where factors represented by CO and NO_2 has influence on the air environment to some degree.

686. The emission parameters are those recommended by GB17691-2005 Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Compression-Ignition and Gas Fueled Ignition Engines and GB-18352.2-2005 Emission Limits and Measurement Methods for Pollutants from Light-Duty Vehicles (Phase III and IV in China) and are shown in **Table 5.1**5.

Table 5.15: Recommended Value of Single Vehicle Emission Factor Unit: mg/(Nr.·m)

Average Speed (km/h)		**30.00**	**40.00**	**50.00**	**60.00**	**80.00**	**100.00**
Small Vehicle	CO	31.34	23.66	17.90	14.76	10.24	7.72
	NO_x	1.77	2.37	2.96	3.71	3.85	3.99
Medium Vehicle	CO	30.18	26.19	24.76	25.47	28.55	34.78
	NO_x	5.40	6.30	7.20	8.30	8.80	9.30

Average Speed (km/h)		30.00	40.00	50.00	60.00	80.00	100.00
Large Vehicle	CO	5.52	4.48	4.10	4.01	4.23	4.77
	NO_x	10.44	10.48	11.10	14.71	15.64	18.38

Odor during operations

687. The atmospheric pollutants in sewage treatment plant in Qingshuihe River Area come from the odor generated from aeration tank, sewage pump house, sludge dehydrator room and sludge drying bed. The main components are ammonia and hydrogen sulfide, both are emitted irregularly at low altitude position. The main components of odor are NH_3, CH_3SH, H_2S, $(CH_3)_2S$ and $(CH_3)_3N$.

688. The impact of individual odorous gas on human body. For example, when the concentration of H_2S reaches 0.007ppm, it will affect the reflection of eyes to light. When the concentration of H2S is 10 ppm, H_2S are least pungent to people's eyes. When the concentration of NH_3 is 17ppm, the content of NH_3 in urine of human body and the consumption of oxygen and respiratory rate decrease after 7-8 hours of exposure in such environment. Pursuant to the grade II standard in Table 4 of GB18918-2002 *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant*, the plant boundary emission limits of ammonia and sulphide ammonia are respectively 1.5 mg/m^3 and 0.06 mg/m^3.

689. Pursuant to *Construction Standard for Municipal Wastewater Treatment Project* JB [2001] No.77, the width of sanitary protection zone of production facilities that will generate odor of the sewage plant shall be not less than 50-100m. The width of sanitary protection zone is in connection with sewage treatment scale. According to the width of sanitary protection zone of several sewage treatment plants in Kunming, the width of sanitary protection zone of the sewage treatment plant in the Project is set as 50m during the environmental impact assessment. Since the treatment scale of the Project is small, and the odor intensity is relatively low and the environment within 50m outside the plant area is not affected after odor isolation and odor adsorption through afforestation in plant area, The Project has little influence on regional air environment.

Oil Fumes Impact

690. During operation of the project, oil fume purifiers are set for oil fumes of school, hospital canteens. The oil removing rate is greater than 85% and oil fume emission is low. It has a small impact on to the surrounding environment.

Volatile Organic Compounds

691. Only low or no volatile organic compound (VOC) emitting materials shall be used (including paints, coatings, adhesives, flooring and furniture) to ensure high indoor air quality inside buildings to be constructed in the project. Water-based nontoxic, no allergenic paint for drywall or plaster surfaces shall be preferred to latex or oil-based paints.

5.5.2 Noise Quality

692. The acoustic environment quality during the daytime and night time on the sensitive points on both side of the road complies with the Category 2 standards specified in Quality Standards for Acoustic Environment (GB3096-2008) during the near, middle and future term operation of the road. During the operation of the Project, the impact of traffic noise on the sensitive sites is small after the distance attenuation.

693. All types of noise generated in the project can meet the following standards after relevant treatment: GB12348-2008，Emission Standard for Industrial Enterprises Noise at Boundary, Category 3, so the impact on the environment is small.

694. The noise of personnel activities is mainly the noise from households, office workers, hospital personnel and Guomen Primary School, which mainly occurs in buildings. The impact of such noise on the external environment is relatively small after passing via the wall obstruction and distance attenuation. The commercial noise is mainly the noise from shops and product display areas, which mainly occurs in the interior area, and its impact on the external environmental is small after passing via the wall obstruction and distance attenuation.

695. Some industrial noise emissions contain characteristics that may make the noise more annoying: tonality (humming, whining), modulation (regular variation in noise level or pitch) and impulsiveness (hammering, banging). In the case of LBECZ noise emissions, Project subcomponent design generally ensures that these characteristics are minimised or not present. In cases where they are present, these characteristics will generally become inaudible due to masking by other background noise at a distance where acceptable noise limits are satisfied.

Equipment Noise

696. The equipment noises are mainly the noises of unloading and loading equipment of enterprises in warehouse and logistics area, equipment noises of sewage treatment station, equipment noises of water supply plant, noises of supporting ventilation facilities in hospital, etc. The ventilation equipment of underground buildings is located underground and noises of such equipment have little impact on external environment after obstructed by buildings. Noises of equipment in warehouse logistics houses at trade zone along the border mainly occur in warehousing buildings and have little impact on external environment after being obstructed by walls and greening vegetation. Sewage treatment plant and water supply plant install basic vibration isolation facilities on fixed noise producing equipment, having little impact on external environment after treatment. All types of noise generated in the project can meet the following standards after relevant treatment: GB12348-2008, Emission Standard for Industrial Enterprises Noise at Boundary (Category 3) and therefore the impact on the environment is small.

5.5.3 Surface Water aspects

697. The wastewater during the operation of the project mainly includes road runoff from road works, wastewater from the Border Resident Trading area at Qingshuihe River Port, Qingshuihe River water supply plants, charging stations, schools and hospitals and other domestic wastewater, process wastewater of water supply plants, medical wastewater and tail water of sewage treatment plants.

Road Runoff of Road Works

698. Roads for the Project are municipal roads. After the proposed municipal road is completed and put into operation, with the growing of traffic volume year by year, the emission pollutants of exhaust from motor vehicles precipitating on road and bridge, the oils of vehicles and other harmful substances scattered on road are gradually increasing by years. The major pollution factors are SS, COD, petroleum, etc., and the content of them is very small. Once the above pollutants flows with rainfall into the water body, the quality of water body will be affected to some extent. Generally, this kind of pollution is called non-point source pollution, also the diffused pollution. The diffused pollution is in connection with multiple factors such as traffic flow, fuel composition, air humidity, wind direction and wind force. The Project is to construct municipal roads which will not be provided with toll station. The pavement is asphalt concrete pavement, belongs to watertight area and has such features as fast runoff generation and confluence. The rainwater brings these pollutants on the road into the

underground rainwater pipe network. The rainwater on the road in this area is collected by rainwater pipe network, enters into the nearby road rainwater pipe network and finally flows into Nanting River.

Green Belt

699. In addition, the green belts on both sides of the road can absorb, filter and precipitate the pollutants in road runoff and can effectively decrease the concentration of pollutants in road runoff of the Project. To sum up, with the implementation of green belts, after the project road is constructed, the road runoff will have little impact on the quality of surrounding water body.

700. The sewage treatment plant of Qingshuihe River area should be provided with more greening rate to beautify the factory. It is suggested to grow tall and big trees to build the health protection isolation belt, and strengthen management of the plant, including piling the sludge generated at the specific location and transporting them to the outside in time.

701. The underground parking lot should be equipped with independent air supply and exhaust system, minimally realizing 6 times of air exchange every hour; moreover, the exhaust outlet should be set in the greening belt of the project area on a height minimally 2.5m above the outdoor ground level, which must not face neighboring buildings or areas for public activities and avoid crowded areas, eddy zones and upwind of dwellings, and the exhaust outlet should have sound deadening measures.

Domestic Wastewater from Qingshuihe river area

702. The domestic wastewater generated during the infrastructure operation of the infrastructure construction project of Qingshuihe River Area is pretreated by the respective septic tanks and oil separation tanks to reach Class 3 standard of Integrated Wastewater Discharge Standard (GB8978 - 1996) (ammonia nitrogen and total phosphorus are based on Class (B) standard of Water Quality Standard for Wastewater Discharged into Urban Sewers (GB/T31962-2015)) and then is discharged into the municipal sewage pipeline network in the area and will eventually enter the sewage treatment plant in Qingshuihe River Area for treatment.

703. The road network in Qingshuihe River Area will be completed during the Project. Both sides of the road will be provided with sewage pipe networks to facilitate the drainage units in the area to discharge domestic sewage into the sewage treatment plant in Qingshuihe River Area. Therefore, it is feasible that the domestic sewage generated during the operation of the Project can enter into the sewage treatment plant in Qingshuihe River Area, having little impact on the surrounding surface water.

Wastewater from schools, hospitals

704. The domestic wastewater during the operation period of the construction works of Guomen Second Primary School of Cangyuan Va Autonomous County will be discharged into the municipal pipeline network after treatment in the septic tank and then enter the sewage treatment plant of Cangyuan County for treatment. The domestic wastewater during the operation period of China-Myanmar Friendship Hospital of Zhenkang County will be treated by the septic tank and then will be treated by the hospital's internal medical wastewater treatment system and then will be discharged into the municipal pipeline network and finally will enter the sewage treatment plant of Zhenkang County for treatment.

705. **Septic tank**: The Project should be provided with septic tanks in the plot area to conduct pretreatment to all wastewater of the Project, but the specific quantity and size of the septic tanks have not been determined yet. According to relevant requirement, the septic tanks should have an individual volume meeting the requirement that the waste wall can be held for 12h – 24h. Therefore, the Employer should arrange septic tanks reaching a total volume not less than 610m^3 for the Frontier Trading Market

for Border People and that reaching a total volume not less than 5m^3 for the International Capacity Cooperation Area; moreover, the Qingshuihe River Port Water Supply Plant should be provided one septic tank of 3m^3, and the charging stations should be separately provided with one septic tank of 8m^3, each. The Hospital of Qingshuihe River Port should be provided with septic tanks reaching a total volume not less than 60m^3, the China-Myanmar Friendship Hospital of Zhenkang County should be provided with septic tanks reaching a total volume not less than 370m^3, the Guomen Primary School should be provided with septic tanks reaching a total volume not less than 40m^3, and the Guomen Second Primary School of Cangyuan Va Autonomous County should be provided with septic tanks reaching a total volume not less than 91m3. The Employer should entrust a unit with environmental engineering design and construction qualification to conduct design and construction in strict accordance with Code for Design of Building Water Supply and Drainage (GB50015-2003), so as to ensure the treatment effect, and the specific scale should be subject to the final design.

706. **Oil separator**: An 8m³ oil separator shall be set at Guomen Primary School, and a 6m³ oil separator shall be set at Hospital of Qingshuihe River Port; and a 48m³ oil separator shall be set at Guomen Second Primary School of Cangyuan Va Autonomous County and a 110m³ oil separator shall be set at China-Myanmar Friendship Hospital of Zhenkang County.

Medical Wastewater

707. During the operation of hospital at Qingshuihe River Port, the wastewater output is 22,133.6m^3/a, including domestic sewage 2,744.8m^3/a, medical waste 19,388.8m^3/a. The medical wastewater requiring pretreatment such as that containing heavy metals and that from laboratory is 525.6m^3/a. It is to be collected through special drainage network, then treated with chemical method and activated carbon adsorption to meet Table 2 of Discharge Standard of Water Pollutants for Medical Organization (GB18466-2005) at outlet of each department, and then discharged into medical wastewater treatment system of the Project. The medical wastewater, office wastewater, restaurant wastewater and domestic sewage produced during operation of the project are treated by oil separation tanks and septic tanks and are then discharged into the medical wastewater treatment station to meet the pre-treatment discharge standard in Table 2 of Discharge Standard of Water Pollutants for Medical Organization (GB18466-2005), and are then discharged into the municipal sewage pipeline network and finally enter the sewage treatment plant in Qingshuihe River Area for treatment.

708. During the operation of the Qingshuihe River Port Hospital of China-Myanmar Friendship Hospital of Zhenkang County, the amount of wastewater generated is 133,049.8m^3/a, including the amount of domestic sewage generated of 38,909m^3/a, the amount of medical wastewater generated of 93,440m^3/a and the amount of heavy metal wastewater and test wastewater to be chemically pretreated in medical wastewater of 700.8m^3/a. After being collected through a dedicated drainage pipe network, chemical methods and activated carbon adsorption treatment are adopted to reach the discharge standards of Discharge Standard of Water Pollutants for Medical Organization (GB18466-2005) at the outlet of the department. Then, wastewater is discharged into the medical wastewater treatment station of the project. The medical wastewater, office wastewater, restaurant wastewater and domestic sewage produced during operation of the project are treated by oil separation tanks and septic tanks and are then discharged into the medical wastewater treatment station to meet the pre-treatment discharge standard of Discharge Standard of Water Pollutants for Medical Organization (GB18466-2005), and are then discharged into the municipal sewage pipeline network and finally enter the sewage treatment plant of Zhenkang County for treatment.

709. Wastewater is classified and collected in the project area. Heavy metal wastewater and inspection wastewater are collected through a dedicated sewage pipeline network and then discharged into a heavy metal pretreatment system to reach the maximum allowable emission concentration of Class I pollutants in of Discharge Standard of Water Pollutants for Medical Organization (GB18466-

2005) and then discharged into the sewage treatment station. The bacteria-containing wastewater, office wastewater and restaurant wastewater in the ward area are treated by oil separation tanks and septic tanks together with the domestic wastewater of the staff quarters, and then transferred to the sewage treatment station in the project area to reach the discharge standard of Discharge Standard of Water Pollutants for Medical Organization (GB18466-2005) and disinfected, and then discharged into the municipal sewage pipeline network and enter the sewage treatment plant of Cangyuan County for treatment.

710. The sewage treatment meets the standard after diversion of rainwater and sewage and classified collection and treatment of sewage; the pipe network collecting rainwater and sewage is complete and the sewage discharge direction is clear and reliable, having little impact on the surrounding surface water environment.

Wastewater of Water Supply Plant

711. The production wastewater of water supply plant at Qingshuihe River Port mainly comes from the sludge wastewater of sedimentation tank and backwash wastewater of filter, including impurities of raw water and residues of reagents added by water plant. The filter shall be back washed one time each day. The output of process sewage is around 500m^3/d. The major pollutant in sewage is SS with the concentration about 80mg/L. To save water resource and minimize SS pollution, during the environmental impact assessment, it is proposed that sedimentation tank and concentration tank should be installed to treat the sludge sewage of sedimentation tank and backwash wastewater of filter. The supernatant is discharged into head distribution well for reuse and the production wastewater will not be discharged to the outside, which has little impact on the surrounding environment.

Exhaust Sewage in Sewage Treatment Plant in Qingshuihe River Area

712. The infrastructure construction project includes a sewage treatment plant in Qingshuihe River Area to treat the domestic wastewater and production wastewater. The recent treatment scale is designed as 10,000m^3/d, the long-term treatment scale is designed as 20,000m^3/d, and the treatment process is CAST Wastewater Treatment Process.

713. The effluent of the sewage treatment plant in Qingshuihe River Area is discharged into Nanting River. According to the effluent quality design of the project's sewage treatment plant, the wastewater discharge situation is shown in **Table 5.16**.

Table 5.16: Design Effluent Quality of Sewage Treatment Plant in Qingshuihe River Area

Indicator	pH	BOD_5	CODcr	SS	TN	NH_3-N	TP
Value (mg/L)	6~9	≤ 20	≤ 60	≤ 20	≤ 20	≤8 (15)	≤ 1

Note: The value in brackets is the control index when water temperature is ≤12°C

714. Based on the above table, after the sewage is treated, the concentration of pollutants in sewage can meet the requirement of grade I (B) Standard of GB18918-2002. It is understood that the "CAST sewage treatment process" employed for the Project is in wide application. The effluent quality is stable. Therefore, it is feasible and reliable that the sewage discharge of the Project can meet the standard.

715. According to the information provided by the feasibility study of the project, the designed integrated influent water quality and effluent water quality in the Qingshuihe River Area are detailed in **Table 5.17**. After the treatment, the recent tail water discharge amount is 10,000m^3/d. Then it is discharged into Qingshuihe River and flows through Nanting River after 1.5 km.

Table 5.17: Design Influent Quality of Sewage Treatment Plant at Qingshuihe River Unit: mg/l

Indicator		BOD_5	COD_{cr}	SS	TN	NH_3-N	TP
The recent treatment scale is 10,000m^3/d	Influent Quality	150	260	180	35	25	4
	Quality of effluent	20	60	20	20	8	1

716. In order to understand the impact of tail water discharge from Qingshuihe River sewage treatment plant on Qingshuihe River, the normal discharge and abnormal discharge of tail water of the sewage treatment plant are predicted. The normal emission source intensity is the effluent water quality, and the abnormal emission source intensity is the influent water quality. The receiving river is Nanting River. Emission Source Intensity is shown in **Table 5.17**.

River water quality and flow conditions

717. Nanting River is primary tributary and is rich in water flow and water resources, and the average annual flow is 253 m^3/s. On May 27, 2017, sewage discharged from sewage treatment plant into Nanting River is monitored within 500m scope of the upstream and the quality result of water in monitoring section is shown in **Table 5.18**.

Table 5.18: Monitoring Result of the Section of Nanting River (sewage drain outlet) Upstream

Item	CODcr	Ammonia nitrogen	TN	TP
Unit	mg/L	mg/L	mg/L	mg/L
Monitoring Result	15	0.281	0.76	0.09

718. According to the features of the Project and the current condition of water quality, the characteristic pollutants in domestic sewage such as CODcr, NH_3-N, TN and TP are analyzed.

719. All pollutants in sewage receiving water in Nanting River can meet the requirement of function of water body. Taking corresponding environmental protection measures for the Project decreases pollutant discharge, reliefs the pollution load on Nanting River and complies with relevant provisions of environmental protection. The impact of sewage on surface water can be effectively minimized provided that the management of sewage treatment facilities is strengthened during the project operation and no sewage can be discharged into Nanting River under abnormal condition. Therefore, the sewage discharge of the subproject has little impact on surface water.

5.5.4 Groundwater Impact

Impact of road runoff of Qingshuihe Road works on groundwater

720. The sewage generated during the operation of proposed road network is mainly the road runoff. The major pollution factors in road runoff formed from early rainwater are SS and petroleum. Seepage pit and seepage well will not be provided to drain road runoff into underground water, which has no direct influence on the quality of underground water. Under normal condition, the road runoff is discharged into surface river after collection, settlement and oil separation treatment. Steel-concrete structure is employed for all treatment facilities. Since major pollution factors such as SS and petroleum are insoluble substances and cannot permeate with water into the underground, the road runoff will not affect the quality of underground water even under abnormal condition.

Impact of Road Runoff in Road Engineering on Underground Water

721. The project construction does not involve the exploitation of underground water. After treated in sewage treatment plant, the sewage is discharged into Nanting River.

722. The Project covers a relatively large area and it will damage the ground vegetation, change the original landform and conditions of recharge, runoff and discharge and affect the underground water to some extent. Therefore, seepage control measures shall be taken for treatment facilities in sewage treatment plant. During the operation, the management of sewage treatment plant shall be strengthened as required by environmental impact assessment to ensure the sewage treatment meets the standard. The management of sewage pipeline shall be enhanced to prevent unfavorable conditions such as pipe cracking thereby affecting underground water.

Impact of Qingshuihe River Port Hospital and China-Myanmar Friendship Hospital of Zhenkang County on Groundwater

723. The influence factors of the hospital at Qingshuihe River Port on underground water environment during its operation are mainly the sewage and solid waste. The project sewage is discharged into sewage treatment plant after the pretreatment meets the standard. Seepage control measures shall be taken for sewage treatment station at project area to avoid medical sewage infiltration. The sewage is finally discharged into the nearby municipal sewage pipe network after being treated by sewage treatment station, and flows into the sewage treatment plant at Qingshuihe River Area, which has little impact on underground water environment.

724. Project medical wastes and sludge of sewage treatment station are reasonably treated as required by PRC specification before discharge or handed to certified waste handlers; domestic wastes are collected such as sludge and transported to specified spot for appropriate treatment. The above solid wastes have little impact on underground water environment.

725. Seepage control measures shall be taken for temporary storage house for project medical wastes during the hardening treatment of ground surface; domestic waste cans are distributed in buildings. The above design removes the impact of rainwater on medical solid wastes and domestic wastes and leaching water in rain season will not occur, which has little impact on underground water environment.

5.5.5 Impact on Fish in river

726. Changes in eco-environment. For the river rehabilitation project in Qingshuihe River and Nanpa River, dredging the channel would reduce the biomass of phytoplankton, phytobenthos such as algae an diatomeae, and zoobenthos including molluscs, annelids and arthropods. These benthos can not only provide food resources for some fishes, but also affect the physical-chemical characteristics of the water body and soil. The density and composition change would affect the fish composition as well. However, there are some small fishes liking *Cotitidae, Homalopteridae* and *Sisoridae*. They are easily recovered after the project completion.

727. There is a temporary engineering construction for intake water in Nangun River (**Figure 5.3**). The water intake infrastructure consists of barrage, sand retention layer and water intake sluice. The barrage would impact on the fishes thereby preventing fish migrations for reproduction, feeding and other purposes.

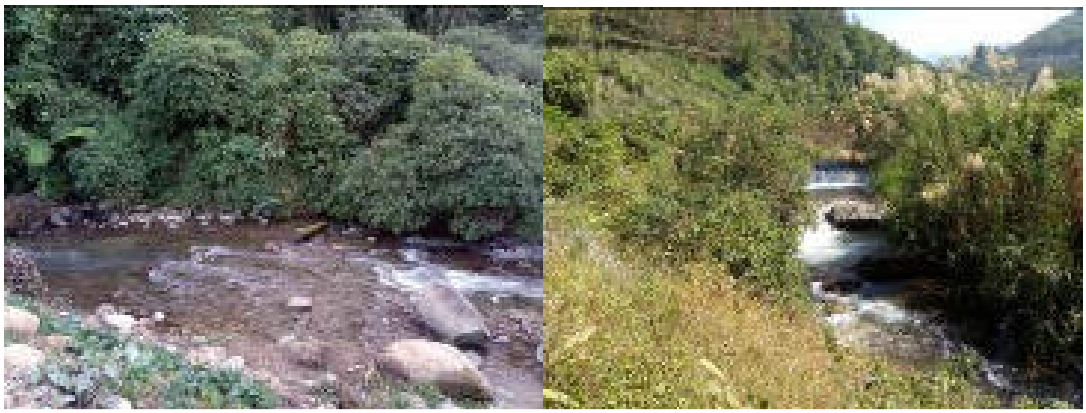


Figure 5.3 The view of water intake area of Nangun River

728. The Cangyuan Guomen No. 2nd Elementary School will pass through Tangchang River, which is one of tributaries of Mengdong River (**Figure 5.4 and 5.5**). Mengdong River is the secondary tributary of Lancang River. The fishes in Tangchang River mainly comprise some small economic species, due to the narrow river channel and big fluctuation of water level. The construction will not have any impacts on the fish resources.

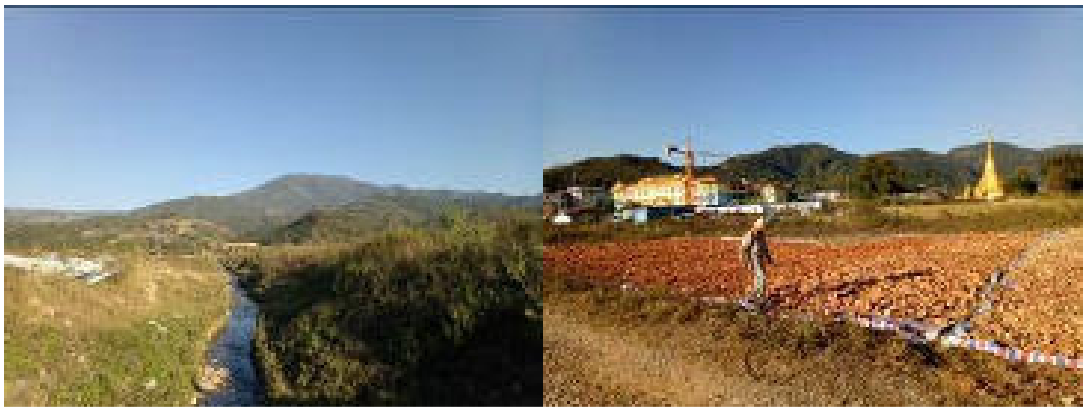


Figure 5.4: View of proposed Cangyuan Guomen No. 2nd Elementary School
(The middle is Tangchang River)

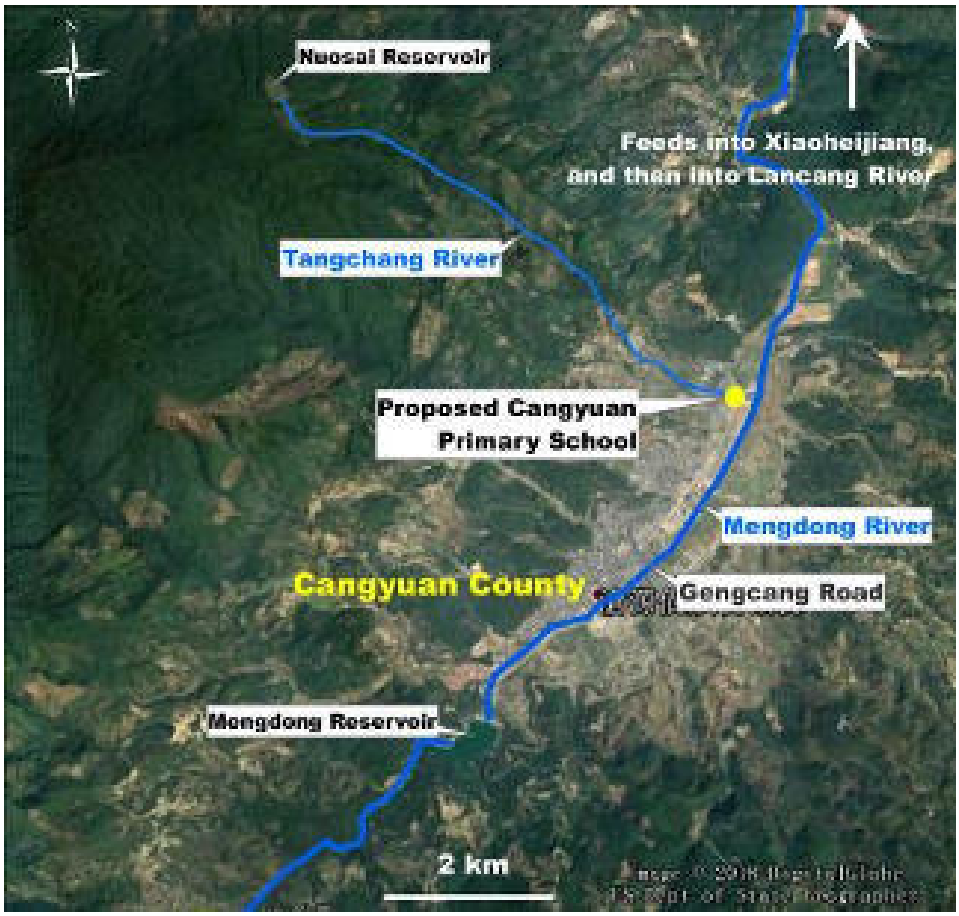


Figure 5.5: The location of proposed Cangyuan Guomen No. 2nd Elementary School and its water systems

729. **Impacts on fish migration in Nanting River**. Considering the design of Nanting Bridge is three span twin cable stayed style (70+140+70 m), the construction will not be happened in the river stream. This will reduce the impact on fishes to a large extent. However, the bridge vicinity may be the important spawning sites for fishes laying floating-eggs, and the river course is the important pathway for migratory fishes. The construction would have some impacts on the fishes in the river. Even if there is no fish species under the national protection animal list, there are four conservation fishes identified in the NAGR of lower reaches of Nanting River.

Alteration of river bottom and sediment transport

730. The construction of bridge and the river embankment rehabilitation will affect river bottom and sediment transport as serving a barrier for waves and river currents. Although some local disruption to the river channel bed can be expected as a result of construction. River bank erosion and accretion are natural processes that take place over a range of time scales. Bank erosion is mostly induced by anthropogenic interference. Changes in wave climate due to construction would negatively impact the water depth. This riverine stretch is well known for heavy sand accretion during monsoonal months. Therefore, some removal of sand may be required along the river channels from time to time.

5.5.6 Other Waste aspects

Green Waste

731. Trees and flowers along the road to produce green garbage are more dispersed and needs regular manpower cleaning methods to collect and disposed through collection vehicles.

Liquid Waste

a. Oil Spillage

732. Contamination of water on land/nearby drainage facilities by the sub-transformer oils from electrical substation at Water treatment plant, Waste water treatment Plant, International Production center can occur during operation due to leakage or accident. Sub-transformers will be normally located will be situated outside and should be installed within secure and impervious areas. The oil for their maintenance will be kept in storage yard having a storage capacity of 110% spare oil. Also, proper drainage facilities will be constructed during the construction stage to avoid overflow or contamination with natural flow paths especially during the rainy season.

b. Vehicle and Equipment Maintenance and cleaning

733. The energy vehicle maintenance will be carried out as per recommended standards by the manufacturers. The typical maintenance and repair activity during operation phase involves preventive and breakdown maintenance of project vehicles, lubricants and oils, brakes, oil filters, dry filters, batteries, coolant, cleaning detergents and solvents. Preventive Maintenance involves labor as well as use of materials and consumables such as minor/low value electrical and mechanical parts for preventive maintenance and upkeep of the equipment including unit transformer electrical, painting of equipment, electrical panels, electrical/mechanical pumps for water treatment plants, WWTP, electrical switch gears and associated protection.

734. In the project engineering area, 17 sets of vehicle cleaning systems shall be set in total to collect and settle down the construction wastewater, so the wastewater can be reused for watering the construction site and suppressing the dust in the dry season but is stored in the rainy season. Each vehicle washing system includes 1 vehicle washing pool, 1 high pressure washing facility and 1 grit chamber. In the project construction area, after the vehicle cleaning systems are set and thus the construction wastewater is collected and settled down, the wastewater is reused for watering the construction site and suppressing the dust in the dry season but is stored in the rainy season.

Solid Waste

735. The abandoned soil and stones excavated in the construction process shall be reused for the leveling and backfilling of construction land in the Qingshuihe River area, so a special spoil area needn't be set. The backfilled soil and stones shall be compacted in time to avoid from causing secondary environmental pollution in the backfilling process.

736. During the construction period, the construction waste shall be classified for treatment to sort out the waste reinforcements, waste timber, waste plastics and waste packaging materials, etc. which has the recycling value, and the construction waste that cannot be recycled shall be transported to the Qingshuihe River area for the leveling and backfilling of land.

737. After the domestic waste is collected during the construction period, an environmental sanitation department shall be entrusted to dispose of it.

738. During the operational period the only source of solid waste would be garbage of the maintenance staff of the site. Facilities for solid waste disposal will be provided by the project and

arrangements will be made with the Mengding SWM facility to transport the solid wastes to their dumping sites.

739. During solid waste collection, odor pollution due to odor-forming NH_3, naphtha, CH_4, organic amine decomposition needs to be controlled and isolated. For preventing environmental pollution, when garbage car collectors dump garbage into containers, nozzle to garbage spray, minimize powder dust by using water mist that contains biological atomization deodorant. Using effective sprays will suppress generation of microorganisms and worms besides odor. At the industry workshop, better ventilation to improve workplace environment, set when spraying aerosol deodorant into transit station make deodorant evenly mixed in air spray to dust down, garbage deodorization system and air deodorization systems.

740. Noise Control for devices in the transfer and collection station can be is reduced by soundproofing, sound absorption and other measures of control .The working noise of the compactor is mainly caused by the hydraulic system which can be reduced by installing liquid pressure system installed inside the compactor.

Sludge Collection and Treatment

741. All solid wastes produced during the project operation are properly treated, which has little impact on surrounding environment. Project medical wastes and sludge of sewage treatment station are reasonably treated as required by specification; domestic wastes are collected and transported to specified spot for appropriate treatment.

742. The assessment mainly focuses on medical wastes of hospital, sludge of sewage treatment station, heavy metal sludge and discarded activated carbon adsorbent as below:

a. Wastewater/Sewage Treatment Plant

743. The temporary sludge storage tank of the Sewage Treatment Plant should be designed to meet the temporary storage requirement of the sludge according to Standard for Pollution Control on Hazardous Waste Storage (GB18597-2001) and the design principles of dangerous waste storage facilities (warehouse type). Sludge containing heavy metals and waste active carbon absorbents should be regularly transported by a unit with relevant qualification for disposal. A qualified unit shall be entrusted to transport and dispose of the heavy metal sludge and abandoned activated carbon.

b. Medical Waste

744. The medical waste disposal unit shall timely clear and transport the medical wastes collected by the hospital, so as to ensure that the medical wastes will not get piled up for more than 48 hours. Thus, only minor effect will be exerted on the external environment. Sludge generated during project construction can be treated and disposed properly and its impact on surrounding environment will be small if the operation complies with relevant laws, regulations and standards. Heavy metal pre-treatment system of the Project applies chemical precipitation method and activated carbon adsorbent to treat heavy metal wastewater and test wastewater, so a certain amount of heavy metal sludge and waste activated carbon, which are hazardous wastes and shall be transported and disposed regularly by qualified unit, will be generated.

c. Water Supply Plant

745. To process wastewater from the water supply plant, sedimentation basin and concentration basin shall be set to treat the precipitated sludge and the filter backwash wastewater, and then the supernate shall return to the head distribution well for recycling, and the industrial wastewater shall not be discharged to the outside. Sludge generated in the Qingshuihe River Port Water Supply Plant should be transported to the landfill for dumping.

5.5.7 Energy Consumption during road operation

746. The energy consumption during the road operation is a kind of long-term continuous investment, which mainly embodies the fuel consumption of various road vehicles during the transportation.

747. For power supply system energy saving during operations, implement the following:

- Using steel-aluminum composite rail new material in structures: Steel Aluminum Composite contact rail resistance is small, not only the voltage quality is good, but it also reduces losses, saves electricity, and saves operating costs.
- Lighting lights and fixtures: The use of high light efficiency lighting and lamps, lamps and lanterns with compensating capacitors, reduced line loss would save electricity.
- Transformer: Adopts low loss transformer to reduce no-load loss.
- Street lamp control: All street lamps using clock control and street lights through computer center centralized monitoring.
- Power Factor: All lamp power factor compensation for single lamp in situ will ensure selecting an electrical device with high efficiency and low consumption.

748. There are no electric generators proposed in the project and therefore there will be no electromagnetic interference (EMI) caused during operation of any project facilities.

5.5.8 Health and Safety

Worker Occupational Health and Safety - Operations

749. Solid Waste Management (SWM) collection and disposal, Water treatment plant and leachate treatment plant operators and staff are exposed to occupational risks of falls on wet floors or into treatment ponds, pits, clarifiers or vats, splashes of hazardous liquids, or cuts from equipment. They are exposed to hazards related to work in confined spaces.

750. The following measures will be implemented to safeguard the safety and health of SWM, WTP, WWTP operators: (i) compulsory use of safety shoes or boots with non- slip soles, protective equipment, and chemical resistant clothing and safety goggles to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapors; (ii) posting of safety instructions in each workshop regarding the storage, transport, handling or pouring of chemicals; (iii) check electrical equipment for safety before use; verify that all electric cables are properly insulated; take faulty or suspect electrical equipment to a qualified electricity technician for testing and repair; (iv) wearing of respiratory mask in sludge dewatering areas and when moving and transporting sludge; and (v) adherence to safety instructions concerning entry into confined spaces, e.g., check atmosphere for oxygen or for poisonous gases, use respiratory protection equipment if needed, have a another worker stand guard in case of need for help. Proper firefighting facilities will be maintained by these facilities to ensure that any flareup of any fume or sparks lead to accidents.

751. Periodic examinations by occupational physician on all workers will be mandatory to reveal early symptoms of possible chronic effects or allergies. Finally, health and safety will be incorporated into the regular staff training programs.

Electric shock

752. This may lead to death or injury to the workers and public in the area. This can be minimized or avoided by:

- Security fences around electrical installations or substations.
- Establishment of warning signs.
- Careful design using appropriate technologies to minimize hazards.

5.5.9 Requirements on Settled Enterprises

5.5.9.1 Requirements on admission of border trade markets

753. The main functions of the Frontier Trading Market for Border People are commerce, trade and exhibition, etc. It is forbidden to introduce enterprises that do not conform to the functional positioning, such as production and processing enterprises. The environmental protection requires:

- The solid waste generated within the project to be classified and collected, and regularly cleaned and disposed.
- It is prohibited to conduct the high-noise propaganda and sales in the product exhibition area.

5.5.9.2 Requirements for warehouse logistics/settled enterprises

754. The main function of the warehouse logistics area in the Project is the storage of general goods, and the warehousing, logistics and distribution services of toxic, hazardous and dangerous goods shall not be introduced into the border trade warehouse logistics houses.

755. The cold–chain logistics zone of the Project should adopt refrigerant complying with relevant requirements stated in Montreal Protocol Treaty and Circular on Strict Control of New Construction of Production Facilities Applying Hydro-Chlorofluoro-Carbon. Liquid ammonia is a flammable, explosive, toxic and hazardous chemical with a hazard class of 2.3. In view of the characteristics of intensive buildings and various items in the warehouse logistics area of the Project, the cold chain logistics area of the Project should not use liquid ammonia for refrigeration. Instead, the R404 is recommended.

756. Some enterprises in the warehouse logistics zone of the Project conducts simple processing and packaging operations, but the processing and packing processes have not been clarified yet; therefore, it is required that the settled enterprises should transact the environmental protection procedures as per relevant provisions:

- The settled enterprises shall not discharge sewage into the river, dump industrial wastes, domestic garbage and other wastes; they shall not discharge oil, acid, alkali or highly toxic waste fluids into the water; and it is forbidden to clean containers and vehicles in the river.
- Enterprises involving fixed noise-producing equipment in the border trade, warehouse logistics houses must report to the environmental protection authority with respect to the equipment that generates the environmental noise pollution, the type, quantity, the noise values emitted under normal operation conditions and the facilities for prevention and control of environmental noise pollution, and provide technical data for the prevention and control of noise pollution. All the settled enterprises should choose low-noise equipment and processes as far as possible and make reasonable layout so as to bring the noise at their boundaries up to the standard. Settled enterprises that will cause noise pollution must strengthen the daily maintenance and renewal of equipment and the management of operating personnel, so that all equipment can operate under normal conditions; they shall also take effective measures to reduce the impact of noise on the surrounding environment.

5.6 Cumulative and Induced Impacts

757. The **Cumulative Impacts**[67] are defined as the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project. The **Induced Impacts** are the adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur later or at a different location.

5.6.1 Development of Infrastructure – access roads, urban facilities

758. The LBECZ involves large-scale excavation and land loss is significant. However, due to increased land use for development of port and facilities, the local access roads, housing and urban facilities will be upgraded in the border area. This is a positive impact and induced impacts will be positive for local community.

759. The traffic projections for the designed life of new road network in the project are as follows:

Table 5.19: Traffic projections on roads within design life

Roads	Road grade	Projected timeframe	Traffic projections in pcu/h
No.1	Secondary road	2020	257
		2025	562
		2030	749
		2035	842
No.2	Secondary road	2020	176
		2025	480
		2030	692
		2035	831
No.3	Secondary road	2020	410
		2025	702
		2030	878
		2035	971
No.4	Secondary road	2020	363
		2025	624
		2030	831
		2035	936
No.5	Secondary road	2020	252
		2025	446
		2030	723
		2035	878
No.6	Secondary road	2020	340
		2025	256
		2030	315
		2035	373
		2040	669

760. The CRVA has developed air emission impacts in terms of project traffic by year 2035

5.6.2 Roads, Bridges, Rail road connectivity and main road access to trading port

[67] Environment Safeguards- A Good Practice Sourcebook on Draft Working Document (December 2012).

761. The induced impact of the rail/road network could be increased number of vehicles to the port due to better availability of regional trading infrastructure and consequent increase in business activity in the area. The development of the bridge connecting the Mangka border will support the cumulative traffic increase as proposed in the **Table 5.19**.

5.6.3 Development of Hospital, school, water supply, waste management facilities etc. at LBECZ

762. Lincang prefecture is now coming under the rapid socio-economic development. It will facilitate the livelihood development of local people and opening of new industries and business along with the agricultural and domestic productions. With the construction of the new infrastructure, number of prevailing issues in surrounding areas will be resolved. This will provide a lasting solution to the livelihood issues in the area and improve the reliability of trading infrastructure in the said areas.

763. The project will not use any natural resources occurring in the area during construction as well as its operation cum maintenance phases. The construction material such as equipment, cement etc. shall come from factories mostly from outside areas, while the excavated soil shall be used for backfilling to restore the surface.

764. The Lincang Municipal Water Affairs Bureau approved the Water Intake Permit Application of Mengding Qingshuihe Port Area Water Supply System (reference No.6 Document, April 27, 2018 **Appendix 10**). A water resources assessment report has been prepared to assess the long term and cumulative impact of water supply issues. **Appendix 4** contains summary of the report.

765. As described in the EIA impact section, the LBECZ project shall not cause any accelerated use of resources for short-term gains and all impacts related to construction are sustainable in nature.

5.6.4 Development of industry, trading and commercial activity

766. The project will increase availability of infrastructure for trading. Hence forth, there may be an increase in setting of factories, trading units and the like, Experience indicates that economic development leads to generation of more jobs, which in turn should raise the living standards of poor. Thus, the project will contribute to reduction of affluent/poor income gap by providing opportunities for employment and rural based economic activities. Majority of the population in project areas are engaged in agricultural activities. Therefore, most of them are seasonally employed. Hence unskilled labor requirement of the construction activities shall be fulfilled with locally available manpower. Generation of local employment during construction period will increase the income and socio-economic standards of the residents of the project area.

5.6.5 Use of Irreplaceable Resources

767. A total of 5.96 ha of forest and woodland, 13.87 ha of sloping agricultural land, and 4.94 ha of grassy shrub land will be occupied by project infrastructure. Loss of these lands will have an environmental effect at the local level, and measures to minimize encroachment on forest areas and for the rehabilitation of damaged natural areas will be included in designs and construction contractor's obligations. The loss of agricultural assets to developments has been calculated from the resettlement planning documents and field inspection. An estimated total of 13.87 ha of agricultural land will be permanently lost due to the land taken for development of the major conveyance tunnels and ancillary works. Farmers who lose land permanently will be compensated by replacement with land of equivalent quality and quantity, or through a lump sum payment.

768. Only one Yunnan key protected fish *Anguilla nebulosa* has been recorded in the assessment area. This fish is neither an endangered or critical fish as per IUCN category; however, the measures will be designed during bridge construction to mitigate any impact. No other rare, threatened, or

protected species have been recorded at the project sites.

5.6.5 Consolidated Summary of Impacts

5.6.6.1 Ambient Noise

Construction Period

769. Predicted value of noise 20 m distanced to the construction site at daytime in the earthwork stage can meet requirements of Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011); the predicted value of noise 40 m distanced to the construction site at daytime in the structure engineering stage can meet requirements of Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011); the predicted value of noise 20 m distanced to the construction site at daytime in the decoration stage can meet requirements of Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011). Adopting measures proposed by environmental evaluation, noises of the Project in the construction period can meet provisions stated in the Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011).

770. It is required to reasonably arrange construction time in the construction process, and sensitive locations should be provided with temporary sound barriers on one side; additionally, construction machineries and equipment should be low noise types to meet emission standards for construction noise. Construction of the Project is of little impact on the acoustic quality of surrounding environment, and the impact will disappear along with completion of construction.

Operation Period

771. During the project operation, except the sensitive points at both sides of the roads in Shuanglongjing village, Bangui village and Tuanjie village, all other sensitive targets meet the requirement of category 2 standard of GB3096-2008 Environmental Quality Standards for Noise during short-term, medium-term and long-term operation in terms of sound environment quality. During the project operation, the traffic noise has little impact on sensitive targets after attenuated by distance.

772. During long-term operation, noises of Shuanglongjing village at daytime and night during short-term, medium-term and long-term operation are qualified and the maximum over-standard value at night during long-term operation is 9.9 dB(A); noises of Bangui village at daytime during short-term, medium-term and long-term operation are qualified and those at night are over-standard and the maximum over-standard value at night during long-term operation is 6.7 dB(A); noises of Tuanjie village at daytime during short-term, medium-term and long-term operation are qualified and those at night are over-standard and the maximum over-standard value at night during long-term operation is 7.8 dB(A); therefore, effective measures must be taken to minimize the impact on Shuanglongjing village, Bangui village and Tuanjie village during operation.

773. For over-standard of noises in Shuanglongjing village, Bangui village and Tuanjie village and the distance to roads, it is proposed in the Report that green belts should be provided and tall trees should be planted; afforestation shall be enhanced and tall trees shall be planted at Road No. 1 and China-Myanmar Highway on the side close to Shuanglongjing village to achieve noise reduction effect. Afforestation shall be enhanced and tall trees shall be planted at China-Myanmar Highway on the side close to Bangui village and Tuanjie village to achieve noise reduction effect. The reasonable arrangement of sound insulation barriers and green belts can reduce the impact of road noises on residents, but this will not change the existing sound environment quality function.

774. Various noises generated during the Project meet the category 3 requirement of GB12348-2008 Emission Standard for Industrial Enterprise Noise at Boundary and have little impact on external environment.

775. Activity noises of people mainly include the noises of residents, office staff, hospital staff and Guomen Primary School and such noises mainly occur in buildings and have little impact on external environment after obstructed by walls and attenuated by distance; commercial noises are mainly the noises from shops and product display area and such noises occurring indoor have little impact on external environment after obstructed by walls and attenuated by distance.

5.6.6.2 Ambient Air Impact Assessment

Construction Period

776. TSP is the main pollutant in the construction period. It is suggested to water the site during operations and relevant link generating raise dust to reduce TSP pollution which can be greatly decreased by frequent watering. Vehicles transporting bulk materials must be under strict control, such as adopting tarpaulin or watering to decrease dust, and transportation should be carried out in coordination with local traffic condition to avoid road congestion as much as possible and to reduce exhaust emission.

777. The dust generated by the project in the construction period causes temporary impact on the surrounding environment, which can be minimized by such measures as water sprinkling near sensitive locations.

Operation Period

778. After the diffusion concentration of vehicle exhaust at construction road is subject to model forecasting at each characteristic year (operation period), the maximum forecasting concentration of CO and NO_2 at each forecast year is below the limit of grade II standard of GB3095-2012 Ambient Air Quality Standard. The exhaust emission has little impact on ambient air.

779. Since the treatment scale of the Project is small, and the odor intensity is relatively low and the environment within 50m outside the plant area is not affected after odor isolation and odor adsorption through afforestation in plant area. The Project has little influence on regional air environment. It is proposed the width of sanitary protection zone of the sewage treatment plant in the Project should be 50m during the environmental impact assessment. No living quarters shall be constructed within the width of sanitary protection zone and afforestation around the plant boundary shall be enhanced.

780. The non-methane hydrocarbon has the highest ground concentration, 0.05382mg/m^3, at the position 94m from the storage tank area and the ratio of maximum ground concentration to standard concentration is 2.69%, which complies with the maximum allowable concentration of harmful substances in the air of residential quarters specified in Hygienic Standards for the Design of Industrial Enterprises (TJ36-79), having little impact on the surrounding environment.

781. During operation of the project, oil fume purifiers are set for oil fumes of school, hospital canteens. The oil removing rate is greater than 85% and oil fume emission is low. It has a small influence to the surrounding environment.

782. The gaseous pollutants emitted during the operation have little impact on concerned points. All sensitive points in the assessment area are within the limit of grade II standard of GB3095-2012 Ambient Air Quality Standard.

5.6.6.3 Water Environment Impact Analysis

Construction Period

783. In summary, construction wastewater generated by the Project in the construction period will be collected for sedimentation process in the sedimentation basins, which will be used in days with fine weather; domestic sewage generated by construction personnel will be used to water the site to control dust after sedimentation process; the surface runoff will be collected for sedimentation process in the grit basins and discharged to gullies nearby. Construction over the Nanting River will cause certain impact on the waterbody; especially that disturbance to the river bottom and scattering of drill slags will increase concentration of suspended solids in some water body.

784. Construction of the Project will generate a little impact on surrounding surface water, which will disappear along with the completion of construction.

Operation Period

785. The road will be provided with rainwater and sewage pipe network after being put into operation, which will generate little impact on the water environment in the operation period. All wastewater generated by infrastructure during operation will be discharged to municipal sewage pipe network embedded in roads nearby after pretreatment to be eventually sent to the sewage treatment plant in Qingshuihe River Area. It can be predicated that comprehensive wastewater of the Project will hardly contribute to pollution of the Nanting River based on qualified treatment; therefore, it is not necessary to make further attenuation prediction. Therefore, the sewage discharge of the Project has little impact on surface water. All pollutants in sewage receiving water in Nanting River can meet the requirement of function of water body. Taking corresponding environmental protection measures for the Project decreases pollutant discharge, relieves the pollution load on Nanting River and complies with relevant provisions of environmental protection. The impact of sewage on surface water can be effectively minimized provided that the management of sewage treatment facilities is strengthened during the project operation, and the structure of sewage treatment station is designed into two grids in parallel. Measures such as one in use and one for standby are adopted for equipment and no sewage can be discharged into Nanting River under abnormal condition.

5.6.6.4 Solid Waste Disposal and Impact Analysis

Construction Period

786. The abandoned earthwork excavated during the construction of the project shall be returned to the site of the construction land of Qingshuihe River Area for leveling and backfilling without setting up a special waste disposal site. In order to prevent secondary contamination produced such as water and soil loss as well as flying dust when earthwork is backfilled in the low-lying area in Qingshuihe River Area, this environmental impact assessment has proposed that the backfilled earthwork shall be timely compacted. The construction waste generated in the construction process shall be recycled and utilized if it can be recycled and utilized otherwise it shall be used as backfill for land levelling in Qingshuihe River Area.

787. In addition, the surface soil excavated during the construction of the project shall be deposited in the green belt of each subproject of the project, which can reduce the temporary occupation of land. Household garbage generated in the construction period will be collected and treated by an entrusted environmental sanitation department. Therefore, solid waste will be properly disposed in the construction period to generate little impact on the external environment.

Operation Period

788. All solid waste generated by the Project in the operation period will be properly disposed, which will generate little impact on the surrounding environment. In this assessment, the hospital shall classify

and collect the medical wastes thoroughly. The wastes shall be collected in different containers and labeled by categories. The hospital shall complete classification, collection, management and disposal of solid wastes after operation to prevent bacteria-bearing solid wastes from being mixed with household garbage or discarded at random, so that the bacteria will not enter the environment and cause the secondary pollution. Meanwhile, the medical waste disposal unit shall timely clear and transport the medical wastes collected by the hospital, so as to ensure that the medical wastes will not be piled up for more than 48h. Thus, only minor effect will be exerted on the external environment. As long as sludge generated in construction project is properly disposed in accordance with relevant laws, regulations and norms, it will generate little impact on the surrounding environment. The heavy metal pretreatment system of the Project adopts activated carbon absorbent in heavy metal wastewater treatment and detection by chemical precipitation method, which will generate certain weight of heavy metal sludge and exhausted activated carbon, and they are hazardous wastes and should be cleaned, transported and disposed by entrusting a unit with relevant qualifications.

5.6.6.5 Ecological Environmental Impact Analysis

789. The loss of vegetation area caused by the construction of this project mainly resulted in the decrease in the number of plant species but that will not lead to the disappearance of species; will not have obvious adverse effects on the plant resources and plant species diversity in the area and will not have major adverse effects on the plant species and their distribution. The surface plants damaged by project construction are mainly rubber and the land occupation of the project does not belong to basic farmland preservation area. But some compensation measures shall be adopted in the process of the occupation. Therefore the occupation will not have a great impact on the agriculture in the area. The project construction has impact on destruction of wildlife habitat, obstruction of migration and population quantity of wild animals. During the project construction period ecological protection measures shall be taken. After the completion of the construction the ecological environment impact caused by the construction is relatively small.

790. The operation period of the Project after completion exerts minor effect on the plant resources in the assessed area. Most buildings are used for warehousing logistics, almost no effect on plants; after the road for the Project is completed, vehicle passing will produce dust and vehicle exhaust, but exert minor effect on ecological environment through filtration and purification by greening facilities. Construction of the Project blocks the living of amphibians and reptiles, so there will be no great change in the impact of the operation period after completion on local ordinary amphibians and reptiles. Road runoff of the Project in the operation period will generate little impact on the water quality along the line, which will neither change the current level of water quality nor affect the aquatic organism.

5.6.6.5 Water and Soil Conservation Impact Analysis

791. The construction and site selection of the project do not present any constraints with regard to water and soil conservation. The water and soil loss will accelerate during construction period, but it will be effectively controlled and rehabilitated through implementation of this plan. After project completion, the project area will be covered by buildings, structures, hardened surface, water and greening. The water and soil loss are micro in extents. The project construction can create ecological benefits, economic benefits and social benefits.

792. Through implementation of all kinds of prevention and rehabilitation measures, at the end of the design level year, the remediation rate of disturbed land in the project area will reach 99%, total rehabilitation rate of water and soil loss to reach 99%, control rate of soil loss to reach 1.55, spoil retention rate to reach 99%, vegetation restoration rate to reach 99%, vegetation coverage to reach 32.90%. **Table 5.20** shows water and soil conservation plan elements.

Table 5.20: Water and Soil Conservation Plan Elements

Project name	Yunnan Lincang Border Economic Cooperation Zone Infrastructure Development Project-Environmental Components		Watershed management agency		Yangtze River Water Resources Commission
Province	Yunnan Province	Or the number of cities involved	Lincang Municipality	Project County	Gengma County
Project scale	68.05hm^2 of land use	Total cost estimate (CNY 10,000)	41960.87	Cost of Civil Works (CNY 10,000)	33599.06
Commencement time	April 2018	Completion Time	December 2020	Design level year	2021
Project components	Construction area	Length / Area (m / hm^2)	Excavated volume (m^3)	Fill volume (m^3)	Spoil(m^3)
	Water Supply in Mending Qingshuihe River Port Area	37.57	217079	207281	9798
	Waste water treatment and associated works in in Mending Qingshuihe River Port Area	10.77	73233		177 265
	Solid waste management in in Mending and Qingshuihe River Port Area	0.44	15,000		101 356
	Qingshuihe River Rehabilitation in Mending Qingshuihe River Port Area	12.67	73090		
	Public transport infrastructure from Mending to Qingshuihe	6.60	48080		
	Total	68.05	426 482	416 684	399 591
National or provincial key prevention and rehabilitation area		National and provincial key areas for prevention and rehabilitation	Landform	Alluvial plain low heat valley area	
Soil type		Latosol	Climate type	North tropical humid climate	
Vegetation Type		Subtropical evergreen broadleaf forest	Original topography soil erosion modulus [t / (km2 a)]		266.73
Scope/ area (hm2)		85.64	Soil Loss Tolerance [t / (km^2 a)]		500
Project area (hm2)		68.05	Disturbed Surface area(hm^2)		68.05
Direct impact area (hm2)		17.59	Area of water and soil conservation facilities damaged (hm^2)		21.97
Total water and soil erosion (t)		4124.41	Additional/New Soil Erosion (t)		3753.91
Major area for new soil erosion		Roads and hardened area, buildings, structures			
Targets	Disturbed land remediation rate (%)	95	Total control of soil erosion (%)		97
	Soil erosion control ratio	1.0	Spoil retention (%)		95
	Vegetation restoration rate (%)	99	Forest and grass coverage rate (%)		27
Measure	Zoning	Engineering measures	Vegetation measures	Temporary measures	
	Water Supply	Project design: topsoil stripping 35640m^3 Storm water pipeline 550m	Project design: landscape-style greening 1.50hm^2,	This plan: 20 mobile sediment tanks, temporary cover 21500m^2, temporary drainage ditch 500m, 1 temporary	

				vegetation restoration 9.48hm^2	sediment basin, temporary retaining 6160m	
	WWTP and associated works	Project design: topsoil stripping 7440m^3 S storm water pipeline 550m		Project design: landscape-style greening 1.36hm^2	This plan: Temporary cover 6200m^2, temporary drainage ditch 1810m, 1 sediment basin, temporary retaining 136m, 5 mobile sediment tanks	
	Solid Waste Management	Project design: topsoil stripping 1200m^3 storm water pipeline 376m		Project design: landscape-style greening 0.18hm^2	This plan: temporary drainage 264m, 2 temporary sediment basins, temporary covering 200m2, temporary retaining 22m	
	Qingshuihe River Rehabilitation	Project design: topsoil stripping 16410m^3		Project design: landscaping 8.23hm^2, vegetation restoration 0.92hm^2	This plan: 20 sediment tanks, temporary covering 900m^2, temporary retaining 600m	
	Public Transport Infrastructure	Project design: topsoil stripping 5220m^3 Storm water pipeline 2000m		Project design: landscape-style greening 0.72hm^2	This plan: Temporary drainage 3240m, 10 temporary sediment basin, temporary cover 760m^2, temporary retaining 240m	
	Cost Estimate (CNY 10,000)	137.26		245.26	268.95	
Total cost estimate for water and soil conservation (CNY 10,000)		870.25, of which the main design: 382.52 New program: 487.73		Other costs (CNY 10,000)	146.23	
Soil and water conservation supervision fee (CNY 10,000)		21.36	Monitoring fees (CNY 10,000)	94.04	Compensation (CNY 10,000)	47.64

5.6.6 Consolidated Positive and Negative Impacts

793. Potential environmental impacts (both positive and negative) associated with all project phases were identified in this section above are illustrated in a summary by the following Table. Most of the minor, temporary adverse environmental impacts relate to the building construction process, and can be relatively easily mitigated with standard best practices that are increasingly being required of the construction industry. **Table 5.21** provides a summary analysis of positive and adverse impacts of the sub-projects.

Table 5.21: Summary Analysis of Positive and Adverse Impacts:

1	Project Activities	Positive Impacts (Type)
A	**Pre-Construction**	
i	Increasing local businesses	Local business will be enhanced due to the construction activities in the area. Local construction companies will be contracted. (Temporary)
B	**Construction**	
i	Employment	Employment opportunity to local population. (Temporary)
C	**Operation**	
i	Socio -economic impact	Development of infrastructure facilities will help poor population in finding long term employment. (Permanent)
ii	State of Art new facilities	Most facilities such as schools, hospitals, facilities, and transportation would be new. (Permanent)
2	**Project Activities**	**Adverse Impacts (Type)**
A	**Pre-Construction**	
i	Site Access	Loss of access to the site for students play area (in Qingshuihe school)

		and other community members in Qingshuihe village. (Temporary)
ii	Site preparation, clearing and earthworks	Clearing of vegetation, trees; land development may create problems in local drainage pattern; emission of dust, Improper management of construction debris and solid waste may pose risk to the residents (Permanent). Reduction in visual aesthetics at site, access road, truck traffic, construction equipment and permanent building (Permanent).
B	**Construction**	
i	Influx of workers	Health & safety of workers at site may pose risk to community; concentration of labor force creates un-hygienic condition and sanitation hazard (Temporary).
ii	Construction equipment/materials	Digging, crushing and equipment installations may create noise; carrying of construction materials may create traffic congestion; cutting/filling, stockpiling of construction material and traffic movement may create dust emission, improper management of construction debris and solid waste may pose risk to the workers and residents (Temporary).
iii	Vehicle and pedestrian traffic	increased number of vehicles on local roads will result in increased wear and tear of local roads thus reducing lifespan of affected roads; pedestrians to exercise care with increase of vehicular traffic on the adjacent roads and increase of exhaust emission from vehicles (Temporary).
Iv	Ecology	Terrestrial and aquatic ecology are impacted negatively during construction period in the area. Rubber trees, shrub trees, vegetation are cleared. (Permanent) Small amphibians and reptiles are driven out of the area due to n lack of greenery. (Permanent) Fish spawning and migratory areas are located in the project area in the River. (Temporary)
C	**Operation**	
i	Vehicle and pedestrian traffic adjacent to School/hospital building	More congestion near the entrance of facilities; Pedestrians to exercise more care with increase of vehicular traffic; increase of exhaust emission from vehicles, which will pollute local atmospheric air (Permanent).
ii	Generation of consumables	Improper solid waste management, sanitation hazard. (Temporary)
iii	Increased demand on local services	Increased risk of water shortages and electricity load shedding. (Permanent)
iv	Extreme climate events, disasters and emergency	The region is earthquake/flooding prone area. Fire hazard or any medical emergency may arise during operation of the facility. (Permanent)

Impacts on key environmental parameters (Air, water, soil and Noise)

794. The **Table 5.22** below lists impacts on environment parameters of the sub-project areas where the project will be implemented.

Table 5.22: Impact of key environment parameters

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures
1	Air Quality	High	Large scale air emission from the construction activity during cutting/filling /stacking/storage of soil, construction material at site	Sprinkling of water, proper handling of excavated soil, construction material, banned substances/VOCs etc.
2	Water Quality	Medium	The project will require huge quantities of water for construction. No hazardous effluent is envisaged to be discharged during construction	The required water will be sourced from tankers by the Construction contractor. Domestic effluent shall be discharged in tanks which will be cleaned regularly and waste thrown at urban body's solid waste management site.
3	Soil Quality	High	Government/community land is available.	Construction contractor to ensure proper housekeeping, sanitation and cleanliness at work site.
4	Noise Quality	Medium	The construction activity may lead to noise pollution during concreting –steel cutting, bending, casting using vibrators, operation of mechanised equipment and drills etc. that will affect the residents of the area. Small noise related installations within shell structure may continue beyond school holidays at Qinghsuihe school.	The Qingshuihe school shall be closed for summer vacation during shell construction of the building to minimize disruption. Noise monitoring will be done at regular intervals. If any night construction activity that is noise intensive is undertaken at this school areas, neighbourhood must be consulted to determine suitable timings.
5	Hazardous Substance – eg. VOCs	Minimal	Buildings such as hospital, school, and offices will not contain any Hazardous substance.	Construction design that contains using any hazardous material will not be selected for implementation.
6	Terrestrial Ecology	Low	No EN or CR species of amphibian/reptile fauna removed from site. No ecologically sensitive place (protected area/reserved forest/Important flora and fauna species) within 5 km radius from each sub-project site	Tree replantation to be carried out at the designated green belt areas. For terrestrial fauna, catch and release programs to be implemented during the project implementation. Regular Monitoring to be implemented.
7.	Aquatic Ecology	Low	No EN or CR species of aquatic fauna at site. Only NT variety of fish that have spawning at bridge site and migration pathways passing across bridge area	Construction over water during April-June to be avoided due to spawning period and vibration and drilling between June-September due to migration upstream.
8	Health and	The	Vector-borne and	A rapid HIA is currently being

#	Environmental Parameter	Magnitude of Impact	Reason	Proposed Mitigation Measures
	safety of local community members and workers	construction phase increases the risk of communicable and vector-borne diseases (Malaria, Dengue Fever, HIV/AIDS, other STIs), traffic injury and mortality and can risk a number of determinants of health if not identified and managed appropriately. The above is applicable for both the workforce and local community members.	communicable disease risks are present given the location of the project site. The risks are well known and accepted as part of the construction of projects where a mobile worker population is required.	conducted that will inform a Public Health Management Plan as standalone or as part of the Environmental Management Plan.

6.0 ANALYSIS OF ALTERNATIVES

6.1 LBECZ'S Approach for Site Selection

795. Alternative studies in the Feasibility Study Report (FSR) are required not only by ADB but also for meeting the domestic requirements. ADB emphasizes the importance of alternative studies during the FSR stage and requires that at least technical and locational alternatives shall be studied and compared in order to recommend the preferred alternative. The alternative studies shall include the comparisons of schemes, construction costs, environmental impacts, social impacts, advantages and disadvantages, summary of the comparison, and the recommended alternative. It is recommended that the alternative studies shall be provided for different disciplines in the feasibility study.

796. At the planning stage itself, one of the factors that govern the establishment of the port is the infringement of scarce population/plantation area. Wherever such infringements are substantial, different alternative options for Project subcomponents will be considered. During site selection, all possible efforts are made to avoid the populated/plantation/cultivated area infringement completely or to keep it to the barest minimum. Whenever it becomes unavoidable due to the geographical locations/terrain, mitigation costs involved towards avoidance needs to be worked out. While identifying the land area for the project, preliminary site assessments, prefeasibility studies have been conducted as part of the due diligence for bridge, equipment and raw material transportation, baseline environmental studies in the area.

6.2 The "no" action alternative

797. As mentioned earlier, this development project on Lincang is an essential part of a large-scale development Regional Cooperation Initiative (RCI) in People's Republic of China. Without this project, Lincang Border Economic Cooperation Zone is suffering from insufficient investments into municipal infrastructure, education, medical, environment, sanitation etc., thereby bringing about poor conditions of municipal infrastructure, with no highways; low service levels of social undertakings such as education, medical, environment, sanitation etc., including serious shortages of necessary school premises and educational facilities, which results in that schools cannot contain adequate students; service levels of medical and sanitation much lower than them in the southeastern coastal regions; no complete water supply and drainage systems, where in some areas, water is still randomly drained in an unorganized manner, which may be a threat to the environment and ecology of the area.

798. Development of this project is invariably associated with environmental impacts as well as some social impacts in the area as project is situated close to Myanmar border at three points The social impacts are relatively much less as the area is sparsely populated and land value is relatively less (except Lincang, which will not be affected). Social impacts include cutting down of trees (mainly rubber) and some project components in private properties, both of which can be satisfactorily mitigated with adequate compensation or barter system (money). So, when compared to positive benefits that will arise from the proposed project the negative impacts are considerably low. Therefore, no-action alternative is not considered as acceptable.

6.3 The "with" project alternative LBECZ site selection

LBECZ Feasibility study and safeguards assessment:

799. Development of each LBECZ will be done by a special purpose company established by Lincang Border Economic Cooperation Zone (LBECZ). The role and responsibilities will include:

a) Acquisition/allocation of land and all the statuary clearances (such as EIA, environmental licenses and other clearances and approvals) for establishing the LBECZs
b) Provision of secure and access controlled facilities within each LBECZ (access control, however, is expected to be limited to a small area within the port).
c) Investing in port/trading facilities for the use of investors, and maintaining the facilities.
d) Development of roads etc. within the common area of each LBECZ and to each investor's project area, as required for transport of equipment.
e) Provisions of ancillary services such as security, landscaping of the common areas, road maintenance etc.
f) Maintaining the Environment Monitoring Station (EMS) and recording of data.
g) Overall site management with legal accountability of the LBECZ.
h) Ensuring that all investors develop infrastructure within the areas allocated to them, without infringing on the rights and the resource of other existing and future investors.
i) Implementing the grievance redress mechanism for social and environmental issues.
j) Statistical studies and publications.

LBECZ Site Selection Criteria:

800. For selection of appropriate site for LBECZ, the following points are taken into consideration:

i) Construction activities do not adversely affect the population living near the proposed LBECZ and does not create any threat to the survival of any community with special reference to tribal community etc.
ii) The location of project subcomponents does not affect any monument of cultural or historical importance.
iii) Minimal resettlement of households by the project subcomponent site (tunnels, roads etc.), minimal loss of livelihoods, siting of project subcomponents away from sensitive receptors, with due consultation with the community and local government units concerned.
iv) Ensure if the site selected will have low ground disturbance by taking into account new construction techniques, logistics, and designated construction area and construction machinery selection.
v) Project subcomponent power infrastructure/ power generator location (s) to ensure that noise will not be a nuisance to neighboring properties.
vi) Site selection should consider seismicity and geography of the local area; the area should not be prone to land inundation or be unstable.
vii) Ensure any protected areas and critical habitat areas are avoided in siting of the project.
viii) Public consultation and consultation with stakeholders such as government bodies (tourism, urban body, etc.) must to determine if the project can be sited in the area.

6.3.1 Alternate site review for LBECZ

801. Potential for port development along the Mengding area extending from Lincang to Myanmar was investigated. In order to facilitate the construction of infrastructure in Lincang Border Economic Cooperation Zone, the Management Committee of Lincang Border Economic Cooperation Zone has invested RMB 3.0583704 billion for construction of infrastructure at Mengding Qingshuihe River Port, mainly including the following 5 types of 14 sub-projects: municipal traffic infrastructure construction projects (6 municipal secondary main roads in Qingshuihe River Port Economic Zone of Mengding Town, China-Myanmar thoroughfare Phase II, China-Myanmar thoroughfare Phase I and infrastructure for connecting Qingshuihe River Port Economic Zone with Mangka Border through Nanting River Bridge), social undertakings development and construction projects (Port Hospital in Qingshuihe River Port Economic Zone of Mengding Town and Border Primary School in Mengding Qingshuihe River Zone), industrial development infrastructure construction projects (frontier trading place for border people at Qingshuihe River Port and infrastructure for international capacity cooperation zone at Qingshuihe River), environmental resources projects (infrastructures for water supply project in

Mengding Qingshuihe River Port Area, sewage treatment plant and auxiliary works and solid waste treatment facilities in Qingshuihe River Port Area, river regulation and landscape works within Qingshuihe River Port, and auxiliary works of urban public transportation from Mengding to Qingshuihe River), as well as capacity building projects etc. In terms of the land use, this area does not seem to pose major development constraints.

802. However, according to local administration officials, the social and environmental situation in this area is fast changing primarily due to influx of and the result of re-settlement activities. Thus, it appeared that development in this region might be susceptible to finer environmental scrutiny at the feasibility study stage.

Lincang site selection justification

803. Selection of potential LBECZ sites is a crucial part of LBECZ development. There are many aspects involved in LBECZ site selection. The principal non-technical consideration is the impact to the environment by proposed development work. Apart from meeting the environmental criteria, potential sites also have to meet certain technical and commercial criteria. The first criterion is that the resource must be sufficient. Therefore, project investment is best utilized by developing sites with excellent resources. The availability of land is crucial and the owners of lands must be willing to allocate those for LBECZ development. In addition to this, site must be accessible to construction traffic either through land or sea routes or any combination of both. The access to trading infrastructure also plays vital role and need to be implemented cost effectively for commercial viability.

804. The Project is consistent with the macroeconomic policies of China and overall planning of Lincang Border Economic Cooperation Zone, as well as the social undertakings development plan of implementing the Belt and Road Initiative in Yunnan Province. The implementation of the Project can accelerate the urban infrastructure construction, improve the service level of social undertakings, save energy, promote the rapid development of urban economy, and bring about a good economic and social benefit. The proposed LBECZ site was recognized, in 2016 as an excellent location for a LBECZ development. The necessary investigation work in terms of assessing and validating the RCI resource has been carried out on the site. Recent environmental impact assessment (DEIA) by LBECZ concluded that the RCI resource in Lincang can be developed in a sustainable and environmentally friendly manner.

805. The proposed LBECZ will be located along the border of Myanmar. The project construction is consistent with the *Regulatory Detailed Plan for Mengding Qingshuihe River Area of Lincang Border Economic Cooperation Zone (2015-2035)* and the *Overall Urban Planning for Mengding, Lincang City (2011-2030)*. The long-term objective of the LBECZ is to develop port in the Lincang region (Lincang, Cangyuan, Zhenkang) with ancillary services required for large scale RC integration. Background to the selection of the proposed LBECZ area is outlined below.

- Trading potential in the Lincang region has been assessed and identified through numerous studies and found to be excellent.
- Favorable site topography in terms of LBECZ infrastructure spread.
- Availability of land, road network, railway, power, water and river links can be easily extended and utilized for LBECZ.
- Trading Port can be easily accessible through river route which offer hassle free transportation up to the border trading infrastructure.
- Reduced negative impacts on human activities in the region.

6.3.2 Qingshuihe Master Plan of LBECZ

806. The development orientation of the Qingshuihe Port section: An important hub of China-Burma International channel, an important demonstration area for Sino-Burmese economic and trade cooperation, a trade and logistics Center for the Indian Ocean Economic Circle, an important gateway for Yunnan to build a radiation center for South-East Asia, and an important platform for Lincang to open along the Myanmar border area.

807. Layout structure and ribbon development policy: Considering the development of port economic zone, transportation logistics area and industrial economic zone, the complete configuration of a port-type city by integrating the idea of production-city integration into the public service facilities and infrastructure.

808. **The upstream development and positioning of the port International Trade Zone**: contains a port management function of the inspection, identification zone, barter, bonded warehousing functions, as well as headquarters for economic zone, border tourism, public service areas.

809. **The middle reaches development locates the transportation logistics area**: relies on the train station, the bus station plan to form the railroad two checks, the railroad logistics, the highway logistics, the Logistics Service Center in one integrated logistics development area.

810. **Downstream development positioning, Port International trade zone**: including a port management function of the inspection, identification zone, barter, bonded warehousing functions, as well as Headquarters economic zone, border tourism, public service areas.

811. **Greater Mekong Sub-region Economic Cooperation New Decade (2022) Strategic framework** deepens China's Yunnan participation in the Greater Mekong sub-region (GMS) as an important platform for economic cooperation, Mengding as a key building area of the Lincang Frontier Economic Cooperation Zone (hereinafter referred to as Lincang), strengthening the construction of Mengding infrastructure, has a far-reaching impact on the participation of Mengding and even Lincang border zones in international regional cooperation.

The development plan of the Edge Zone

812. Through open lead, planning priority, internal and external linkage, the foundation first, the production of city integration, county-building, the Lincang side of the region to create a major hub for the international channel, China-Burma cooperation demonstration zone, the Chinese Trade and Logistics Center for the Indian Ocean Economic Circle, Yunnan to build an important gateway to South-East Asia Radiation Center, Lincang is an important platform to develop and open along the edge.

Land use planning

813. The Project is located at Qingshuihe River in Mengding Town, Gengma Dai and Va Autonomous County, Lincang City, Yunnan Province. According to the survey of land use current status of the Project (See **Figure 6.1**), the total floor area of the Project is 137.84 hm^2 and the main types of land occupation are rubber forest, wasteland, transportation land, etc., where the rubber forest is the principal occupation of the area**. Table 6.1** gives the list of planning in the LBECZ area.

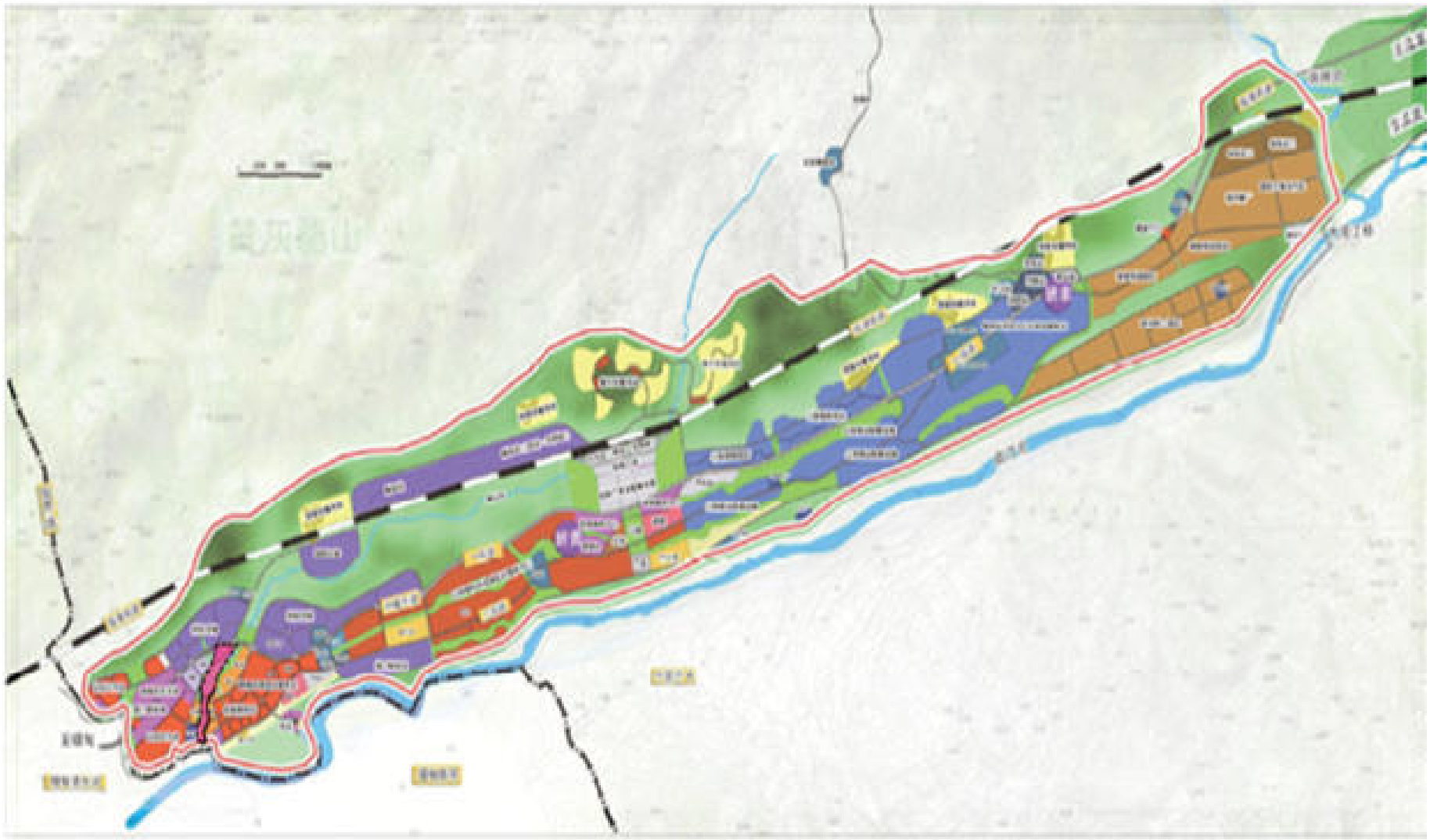


Figure 6.1: Land-use planning map

Table 6.1: List of planning and construction land at LBECZ

No	Code	Land classification	Land area (h ㎡)	Proportion of construction land (%)
1	R	Residential land	25.7	6.3%
	R21	Residential land	25.7	
	A	Public administration and public service facilities		
		Ground	36.1	8.8%
2	A1	Administrative office space	29.9	
	A33	Primary and secondary school land	2.1	
	A51	Hospital land	4.1	
	B	Commercial service facilities land	123.4	30.1%
	B11	Retail Commercial Land	36.7	
	B1	Commercial land	28.8	
3	B2	Commercial land	18.8	
	B/R	Mixed commercial and residential land	32.5	
	B41	Refueling station land	5.1	
	B9	Other service facilities land	1.5	
4	W	Logistics and warehousing land	80.3	19.6%
	W1	A type of logistics and warehousing land	80.3	
5	S	Roads and transport facilities	76.2	18.6%
	S1	Urban road land	71.9	
	S41	Public transportation station site	4.3	
6	U	Utility land	11.4	2.8%
	U12	Power supply land	3.4	
	U16	Communication land	2.0	
	U21	Drainage site	1.6	
	U22	Sanitation land	3.0	
	U31	Fire land	1.4	
7	G	Green space and square land	57.0	13.9%
	G1	Portland	45.1	
	G2	Protection of green space	10.5	
	G3	Square land	1.4	
	H11	urban construction land	410.1	100.0%
	H14	Village construction land	5.5	
	H23	Port land	0.6	
	E	Non-construction land	89.5	
	E1	Waters	29.2	
	E2	Agriculture and forestry land	60.3	
		Planning area	505.7	

6.3.3 Alternatives – Design, location and technology

6.3.3.1 Alternatives to Water Treatment and Supply Network

814. **Site selection principle:** Water plant site selection should be in the entire water supply system design plan comprehensive planning, taking into account the water, water and water distribution, through technical and economic comparison. In selecting the site, following principles will be met:

- the site should be chosen in good engineering geological conditions. The general selection in the groundwater level should be low, bearing capacity large where collapsible grade is not high, has less rock, flat terrain to reduce project cost and ease of construction.
- the water plant should be chosen as far as possible from the threat of flooding, or should

consider flood control measures.

- the water plant should be setup to facilitate better construction management and reduce water and drainage pipes and cost of the access road.
- Should not be located in good farmland, try to choose the open space or wasteland, and leave room for proper development.
- in line with the overall planning, water supply regulations on the site requirements, to avoid being located in the vicinity of more polluting factories.
- topography, geology, pipelines, disposal of sludge, power supply, communications, transportation and other conditions should be better.

815. According to the principle of site selection, starting from the needs of planning and development of Qingshuihe Port Economic Zone, apart from considering traffic, geology, flood control, sewerage, electricity, communications and convenience management and other general requirements, the following conditions should be met:

- the surface water treatment plant elevation to meet the water supply area gravity water requirements;
- within the scope of this elevation should have sufficient area layout of water treatment structures;
- the ground must have a certain slope. In this, elevation and area is a necessary condition, the slope of the ground is the ideal conditions.
- due to the planning of land use arrangements, should be selected in the planning permit land construction.

816. Site Options: Water treatment plant site under normal circumstances should be selected in the water supply area to the area near the suitable elevated place. For the water supply station, the first option is situated close to the water source while the other is close to the main water supply area.

817. The water source selected for the water project is Nanguang River and Yunjing Reservoir, about 30 km away from the economic zone of Qingshuihe Port. This will substantially increase the water distribution network construction costs, because the design of the raw water delivery pipe increases by 30% or more thereby requiring more power for pumping water for operation of water treatment plant. Therefore, the project considered to select the site close to Qingshuihe Economic Zone, with suitable elevation, relatively flat and land acquisition conditions. Two options were considered during the study:

818. **Option One**: New waterworks at 2250m southeast of Baogui Village. This site is located in Mengding Town, Qingshuihe Port Area on the southeast of Ban Gui Village 2250m, north of the site on the Burma Road. Floor elevation is approximately 680m. According to the scene reconnaissance, the present situation of the site is wooded land, which has a sloping grade of slope and the external traffic is routed on the Burma Road. Site has more open space for the general planning etc. **Figure 6.2** and **Figure 6.3** give the location 1.

Figure 6.2: Water treatment plant site - satellite image

Figure 6.3: Water treatment plant location at Site one

819. **Option Two**: Located in Baoxing village 800m south of new waterworks. The site is located in Baoxing village south of 800 meters on the slopes, the status of South Burma Road, the site elevation of the floor at 640m approx. According to the scene reconnaissance, the present site status is woodland, which is a grade slope with a large gradient and external traffic Burma Road, site area is more open, non-planning site**. Figure 6.4** and **6.5** gives the location 2.

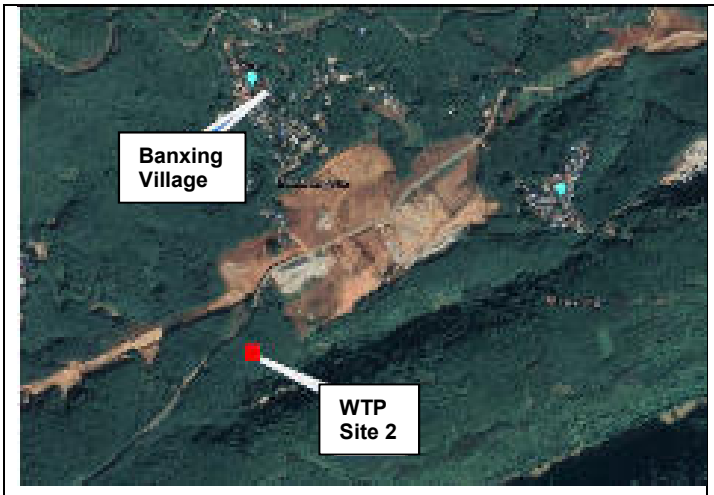


Figure 6.4: Water treatment plant site two satellite image

Figure 6.5: water treatment plant site two status quo

820. Following **Figure 6.6** shows the locations while **Table 6.2** depicts the differences in both the options considered for Water supply plant.

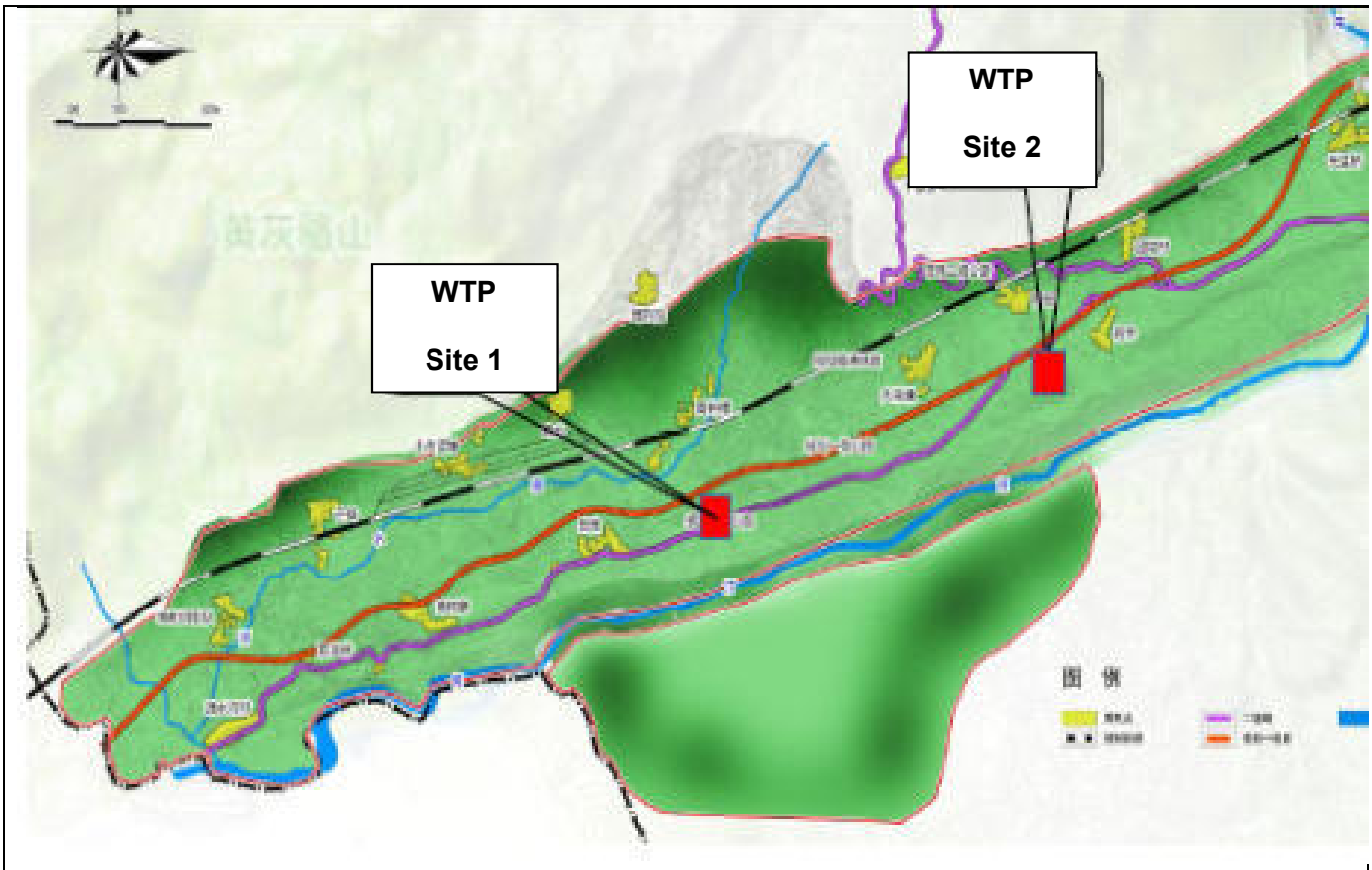


Figure 6.6: Alternative locations of water treatment plant site

Table 6.2: Comparison table of two sites

Site project	Option I	Option II
Site elevation	680 m approx.	640m approx.
Distance to water	About 31.5 km	About 29.5 km
From the main water area distance	Located in the center of the planned range, away from the main domestic water area port functions and international trade zone, integrated transportation hub and logistics port. Close, convenient water distribution	Located on the southeast side of the planning area, close to the gauge Planning import and export processing and international capacity cooperation. District (industrial land), from the water area
Far field Around the site	Surrounding the area is woodland, planning for green space, Site for the planning site is near the road.	The current situation is woodland, planning for the logistics ground, near the road.
Traffic and construction conditions	The site is close to the main road in the town, nearby planning roads, the road is smoother, wide straight, convenient transportation,	The site is close to the main road in the town, nearby planning roads, the road is smoother, wide straight, convenient transportation,

Site project	Option I	Option II
	construction conditions are good.	construction conditions are good.
Site and Engineering Geology condition	Site conditions better, good engineering geology.	Site terrain slightly steep, larger earthwork.
Water plant operating costs	The site elevation is higher than most of the water supply area elevation, can achieve full gravity water and water distribution, close to the main water area, water works into are lower.	One of the site elevations is low; locality would need pressurized water supply, water plant operating costs slightly higher.
Water plant management	Close to the built-up area, management is more convenient.	Close to the built-up area, management is more convenient.
The main advantage	1. the plant elevation of about 680m, site elevation higher than the town area most of the water supply area Elevation, can achieve gravity water supply, water transport Line low cost. 2. the site below the water elevation, it is real gravity is the original water transport, water plant operating costs are low. 3. in line with the planning land requirements. 4. close to the main water area, distribution network low construction costs. 5. site open, are slopes, field - low cost of levelling.	1, the site near the highway, convenient transportation, Easy to construct. 2. the site below the water elevation, it is real Gravity is the original water transport, water plant operating costs low. 3. raw water pipelines than one of the short field.
There is a problem	Raw water pipe longer than the program.	1. the status quo slope larger, site formation costly. 2. far from the main water area, water distribution Pipeline construction costs are higher. 3. the status quo site is an economic forest planting, green Miao high compensation costs. 4. local need to pressure, high operating costs.

821. To sum up, after comparing and selecting above site solutions, it can be seen that both site solutions can guarantee safe water supply. From consideration of construction investment, site option I is preferable due to site formation, water distribution pipeline construction; however due to young crops compensation and other issues, the construction costs will be higher than the Option II. In addition, due

to the distance from the main water area, the local need for pressurized water supply, operating costs will also be higher in Option II than Option I. Therefore, for this project, site plan Option I is slightly better than plan Option II. Therefore, water treatment plant site is selected 2250m southeast of Baogui Village, Sino-Burma Road on the northern slope.

822. Based on the testing results of the source water, the conventional water treatment process will be used, which consists of mixing, flocculation, settlement, filtration, disinfection, and distribution.

6.3.3.2 Alternatives to Water Supply Raw water pipeline:

823. In determining the water pipelines mainly follow the following principles:

- the line as short as possible, less number of ups and downs, earthwork less, cost-effective, no encroachment of farmland.
- the line direction, the location should be consistent with the requirements of urban planning, and try to lay along the existing roads or planned roads, with ease of construction and maintenance.
- try to avoid crossing valleys, ridges, swamps and flood discharge areas, and pay attention to avoid landslides and avoid areas of raw debris flows and highly eroded soil areas.
- construction, easy maintenance, cost savings, safe and reliable operation.

824. The net height difference between the water withdrawal elevation at South Roller Creek (730m) and the water plant at the waterfront of Qingshuihe Port (676 ~ 685m) is about 50m. Therefore, in order to reduce the running cost of the water plant and realize the gravity water transportation of the raw water through pipeline selection is particularly important. The design of the site survey found that in the distribution of water, more villages lie along the road. The two options considered are as follows:

Option I: along the water point - well village - Mengding Town - Mo teeth Xinzhai - water plant line

825. The program of the original water pipe for the beginning of the South Rolling Creek intake of low-dam, south along the river bank layout, to allow the village after the Pro-Pro Road layout, arrived in Mengding after the road along the Qinglin Road laying side, and then reaches the water treatment plant. The total length of the line is about 33 km. The site survey, the main line along the roads and roadside wasteland is flat but undulating; the construction is more convenient, can achieve full gravity water delivery to the water plant.

Option II: water intake point - village - Mo teeth Xinzhai - water plant line program

826. The program of the water pipe for the beginning of the South Rolling Creek low dam, along the south roll river bank layout along the field upto the west layout, on the south side of the Shangzhai, Sa highway to Mo Mo Xinzhai, and then laid along the edge of Linqing line, most finally reaching the water treatment plant. The total length of the line is about 31 km.

827. Both options are shown below in **Figure 6.7**.

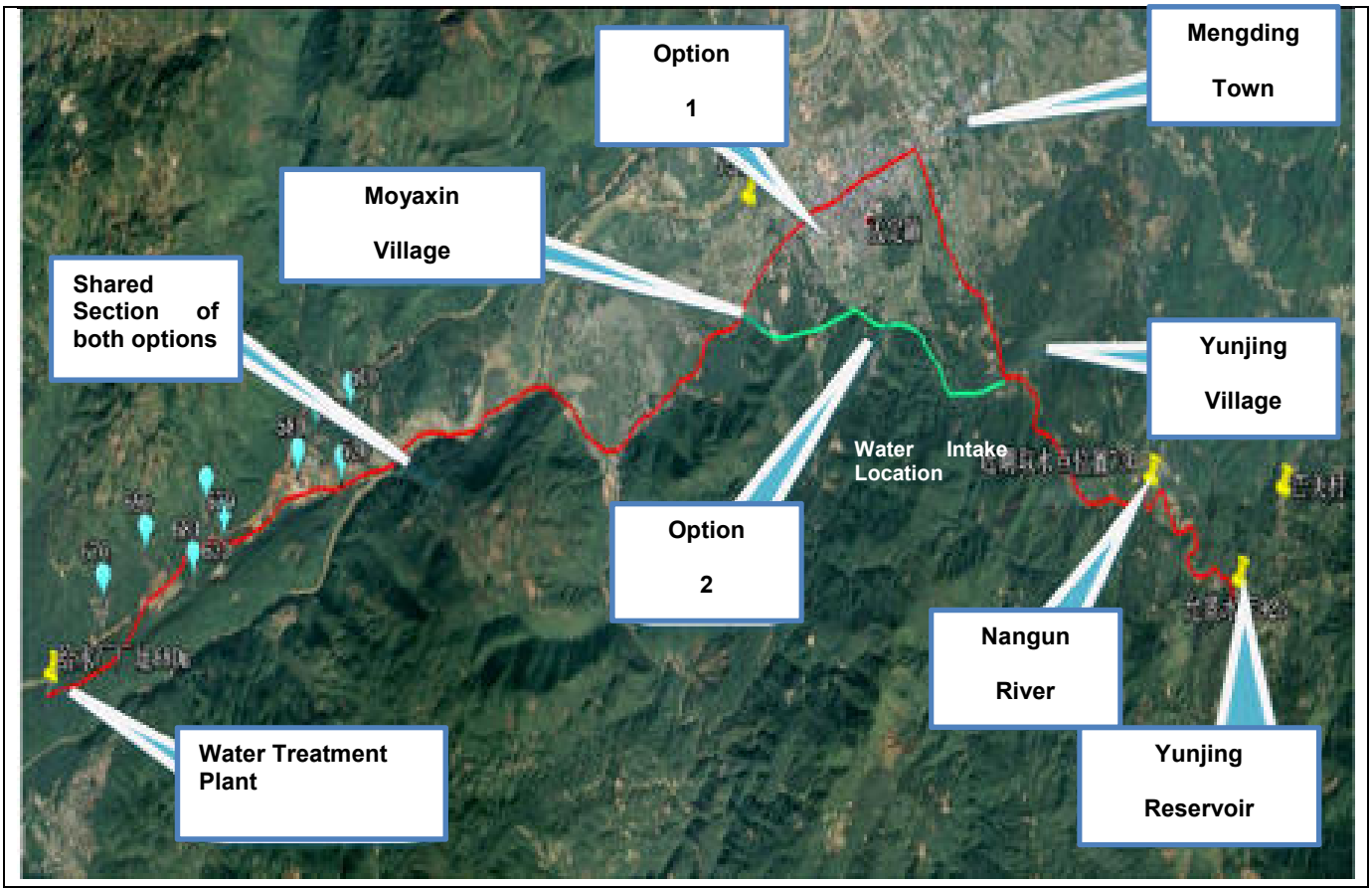


Figure 6.7: Raw water pipeline plan for both Options

828. The above two options are compared in Table 6.3 as follows:

Table 6.3: Raw water route comparison table

	Option I	Option II
Basic program feature	1. water pipeline laying along the dirt road and farmland. 2. water pipe about 33 km long. 3. to ensure that the water delivery is done by gravity upto the water plant.	1. water pipeline laying along the dirt road and farmland, about 7 kilometres of pipe laying along the mountain. 2. water pipe about 31 km long. 3. to ensure that the water delivery is done by gravity upto the water plant.
The main advantage	1. pipelines laid along the road, the construction phase is not difficult. 2. smooth pipeline laying, operation workers condition is better. 3. pipeline will be laid along the road, maintenance and management convenient 4. although the pipeline longer	1. water pipelines through the area of small flow, the impact of construction is small. 2. pipe length shorter than the proposal.

	Option I	Option II
	than the proposal, however due to construction convenience, total investment it is preferred.	
The main disadvantage	Water pipelines transgress through populated area and hence the impact of construction will be large.	1. some pipe laying along the mountain and therefore the construction will be difficult. 2. part of the pipe has no adjoining roads thereby making construction, maintenance and management inconvenient. 3, the pipeline needs to cross the mountain leading to hard work conditions. Pipeline will be undulating and therefore to maintain pressure in the line, electrical pumping may be required.

829. The comparison shows that both options mentioned above are implementable, but Option I is more preferred. The main reasons are as follows:

- Although the raw water supply pipeline is slightly longer than the second scheme, the total investment is quite high;
- Road laying along the road, construction convenience, ease of maintenance and management of the pipeline, the whole pipeline without major ups and downs, running in good condition.

830. Therefore, this study recommends Option I for raw water pipelines development program.

831. Attached in **Annexure 10** is the Approval of Lincang Municipal Water Affairs Bureau on the Water Intake Permit Application of Mengding Qingshuihe Port Area Water Supply System No.6 Document, April 27, 2018.

6.3.3.3 Alternatives for Nanting Bridge

Scenario One: Using the 3x40T girder bridge

832. **Benefits**: The medium-SPAN 1 hole crosses the channel, without piers in the river, and has a better landscape without flood control.

833. **Disadvantage**: the abutment position fill height is too high and need roadbed construction can carry on bridge abutment.

Scenario Two: Scenario Two: using the Mi Shanhan Scheme

834. **Advantages**: The structure is good, because the upper slope can fill the soil, more convenient for construction, safety, cost than bridge scheme savings.

835. **Disadvantages**: The flood-crossing section is small and has a great impact on the flood, so it is necessary to check. Inconsistent with the planning, the landscape effect is poor.

836. **Recommendation**: According to the comprehensive comparison, taking into account the upstream of China-Myanmar Avenue has been set 6x30mT girder bridge, and according to the planning of the location for the planning of Landscape River, the use of bridge scheme can not only ensure the flood control requirements of the Qingshuihe, but also meet the planning landscape requirements, so the scheme one is recommended.

837. **Table 6.4** provides the comparison for each bridge alternative. Figure 6.8 and 6.9 shows proposed designs for both the scenarios.

Table 6.4: Main bridge scenario comparison table

Bridge type	Scheme One (twin-tower cable-stayed bridge)	Scheme two (continuous rigid frame bridge)
Master span Layout	70m+140m70m	72.5m+140m+72.5m
Total length of bridge	350m	355m
Total width of bridge deck	16.5m	16.5m
Construction period	24	22
Bridge estimate Total investment	10131.4 million	9210.7 million
Construction Features	The main girder cantilever pouring construction, the craft is mature, the main tower structure is complex, the aerial work is many, the duration is longer.	The main girder construction adopts the traditional hanging basket cantilever pouring construction, which has short construction period.
Comprehensive evaluation	The bridge is magnificent, the shape is beautiful, the tension feeling is strong, has fully demonstrated the Qingshuihe port Economic zone as the External Exchange window.	The bridge is simple and smooth in style, easy in modelling and relatively low in maintenance costs.
Conclusion	Recommended	

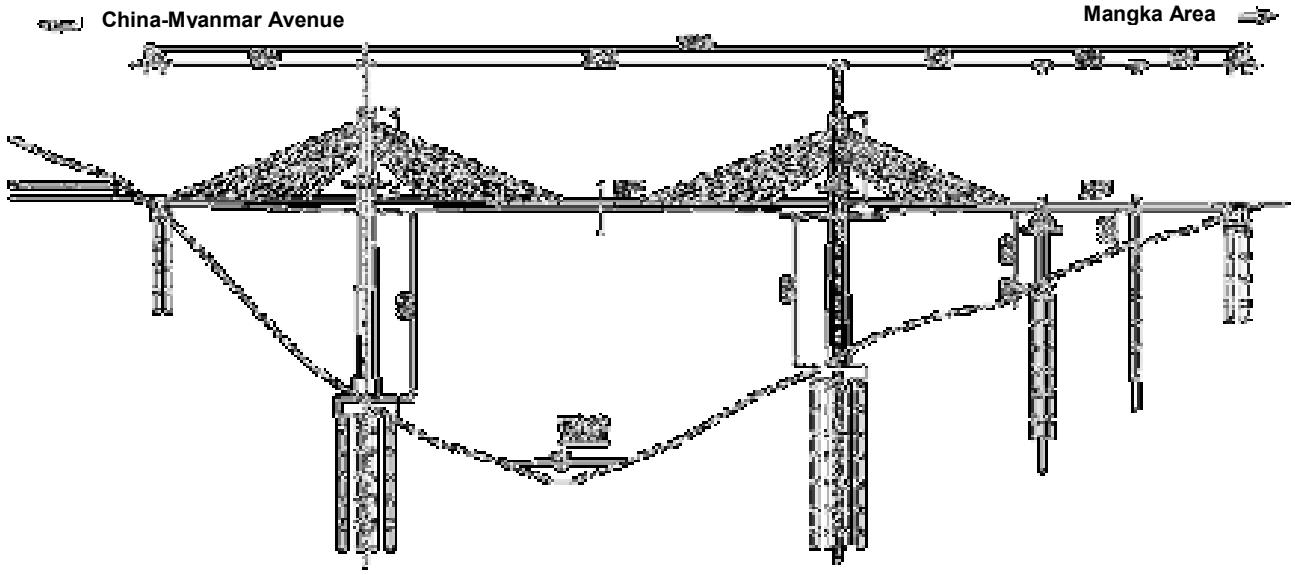


Figure 6.8: Bridge Design for Scenario 1

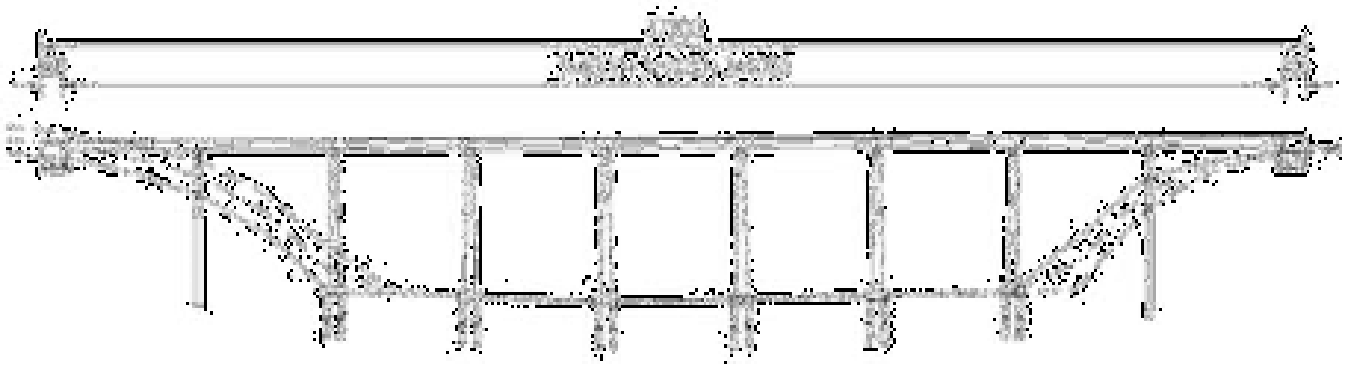


Figure 6.9: Bridge design for Scenario 2

6.3.3.4 Alternative Technology for Waste Collection

838. The selection of MSW collection and transportation plan is based on the principle of meeting sanitation requirements, lowest operational costs, convenient end treatment and reduction of environmental pollution. According to population, residential distribution, waste generation, characteristics of waste components, road conditions, distances from landfills from collection stations or transfer stations, and facilities utilization, MSW collection and transportation equipment are selected to form an economically reasonable and environmentally friendly MSW collection and transportation plan.

Mode of transfer:

839. Based on the characteristics of the project site, alternative collection and transportation options can be selected from 1) direct transportation mode; 2) once-transfer mode. Generally, the direct transportation is suitable for the MSW relatively centralized generated, with a large amount and a transportation distance of not more than 10 km. The once-transfer mode is suitable for the relative dispersed MSW generation, the large amount and the distance between 10-30 km.

840. The service scope of this project mainly includes two regions, Qingshuihe District and the urban center of Mengding. Qingshuihe District is about 27 km away from the Mengding Landfill. Mengding

City is about 5-6 km away from the Mengding Landfill. Take Qingshuihe District MSW collection plan as an example for analysis. The long-term generation amount of MSW in Qingshuihe District is about 50t/d. The alternative analysis is shown in **Table 6.5** as follows:

Table 6.5: Alternative Transfer Mode

Plan	Content	Cost	Environment
Direct transportation	Three back-compression trucks with loading capacity of 5t each are needed to go back and forth between Qingshuihe and the landfill 10 times per day. They are also necessary to collect garbage continuously in the Qingshuihe area.	The truck has a weight of about 10 tons by itself. The energy consumption is high of such vehicle with a large weight travelling back and forth between the Qingshuihe and the landfill. The plan is economically unreasonable.	The tightness of the waste transportation process is good, and no contamination caused by scattering. However, many medium-sized vehicles running on the road back and forth may increase air pollution by emissions and increase traffic pressure.
Once-transfer with compression	Five 1t small collection vehicles are selected for collection and transportation to the transfer station. After compression, 2 vehicles with loading capacity of 12t each are used to transport to the landfill 4 times per day.	The small vehicles will greatly save energy and has low requirements for road conditions. The weight of the 12t car is about 13t. Compared to the direct transportation, the energy consumption will be reduced by 50%, and economically reasonable.	The small collection of vehicles has no impact on the main road conditions; and a small number of large vehicles will not increase traffic pressure on arterial roads, and emissions of exhaust gas will be greatly reduced.

Source: Solid Waste Management Study

841. Based on the analysis, once-transfer mode can be selected for MSW collection and transportation of Qingshuihe Area.

Alternative transfer process:

842. There are two types of conversion techniques - one is No Compression that uses large garbage cars for garbage removal; while another is a Compression which has garbage compression machines that increase garbage transfer volume, reduces trash transshipment and reduces running costs. The Qingshuihe River port Trade zone would have garbage production from about 19 tonnes/day to a projected volume of 50 tonnes/day that will need to be transported to Mengding landfill area that is approximately 28 km. The Qingshuihe River capacity cooperation area's current garbage production is about 8 tonnes/day upto 25 tonnes/day. To reduce the costs of transportation of waste to landfill site, the domestic garbage after collection should be compressed.

843. **Horizontal compression** process involves docking of the garbage container with the horizontal compressor horizontal; discharging device is unloaded from the upper part into the compression chamber of the compressor which uses mechanical force to compress the trash into the garbage container as shown in **Figure 6.10**.

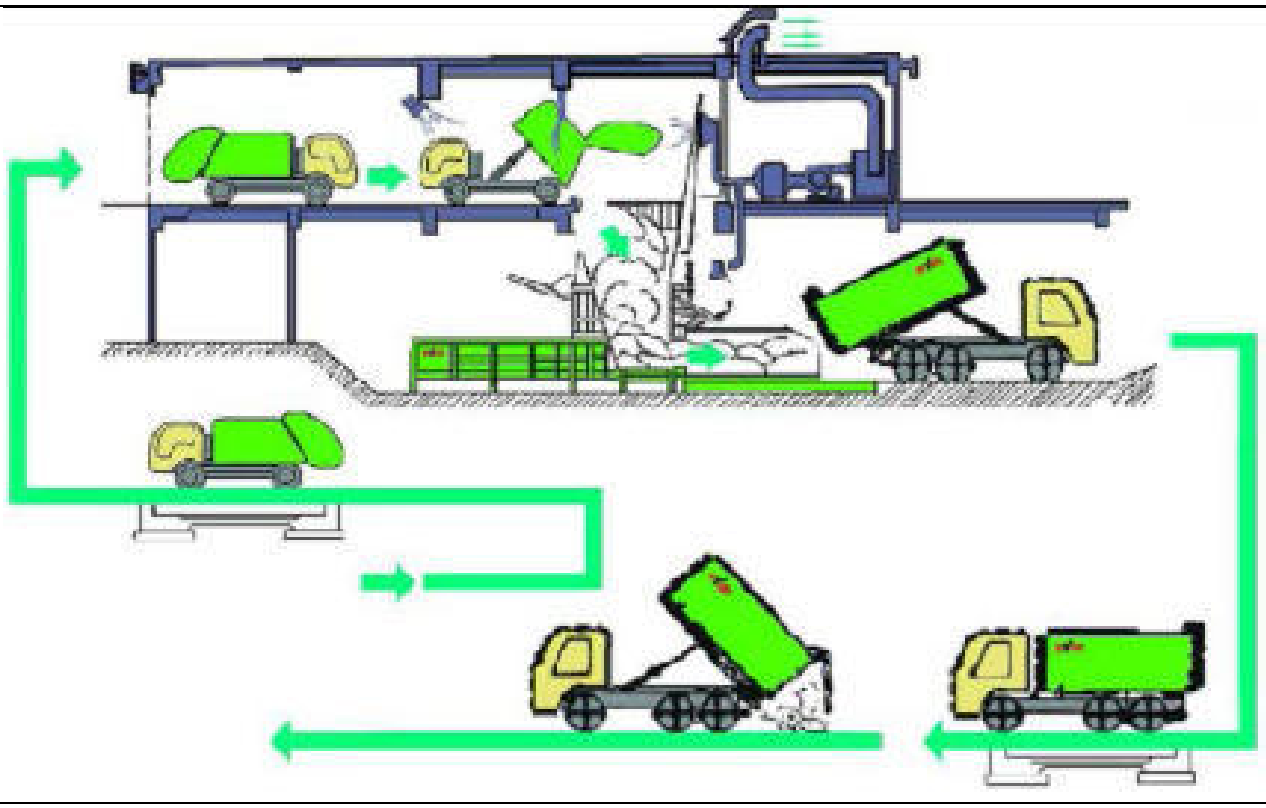
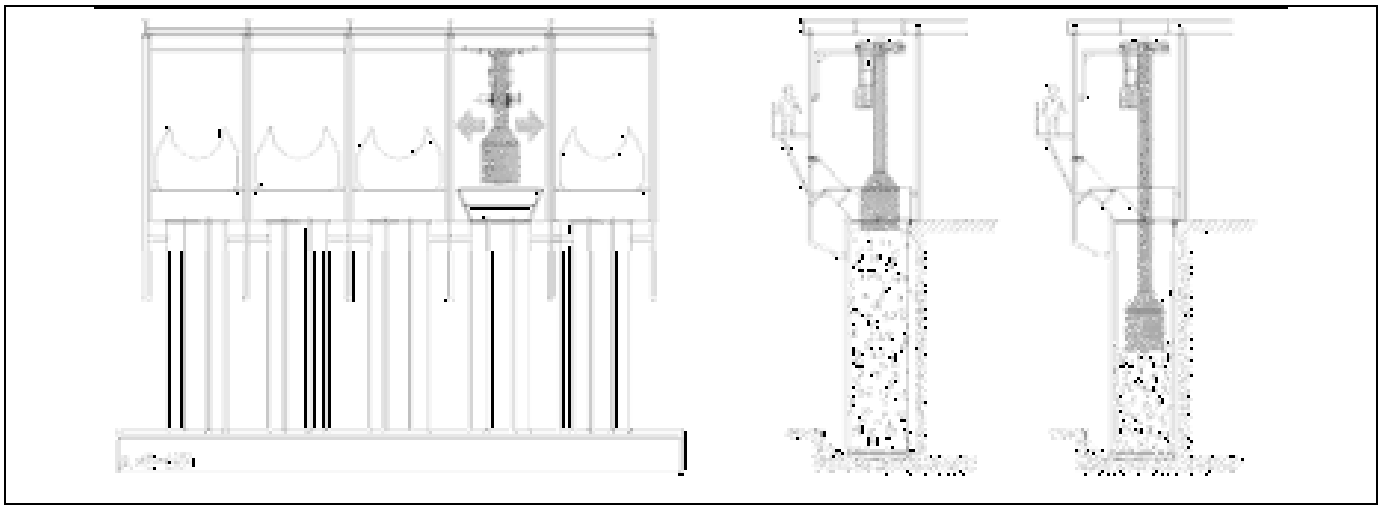


Figure 6.10: Horizontal Compressing Method of waste processing



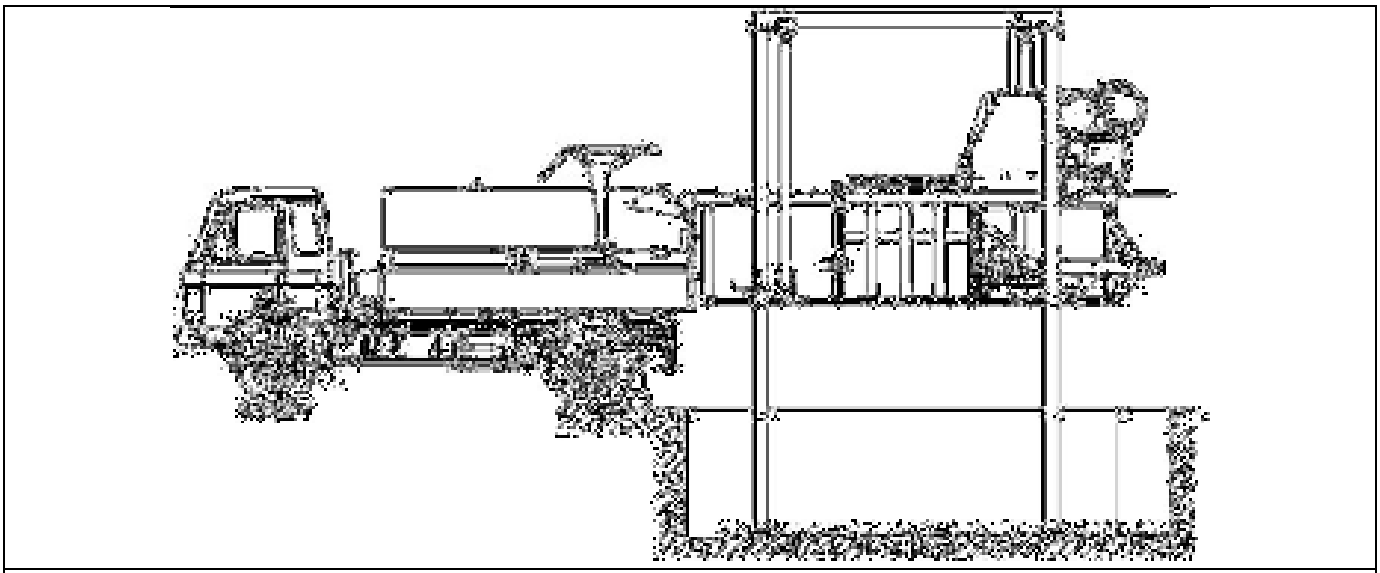


Figure 6.11: Various techniques used for Waste processing

844. Vertical Compression: The vehicle transports the collected garbage to the station and pours it into a garbage bin placed in the pit. It is then compressed as shown in the Figure 6.11.

845. Except when the garbage is exposed when compacting, the shipment procedure is always in a closed state. The leachate from the compression process needs to be discharged to the leachage collection at landfill site. For transportation to Mengding Landfill site, it can be evaporated and then transferred along with the garbage.

6.3.4 Economic Viability[68] of the LBECZ site

846. The economic analysis was conducted in accordance with the Guidelines for Economic Analysis of Projects of the ADB and the Cost-Benefit Analysis for Development – A Practical Guide[69]. The projected financial internal rate of return (FIRR) for all revenue generating subprojects aggregated is 4.57%. The net present value is negative CNY55.44 million. The project is most sensitive to revenue shortfall of which FIRR falls to 2.61% if the revenues are reduced by 10%. The FIRRs for Qingshuihe Border Area Water Supply, Wastewater Treatment, and MSWM subprojects are 4.07%, 3.34%, and 6.20% respectively.

847. The base case EIRR calculation for individual subprojects and the whole project are presented in the following tables. At a 9% discount rate, the whole project is found to be economically viable. The NPV for the whole project is CNY 671.6 million and the base case EIRR for the whole project is 13.9%, which exceeds the EOCC. The EIRRs for cross border capacity improved, integrated urban environmental infrastructures in Qingshuihe border area, social infrastructure and service improved subprojects are 13.4%, 12.5%, and 15.9%, respectively. The sensitivity analysis shows that the project's economic return is robust against negative impacts from benefit reduction, cost overrun and project implementation delay.

[68] Result from Project Economic and Financial Evaluation report as presented in RRP.

[69] http://www.adb.org/documents/guidelines-economic-analysis-projects

7.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

848. This section describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures. The section also describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

7.1 Information Disclosure

849. The EIA public participation process has followed the requirements of the relevant laws and regulations, such as the Law of the People's Republic of China on Environmental Impact Assessment and the Interim Measures on Public Participation in Environmental Impact Assessment.

850. **PRC Requirements.** Relevant provisions in the PRC "Environmental Protection Law (2003)" and the "Regulations on the Administration of Construction Project Environmental Protection (No. 253 Order of the State Council)" require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and stakeholders concerned. However, the requirements for public consultation are different from various sectors and projects. For an environmental Category A project, two rounds of public consultations are required, while for a Category B project, only a simplified tabular EIA is required without requirement for any public consultation.

851. **ADB Requirements.** According to ADB SPS 2009, public consultation and information disclosure is to be made during the initial stages by the client itself. For environment category A projects, such consultations will necessarily include consultations at the early stage of Domestic Environment Impact Assessment (DEIA) report development field work and once when the draft DEIA report is available during project preparation, and once before project appraisal by ADB.

852. This activity supports the view to understand the public's perception of the project and respond to their concerns and suggestions during the early stages of the project design. Incorporation on the environmental concerns to the decision-making process through the public consultation will avoid or minimize conflict situation during the implementation process.

853. The project proponent should involve stakeholders, including affected people and concerned nongovernment organizations and ensure that their views and concerns are made known to and understood by decision makers and taken into account. During project implementation, consultations with stakeholders as necessary to address issues related to environmental assessment would be conducted. The project proponent shall consider inclusion of a stakeholder communications strategy/plan to raise awareness of key stakeholders about environmental protection measures in Infrastructure Development and other relevant issues. In particular, the project proponent shall implement a public communications approach centered on sustained, integrated, and efficient communications that is adapted to suit stakeholder needs.

854. In the first round of information disclosure at the early stage of EIA report preparation, key findings of environment assessment including potential impacts, designed corresponding mitigation measures for both construction and operation of the projects have been disseminated to the public by following approaches:

i. Information of projects were posted on local government official websites of Mengding, Zhenkang and Cangyuan, including a brief introduction of local projects, contact information of responsible departments, main content and procedures of EIA, major issues requiring response and feedback from the public, time and location of public consultation meetings, and channels of collecting feedback.

ii. The first round of information disclosure lasted for 3 days from 7th Feb.2018 to 9th Feb. 2018, carried out by the DEIA institute, staff of LBECZ, and coordinated by ADB consultants. Public notices were put up at public places to conduct the questionnaire surveys, mainly targeted at individuals in order to seek the views of the wider population about the project. This involved a questionnaire survey circulated at public forum in the area affected by the project to listen to the views of the stakeholders and individuals about the construction of the project No comments or objection to the projects were received.

iii. At the same time, DEIA information was published on the Internet on 27th January 2018 on LBECZ website. Further consultation was undertaken between 20 and 25 April, 2018, with local people once the DEIA has been completed and disclosed to inform them about the project and listen to their comments.

855. A second release of draft ADB format EIA information was made on the Internet (insert details), which included a simplified version of the EIA report, to continue to seek the public's views. Details of the consultations undertaken are documented in the LBECZ website and ADB EIA Report.

856. The details of information disclosure are summarized in Table 7.1.

Table 7.1: Time and website for on-line posting

County/District	1st Information Disclosure		2nd Information Disclosure	
	Date	website	Date	website
LBECZ Area	2018.1 .27	http://www.lcmdbhq.com/tzgg/0622038452126603714	2018.4 .13	http://www.lcmdbhq.com/tzgg/0237279677 5629260088
Zhenkang	2018.1 .27	http://www.lcmdbhq.com/tzgg/0622038452126603714	2018.4 .13	http://www.lcmdbhq.com/tzgg/4667357968 317817334
Cangyuan	2018.1 .27	http://www.lcmdbhq.com/tzgg/0622038452126603714	2018.4 .13	http://www.lcmdbhq.com/tzgg/0291869037 8548211650

Source: PMO

857. Examples of the above are shown in the Annexure 6 Figure 6A1. Examples of public notices are shown in Annexure 6. Figure 6A.2.

858. Two Rounds of public notices were posted on the walls or bulletin boards of local community centers, health centers, schools, or residential buildings, including a brief introduction of local projects, contact information of responsible departments, main content and procedures of EIA, major issues requiring response and feedback from the public, time and location of public consultation meetings, and channels of collecting feedback. During the consultations performed at the site, the project team ensured that consultation was gender Inclusive and inclusive of views of any disadvantaged people.

7.2 Public Consultations

859. Public consultations were conducted in project-affected area between February 2018-April 2018. **Table 7.2** indicates a list of public consultations conducted during the field surveys with various

stakeholders from project-affected area.

Table 7.2: Public Consultations held between Feb 2018- April 2018

SNo	Location	Distance from LBECZ Area	Date of consultations	Number of Participants at Consultation		
				Total	Male	Female
	1st round of Project Consultation					
1	At Cangyuan School		Feb 7, 2018	16	8	8
2	At Zhenkang County		Feb 8, 2018	18	12	6
a	At LBECZ Area		Feb 9, 2018	22	12	10
	2nd round of Project Consultation					
3	At Cangyuan School		April 25, 2018	28	-	-
	At Zhenkang County		April 24, 2018	-	-	-
4	At LBECZ Area		April 20, 2018	-	-	-

- Data being collected

860. Participants were required to sign up before the meetings started. Participants who registered include affected residents, local authorities, and other organizations. Annexure 6 Figure 6A.5 shows examples of sign-up sheets, with name, gender, age, relationship with the project and phone number on it. Besides, meeting minutes were recorded respectively.

861. Before and during public consultation meetings, questionnaires were provided by EIA institute to affected persons, local communities and departments, and other stakeholders. Besides, questionnaires were designed into two forms for different uses of individuals and groups, showing different sociological information, containing 12 and 10 questions covering environmental issues as well as opinions on the projects (attached in Annexure 6 Table 6A.3 and 6A.4).

862. After the introduction of the projects and environmental impacts, all the participants understood the importance of the projects to their local environment and thought the projects would bring a positive impact on their local community and environment. Participants from all project locations were supportive to the projects. No objection was received during two rounds of public consultation meetings.

863. Between Dec 2017 to March 2018 consultations and focus groupd discussions were held for the Poverty and Social assessment report in LBECZ area. A total of 300 households in the project townships of Gengma Wa and Dai County, Cangyuan Wa County and Zhenkang County were randomly selected for household survey, 55 respondents were from Myanmar. A total of 17 FGDs were held in four sub-districts and Jiya Township participated by 64 males and 69 females with different gender, age, household economic level and occupations. A total of 16 key informants were interviewed including relevant governmental organizations or bureaus, representatives of target groups or potential affected groups, and other important stakeholders, as well as leaders from village committees, hospitals and schools to gather their comments or suggestions on the project design.

7.2.1 Questionnaire Survey (First Round)

864. **LBECZ area.** A total of 40 individual questionnaires were distributed, and 50% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- The respondents believe that the largest environmental problem existing in the local area is the pollution of water environment (25%) and the quality of drinking water (40%).

- The most negative environmental impact of the project construction is mainly noise pollution (50%).
- Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (55%) and construction of sewage treatment facilities (40%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (35%) and noise (70%).
- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (60%).

865. **Zhengkang**. A total of 20 individual questionnaires were distributed, and 70% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- The respondents believe that the largest environmental problem existing in the local area is the pollution of water environment (7%) and the quality of drinking water (0%).
- The most negative environmental impact of the project construction is mainly noise pollution (64%). Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (36%) and construction of sewage treatment facilities (50%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (21%) and noise (79%).
- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (29%).

866. **Cangyuan**. A total of 20 individual questionnaires were distributed, and 50% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- No respondents believe that the largest environmental problem existing in the local area is the pollution of water environment and the quality of drinking water.
- The most negative environmental impact of the project construction is mainly noise pollution (50%).
- Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (70%) and construction of sewage treatment facilities (20%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (10%) and noise (60%).
- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (80 %).

7.2.2 Questionnaire Survey (Second round)

867. **LBECZ area.** A total of 30 individual questionnaires were distributed, and 73% of them were received. A total of 10 Group questionnaires were distributed, and 60% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- The respondents believe that the largest environmental problem existing in the local area is the pollution of water environment (11%) and the quality of drinking water (36%).
- The most negative environmental impact of the project construction is mainly noise pollution (36%).
- Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (53%) and construction of sewage treatment facilities (64%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (32%) and noise (50%).

- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (75%).

868. **Zhengkang**. A total of 20 individual questionnaires were distributed, and 90% of them were received. A total of 10 group questionnaires were distributed, and 40% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- The respondents believe that the largest environmental problem existing in the local area is the pollution of water environment (5%) and the quality of drinking water (50%).
- The most negative environmental impact of the project construction is mainly noise pollution (50%). Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (60%) and construction of sewage treatment facilities (50%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (50%) and noise (36%).
- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (82%).

869. **Cangyuan**. A total of 20 individual questionnaires were distributed, and 60% of them were received. A total of 10 group questionnaires were distributed, and 20% of them were received. After analyzing the collected data, the results are summarized as below.

- Individuals surveyed have no objections to the construction of this project.
- No respondents believe that the largest environmental problem existing in the local area is the pollution of water environment and the quality of drinking water.
- The most negative environmental impact of the project construction is mainly noise pollution (64%).
- Measures to reduce the adverse impacts during the construction period are mainly to strengthen construction management (36%) and construction of sewage treatment facilities (43%).
- The most negative impact on the environment during the operation period of the project is mainly the influence of groundwater (21%) and noise (29%).
- Mitigating the adverse impact of the project during the operation period should adopt environmental protection measures, mainly to strengthen the operation supervision (79 %).

7.3 Follow-up Actions from the consultations

870. As a follow-up of consultations with local community during the ADB's consultants in February/April 2018, the following issues have been elaborated by Biodiversity/Civil Engineering/TRA consultants. After discussion, the comments of the participants and response from EIA institute can be summarized as follows:

Table 7.3: Comments and Response at LBECZ Public Consultation Meetings

Comments	Response
Reduce resettlements as much as possible	Project site location was reasonably analyzed and ensured in compliance with relevant standard.
Scientifically arrange the construction site and construction period, regularly sprinkle water to reduce dust, and minimize the impact of dust generated during the construction process on the surrounding environment.	Suggestion received.
Considering drinking water issue.	During the construction period, there will be small impact on drinking water; during the operation

Comments	Response
	period the impact will be nil as the water supply will be provided by new water supply plant.
Doupi Reservoir is nearby. Is there any impact on the reservoir?	Groundwater flow does not flow directly to the reservoir. This project is a governance project and will reduce the impact on the surrounding environment after it is completed
Will the project create any employment opportunities for community members?	No.
Can the project train and provide employment to local community members in maintenance services?	Yes.
Will cutting rubber trees increase the temperature levels in the area and cause climate change?	Project will strictly monitor the possible impacts caused by temperature changes.

Source: PMO

Table 7.4: Comments and Response of Zhenkang PC Meeting

Comments	Response
Please ensure the implementation of environmental protection measures in the construction period	The EIA report has identified the main body of the implementation of environmental protection measures, and has included various environmental protection measures in the environmental protection acceptance form for completion to ensure that it is in place.
Will the project create any social problems for local communities with permanent residence from outsiders who come for operation and maintenance services?	No.
Will the project release any pollutants which are harmful to the lives of people?	Mitigation measures will be considered in EIA and taken during construction and operation.

Source: PMO

Table 7.5: Comments and response of Cangyuan PC Meeting

Comments	Response
Will the project accelerate the soil erosion that regularly occurs within the project impact area? Any increase in the level of soil erosion can adversely affect the settlements and the residential dwellings of the people.	Mitigation measures will be considered in EIA and taken during construction and operation.
Will the project generate any solid or liquid waste and affect the ground water levels?	Mitigation measures will be considered in EIA and taken during construction and operation.
When the project will start construction? The local neighbours suffered the problem of pollution and contamination caused by chicken and pigs farms. They expect the new building of the school will address the environmental issue.	The project construction information will be disclosed by local website and other channel. The environmental issues will be considered in EMP.

Source: PMO

7.4 Future Public Consultations

871. A dialogue channel will be maintained with the affected public and stakeholders throughout

project implementation by continued public consultation. Such dialogue will ensure that public concerns are understood and dealt with in a timely manner. A plan for future consultation during design, construction and operation has been developed, and is presented in the EMP. Future public consultation will be conducted via questionnaires surveys, household visits, workshops, and public hearing (consultation meeting) when they are complaints or unanticipated negative environmental impacts.

872. The plan includes public consultation on (i) inspection and monitoring the impacts and mitigation measures during the construction and operation; (ii) evaluating the environmental and economic benefits and social impact; and (iii) consulting with the public after the project completion. The implementing agencies and the PMO will be responsible for organizing the public consultations. The contractors will be required to communicate and consult with the communities in the subprojects' areas, especially those close to their construction sites. Eye-catching public notice boards shall be set at each construction site to proclaim the purpose of the construction, the duration of disturbance, the responsible entities on-site (contractor, implementing agencies), and the project level GRM. Contact information of all GRM entry points (including community leaders, neighborhood organizations, local authorities, district EPBs, and contractors) and the Project Public Complaints Units (PPCU) will be disclosed on the construction site information boards. The cost for GRM will be included in the IAs' operation budget.

873. Prior to construction, the implementing agencies will inform the affected people of the planned project interventions and the likely disturbances through information disclosure in the local newspaper. The GRM entry points will be briefed, which will in turn ensure that information is disseminated to project affected areas. During construction, affected people will be consulted at semi-annually through formal questionnaire surveys and a public workshop. The surveys and the public workshop will be conducted by the implementing agencies supported by environment consultant. On-site environmental engineers of the construction contractors or construction supervision companies will conduct informal interviews with affected people on a regular basis. Public consultation will focus on complaints about community disturbances from construction activities, such as construction noise, dust, solid waste and wastewater, as well as public concerns about soil erosion, air pollution and water pollution.

874. The public consultation will continue annually during operations until the Project Completion Report is filed. The consultations will ensure that all consultation would be Gender inclusive as well as include disadvantaged people in the discussions.

8.0 GRIEVANCE REDRESS MECHANISM

875. This section describes the grievance redress framework (both informal and formal channels), setting out the timeframe and mechanisms for resolving complaints about environmental performance.

8.1 Awareness of Stakeholders

876. During public consultation sessions of the EIA study, the discussions with groups and individuals were conducted to make them aware of the proposed project. Thus, the project-affected community residing beside the proposed project has gained a reasonable knowledge about the potential grievances, which will arise in the future.

877. A community awareness programme must be conducted one month prior to construction by the Project Implementation Unit (PIU) of LBECZ regarding the scope of the project, procedure of construction activities, utility of resources, identified impacts and mitigation measures. These awareness programs will help the community to resolve problems, and clarify their distrusts related to the proposed project at initial stage.

878. The Project Management office (PMO) of the LBECZ will establish a Grievance Redress Mechanism (GRM) to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the Project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

879. The Community should be informed about the Grievance Redress Mechanism (GRM), its procedure for making complaints, including the place and the responsible person to contact in practical way in this regard. Almost all the stakeholders related to the GRM will also be made aware of the established grievance process, the requirement of grievance mechanism, goals, benefits, relevant laws regulations etc.

8.2 The Grievance Redress Mechanism and LBECZ

880. ADB procedures require LBECZ to establish a Grievance Redress Mechanism (GRM) having suitable grievance redress procedure to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the subproject's environmental performance. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. A common GRM will be in place for social, environmental or any other grievances related to the project. The GRM will provide an accessible and trusted platform for receiving and facilitating resolution of affected persons' grievances related to the project. The GRM procedure for the project is outlined below, which follows a time-bound schedule, with responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required.

The Current Grievance System

881. The 2005 PRC Decree No. 431 entitled Regulations on Letters and Visits codifies complaints receival mechanism at all levels of government, and safeguards the complainants from any retaliation. In 2007, the national regulation was adapted to environmental matters in Decree No. 34 of SEPA on Environmental Letters and Visits System.

882. Currently, when residents or organizations are negatively affected by project activities, such as noise, dust or safety issues caused by construction activities, they may complain to the contractors and

implementing agencies by themselves or through their community committees, or complain directly to local EPBs before they finally appeal to the court. In the case of issues occurring during the construction period, they can complain to the contractors first if the construction is the source of the problem. If the contractors' responses cannot resolve the issues or if the contractors do not respond to the issues, they may contact municipal EPBs or the district/county EPBs, who will record the complaints and then visit the sites to investigate and obtain the contractors' side of the story. Sometimes, the two sides might contradict, each defending its own argument. In such cases, the local EPBs will need to consult with the contractor or the environmental supervision engineer to acquire relevant project information and collect data. This kind of fact-finding or site investigation is usually time-consuming, thus delaying the mediation process. The major weaknesses of the current system are: (i) the lack of a specialized unit to address grievances on a project level; and (ii) no specific timeframe for the GRM.

Current Complaints Methodology

883. In the current system (shown in Figure 8.1), when people are adversely affected by a project, they can appeal to:

- Construction Contractors,
- LBECZ Local government,
- Lincang EPB (LEPB), or
- Court.

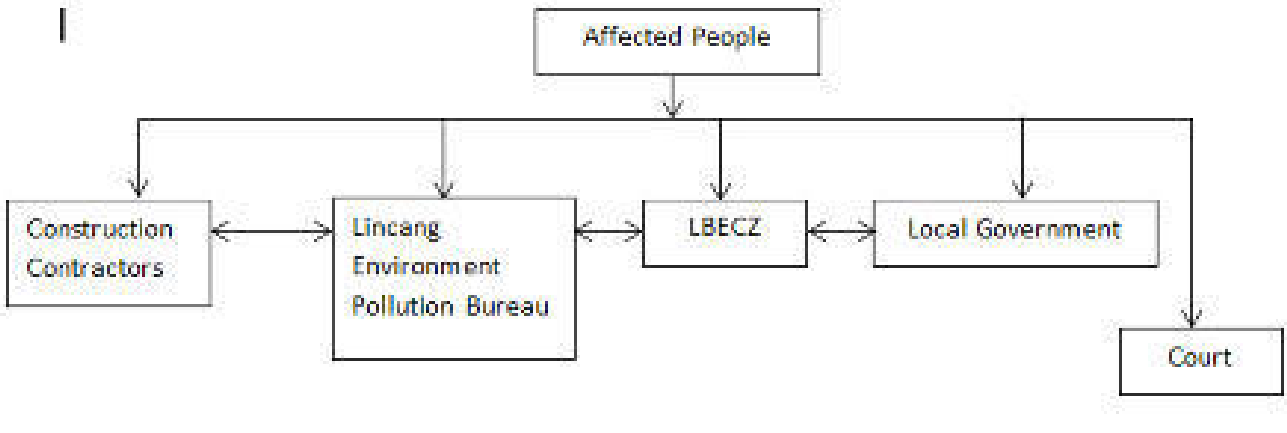


Figure 8.1 Current Grievance system

884. Among the agencies involved, PMO of LBECZ together with LEPB takes the leading coordination role in dealing with environmental complaints. In case of problems during the construction, affected persons usually complain to the contractors first if they believe the construction is the source of issues. If the contractors' responses are unsatisfactory, they then go to LEPBZ. If they refer their complaint to the LEPB, the LEPB will need to consult with the LBECZ's PMO or environmental supervision engineer to develop project understanding. Therefore, it is usual for the PMO of LBECZ, who is familiar with the project, to take the lead role in complaint investigation.

Proposed Grievance Redress Mechanism

885. Project Management Office (PMO) shall formulate procedures for implementing the GRM, and undertake GRM's initiatives that include procedures of taking/recording complaints, handling of on-the-spot resolution of minor problems, taking care of complainants and provisions of responses to distressed stakeholders etc. paying particular attention to the impacts on vulnerable groups.

886. The grievance mechanism will be scaled to the risks and adverse impacts on environment due to size of the project type, size, type of area (sensitive area) and impacts. It should address affected people's concerns and complaints promptly, using a transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution.

887. The Proposed Grievance Redress Mechanism (GRM) for the infrastructure development project provides an effective approach for complaints and resolution of issues made by the affected community in a reliable way. This mechanism will remain active throughout the life cycle of the project. This system also mirrors the approach of the grievance redress mechanism for the Project's resettlement and asset compensation. This GRM would consist of a Grievance Redress Committee (GRC) headed by the Project Head. The committee would consist of the following constitution as listed in **Table 8.1**.

Table 8.1: Constitution of Grievance Redress Committee

1	Project Head, LBECZ
2	LEPB/County Representative or their nominee
3	Representative of Village Council
4	Women representative of village/council
5	Representative of Construction contractor
6	Environment Officer at PMO or nominee

888. This Grievance Redress Mechanism (GRM) would provide an effective approach for resolution of complaints and issues of the affected person/community. The PMO will establish a Public Grievance Center (PGC) at project site prior to construction to deal with complaints from affected people during implementation of the Project. The Centre will act as a clearing house for complaints, compiling records which are included in project monitoring reports.

889. The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, should be available. Opportunities for confidentiality and privacy for complainants should be honored where this is seen as important.

Public Grievance Center (PGC)

890. Grievances of affected persons (APs) will first be brought to the attention of the Public Grievance Center (PGC). Grievances not redressed by the PGC will be brought to the Grievance Redress Committee (GRC) set up to monitor subproject Implementation for each subproject affected area. The GRC will determine the merit of each grievance, and resolve grievances within an outer time limit of fifteen days of receiving the complaint. The proposed mechanism does not impede access to the country's judicial or administrative remedies. The AP has the right to refer the grievances to appropriate courts of law if not satisfied with the redress at any stage of the process.

891. The proposed mechanism for grievance redress of environmental matters in construction and operation of the project's infrastructure components uses existing administrative structures (affected persons/ village committees/ village groups), any of which can be complainants. It may use diverse complaint media that are culturally appropriate, including self-identified, confidential, or anonymous procedures such as letter, suggestion boxes, mail-in forms, hotlines, and electronic submission through a website.

892. The PGC will keep records of all grievances received including: contact details of complainant, date that the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome.

893. People will be encouraged, should any issue occur, to contact the PGC with confidence that it will handle the problem until a solution is found and implemented. For this purpose, the PGC's phone number, fax, address, email address will be publicized through notice boards at the project sites and within nearby communities. The Terms of Reference for the PGC also cover mechanisms for the referral of complaints made through other government agencies and the statutory time limits which these actions entail.

894. The Head of PGC will investigate the complaint, identify appropriate corrective measures and instruct the Contractor to implement corrective actions. The PGC will review the Contractors response and undertake additional monitoring and verification to ensure that the cause for any complaint does not recur. During the complaint investigation work, the PGC will work in close consultation with the Contractors, PMO, and the Construction Environmental Supervisor.

GRM Steps and Timeframe

895. If any grievance was not effectively solved at the subproject level, provincial PMO will facilitate the development of reasonable, effective, and satisfactory resolution. The following describes the five main steps of the Project level GRM.

896. **Stage 1**: Resolution at Subproject Level. If a concern arises, the affected person (AP) may try to resolve the issue of concern with the GRM designated staff at the subproject or complain to the local authorities, such as local EPB. If the concern is resolved successfully by the subproject, no further follow-up is required. Nonetheless, the GRM designated staff at the subproject shall record any complaint and actions taken to resolve the issues and report the results to the GRM designated staff of PMO. If no solution is found within 7 working days or if the complainant is not satisfied with the suggested solution, proceed to Step 2.

897. **Stage 2**: Official Complaint to PMO. The AP will submit the grievance directly, or via the GRM designated staff at the subproject, to the GRM designated staff of PMO who must assess the eligibility of the complaint, including whether Step 1 has been implemented properly, identify a solution in conjunction with the subproject, and give a clear reply within 7 working days to the complainant and to the GRM designated staff at the subproject with the suggested solution. The subproject PIU shall implement the redress solution and convey the outcome to the PMO within 7 working days.

898. **Stage 3**: Stakeholder Meeting. If no solution is identified or if the complainant is not satisfied with the suggested solution under Step 2, the GRM designated staff at the subproject will organize, within 7 days, a multi-stakeholder meeting where all relevant stakeholders, including the complainant, the GRM designated staff at the subproject or other representative(s), the GRM designated staff of PMO, and local EPB will be invited. The meeting will aim to find in a solution acceptable to all parties, and identify responsibilities and an action plan. The subproject PIU will implement the agreed-upon redress solution and convey the outcome to the PMO within 7 working days.

899. **Stage 4**: Special consultation. If the multi-stakeholder hearing process under Step 3 cannot resolve the complaint successful, PMO in consultation with the subproject PIU, the relevant EPBs, and ADB, will review the situation and attempt to develop an alternative approach to resolve the complaint within 7 working days.

900. **Step 5**: Large Scale Stakeholder Meeting. If the complainant is not satisfied with the suggested solution under Step 4, the subproject PMO, PMO, relevant EPBs, and other local government authorities, shall organize another multi-stakeholder hearing process within 10 days and shall find a

solution acceptable to all parties. Based on the agreement, an action plan shall be developed and implemented by the subproject PIU within the agreed timeframe.

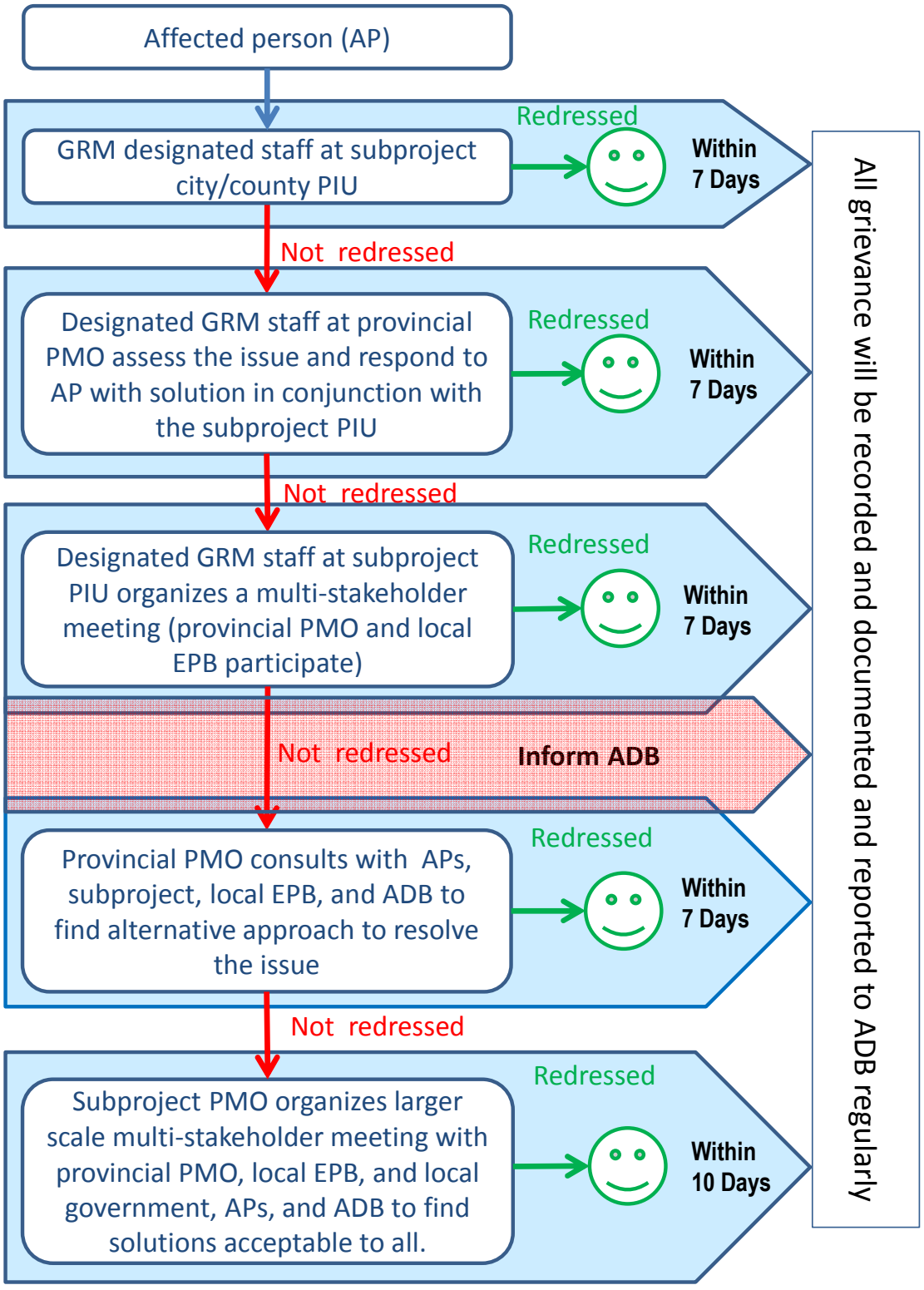


Figure 8.2: Proposed Environmental Grievance Redress Mechanism
* The AP has right to go to court at any stage of the GRM is he/she is not satisfied.

Reporting

901. Finally the PBC will report the investigation results and subsequent actions to the complainant, and record the complaint, investigation, and subsequent actions and results in the monthly EMP reports. The activities and responsibilities of the PGC are set out below, in procedural order:

a. The PGC will be managed by the PMO. The Environment Supervisor from the department should be designated to deal with public complaints and directly report to the Bureau Director.
b. PGC's phone number, fax, address, email address will be publicised through notice boards at the project sites and within nearby communities. People will be encouraged, should any issue occur to contact the PGC with confidence that it will handle the problem until a solution is found and implemented.
c. The PGC will instruct contractors and construction supervisors to refer any complaints which they have received directly to the PGC. Similarly, the PGC will coordinate with local government or LEPB to capture complaints made directly to them.
d. The PGC will log complaint and date of receipt onto the complaint database and inform the Construction Chief Engineer and Environmental Supervisor at PBC.
e. The PGC will investigate the complaint to determine its validity, and to assess whether the source of the problem is due to project activities, identify appropriate corrective measures and advise the Contractor for implementation.
f. The PGC will review the Contractors response on the identified mitigation measures, and the updated situation.
g. If complaint is transferred from government agencies such as LEPB or Lincang Municipal Public Complaint Bureau (LMPCB 210282, 21222098), the PGC will submit interim report to the LEPB or PBC on status of the complaint investigation and follow-up action within the time frame assigned by the above agencies
h. The PGC will undertake additional monitoring and verify the situation if necessary as well as review that for any valid reason for complaint does not recur.
i. The PGC will report the investigation results and subsequent actions to the source of complaint for responding to complainant.
j. The PGC will record the complaint, investigation, and subsequent actions and results in the monthly EMP reports.
k. During the complaint investigation work, the PGC should work together with the Contractors, General Manager, Construction (Investment Corporation), (referred as Construction Chief Engineer), and the Environmental Supervisor at PBC. If mitigation measures are identified in the investigation, the Contractors will promptly carry out the mitigation. The Construction Chief Engineer will ensure that the measures have been carried out by the Contractors.

902. In the construction period and the initial operational period covered by loan covenants the PMO will be reporting progress to the ADB, and this will include reporting complaints and their resolution.

903. The tracking and documenting of grievance resolutions within the county PMO will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the PMO and the PMO's report to the ADB.

9.0 ENVIRONMENTAL MANAGEMENT PLAN

904. This section deals with mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts. The EMP includes management plans and mitigation actions that identifies and summarizes anticipated significant adverse environmental impacts and risks and describes each mitigation measure including the type of impact to which it relates, as appropriate.

9.1 Construction Management, Material sourcing and Demolition

905. The total floor area of the Project covers 137.84 hm^2 and the main types of land occupation are rubber forest, wasteland and transportation land, etc., where the rubber forest is as the principal occupation.

9.1.1 Main Material and Sources

Cement and Steel:

906. Cement required for the construction of the Project can be procured locally while steel is supplied by KISC and Yu Kun Iron and Steel Co., Ltd.

Asphalt

907. The Project area is not equipped with an asphalt mixing plant so that asphalt required in the Project will be procured and transported to the Project area with tank trucks, conforming to requirements of Project construction.

Stones

908. **Concrete**: The concrete to be used in the Project should be commercial concrete.

909. **Mortar Rubble**: The rubbles are procured from around legitimate sand stocking yard.

910. **Crushed Stones**: Graded crushed stones and cement stabilized macadam are procured from around legitimate sand stocking yard.

Electricity and Water for Construction

911. Electricity and water required within the Project area are provided by the local power grid, conforming to requirements of the Project.

Access/Construction Roads

912. The construction road of the Project relies on the Zhen Zhenqing Line so that new construction roads are not required.

Construction Site and Camp

913. There are about 200 constructors in the Project construction yet none of them receives room and **board** within the Project. Accommodation can be provided by the Construction Contractor for constructors or addressed by renting houses nearby by constructors themselves.

9.1.2 Three-yard Setting in Construction

914. **Sand stocking yard**: Sand-gravel aggregate required in the Project construction will be **procured** from legitimate sand stocking yard and sales place within the territory of Gengma County. The Project will set no special sand stocking yard.

915. **Soil borrow yard**: The Project will set no special soil borrow yard.

916. **Temporary soil stocking yard**: Considering the removal of surface soil, the Project sets 70 stocking sites for the surface soil. The average floor area of scattered stocking yards for surface soil covers 300m^2. The peeled off surface soil is packed in woven bags. The temporary stocking yards for surface soil are set in the planned land for landscaping to decrease temporary occupation land in construction.

9.1.3 Waste disposal site:

917. Earthwork excavated during construction will be transported to low-lying areas of the planned construction land within this area for backfilling. The Project will set no waste disposal site in construction. The environmental impact assessment has proposed that the backfilling area shall be compacted in time, to prevent the secondary pollution such as raising dust pollution in dry seasons and water and soil loss in rainy seasons.

9.1.4 Demolition/Resettlement

918. Demolition along and around the Project is minimal in nature. Resettlement due to any demolished structures are dealt separately in the Resettlement Plan developed for this project.

9.2 Disaster Management, Health and Safety, Training

Disaster Management

919. Abnormal natural environment phenomena include lightning, earthquake, flood, landslide, soil corrosion, etc. Post -earthquake ground vibration, soil degradation or dislocation in the fault zone, vibration and ground rapture, etc. may result in the damage to equipment, pipelines and buildings in the project. Though major earthquake in recent years, small to moderate earthquake have been felt in PRC. The flood risk in Yunnan province is lower than in other parts of country.

920. The China National Commission for Disaster Management and the Ministry of Civil Affairs (MOCA) monitors responses to any natural or manmade disasters and deploys national teams across the affected areas. As part of the new plan for disaster response, more than 22,000 weather service stations have been built in China and 437,000 rural weather messengers disseminate disaster warnings to rural residents. These facilities now serve nearly 85 percent of the country's rural regions, according to statistics from the China Meteorological Administration[70]. To respond to natural disasters more effectively, China is expected to train over 2.75 million people in disaster prevention and emergency management by the end of 2015. On May 10 of this year, a new national map of disaster-prone areas was released by the State Key Laboratory of Earth Surface Processes and Resource Ecology at the Beijing Normal University. The map shows the eastern and central parts of China are highly prone to earthquakes, floods, landslides, typhoons and droughts.

921. In order to improve its ability to prevent and mitigate disasters, the Chinese Government authorized the MOCA to establish the National Disaster Reduction Commission NDRC in 2002, which became functional in May 2003. In 2009, a satellite disaster reduction application center was established at the NDRC.

[70] Source: http://www.un-spider.org/news-and-events/news/china-prepared-worst-measures-are-taken-enhance-disaster-relief

922. Disaster resilient features[71] will be built into new infrastructure. The facilities designed in the project will have sound seismic design to withstand earthquakes, improved flood control and precipitation resistant features for all the proposed facilities.

Health and Safety Issues Management

923. To avoid/ minimize inherent risks during construction, operation and maintenance, the Construction contractor will follow national and international Environment, Health and Safety Procedure for construction and expansion of subprojects and the operations and maintenance (O&M) period. Some other implications and mitigations from safety point of view are listed in **Table 9.1** below:

Table 9.1: Safety Implication and Mitigation

No	Implication	Mitigation
1	Falling object accidents	Proper signs to avoid areas where falling objects can hurt passer-byes, workers, community living nearly etc.
2	Open construction boundary	Construction contractor to install metal sheet barriers that are high enough to make a boundary so that residents cannot get unauthorized access into construction sites.
3	Electrical shock/fire due to any open wiring at construction site	Ensure all access points do not have any open electrical connections/wires lying in open. Safety protection set up an effective grounding device. All the electrical equipment of the metal casing, underground metal pipelines have set grounding devices
4	Redundancy in Safety design parameters	Engineering safety protection in strict accordance with the design Code for structural calculation and design.
5	Accidents at facilities due to congestion caused during construction	Proper Traffic management by Construction contractor

Operator Safety training Program:

924. After the operation of the project, the staff engaged in special work types should be sent to the Labor Bureau to carry out specialized training in safety production, and obtain special work type certification.

Training Programs

925. Under the oversight of the PMO Environment Supervision Officer, the training program will be developed by PIU Environment Supervision Consultants[72] and Loan implementation Environment Consultants (LIEC), who will be contracted during project implementation. Each of training should last at least one day with specific program and should include interactive problem solving tasks

926. Trainings on EMP implementation for Construction contractor, Emergency Response systems for all emergency situations, Occupational Health and Safety etc. are proposed to be held as per

[71] The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR Terminology on Disaster Risk Reduction. https://www.unisdr.org/we/inform/terminology) Source: Reducing Disaster Risk by Managing Urban Land Use, Guidance Notes for Planners, ADB, 2016

[72] One PIU Environment Supervision Consultants to be hired during construction process for EMP and EMoP monitoring for each PIU.

training program schedules shown below in **Table 9.2.** The costs for all the training programs are included in the ADB funding for the project.

Table 9.2: Training programme - summary of training needs

Training topic:	Summary of training purpose and content	Recipients/ Participants	Frequency or target date
Induction to EMP	Overview of EMP including site information, pollution risks and controls, and programmes. Preparation of site specific EMPs and training on implementation to staff of Construction contractor (s)	All PIU engineers/contractors	At beginning of project
Review of EMP, Refresher training on EMP	Review of EMP including new changes and updates	All PIU Engineers/contractors	One year after project start, or more frequently if required
Training on specific pollution risks and controls			
Emergency case response planning	To identify on-site potential accident scenario and how to plan potential emergency response actions.	All PIU Engineers /contractors/Local residents	During the project implementation
Air Quality Monitoring	Ambient Air Quality, Volatile Organic Compounds (VOCs), Particulate Matter (PM), Ozone Depleting Substances (ODS), Greenhouse Gases (GHGs)	All PIU Engineers /contractors	During the project implementation
Water Conservation	Water Monitoring and Management, Process Water Reuse and Recycling, Heating Systems	All PIU Engineers /contractors	During the project implementation
Waste water and Ambient Water Quality	Liquid Effluent Quality, Discharge to Surface Water, Discharge to Sanitary Sewer Systems, Land Application of Treated Effluent, Septic Systems, Wastewater Management	All PIU Engineers /contractors	During the project implementation
Hazardous Materials Management	General Hazardous Materials Management, Hazard Assessment, Management Actions	All PIU Engineers /contractors	During the project implementation
Fire safety	Fire, and Explosion Prevention, Control Measures,	All PIU Engineers /contractors	During the project implementation
Occupational Safety, Health and Safety	Occupational Health and Safety Emergency Preparedness and Response, Community Involvement and Awareness	All PIU Engineers /contractors	During the project implementation
Waste Management	General Waste Management, Waste Management Planning, Waste Recycling and Reuse, Treatment and Disposal, Waste Storage, Transportation, Treatment and Disposal, Commercial or Government Waste Contractors	All PIU Engineers /contractors	During the project implementation
Monitoring and evaluation			
Participatory M&E of impacts.	Simple methods for recognizing adverse impacts on environment Methodology of monitoring and evaluation on the water quality	Local residents, Construction contractor	During the project implementation
Energy Efficiency and Green Buildings	Introduction to energy efficiency, heat loss, green building concept	Local residents, facility management bodies	During the project implementation

Training topic:	Summary of training purpose and content	Recipients/ Participants	Frequency or target date
Project management and implementation	M&E, Implementation assessment the program.	All PIU Engineers /contractors	At the beginning of the project

9.3 Critical Environmental Review Criteria

(i) Loss of irreplaceable resources

927. The project will involve large-scale excavation of land and felling of rubber trees. There will be a net Biodiversity Loss due to felling of rubber trees, but they are commercial trees that serve as temporary carbons sinks and need to be replaced after a particular life span. The tree replacement including the green belt development and forest areas shall be planted in suitable ratio to ensure positive offset of cutting trees in the area.

(ii) Accelerated use of resources for short-term gains

928. The project will not use any natural resources occurring in the area during construction, operation and maintenance phases. The construction material such as steel, cement, etc. shall come from factories while the excavated soil shall be disposed in designated waste management sites designated by urban body. Thus, the project shall not cause any accelerated use of resources for short term gains.

(iii) Endangering of species

929. No endangered (EN) or critical (CR) species of flora and fauna exist in the project area and there seems to be no possibility of endangering/causing extinction of any species. There are some vulnerable species of reptiles that will be affected for which specific mitigation and monitoring measures will be implemented. The Nanting Bridge area that may have fish species that frequent for migratory or spawning will be take special care to ensure no interference to migration or spawning happens.

(iv) Promoting undesirable rural-to urban migration

930. The project involves acquisition of some private land holdings and community rubber tree lands which are being dealt in the Resettlement Plan (RP) for this project. However, there is no possibility of any migration as employment opportunities are going to grow in the area.

(v) Increase in affluent/poor income gap

931. The project will increase availability of hospital/education/transportation facilities to the neighbourhood communities. Several communities are also going to be benefitted due to these facilities. Thus, the project is expected to contribute in reduction of affluent/poor income gap by providing livelihood opportunities.

9.4 Environmental Management Plan

Potential Adverse Impacts and Associated Mitigation Measures

932. EIA investigations and other project reports have shown that potential project impacts are significant and need to suitably mitigated through the implementation of the EMP. Widespread construction activities have the potential to result in site erosion and substantial waste generation. These will be mitigated by the implementation of strict construction site environmental management.

933. For disposal of a net total (after uses for fill) of 426.482 m^3 of excavated spoil, 399.591 m^3 spoil disposal sites will be located throughout the construction land area of 68.05 hm^2 as mentioned in Table 5.15. A comprehensive Water and Soil Conservation Plan (**Appendix 2**) has been prepared. It provides

a detailed analysis of all erosion sources and mitigation measures to prevent or control them. It includes setting principles and erosion control prescriptions for spoil dumps.

934. Although the total number of people to be resettled is not large by PRC project standards, a comprehensive RP is being prepared for the Project. The plan prescribes the resettlement and compensation of affected households and people.

Follow-Up Monitoring and Environmental Management Requirements

935. The Environmental Management Plan (EMP) has been prepared for the project (**Annexure 3)** that discusses the anticipated impacts, monitoring requirements, and development of mitigation measures with respect to the following stages: (i) pre-construction, (ii) construction, and (iii) operation and maintenance. Detailed, site-specific mitigation measures and monitoring plans were developed and will be implemented during the project implementation phase. An effective environmental management system is a dynamic, continuous process initiated by management and involving communication between the project proponent, the workers, and the local communities directly affected by the project.

936. This EMP is appropriate for the environmental safeguarding of the planned works and forms part of a comprehensive set of environmental management documents including the EIA, the biodiversity report, the Climate Risk and Variability Assessment (Appendix 3) and Water and Soil Erosion Prevention Report (Appendix 2). The EMP includes institutional responsibilities and costs for implementing the mitigation measures and the monitoring requirements.

937. The mitigation measures will be incorporated into tender documents, construction contracts, and operational management plans. Construction Contractors and the project implementing agency (IA) will implement the measures. The effectiveness of the measures will be evaluated on the basis of the results of the environmental monitoring to determine whether to continue them or to make improvements. The construction contractor shall encourage site specific EMP based on the EMP attached in (**Annexure 3**).

Site specific environmental management plan (SEMP)

938. The construction contractor shall prepare a site-specific environmental management plan (SEMP) prior to the commencement of construction works in consultation with ESC of the PIU and LIEC, and shall submit the plan to the project management office (PMO) and PIU for review and approval. The plan shall include construction method statements on the implementation of pollution control and mitigation measures, adherence to energy-and resource- efficient construction practices, as well as an emergency spill contingency plan for containing and cleaning up accidental chemical spills on construction sites. The SEMP shall be updated as needed as and when environmental issues not covered by the plan arise.

939. A summary environmental impact matrix and the mitigation measures are given in **Table 9.3** below.

Table 9.3: Environmental Impact Matrix (based on Resource Mapping)

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
A.	**Physical Resources**							
1.	Topography	Change in the surface features and present aesthetics due to the construction of the project.	Direct/Local/ irreversible		X		The surface soil will be restored to normal slope after construction. If there is any excess soil, it shall be disposed off at suitable location. Any loss of vegetation will be attended by PMO as per existing PRC norms and per EMP.	During construction activity.
2.	Climate	Impact on the climatic conditions due to cutting of rubber trees.	Direct/Local/ irreversible		X		Small impact on the climatic conditions due to tree removal and reafforestation required.	
B.	**Environmental Resources**							
1.	Air Quality	Project will have impact on air quality during the construction period due to increase in the dust emission due to cutting/filling, stockpiling of construction material and traffic movement	Direct/Local/ reversible		X		Water sprinkling at construction site, limited bare soils, maintenance of vehicles.	During construction activity.
2.	Noise	Noise from digging, piling, crushing, concreting and equipment installation.	Direct/Local/ reversible		X		Restriction of noise generating activities at night and use of personal protective equipment like ear plugs, mufflers.	During construction activity.
3.	Surface and Ground Water quality	Runoff from the construction site.	Direct/Local/ reversible		X		Land development may create problems in local drainage pattern, minor impact. Careful siting of soil dump and construction material at site.	Before and during construction activity.
		Domestic wastewater from construction sites. Cutting/filling at construction site would create natural drainage blockade during rainy season.	Direct/Local/ reversible		X		Domestic waste treatment by providing septic tank/soak pits at work site for workers at each location.	During construction and operation.

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
4.	Soils and Geology	Soil erosion due to clearing of topsoil at site.	Direct/Local/ reversible		X		Rehabilitation and stabilization of disturbed land at the project site.	During and after the construction activity.
		Damage due to seismic activity.	Direct/regional/ reversible	X			Site selection and proper foundation design considering the geological conditions and seismicity of the area.	Before the construction activity.
		Settling of foundations by digging piles and pier on the river	Direct/regional/ reversible		X		Site selection and proper foundation design considering the geological conditions of the area.	Before the construction activity.
C.	**Ecological Resources**							
1.	Terrestrial Ecology	Loss of vegetation.	Direct/Local/ irreversible		X		The tree planting/Green belt development to offset trees felled will be done by the Construction contractor	Before the construction phase.
2.	Terrestrial Fauna	Small mammals, insects will be significantly impacted.	Direct/Local/ reversible			X	Implement catch and release program to reduce direct impact	Before and during construction phase.
3.	Aquatic Ecology	Significant impacts envisaged due to river rehabilitation and bridge construction on migration and fish spawning	Direct/Local/ reversible			X	Disposal of construction waste and other waste to avoid polluting any river bed.	Before and during construction phase
D.	**Human Environment**							
1	Health and Safety	Fires, explosion and other accidents, Health & safety of workers at site may pose to risk in some cases.	Direct/Local	X			Use of personal protective equipment during construction. Regular inspection of construction site for faults prone to accidents. Volatile organics to be handled	During construction and operation phase
		Banned Substances; safe drinking water and sanitation hazard	Direct/Local	X			High concentration of labor force creates un-hygienic condition; provide proper facilities	During construction phase
		Vector-borne and Communicable Diseases	Direct/Local/ Regional/Irreversible			X	Integrated mitigation measures for workers and community members alike	Before Construction Activity
		Traffic Injury and Mortality	Direct/Local/ Irreversible			X	Traffic Management Plan; consequences for non-	Before Construction

Sl. Nº	Environmental attribute	Potential impacts	Nature of impact	Magnitude of impacts			Mitigation measures	Implementation and Monitoring
				Low	Medium	High		
							compliance for contractors and subcontractors	Activity
2.	Agriculture	Small amount of land will be acquired - impacts envisaged.	Direct/Local/ reversible		X		Some agriculture land used for project area	Before and during construction phase.
4.	Socio-economics	Beneficial impacts job opportunities during construction phase	Direct/regional		X		Unskilled labor and indirect benefits. Overall economic growth of the region.	During operational phase
5.	Resettlement	Small amount of land will be acquired - impacts envisaged.	Direct/Local/ reversible			X	Resettlement issue details in RP Document.	Before the construction phase.
6.	Archaeological /Cultural sites	No archaeological, historical or cultural important sites are affected by the construction.	Direct/Local/ reversible	X			No archaeological, historical or cultural important sites are affected.	--
7.	Traffic and Transportation	Traffic congestion due construction vehicles, ferry of construction and waste material.	Direct/Local/ reversible	X			Proper traffic signs at the construction site, ensuring availability and maintenance of proper access roads.	During construction phase
		Increase in temporary traffic					Ensuring more staggered timings for students at Qingshuihe school.	During construction and operation phase
8.	Waste Generation	Probability of surface and ground water pollution. Improper management of construction debris and solid waste may pose risk to the neighbours.	indirect/Local/ reversible	X			Minimization, reuse and recycle whenever possible. Final wastes to be collected and disposed off in compliance with applicable regulations and rules.	During operation phase
		Pollution from liquid discharge	indirect/Local/ reversible	X			No liquid discharge from the project, domestic sewage should be disposed through sewage network	During operation phase
9	Site Security	Improper site security may pose risk to the Qingshuihe school children or community at Cangyuan/LBECZ	Direct/Local/ reversible	X			Proper fencing and protection at the construction sites, and manned security a must at the school site.	During construction phase

9.5 Mitigation Measures

940. The Construction contractor shall comply with EMP to be based on **Annexure 3** for compliance with ADB's SPS 2009 which must be read together with the EIA as a whole for ensuring environmental safeguards compliance.

9.5.1 Aquatic Life - Mitigatory measures

Mitigation of Impacts to River Waters

941. Techniques for minimizing adverse effects of constructing foundations in water and stream environments include avoiding impacts, minimizing impacts, and/or effective remediation of the impacts. After construction, impacts shall be remediated. **Table 9.4** discussed the construction timings for construction on various river sub-projects.

Table 9.4: Timing of Construction for River sub-projects

No.	Activity of Fish	Season	Activity to Stop/Start	Result of Action
1	Spawning Concentration period	April to June	Stop construction of river rehabilitation and water intake structure	Fish breeding succeeded.
2	Flood Migratory Season	June to September	Stop Piling and excavation works for Nanting Bridge	Free fish migration completed.
			Develop Fish pass structure at intake location at Nangun	Migration between upper and down reaches.
			Water retention weirs at Qingshuihe River	Migration between upper and down reaches.

Construction Material Spillage from Bridge and river rehabilitation.

942. River bank rehabilitation and spillage of construction material, piers on riverside for bridge erection are the main activities during the construction in two river related subprojects of the LBECZ. The very low level impacts could be expected to the hydrological environment during the construction stage. During construction of the footing, care must be taken not to disturb the river bed to cause irreversible damage. The siting of the pier foundations should be done to avoid any sensitive riverine area. The topography of the surrounding area will not be changed during the erection of the bridge and associated roads. The direction of the surface water flow will not be disturbed by putting excess soil.

943. During the construction, sheet piles will be used to isolate the foundation locations and not to damage sediments in surrounding areas around footing area. The excavated materials will not be dumped in to the surrounding areas. After completion of the installation activities of foundations, all unwanted materials (waste), if any, will not be dumped to the surrounding areas but taken out for disposal at designated dumping sites identified by local government.

944. When the bridge girder substructure is constructed, the construction method of circulating cast-in-place bored pile shall be taken to realize the recycling of slurry and reduce the discharge quantity of slurry. After construction, the naturally settled slurry and the excavated waste slag shall be transported to the designated spoil area for stacking. To avoid and reduce the suspension pollution formed from surface runoff at the pile foundation construction site, an intercepting ditch shall be built at the pile foundation construction site to guide the SS sewage generated from construction into the temporary sedimentation tank to be settled and then discharged.

945. Cavings produced form the piling shall be stored outside river district and protective measures shall be carried out in strict accordance with relevant regulations. Storage places could be set at stated waste disposal area. Abandoning cavings freely is not allowed so as to protect river and surrounding water quality to the maximum extent and prevent adverse effect of throwing away cavings on flood control. The river bed should be cleaned up and be restored after bridge construction is finished.

946. The stacking places of construction materials like asphalt, oil and chemicals should keep away from river bed with canvas for temporary cover to prevent rain wash. Abandoned mechanical oil and waste oil should be recycled and processed in time as well as should be submitted to the unit which is qualified to recycle and process hazardous goods for processing.

947. Two sedimentation tanks should be set inside the coffer dam area for the bridge construction across Nanting River. Those sedimentation tanks are not allowed to be set in fisheries genetic resources conservation area. Production wastewater during construction will be collected by sedimentation tank and be carried out simple process of acid-base neutralization sedimentation, oil removal and deslagging. Then the removal rate of SS, the major pollutant, could be controlled at 80%. pH value will be adjusted to neutral or faintly acid. The concentration of other pollutants like petroleum will be decreased. The Construction contractor shall monitor the surface water quality in the river channel on a monthly basis to observe any changes in water quality in the project area.

948. During the construction period, at the road sections arranged along the river (both Qingshuihe and Nanting), woven earth bags shall be set or a retaining wall shall be built for effective retaining between the construction area which is less than 30m away from the water body and has a surface slope of more than 25 degrees and the water body, thereby reducing the influence on water quality along the line by construction, excavation and filling.

949. Besides, spilling of construction waste oil will also lead to water pollution. Site concreting of bridge superstructure requires a large amount of frameworks and mechanical oil for hydraulics. If mechanical oil leaks or used waste oil is discharged into river directly, it will lead to increase of water quality indexes like petroleum in water environment and lead to water quality reduction. Therefore, discharge of construction waste residue, waste oil and waste water into river should be avoid both during mechanical operation of bridge substructure drilling and site concreting of superstructure. Meanwhile, construction site should be cleaned up after bridge construction is finished to prevent construction wastes being discharged into the river.

950. During the construction period, various measures will be implemented to protect fish.

- In the spawning concentration period from April to June, it is recommended to stop construction of Nanting Bridge and water intake infrastructure as well, to ensure fish free migration and spawning.
- In the flood season from June to September, there are many fishes swim upstream. Piling and excavation works will be forbidden, especially for the construction of Nanting Bridge.
- Avoid of construction waste water, waste residue and residual mud waste getting into the river course.
- It is recommended to increase fish pass structure in the water intake location of Nangun River, and along water retention weirs in Qingshuihe River to ensure the fish movement between upper and down reaches.
- Employing the LID (low impact development) approach such as gabion ditch and gabion dam, to manage rainwater and reduce soil erosion.
- Maximum use of ecological measures to protect the river slopes, to reduce the soil erosion, and increase the interaction between the water and soil.
- The contractors will be requested to have the environment education to the workforce. All staff

should comply with the Management Regulation of Nanting River, which was issued in December 2017. All illegal activities such as harvest in March to May, use of certain types of capture methods, and disposal of polluted wastes into the river.
- Any fish caught in the construction period will be released back into the river, especially for the temporary river diversion period in Qingshuihe River and Nanpa River.

951. If a construction material spillage happens, response will depend on the amount, severity, type of material, water condition and distance from sensitive ecosystems. The Construction contractor should be well aware and prepared for an immediate response in case of an accidental oil spill. For construction material spillage retrieval, boats could be used to dredge/scoop the fallen debris/material from river bed. Any of the following methods and/or combination may be applied in such situations.
- Booms, which are floating barriers to oil.
- Sorbents, which are big sponges used to absorb oil.
- Skimmers, which are boats that skim (scoop) spilled oil from the water surface.

952. During the project operation period, the following measures are recommended:
- Investment in scientific research programmes, to collect the fish inventory, population distribution, population trends and threats, and biological information for developing more effective management strategies.
- Enhancement of capacity building of local Fishery Management Authority and Administrative Bureau of NAGR of lower reach of Nanting River.
- Identification of important fish habitats by the local Fishery Management Authority, while fishing and harvesting in these areas being prohibited during the spawning season.
- Monitoring of the fish population status and assessment of population dynamics, fish migration in the vicinity of project sites in Qingshuihe River, Nanpa River, Nangun River and Nanting River.
- Collecting the waste water and oil contamination from the surface of Nanting Bridge into the urban waste water network, rather than feeding into the river course directly.

Discharge of wastewater into River water

953. In addition, the monitoring will be enhanced for the releasing water from waste water treatment plant, and potential leachate from municipal solid waste transfer/compaction station. The primary purpose is to prevent contamination to the river ecosystem.

Summary of mitigating potential impacts to Aquatic biology

954. LBECZ will ensure lessening or mitigation of potential environmental impacts by adjusting the proposed Bridge and river rehabilitation construction periods to reduce locational impacts. The Construction contractor should incorporate specific mitigation methods into the project design, construction process, and/or maintenance procedures. Examples of common mitigation techniques are shown in the **Table 9.4** below.

Table 9.4: Mitigation strategies for Aquatic species

Project Phase	Feature	Mitigation Methods	Benefit of mitigation
Design Phase	Minor changes to Project subcomponent locations	Making minor adjustments in subcomponent locations to avoid any natural habitats.	Use flexible placement of temporary construction barriers to ensure minimal impact with advice of an ecologist (if required)
Construction Phase	Timing of Bridge construction, river rehabilitation	Constructing during April-September controlled to minimize impacts to fish habitat and widespread erosion.	Reduction in disturbance to any habitats

Project Phase	Feature	Mitigation Methods	Benefit of mitigation
	Erosion Control during river embankment and rehabilitation	Installing and maintaining proper erosion controls during construction to minimize run-off of top soil and disturbances to natural areas.	Reduce turbidity due to loosen soil from water runoff (if any).
	Drilling and Pile perfusion for bridge on river bank	Drilling carried out in within protected area inside cofferdam	Isolated from water body and not impacting river water quality due to cofferdam
	Boat Operations at the bridge construction site	Oil Spillage from boat engines, lubes from gearboxes of cranes used at bridge sites for unloading, concreting etc.	• Booms, which are floating barriers to oil. • Sorbents, which are big sponges used to absorb oil.
Post-Construction Phase	Invasive Species Management	Annual surveying for new populations of invasive species caused by construction disturbances. Early detection of invasive species increases the likelihood of successful outcomes.	Increase in invasive species in river will damage the aquatic ecosystem in the area.
	Restoration after removal of temporary protection measures near foundations used for bridge construction	Ensure no shoal formation is started, and rehabilitate area if required. Prevent discharge of slurry and contaminated waste water from cofferdam	To restore river water quality to Class III quality standard and any natural habitat to original condition for aquatic species

9.5.2 Land Area - Mitigation Measures

Soil Run-off from landscaping

955. In order to control the surface runoff and increase the infiltration, soil compaction should be carefully carried out. After the completion of construction work, in order to regulate the runoff and infiltration, maintenance of landscaping and proper drainage system is essential. Some illustrative figures are shown below in **Figure 9.1** and **9.2**:

Figure 9.1: Slope Grass Protection

Figure 9.2: Dome shape skeleton protection

956. Soil excavation should be minimized during the rainy season to reduce soil/sand erosion that lead to sedimentation in adjoining shallow sea water. During the dry season wind erosion can be reduced by spraying water to the surface of the excavated soil. In addition, it is necessary to remove excess soil in the land to suitable location soon after the excavation. The excavated soil should be transported through the recommended procedures and should backfill or dump in suitable locations. All construction material stored at site will be covered and or kept wet on surface to avoid dispersal with wind. All vehicles carrying construction material will be covered while travelling on public roads. **Table 9.5** gives the subgrade protection by various techniques.

Table 9.5: Subgrade Protection Comparison table

Main Treatment Plan	Three-Dimensional Geotechnical Grid Mat	Protection of Planting Grass In Geogrid	Spraying Planting Grass
Protective type	Flat slope surface, pneumatic into holes, into the anchorage tendons, paving the three-dimensional geogrid mesh pad, hydraulic spraying planting grass.	Clear slope surface loose soil, repair slope surface, slope surface laying geogrid and fixed, lattice indoor backfill and tamping, slope planting grass species, slope surface maintenance.	Flat slope surface, direct hydraulic spraying planting grass.
Applicable geological conditions	Suitable for slope stability, slope surface flow scouring general, and easy to grass growth of soil or weathering layer excavated slope.	Suitable for slope stability, slope water erosion is serious, easy to grass growth of soil or weathering layer excavated slope.	Suitable for slope stability, slope water erosion slight, and easy to grass growth of soil or weathering layer excavated slope.
Main project Plan	Slope Height≤3m cutting slope ecological protection	Slope Height h≤3mcutting slope ecological protection	Slope Height h≤3m cutting slope ecological protection
Comprehensive comparison of schemes	Extensive use, Good Landscape, Simple Construction Process. Project Area construction experience is rich, the project cost is lower, has no impact on the environment.	Extensive use ,Good Landscape, Simple Construction Process, Project Area construction experience is rich, the project cost is relatively high, the has no effect on the environment.	Extensive use, Good Landscape, Simple Construction Process, Low project cost, has no effect on the environment, But the scour resistance is weak.
Comparative conclusion	Cutting along the road h≤6mcutting slope Recommended use	Not recommended	Not recommended
Comparative conclusion	Embankment along the road 8m Multi-level slope recommended use	Not recommended	Not recommended

957. The applies to: all kinds of soil slopes and weathered very serious rock slopes, slope is not steep in 1: 1.5 The planting of plants on the roadbed slope and the floodplain is a good result for the reinforcement of the subgrade and the protective banks. It can reduce the velocity of water, species in the flood can induce silt deposition, prevent water directly scour the embankment. Planting trees is best

combined with planting grass. It is forbidden to plant trees on high-grade highway slopes. Disadvantages: The applicable slope range is small, in some areas of poor soil environment, plants do not have the necessary nutrients to grow, the survival rate is low, affect the stability and beauty of the slope.

Surface/ ground water

958. Some impacts could be expected to the groundwater of the area due to the proposed project activities. It is needed to provide wash up toilet facilities along with soakage pit and septic tanks for all the workers in the construction and operation phases. Septic tank should be constructed at relatively high elevated areas. No water well will be located within minimum 100 m of a toilet facility.

959. The impact of pesticides was not found during the testing of soil and water for baseline parameters. Similarly, no pesticides/herbicides will be used in the removal of vegetation.

Water and Soil Erosion

960. The construction contractor must meet the water and soil conservation requirements during construction. The implementing unit shall carry out water and soil conservation monitoring at the earliest after approval of this plan, and undertake supervision and monitoring on water and soil conservation during project construction. The surface runoff generated during the construction period of the project must go through sedimentation before discharging.

961. During construction, the soils for land rising will be taken from vegetated hills, which will involve the removal of vegetation and soil. The spoil disposal sites would cover the vegetated valleys. It is proposed to introduce soil and water conservation measures to help the restoration of these sites. In addition, the spoil disposal sites should avoid the valleys with high proportion of natural habitats including shrubs and grass.

Noise Control Measures

962. The following engineering noise control measures proposed are shown in Table 9.6

Table 9.6: Table of Comparison among Common Noise Reduction Measures

Name of Measure	Applicable Condition	Noise Reduction Effect	Advantage	Disadvantage
Sound barrier	Central living quarters close to the road and seriously exceeding the standard.	8～12dB	Excellent. It is applicable to the road itself, easy to be implemented and beneficial to a large quantity of people.	Large investment. Some types of sound barriers have impact on landscapes.
Construct enclosure at environmental protection target positions	Some living quarters or schools close to the road and moderately exceeding the standard	3～5dB	Ordinary. Low costs.	Limited noise reduction performance, small application scope. Affect the living of residents and landscapes.
Ordinary sound insulation window	Dispersedly distributed and seriously affected living quarters.	8～15dB	Excellent. Low costs and strong applicability	Unventilated. Inapplicable to hot summer. Affect the living of residents and landscapes.

Name of Measure	Applicable Condition	Noise Reduction Effect	Advantage	Disadvantage
Landscaping	Applicable to central living quarters not seriously exceeding the noise standard and having conditions to plant trees.	The green belts can reduce 5dB noise.	Reduce noise, purify air and improve ecological environment.	It takes long time to achieve certain noise reduction effect. The seasonal change of noise reduction effect is great and investment is high. The applicability is limited in areas where the land is valuable.

963. In view of the possible excessive noise during the night time for the middle term and the exactly excessive noise during the night time for the future term in Qingshuihe Village, and its distance from the road, it is recommended to set up green belts and plant tall trees; the afforestation is improved on the side of the Road No. 3 near Qingshuihe Village, and tall plants are planted for sound insulation. A reasonable arrangement of sound insulation barriers and green belts can reduce the impact of road noises on residents, but this will not change the existing acoustic environment quality function.

Road Noise Management Measures

- Traffic noise can be effectively controlled by strengthening the road traffic management, for example, speed limit signs and no tooting signs are provided at both sides of the road section near the sensitive point.
- Maintain the road frequently and ensure the road roughness to avoid noise increase due to unfavorable road condition which leads to abnormal driving of vehicle.
- Based on the results of noise prediction during the operation period, it is recommended to improve the afforestation on the side of the Road 3 near Qingshuihe River. i.e. planting tall trees to provide sound insulation, so as to ensure that the acoustic environment quality is up to the standards specified in (GB3096-2008).
- To reduce the impact of traffic noises on other internal functional areas of the Project and surrounding sensitive points, the transport route shall be optimized to avoid transporting at night and lunch break. Speed limit signs and no tooting signs shall be provided on the transport road within project area to reduce traffic noises. To minimize the impact of logistics transportation of the Project on sensitive points, the transport route shall be optimized and the transport vehicles shall lower the speed near sensitive points and stop blowing the horn.

Road Traffic management

964. During the construction period, vehicles by which transport building materials are large-sized vehicles. The increase in the traffic volume increases the road load and traffic will become congested and chaotic during rush hours, which are likely to cause traffic accidents. Besides, construction wastes, such as abandoned soil, which were left behind during transportation, will cause roads to be muddy during rainy days, affecting traffic capacity and people's traveling. For the purpose of not affecting local residents' transportation, the environmental impact assessment has proposed the following measures:

- Arrange construction process reasonably; control the construction procedure; organize construction step by step as well as plan the space-time transformation relationship of roads under the construction. Do not pile up building materials optionally on the road to block traffic.
- Improve the management system of traffic organization, including traffic organization planning and construction program approval system, etc.
- Clarify the construction site and the surrounding traffic situation and specify reasonable construction plan, which shall not affect the traffic but also meet the construction requirements. Contact the transportation department and ask that to give support, guidance and improvement scheme of the transportation and make detailed implementation rules prior to the commencement of the construction.

- The surrounding roads of the construction operation control area shall be set up warning signs of the construction, other temporary guide signs, indicative and prohibition signs guide passage of vehicles.
- Vehicles for transporting bulk materials shall be closed-roof vehicle and covered with a covered with canvas.
- Transport vehicles shall not be overloaded and the ledges as well as wheels shall be washed and cleaned before the vehicles access the scene, so as to avoid the pollution of urban roads by the construction and earth-moving vehicles.

Tree Felling and Replantation

965. The site clearance for erection, roads and ancillary facilities will be restricted to the necessary footprint area. Vegetation shall not be removed from areas falling in land not required for any construction activity. Disturbed areas and green belts shall be re-vegetated as soon as the activities in the immediate surroundings are completed. Same species shall be planted after completion of construction activities to avoid any invasive trees/evegetation in the aeea.

966. Seedling of these species are found in nearby area and these should be introduced into the localities that were not affected by the project. Also, these plants can be replant outside the covered area (once the constructions are over).

967. The project will require a tree/species related plantation program i.e. replanting them in the suitable ratio as per PMO/ADB requirements. This will be done by the Construction contractor under the supervision of LBECZ, after the construction work is completed. The LBECZ will decide the area for replanting (outside of the parking area, roads, buildings etc.) and in consultation with the Forestry Bureau.

968. LBECZ will decide the locations for tree replantation in consultation with Forest Bureau after implementation. The location of replantation will be intimated to ADB and will be plotted on a Google map (or topographic map of the area) during operations monitoring period. In addition, it is recommended to plant more C4 plants than C3 plants to increase the carbon sink, such as sedge, dicotyledon, euphorbiaceae, chenopodiaceae and amaranthaceae (all C4 plants).

Solid Waste Mitigation Measures

969. Different functional zones of the Project produce different types of domestic wastes. Domestic waste production is shown in **Table 9.7**.

Table 9.7: Table of Solid Wastes Production Amount and Treatment Methods During the Project Operation

Source	Name of Solid Waste	Output (t/a)	Waste Handling/Mitigation Measures
Road facilities	Household waste:	Small amount	Set trash cans along the route which are collected and sent by sanitation workers
Border Resident Trading Market	Commodity packaging wastes	626	Recycle the recyclable wastes. Unrecyclable wastes should be processed by environmental sanitation department.
International Capacity Cooperation Area	Warehousing garbage	200	To be processed in accordance with relevant requirements. Recycle the abandoned packing materials.
	Household waste	18.25	To be processed by environmental sanitation department through collecting.

Source	Name of Solid Waste	Output (t/a)	Waste Handling/Mitigation Measures
Water Supply Plant	Sludge	365	Slime will be sent to and filled in landfill.
	Household waste	8.03	To be processed by environmental sanitation department through collecting.
Sewage Treatment Plant	Sludge	456. 25	To be dried (moisture content being lower than 60%), sent to and filled in the landfill at Mengding Town.
	Grid slags and sand setting	18.25	To be sent to landfill through collecting.
	Household waste	7.3	To be processed by environmental sanitation department through collecting.
Charging station	Household waste	54.75	To be processed by environmental sanitation department through collecting.
Qingshuihe River Port Hospital	Household waste	36.5	To be processed by environmental sanitation department through collecting.
	Canteen swill	94.9	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	0.6	To be processed by qualified unit through collecting.
	Medical wastes	29.2	The medical solid wastes shall be temporarily stored in medical waste storage room through collecting and shall be carried out regular harmless treatment by qualified medical wastes treatment company.
	Sludge of sewage treatment facilities	21.83	To be dried and sterilized with lime until the moisture content is below 60% and to be collected, sent to and filled in landfill together with household garbage.
	Heavy metal sludge and abandoned activated carbon absorbent	1	To be processed by qualified unit through collecting
China-Myanmar Friendship Hospital of Zhenkang County	Household waste	328.5	To be processed by environmental sanitation department through collecting.
	Canteen swill	593.1	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	3.75	To be processed by qualified unit through collecting.
	Medical wastes	912.5	The medical solid wastes shall be temporarily stored in medical waste storage room through collecting and shall be carried out regular harmless treatment by qualified medical wastes treatment company.
	Sludge of sewage treatment facilities	81.09	To be dried and sterilized with lime until the moisture content is below 60% and to be collected, sent to and filled in landfill together with household garbage.
	Heavy metal sludge and abandoned activated carbon absorbent	1.33	To be processed by qualified unit through collecting
Guomen Primary School in Qingshuihe	Household waste	64.26	To be processed by environmental sanitation department through collecting.
	Canteen swill	5.4	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	0.3	To be processed by qualified unit through collecting.

Source	Name of Solid Waste	Output (t/a)	Waste Handling/Mitigation Measures
Changyuang 2nd Guomen Primary School	Household waste	152.55	To be processed by environmental sanitation department through collecting.
	Canteen swill	12.82	To be sold to local pig farms for comprehensive utilization through collecting
	Grease in oil separation tank	0.71	To be processed by qualified unit through collecting.

970. Based on **Table 9.7**, all solid wastes produced during the project operation are properly treated, which has little impact on surrounding environment. Since Hospital of Qingshuihe River Port will become operational after construction, the Assessment mainly focuses on medical wastes of hospital, sludge of sewage treatment station, heavy metal sludge and discarded activated carbon adsorbent.

9.6 Monitoring

971. In addition to the EMP, to ensure that project would not be generating a negative impact to the overall environment quality, an Environmental Monitoring Plan (EMoP) will be prepared. The monitoring activities of the project include site supervision, verification of permits, monitoring of water quality, soil, noise and air. Monitoring of the quality of water, soil, air, and noise during the construction stage is a responsibility of the contractor, and of the approved government agency. The environmental monitoring activities along with their periodicity for developing the EMoP for the project are summarized in **Annexure 4**. The project Environment Safeguards monitoring report template is attached in **Annexure 5.**

972. PIU engineers (who are contracted by PIU) will supervise civil works contractors. For example, they will monitor sanitary waste treatment, water treatment, wastewater treatment etc. should be done periodically to avoid air, water and land pollution. Other environmental good practices include noise abatement, maintaining hygienic conditions, maintenance of fire and safety equipment etc. Monitoring report should be prepared once in three months with the corrective action plan for the problem areas. The PIU will be responsible for internal monitoring of the EMP implementation, and will develop quarterly progress reports with details of activities and progress made during EMP implementation.

973. The PMO will employ one Environmental Supervision Officer to articulate the monitoring needs and basic operation instruction to the PMO, DIs, construction contractors, supervision agency and local Natural Resources Management Bureaus (Forestry, Wildlife, Fishery). The PIUs will hire one Construction Supervision Consultants each to make sure that they can fulfill the duties to do monitoring in the different construction stages as described in the monitoring plan.

974. The PIU will submit annual monitoring reports to ADB. A template of the Environment Monitoring Report is attached as **Annexure 5**, which will be required to submit quarterly by PMO to ADB.

External Experts

975. For environment Category A and If project activities are noticed to have significant adverse environmental impacts, ADB requires PMO to retain qualified and experienced experts[73] or qualified Non-Government Organisation (NGO) or Community Based Organization (CBO) to verify the environment monitoring reports. If required, these external experts/NGO or CBO will report on a semi-

[73] External expert who is not involved in day-to-day project implementation or supervision

annual basis directly to ADB to verify if sound environmental management practices were followed during implementation. In case the implementation of EMP measures is not satisfactory, the external experts/NGO or CBO will recommend actions to enhance environmental compliance.

Biodiversity Monitoring Specialist (s)

976. The **monitoring of terrestrial fauna and flora** is recommended to be contracted with the university or academy or qualified consultant team. They would have the qualification as the follows: (1) The team leader has the postgraduate degree with at least 10 years' experiences on inventory surveys on terrestrial fauna and flora; (2) The team leader has the ability to develop, analyze and articulate project issues. Ability to diagnose problems and propose reliable solutions; (3) The team members should have the professional staff in wild fauna and wild flora; (4) The working experience in Yunan Province would be desirable.

977. The **monitoring of aquatic environment** is also recommended to be contracted with the university or academy or qualified consultant, especially at the beginning of the project construction. The team would have the qualifications as the follows: (1) The team leader has the postgraduate degree with at least ten years' experiences on inventory survey on fish and their habitats; (2) Ability to develop, analyze and articulate project issues. Ability to diagnose problems and propose reliable solutions. (3) The working experience in Yunnan Province would be prefect; (4) Skills to train the working staff of NAGR in lower reach of Nanting River, and Aquatic resources management stations of Lincang and Gengma Agriculture Bureaus.

9.6.1 Environmental Monitoring Plan (EMoP)

978. The mitigation measures suggested requires monitoring of environmental attributes both during construction and operational phase of the project by the PMO. During the construction and operation phase of this project, the monitoring of the environmental aspects shall be done at the project sites by the Environment Supervision Consultants of the PIU.

Review process of site specific EMPs

979. PMO will be responsible for implementing internal monitoring systems for EMP implementation, and will forward quarterly progress reports to the Government and ADB. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. On-going consultation measures will be incorporated in the EMP.

980. The Environment Supervision Consultant will review the Contractor's internal procedures and capacity to manage and implement site specific environmental management mitigation measures. To this end, the training program in **Table 9.2** has provision for training of the Contractor's staff. The Environment Supervision Consultant[74] will be the key person reviewing the implementation of EMP. **Annexure 4** provides the periodicity of the measurements of environmental parameters – air, noise, soil and water at the various project sites to be implemented by the Construction contractor during the construction phase. The Annexure also lays down the following checklist/clauses for the Construction contractor to adhere to.

- Environmental Site Inspection and Monitoring Checklist, and
- Environmental Safeguard Clauses for Civil Works Contracts.

981. The environmental monitoring plan is to be utilized for measuring the extent of compliance with the EMP during the project implementation. The main objective of environmental monitoring is:

[74] The Environment Supervision Consultant shall be hired for the PIU during the construction period

- to evaluate the performance of Construction contractor in mitigating negative impacts vs. the proposed measures in the EMP;
- to provide information on unanticipated adverse impacts or sudden change in impact; to determine if any impacts are irreversible in nature which required remedial measures and monitoring;
- to suggest improvement in environmental mitigation measures, if required;

982. During the construction phase, civil works contractors should ensure that activities like handling of earth works, clearing work, access road construction, putting proper traffic signals is done properly to have minimum impact. This in turn should be monitored by the construction supervision specialists responsible for the project implementation.

983. Implementation of environmental mitigation measures will be ensured through both routine and periodic monitoring. **Table 9.8** lists environmental monitoring activities during construction phase:

Table 9.8: Construction Phase Monitoring

#	Indicators of Monitoring	Types of Monitoring/ Method of Monitoring	Monitoring Frequency	Who does it	Who supervises
1	Safe transportation of construction material through roads	Visual Inspection Continuous	Regular during construction	Civil works contractors	PIU
2	Stockpiling of excavated materials and appropriate disposal	Visual Inspection	Regular during construction	Works contractors	PIU, ESC
3	Occupational health and safety, use of safety gears by workers	Use of PPE Visual Inspection	Regular during construction	Civil works contractors	PIU, ESC
4	Safety to students (school), staff, local community etc.	Record of injury or accidents	Regular during construction	Contractor	Schools, PIU
5	Inconvenience to community due to power cut, water logging etc.	Visual Inspection Continuous	Regular during construction	Works contractors	PIU
6	Solid waste segregation disposal	Visual Inspection	Regular during construction	Civil works contractors	PIU
7	Replantation of cut trees	Continuous	Regular during construction	PIU, civil works contractor	PIU, PMO
8	Environmental Parameters Quality	Air, Water, Noise, soil sampling lab testing & comparison with Baseline of the area	six monthly	Civil works contractors	PIU, PMO

PPE: personal protective equipment

984. During the operation phase, the PIU could continue to conduct monitoring as specified below in **Table 9.9**:

Table 9.9: Operations Phase Monitoring

#	Indicators of Monitoring	Types of Monitoring/ Method of Monitoring	Monitoring Frequency	Who does it	Who Supervises
1	Solid waste management system	Records of waste collected and managed	Quarterly	O&M operator	PIU, PMO
2	Number of orientation and trainings on safety, facility usage to staff	Number of orientation and trainings conducted	Regular	PIU	PMO
3	Preparation of monitoring reports and Impact audits	Preparation of monitoring reports and Compliance with EMP	Quarterly	LIEC, PIU	PMO

EMP = Environmental Management Plan, PIU = Project Implementation Unit

Construction Contracts

985. The Construction contractor will adhere and comply with all measures and procedures identified in the EMP. The EMP and EMoP which are endorsed by the EA will be monitored in accordance to ADB's Safeguard Policy 2009 requirements. Mitigation measures related to construction as specified in the EMP will be incorporated into civil works contracts, and their implementation will be primarily the responsibility of civil works contractors. In addition, civil works contractors will be requested to submit monthly progress reports on the implementation of EMP measures to EA/PIU.

9.6.1.1 Water and Soil Erosion Monitoring

986. **Table 9.10** provides the water and soil erosion monitoring on land areas during the construction phase.

Table 9.10: Water and Soil Erosion Monitoring methods

Monitoring content	Monitoring methods	Who does it	Who supervises it
Disturbed ground surface area	GPS survey, measurement, data collection	Construction Contractor, O&M contractor	PIU
Damage to soil and water conservation biological facilities			
Causing soil erosion area			
Volume and smoothness of earthwork in extension period			
Monitoring of soil and water loss	Observation field of monitoring and simple soil erosion in sedimentation tank	Construction Contractor, O&M contractor	PIU
Monitoring the impact of local mass production and life	Inspection, visit, interview, sample volume survey	EPB	PMO
Quantity and quality of soil and water conservation measures	Census, GPS Surveys, sampling surveys, data collection, sample surveys, inspections	LIEC	PIU, PMO
Survival rate, preservation ratio, growth and coverage of forest and grass measures in various regions			
Soil and water conservation effects after the implementation of various preventive measures			

9.6.1.2 Aquatic Environmental Monitoring Plan

987. The plan is mainly consisted of five aspects, such as impacts on fish resources, riverine habitats and water quality, sediments in riverine environment, and scientific information gaps. Even there is no nationally protected fish species found in the river systems, thirteen fish species were the endemic in

Nu river system and four species were identified as the conservation targets by the NAGR of lower reach of Nanting River.

988. Even 48 fish species were identified in Nanting River system, there is no any fish species found in the nationally protected animal list and IUCN RedList. Actually, 13 fish species area endemic in Nu River System in China (Zhu et al., 1990). In this report, four fish species were identified as the conservation objectives: *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis* in Nanting River system. This is consistent with the conservation targets of NAGR of lower reach of Nanting River.

989. The basic biological information of the four conservation fishes are the follows:

- The *Neolissochilus baoshanensis* was listed as Data Deficient (Kullander, 2012). The fish has only been reported from the Nu River (Salween River) and Lancang River drainages in Yunnan, southern China (Shan et al., 2000), and might be present in lower parts of these basins. There is not enough information available to assess the risk of extinction of this species. More research is needed to determine actual distribution, population trends and threats.

- The *Bagarius yarrelli* was assessed as the Near Threatened by IUCN RedList (Ng, 2010). Irrespective of the confusion surrounding the taxonomy of this species, the currently known populations of *Bagarius yarrelli* are harvested heavily in different parts of its range as food fish and for ornamental trade and as sport fish. Some declines reported in some studies for *B. bagarius* may refer to this species. However, more empirical data is needed to support this claim.

- *Anguilla bengalensis* was assessed as the Near Threatened by IUCN RedList (Jacoby et al., 2014). It is migratory, breeding in the ocean (see Seegers *et al*., 2003) and migrating into freshwaters and estuaries, including large rivers, as juveniles (glass eels/elvers). Elvers can migrate high up rivers into streams where they inhabit pools until they mature although like many anguillid species some individuals will remain in coastal waters. There has been little or no quantitative time-series data relating to declines in the species, anecdotal evidence would indicate that both range and abundance of the species are shrinking. However, it is essential further information is collected, as there is concern that a 'threatened' category would be more appropriate.

- The *Balitora nantingensis* was not assessed by IUCN RedList due to the information gaps. It mainly inhabits streams with clear and swift current, rocky bottom, seldom in the main course (Chen et al., 2005). There is almost empty about the biology of this fish species. Further data collection and study are needed to assess this fish species.

990. However, given the information above, the biological information of four conservation targets is very limited. The capacity of local fishery staff is not qualified for the regular monitoring. With the issuance of protection and management regulation of Nanting River in Lincang Prefecture, the enforcement should be enhanced in the future. Species composition, average catches from each species (or by groups), by catch, fishing effort, catch per unit effort etc. should be monitored before the start of project, during the construction and minimum of one/two years after the commencement of the project.

991. In view of the above considerations, it is recommended to carry out regular river monitoring in the vicinity of the proposed bridge. The monitoring is to be in the form of surveys to obtain river water and bed profiles, extending from the one side of the bridge to the other side. The profiles are to be taken at the location on either side of it at specified distances from bridges and time intervals. It is recommended that profiles are to be taken at the proposed bridge location and on either side of it at 25

m intervals up to a distance of 100 m from the bridge location and then at 50 m intervals up to a distance of 250 m from the bridge location. It is also recommended that surveys are to be conducted, prior to the construction of the bridge, at the onset of the rainy season at 3 month intervals over a period of one year. **Table 9.11** describes the aquatic monitoring plan.

Table 9.11: Aquatic Environmental Monitoring Plan

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Location	Performance Indicator	Responsibility [75]	Approximate Cost US$
A	**Construction Phase**						
1	Impact on fish resources	River diversion and dredging works will be occurred in dry seasons. Constructions of fish pass structure together with the retention weirs.	Once before and once after construction	River rehabilitation project area	Records of assigned activities before and after construction	DIs and Contractors	10,000
		Construction of fish pass structure in the water intake location.	Once before and once after construction	Water intake location of Nangun River			
		Construction works, such as piling, excavation and installation, will avoid the spawning season (April to June) and flooding season (June to September); Require making channels for fish and benthic fauna and maybe cover at bridge area so no debris flows to river bed on sides	Once before and once after construction	Nanting River Bridge and water intake location of Nangun River			
		Environmental training to workforce on importance of fisheries and prohibit illegal fishing practices	Regular monitoring	PMO			
2	Impact on riverine flora	Replanting the local and native plants along the river sides to compensate the loss of biodiversity. Employing the ecological slope protection technique to the maximum extent. Employing the LID (low impact development) approach such as gabion	Once before and once after construction	River rehabilitation project area	Records of assigned activities before and after construction	DIs and Contractors	10,000

[75] The contracted survey specialist will interact with these organizations to conduct survey

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Location	Performance Indicator	Responsibility [75]	Approximate Cost US$
		ditch and gabion dam, to manage rainwater and reduce soil erosion.					
3	Scientific information gaps resulting in the poor EMP of aquatic environments	Enhancing the capacity building of fishery management staff. Improving the implementation of fishery protection measures and wetland management regulation of Nanting River.	Regular training during the construction period	Fishery Management Agencies in Lincang/Gengma	Records of training and legislation	Fishery Management Agencies in Lincang/Gengma	15,000
		Population variation understood in the project affected rivers.	Once before, regularly during and once after construction.	Project affected rivers	Fish inventory and trend, and the fish catch data	Fishery Management Agencies /contractors	20,000
		Investigation of current and potential key spawning and foraging habitats.	One before and once after construction.	Project affected rivers	Investigation reports	Fishery Management Agencies /contractors	10,000
		Biological study on the four conservation fish species.	Routine study	Nanting River	Study reports	Contractors	15,000
4	Sedimentation in riverine environments due to rehabilitation, dredging and disposal of excavated material	Any disposal of excavated material should be done outside the riverine area from fish migration or breeding grounds. Disposal should be timed to be outside of the very rough areas.	Once before, regularly during and once after construction.	Project affected areas	Siltation of riverine ecosystems due to construction activities.	Contractors	5,000
		Soils excavated for LBECZ should be used for re-filling and should not be left exposed to wind or water for long periods.	Routine monitoring	Project affected areas	Physical water quality, (TSS, soil texture)	Contractors	10,000
		Sediment control measures such as retention weirs will be used, as necessary, to minimize sediment transport offsite. Silt fencing will also be implemented to minimize erosion of soil stockpiles.	Once before, regularly during and once after construction	Project affected areas	Monitoring report of water and soil conservation	Contractors	15,000

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Location	Performance Indicator	Responsibility [75]	Approximate Cost US$
	Total cost for Monitoring Aquatic Environment during Construction						
B	**Operations and Maintenance Stage Costs**						
1	Impacts of fish due to LBECZ operation	Fish catch monitoring program	Six monthly fish catch analysis from the area for three years	Upper and down of Water intake dyke, Dawanjiang, and Estuaries of Nanpa and Qingshuihe Rivers.	Variation in Fish species composition and catch before construction and during operation	Fishery Management Agencies /contractors	20,000
2	Impact on river water quality	Management of waste water and oil contamination into urban waste water network; Contractor must dispose solid wastes away from the site to an approved licensed waste disposal site instead of rivers and valleys.	Routine maintenance	Qingshuihe River and Nanpa River	Supervision report	Supervision company	10,000

9.6.1.3 Terrestrial Environmental Monitoring Plan

992. The plan is designed in three impact aspects: avifauna biodiversity, amphibians and reptiles, and timberland and habitat degradation. In the light of conservation values, there are not special animals or habitats needed to be conserved, with exception of Asian water monitor. However, this number is rare in the project area and its distribution is widespread.

a Flora

993. In project sites, the plant composition mainly include the planted species, such as rubber, pineapple, coffee, banana, teak and sand benevolence in rubber plantations, and vegetables and fruits in garden fields. The native plants are cosmopolitan species, which have a general distribution and high fitness to establish in new ranges. All of them have relatively low conservation values. Therefore, we do not select any plant species as the conservation targets during this project period.

994. The rubber plantations is close to the rotation period in the project construction area of Qingshuihe Border Area. There may have some old rubbers with mistletoes, as this is a very common phenomena in the rubber plantations in Yunnan Province. Unfortunately, almost all rubber trees have been cut before the site visit. Mistletoes, a diverse group of parasitic plants on rubber trees, providing key resources in rubber plantations through provision of abundant fruits and nectar (Watson, 2001). This indicates that the old rubber trees with mistletoes would have high conservation values for increasing the avifauna diversity.

995. There are the two patches of teak forests in the project construction area: One located in the left valley of Nanting Bridge, and the other located in the right side of Qingshuihe River and close to Shantouzhai Jiaodui. In addition, the scattered teaks and banyans were found in rubber plantations, and a few banyans in the construction area of Zhenkang Sino-Myanmar Friendship Hospital. Even they have low conservation values for biodiversity, they have higher ornamental values and economic values in comparison with the other planted trees.

b Terrestrial fauna

996. Even 111 bird species, 6 mammal species, 5 amphibian species, and 7 reptile species were identified in the project sites. Only two bird species, 1 amphibian and 2 reptiles are under the nationally protected animals. And two additional reptile species such as Soft-shell Turtle *Pelodiscus sinensis* and King Cobra *Opiophagus hannah*, were recognized as the vulnerable by IUCN Red List. All of these seven species have the conservation value.

997. Considering the open beaches of Qingshuihe River was almost developed for garden fields in both side of river rehabilitation project, the number of amphibian and reptiles is limited. Taking into account of the distribution range, population size, and habitat extent/quality of seven conservation species, the conservation values are not significant.

998. The basic biological information of the seven conservation species are the follow:

- The Greater coucal (*Centropus sinensis*) is common and widespread in its range. It is resident in southern Asia, from India east to south China and Indonesia. The population trend appears to be stable, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The species is evaluated as Least Concern by Bird Life International (2018).

- Common Buzzard (*Buteo buteo*) has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion. The species is evaluated as Least Concern by Bird Life International (2018).

- The Asian water monitor (*Varanus salvator*) has been assessed as Least Concern. This species has a wide distribution throughout Southeast Asia, can be found in various habitats, and adapts to habitats disturbed by humans. It is also abundant in parts of its range, despite large levels of harvesting (Bennett, 2010).

- The Tiger frog (*Hoplobatraclrus rugulosus*) has not been assessed by the IUCN RedList. The species is often found in paddy fields, ditches, reservoirs, ponds, marshes, and other nearby grass. With the success of captive breeding, the wild population remains stable.

- The tokay gecko (*Gekko gecko*) is a nocturnal arboreal gecko in the genus Gekko, the true geckos. It is native to Asia and some Pacific Islands. Its native habitat is rainforest, where it lives on trees and cliffs, and it also frequently adapts to rural human habitations, roaming walls and ceilings at night in search of insect prey.

- The King cobra (*Ophiophagus hannah*) has been assessed as Vulnerable by IUCN Red List (Stuart et al., 2012). This species widely distributes in South and Southeast Asia, and has experienced local population declines of over 80% over 10 years in parts of its range. Pressure on this species from both habitat loss and exploitation are high throughout this snake's range, and while no quantitative population data is available. In China, the snake is considered to have declined by over 50% over ten years in this country as a result of exploitation for both subsistence and regional trade (Wang and Xie 2009). However, it is not common in any area in which it occurs, is very rare in much of its range. Therefore, it will not be listed as the monitoring species in project sites.

- The Chinese Softshell Turtle (*Pelodiscus sinensis*) was assessed as Vulnerable by IUCN RedList (Asian Turtle Trade Working Group, 2000). The status assessment was made with respect to the natural populations only. The taxonomic and genetic diversity of this taxon (several component species have been described or resurrected in recent years) has been confused and compromised by the mixing of animals of different origin in farms, and the escape of farmed animals into wild populations. In China, the wild population kept stable with the success of captive breeding.

999. The contractors will be required to undertake certain actions to minimize the impact on terrestrial fauna besides the control of construction noise to avoid causing a disturbance; avoidance of land clearance in avian breeding period, environmental education to workforce not hunting or harvesting wild fauna. **Table 9.12** above gives the terrestrial monitoring plan.

Table 9.12: Terrestrial Environmental Monitoring Plan

No	Potential Impact	Proposed Mitigation measures	Monitoring Means and frequency	Location	Performance Indicator	Responsibility[76]	Approximate Cost US$
A Construction Phase							
1	Impact on the avifauna biodiversity with generally low conservation values	Avoid of land clearance in breeding season.	Investigation in beginning and three months after the start of construction	Project area of LBECZ	Avian composition and population size	LBECZ/contractors	15,000
2	Impact on the amphibians and reptiles, especially for Tiger frog, Tokay gecko, and Asian water monitor.	Avoiding land clearance of key habitats of amphibians and reptiles in hibernation period	Investigation in beginning and three months after the start of construction	Project area of LBECZ	Number of key hibernation habitats	LBECZ/contractors	5,000
3	Removal of trees, degradation of habitats	Replanting and restoration	Once in each year during the first three years of planting	Project area of LBECZ	Number of new plants, and area of restored habitats	LBECZ/ contractors	10,000
B Operation Phase							
1	Impact on terrestrial animals and vegetation due to the LBECZ operation	Monitoring	Once before, and 1st and 3rd after the project completion	Project area of LBECZ	Monitoring report including inventory, status and trend	Natural resources management agency of Lincang	30,000

[76] The contracted survey specialist will interact with these organizations to conduct survey

9.6.2 Reporting

1000. In addition to the EMP, to ensure that project would not be generating a negative impact to the overall environment quality, an EMoP has been prepared. The EMoP describes monitoring measures with technical details, including parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and describes monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation.

1001. The EA in turn will be expected to report to the ADB on progress achieved against the EMP activities and milestones on a quarterly basis. Progress reports will include a description of implementable activities and their status; identify the responsible party (ies) involved in their implementation; and provide project management schedules and timeframes for doing so, along with their associated costs. **Table 9.**13 gives the Reporting Plan for the project phases.

Table 9.13: Reporting Plan

Reports	From	To	Frequency
Pre-construction Phase			
Project Readiness	LIEC, PMO	ADB	EMR
Construction Phase			
Construction Implementation	Contractor	PIU	Monthly
Project progress reports	PIU	PMO	Quarterly
Environmental monitoring progress	EMS	EPB, PMO, PIU	Quarterly
Environment progress and monitoring reports (EMR)	PMO	ADB	Quarterly
Environmental acceptance	Licensed acceptance institute	EPB	Once; within 3 months of completion of physical works
Operational Phase			
Environmental monitoring progress (until PCR is issued	EMS	EPB, PMO, IAs	Semi-annually
Environment progress and monitoring reports (EMR)	PMO	ADB	Annually
EMP implementation completion	PMO, LIEC	ADB	At PCR stage
ADB = Asian Development Bank; EPB = Environment Protection Bureau; EMS = Environmental Monitoring Station; LIEC = Loan Implementation Environment consultant; PMO = Project Management Office, PCR = Project Completion Report			

1002. As per ADB's Safeguards Policy 2009, ADB requires the borrower to retain external qualified experts or qualified NGOs to verify monitoring reports with significant impacts and risks for all Category A projects. The experts will produce an external monitoring report on a quarterly basis while works are ongoing, and semi-annually thereafter and submit it directly to ADB to verify whether sound environmental management practices are applied, and the set environment targets are being achieved. In case the implementation of EMP measures is not satisfactory, this external monitoring experts/NGO will recommend corrective actions to address environmental compliance. LBECZ may engage with NGOs through CSR activities for monitoring of EMP and EMoP for the LBECZ project.

9.7 Environmental Management and Monitoring Plan Budget Costs

1003. The main benefits of the environmental mitigation plan are (i) ensuring that environmental standards are met during design, construction, and operation of the project; (ii) providing offsets to

negate project impacts especially ecological impacts. Without such expenditures, the project might generate large environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly depressing the economies of local communities.

1004. The gross investment is RMB 2,450,728,100 where investment in environmental protection is RMB 32,260,000, accounting for 1.3% of the gross investment total project investment, and the environmental investment estimation is shown in **Table 9.14**.

Table 9.14: EMP Budget Estimation

No.	Environmental Protection Item	Content of Measures		Qty.	Amount coasted by DI	Amount paid directly by EA/IA	Source of Costs	Remarks
	1	2	3	4	5	6	7	8
A	**PRE CONSTRUCTION BUDGET**							
1.	Tree Replantation Costs	Land acquisition stage	tree replantation costs			2087.5	Paid as per PR budget Table	
	SUB – TOTAL (A). LAND ACQUISITION					2087.5		
B.	**OPERATIONS BUDGET**							
1a	Prevention and Control of Ambient Air Pollution	Construction Period:	Sprinkling by sprinklers	2	26		Construction Company	
1b.			Dust-proof curtains and baffles	The side close to the village	10		Construction Company	
1c			Built-in emission exhaust flue		45		Construction Company	
1.4			Oil fume purification equipment		80		Construction Company	
2a.	Preventive and control measures for water pollution	Construction Period	Vehicle cleaning system.	17 sets	34		Construction Company	
2b.			Temporary drainage ditch	8290m	12		Construction Company	
2c.			Temporary grit chamber	40	30		Construction Company	
2d.			Wastewater sedimentation tank of bridge girder construction site	2	4		Construction Company	
2e.	Measures for prevention and control of acoustic environment	Construction Period	Sound insulation and vibration reduction measures		30		Construction Company	
2f.			Mobile or temporary sound barrier	The whole construction area	20		Construction Company	
3a	Solid waste	Construction Period	Sound insulation room and shock pad		60		Construction Company	
3b.			Mobile or temporary sound barrier		20		Construction Company	
3c.			Garbage collection facilities		10		Construction Company	
4a.	Ecological Environment	Construction Period	Drainage and protection engineering of construction site		100		Construction Company	
4b.			Bridge girder construction protection		40		Construction Company	

No.	Environmental Protection Item	Content of Measures		Qty.	Amount coasted by DI	Amount paid directly by EA/IA	Source of Costs	Remarks
			engineering					
5.	Water and Soil Erosion	Construction Period				651.4	PIU to pay	Total 870.25
6.	Terrestrial Survey	Construction Period	Survey Terrestrial	1st year 2 surveys		0	PIU to pay	$60,000 by PIU included in C11
7.	Biodiversity Survey	Construction Period	Survey of Aquatic Life – fish etc. in Nanting River, Qingshuihe river	2 surveys each year for 3 years		0	PIU to pay	$140,000 by PIU included in C11
8.	Public Consultation	Construction Period	2 consultations per annum for 3 years			0	PIU to pay	Included in item C11 below
9.	Environment Monitoring Station Cost		Semi-annual data collection of environment parameters for 4 years	8 Nos.		0	PIU to pay	Included in item C11 below
10.	Environment Supervision Consultants at each PIU		Full time once Environment Supervision Consultant (ESC) for each PIU	3 Nos.		0	PIU to pay	Included in item C10 below
11.	Environment Training		Environment trainings as per PAM/EIA	12x3 No's		0	PIU to pay	Included in item C10/Capacity city Building budget
	SUBTOTAL (B) CONSTRUCTION				521			
C.	**OPERATIONS BUDGET**							
1	Prevention and Control of Ambient Air Pollution	Operation Period	Underground discharge system		60		O&M operator	
2a	Preventive and control measures for water pollution	Operation Period			783		O&M operator	
2b			Set up oil separation tanks for dining halls of Guomen Primary School and Qingshuihe River Hospital	8m³/48m³	20		O&M operator	
2c.			Biochemical treatment+disinfection process wastewater treatment station	1 sets	130		O&M operator	
2d.			All wastewater containing heavy metals and cyanides	1 sets	20		O&M operator	
2e.			Sewage outlets and sewage collection pipe network in the area		400		O&M operator	
3	Measures for prevention	Operation Period	Plant tall trees on the side close to		20		O&M operator	

No.	Environmental Protection Item	Content of Measures		Qty.	Amount coasted by DI	Amount paid directly by EA/IA	Source of Costs	Remarks
	and control of acoustic environment		sensitive points and strengthen greening.					
4a.	Solid waste	Operation Period	Collection facilities		40		O&M operator	
4b.			Medical waste temporary storeroom	$5m^2$, $30m^2$	19		O&M operator	
4c.			Set up special containers in various departments.		10		O&M operator	
5	Ecological Environment	Operation Period	Landscaping		600		O&M operator	
6.	Water and Soil Erosion	Operation Period				218.8	PIU to pay	Total 87.02
7.	Environment Monitoring Stations	Operations Period	Collection of environment parameter data until submission of Project Completion Report	Annual, 3 years= 3 Nos.		0	PIU to pay	Included in item C11 below
8	Public Consultation	Operation Period	One consultation per year upto PCR submission	3		0	PIU to pay	Included in item C11 below
9.	Environment Supervision Consultants at each PIU		One full time Environment Supervision Consultant (ESC) for each OIU	3 Nos.		0	PIU to pay	Included in item C10 below
10.	Environmental supervision	Both Construction and operation		3	120		PIU to Pay	Loan implementation Consultant
11.	Environmental Monitoring	Environmental monitoring during operation period, including completion acceptance			120		PIU to Pay	
12.	Environmental impact assessment (updation)			3 times	80		PiU to pay	To update EIA/EMP periodically
C.	SUBTOTAL OPERATIONS				2422			
	Total A+B+C				2943	2174.5		
	Total EMP cost				5117.5			

It is assumed that

- all costs items: B6, B7, B8, B9 and C7, C8 are included in Item C11 and all cost items: B10, C9 are included in item C!0.
- All items in Column 6- A1, B5 and C6 are incurred by EA already as part of forestry costs and water and soil erosion costs
- Item C 11 cost is already added to Component 4 on Capacity Building

Water and Soil erosion prevention costs

1005. The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including CNY 3,825,200 for those water and soil conservation measures included in the project design, and CNY 4,877,300 for those additional water and soil conservation measures in this plan.

1006. The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 1,372,600 for engineering measures, 2,452,600 for vegetation measures, 2,689,500 for temporary measures, and 1,462,300 for other costs (including 213,600 for water and soil conservation supervision and 940,400 for water and soil conservation monitoring), physical contingency of 249,100, compensation for water and soil conservation facilities of 476,400.

GHG Emission Balance Equation

CO_2 Sequestration

1007. Based on the environmental survey carried out during the study, one notable negative environmental impact of the Project is the requirement to cut 47,324 rubber trees and removal of 5300 shrubs resulting in a reduction in CO_2 sequestration. Besides CO and CO_2 emissions will increase due to increase of traffic while CH_4 would increase due to waste water and sewage in the area.

1008. Therefore, to make the project net positive to CO_2 sequestration reduction impact, the project would implement tree replantation schemes in the Green belts formation around all sub-projects as well as through the Forestry Bureau. Based on domestic procedure, tree replantation costs need to pay for Forestry Bureau only during land acquisition. It has been already included into PR budget table with total 20.8748 million yuan for all project components

1009. The annual carbon emission balance calculation: 35,890 $eTCO_2$ e Emission increase due to tree cutting alone (Annexure 11):

a. Deforestation: = **23,027 $eTCO_2$** Carbon sink loss
b. Facilities of wastewater treatment = **- 31,990 $eTCO_2$** Emission Reduction
c. Transportation = **- 23,999 $eTCO_2$** Emission Reduction
d. Waste treatment = **- 3,403 eTCO2** Emission Reduction
e. Building construction = **72,255 $eTCO_2$ Emission**

1010. The above calculations will be validated in the model to be derived for the Climate Risk and Variability Report for the project. The report may recommend suitable measures to manage the GHG offset required for ensuring a net positive GHG emission reduction project. It is recommended to plant more C4 plants than C3 plants to increase the carbon sink, such as sedge, dicotyledon, euphorbiaceae, chenopodiaceae and amaranthaceae (all C4 plants).

9.8 Institutional arrangements

9.8.1 Project Implementation Organizations: Roles and Responsibilities

1011. The LBECZ will be the executing agency of the project and will oversee overall project implementation and management activities to ensure smooth and timely implementation and completion of project activities. The PMO will be the implementing agencies. The project will be implemented from September 2018 to June 2021.

1012. In order to successfully prepare and implement the project the ADB project management system shall be implemented and the project management policies and procedures shall be followed. A

project management system shall be established with the necessary institutional arrangement and adequate management staffs assigned to the project management. The institutional arrangement shall be established at both EA and PMO/PIU levels and outlined in the followings.

1013. The project executing agency (EA) is Lincang Municipal Government, under which a project leading group (PLG) has been established, comprising members from concerned government agencies. The PLG is headed by Lincang Municipal Government mayor, with the representatives from Lincang Municipal government Financial Bureau, Development and Reform Commission (DRC), Housing and Construction Bureau, Planning Bureau, State Land Bureau, Environmental Protection Bureau, Public Health Bureau, Education Bureau, etc. There are three project implementing agencies (IAs), which are the LBECZ, Cangyuan Wa Autonomous County Government, and Zhenkang County Government.

1014. A Project Management Office (PMO) has been established in the Lincang Border Economic Cooperation Zone (LBECZ) Management Commission (LMC). The PMO will oversee all procurement activities under this Project. Currently the PMO has 2 directors and deputy directors and 6 part-time employees headed by the director of LBECZ. In the future a procurement unit will be officially established within the LPMO with the Director of the LBECZ Land Resource and Planning Bureau acting as the unit head with support of 4 staff.

1015. Under the PMO, there are several other organizations involved in the procurement activities. There are three implementing agencies (IAs) for the project including the LMC, the Zhengkang County Government (ZCG) and the Cangyuan County Government (CCG). There are also three project implementing units (PIUs) under the three County/Zone level IAs, including the LBECZ planning and construction Bureau (LPCB), the Zhengkang Health Commission (ZHC) and the Cangyuan Education Bureau (CEB). The PIUs report to the county level PMOs, and the county level PMOs report to the LMO, which represents the EA, Lincang Municipal Government in daily management of the project. The LPMO conducts overall project management and directly communicates with ADB.

1016. **Table 9.15** below depicts Management roles and responsibilities.

Table 9.15: Management Roles and Responsibilities

Project Implementation Organizations	**Management Roles and Responsibilities**
Executing agency – Lincang Municipal Government (LMG)	(i) Establish project implementation unit. (ii) Establish Project Lead Group. (iii) Establish systems, procedures, and mechanisms to ensure effective and efficient project implementation. (iv) Oversee overall project implementation and management activities to ensure smooth and timely implementation and completion of project activities.
Project Lead Group (PLG)	(i) Approve annual budgets and plans for the project. (ii) Oversee progress in project implementation. (iii) Guide and support project implementation. (iv) Provide coordination between ministries and other stakeholders involved in project implementation.
Project Management Office – PMO	Provide oversight and daily management of the project preparation and implementation; (i) Assign Safeguard specialists - Environment specialist and social officer; (ii) Direct project preparation and implementation activities; (iii) Engage project implementation consultants, including loan implementation environment consultant (LIEC), and other relevant specialists;

Project Implementation Organizations	Management Roles and Responsibilities
	(iv) Update the EMP after detailed design and ensure its effective implementation; (v) Appoint one environment specialist as EMP Supervisor; (vi) Establish and coordinate GRM; (vii) Coordinate training and capacity development activities; (viii) Establish PPMS to monitor project progress, including regular monitoring of physical and financial progress, and safeguards compliance; (ix) Prepare and submit (a) annual project progress reports, (b) annual environmental safeguard monitoring progress reports, (c) annual audit reports, (d) annual consolidated project financial statement, and (e) mid-term and project completion reports to ADB and LMG with assistance from the project implementation consultant; (x) Ensure project implementation compliance with loan agreement and project agreement.
Implementing Agencies (IA) • LBECZ Management Commission (LMC) • Cangyan County Government (CCG) • Zhenkang County Government (ZCG)	(i) Implement project components in their jurisdiction, including finance and administration, technical and procurement matters, monitoring and evaluation, and safeguard compliance; (ii) Coordinate with the PMO for project management and implementation; (iii) Incorporate EMP into bidding documents; (iv) Supervise and monitor EMP implementation and semi-annual reporting to the PMO (with support of LIEC); (v) Contract local EMS to conduct environmental monitoring; (vi) Contract construction supervision company (CSC) for construction supervision and quality control as required; (vii) Coordinate commissioning of completed facilities, including environmental and safety acceptance audits, as needed.
Project Implementation Units (PIUs) - LBECZ planning and construction Bureau (LPCB), the Zhengkang Health Commission (ZHC), Cangyuan Education Bureau (CEB)	(i) Perform day-to-day management of the project. (ii) Coordinate and implement project activities, including procurement, recruitment, disbursement, contract administration, monitoring, and reporting. (iii) Prepare, on behalf of the executing and implementing agencies, bidding documents, terms of reference, reports, and other supporting documents and submit them for review and approval. (iv) Review and approve site-EMPs developed by contractors, supervise their environmental activities and compliance with the site-EMP; Maintain on behalf of the executing agency the imprest accounts; and prepare and submit withdrawal applications and supporting documents, quarterly and annual reports, annual audit reports and financial statements.
Asian Development Bank (ADB)	(i) Provide technical support for project implementation. (ii) Supervise and ensure compliance by the executing and implementing agencies with Asian Development Bank's policies and procedures in project implementation.

1017. According ADB policy and requirement, the PMO has the responsibility to manage the project preparation and implementation for the EA, which is Lincang Municipal Government. The PMO shall have the entitlement to represent the LMG to manage the three project implementing agencies, which are LBECZ, Cangyuan and Zhenkang, for the project management. The staff of PMO can be from LBECZ, but the official PMO establishment documents shall be issued by LMG and to clearly define that the PMO will manage the project including the day to day operation on behalf of the project EA, which is LMG. Based on the project management requirements, typically there shall be four units under PMO, which are engineering unit, procurement and contract management unit, environmental and social safeguard unit, and accounting unit.

1018. In each of the IA, a project leading group (IAPLG) shall be established, headed by the IA government head such as county commissioner and with the representatives from the relevant

government agencies such financial bureau, DRC, construction bureau, planning bureau, state land bureau, public health bureau, education bureau and other project involved bureaus. The main responsibility of the IAPLG is to provide inter-agency coordination and leadership for the project preparation and later the project implementation after the project approval. The establishment of the IAPLG shall be by official government document issued by the local government with the clear designation of staffs and definition of roles and responsibilities.

1019. At each Implementing Agency (IA), A project implementation unit (PIU) shall be established for the daily operation of the project management during project preparation as well as the project implementation. The PIU shall have the designated staffs responsible for engineering management, procurement and contract management, environmental and social safeguard, financial and accounting. The establishment of the PIU shall be by the government official document issued by the local government with the clear designation of staffs and definition of the roles and responsibilities.

1020. The project implementation unit will be staffed with experienced professionals (civil, electrical, mechanical, social and environment experts) and supported by the Environment Specialist (ES)) to handle day-to-day project management.

1021. At both prefectural and zone/county government levels, the PMO and PIUs shall engage adequate resources and entitlements are essential to ensure the project preparation and implementation, and to handle the heavy work load of coordination and management to complete preparation and implementation tasks for project management, progress control, environmental management, land acquisition and resettlement, social safeguard, procurement, and other tasks as required for the project preparation and especially for the future project implementation.

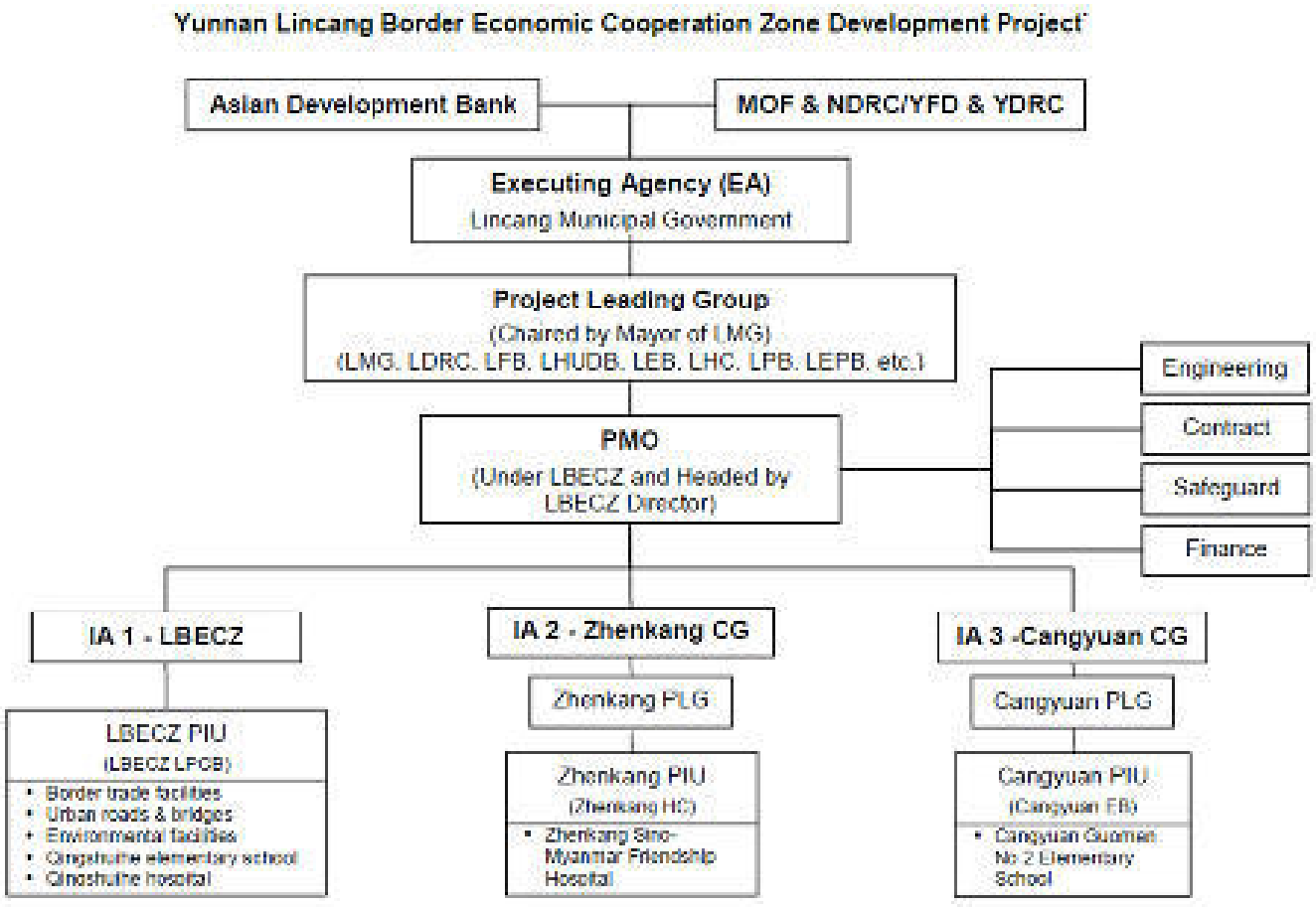


Figure 9.8: Implementation Arrangements

ADB = Asian Development Bank, MOF = Ministry of Finance, NDRC = National Development and Reform Commission, YFD = Yunnan Financial Department, YDRC = Yunnan DRC, LMG=Lincang Municipal Government, LDRC = Lincang DRC, LFB = Lincang Financial Bureau, LHUDB = Lincang Housing and Urban-Rural Development Bureau, LEB = Lincang Education Bureau, LHC = Lincang Health Committee, LPB = Lincang Planning Bureau, LEPB = Lincang Environmental Protection Bureau, PMO = Project Management Office, EA = Executing Agency, IA = Implementing Agency, LBECZ = Lincang Border Economic Cooperation Zone, LPCB = Lincang Planning and Construction Bureau, EA – Executing Agency, IA = Implementing Agency, CG = County Government, IAPLG – IA Project Leading Group, PIU = Project Implementing Unit

9.8.1 EMP implementation arrangements

1022. The Project Implementation Units (PIU) which will assume primary responsibility for the environmental assessment as well as implementation of EMP through Construction contractor (civil works contractors) or any third party consultants. The PIU coordinator will be assisted by the ESC for environmental monitoring and EMP measures. PIU and ESC will coordinate with Construction contractor to address environmental mitigation issues[77].

[77] ADB advises that all EAs develop in-house capability for environmental, health, and safety (EHS) program consistent with international best practices. The EHS program should include accounting for environmental benefits resulting from investment projects within three months of loan approval. The monitoring agency shall report on semi-annual basis directly to ADB and determine whether sound environmental management practices have been achieved, and suggest suitable recommendations and remedial measures for midterm correction and improvement.

1023. The PIU's Environmental Supervision Consultant will at a minimum, perform: (i) oversight of Construction contractor for monitoring and implementing mitigation measures; (ii) liaising with the subproject management and Construction contractor (civil works contractors) and seeking their help to solve the environment-related issues of project implementation; and (iii) technical progress reporting as well as preparation of environmental management reports every 6 months (as required by ADB).

1024. The ESC will be assisted in monitoring of the contract requirements and any specialist functions by the construction supervision specialists (civil, mechanical and electrical engineers etc.) working for the construction contractors. Being an Environment Category A project, PMO will engage third-party services as required by ADB. Further details on person/agencies responsible for EMP activities are in **Table 9.16**.

Table 9.16: Institutional Roles and Responsibilities for EMP Implementation Activities

Activity	Responsible Person/Agency
Sub-project Initiation Stage	
Establish PIU and award contracts	Project Coordinator, Procurement Specialist, PIU PMO
Clearances/approvals from relevant PRC agencies-urban, water, power etc.	PIU, PMO
Disclosure of subproject EMP details on PMO website	PIU, PMO
Conducting discussions/meetings/workshops with APs and other stakeholders	ES and other Specialists at PIU
Updating of EMP mitigation measures based on discussions	ESC, PIU
EMP Implementation Stage	
Meetings at community/household level with APs	ESC, Construction contractor
Implementation of proposed EMP mitigation measures	ESC, Construction contractor
Consultations with APs during EMP mitigation measures implementation	ESC, Construction contractor
Grievances Redressal	PIU /District Administration
Internal monitoring	PIU/ PMO
External monitoring*	External Experts

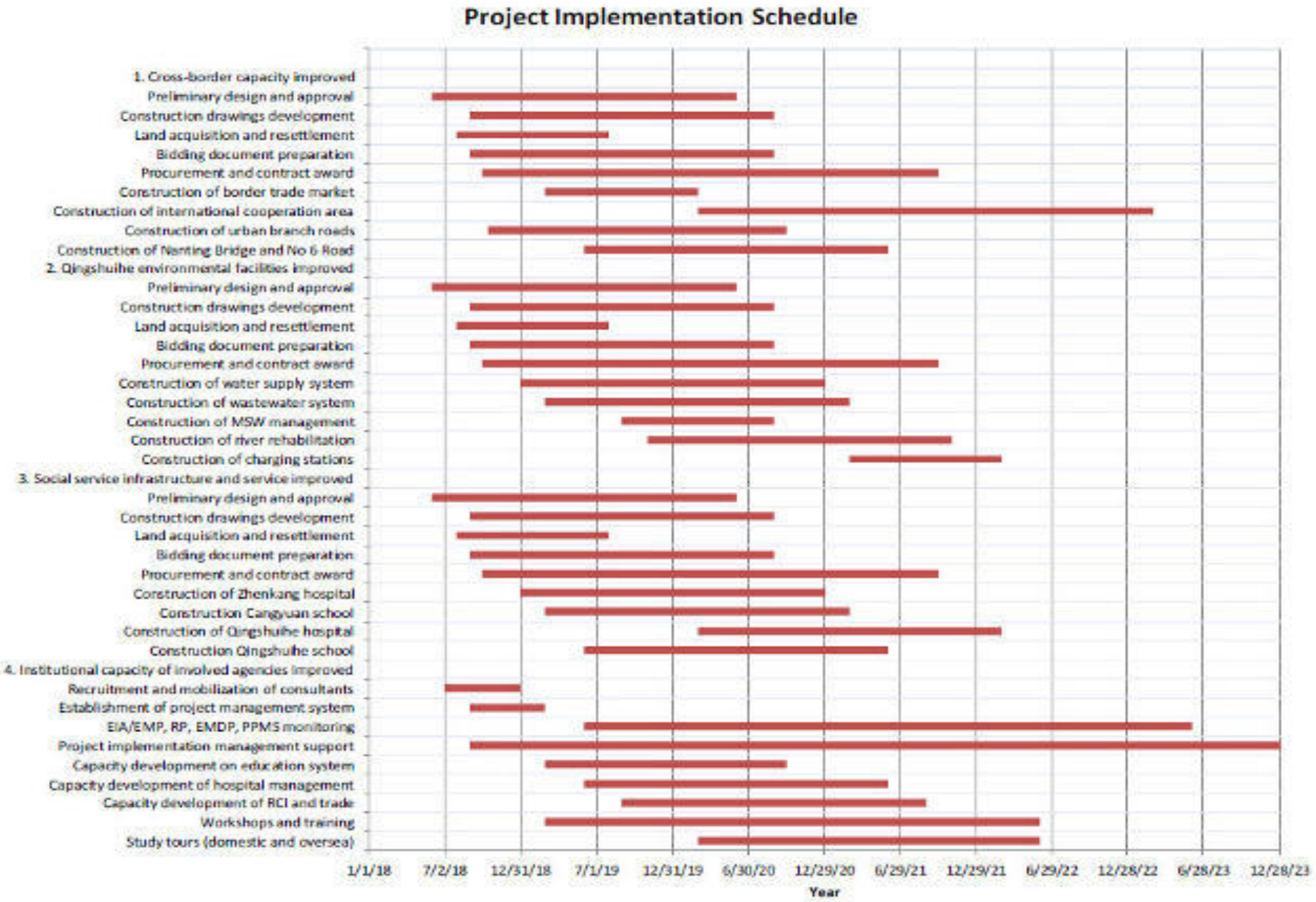
ADB-Asian Development Bank; AP-Affected Persons; EA-Executing Agency; EMP-Environmental Management Plan; PIU- Project Implementation Unit, ESC – Environment Supervision Consultant
*Note –External monitoring only required when projects are noticed to have significant adverse environmental impacts. Normally not required for Environment Category B project.

9.9 Implementation Plan

1025. The project will involve survey work, land clearance, design and engineering of plant equipment, floating tenders for procurement, civil work and testing and commissioning of buildings. Total project work in is costing USD 510.91 million (including IDCs and contingencies).

1026. The Project is proposed to construct in July 2018 and to complete in February 2023. The overall draft project implementation schedule for Outputs 1-4 under the project is attached as Table 9.17.

Table 9.17: Overall Project Implementation Schedule



Source: LBECZ Project documents

Project Management Office (PMO)

1027. The PMO will be responsible for overseeing project compliance with environmental and social safeguard requirements that include: (i) project selection taking into account environmental screening criteria; (ii) project environmental assessments prepared in accordance with the SPS requirements; (iii) appropriate public consultations and disclosures; (iv) effective management of the grievance redress mechanism; and (v) compliance reported in the environmental monitoring report. The PMO structure is shown in **Figure 9.8**. The PMO head will be responsible for coordinating all external functions with ADB, Lincang Municipal Government, as well as coordinating the internal functions for coordination of Environment and Social/R&R reporting, Legal, Finance and Accounts, PIU monitoring and reporting, Procurement and Contracts, and other functions within LBECZ.

1028. PMO has designated Environment Supervision Officer of PMO who has oversight responsibilities for monitoring for all projects in areas such as Environment, R&R and Social safeguards. PMO will hire appropriate External consultants (specific role mentioned in Consultants etc. below) for monitoring Project implementation as deemed necessary for meeting SPS 2009 guidelines for Category A project.

1029. The duties of the PMO will include at a minimum: (i) oversight of field offices and construction contractors for monitoring and implementing mitigation measures; (ii) liaising with the field offices and contractors and seeking their help to solve the environment-related issues of project implementation; and (iii) preparation of environmental management reports every 3 months (as required by ADB for Environmental Category A projects). PMO must coordinate with PIU for monitoring as well as designing appropriate mitigation measures to address environmental and social issues[78].

Environment Supervision Consultant (ESC)

1030. The PMO has established the position of Environment Supervision Officer to coordinate EMP implementation with PIUs and Construction Contractors. The Environment Supervision Consultants will be hired by each PIU to supervise the construction consultants, Loan Implementation Environmental Consultant (LIEC, see below), will do the following.

- Update the EMP after detailed design and ensure its effective implementation;
- Ensure that the five implementing agencies (see below) understand their roles for EMP implementation and allocate adequate budgets;
- Prepare selection criteria for the project bidding procedures to ensure the EMP is included in tenders by the PMO and bids by applicants. These criteria will include clear directions for bidders on how to include actions and budgets for the EMP in their bids, enabling fair and transparent comparison between bids;
- Review tenders for conformance with selection criteria for EMP implementation;
- With the assistance of a contracted Tendering Agency, prepare clauses to be included in the contractual terms and conditions for contractors to ensure full and effective implementation of the EMP;
- Prior to first civil works, and regularly thereafter, assess project readiness of PMO, IAs and contractors based on indicators;
- Arrange field visits to contractors prior to their site specific EMP preparation;

[78] ADB advises that all EAs develop in-house capability for environmental, health, and safety (EHS) program consistent with international best practices. The EHS program should include accounting for environmental benefits resulting from investment projects within three months of loan approval. The monitoring agency shall report on semi-annual basis directly to ADB and determine whether sound environmental management practices have been achieved, and suggest suitable recommendations and remedial measures for midterm correction and improvement.

- Review and approve site-EMPs developed by contractors, supervise their environmental activities and compliance with the site-EMP;
- Monitor the progress of all agencies for EMP implementation;
- Implement and coordinate the Grievance Redress Mechanism;
- Prepare and submit annual environmental monitoring reports (EMR) in Annexure 5, as well as environment appendixes to Midterm Report and Project Completion Report to ADB;

1031. Since there are three PIUs, three ESCs will be hired for the entire project construction and operation of the project until PCR is submitted.

Environmental Monitoring Station (EMS)

1032. In Lincang, the EMS of the City Environment Protection Bureau (EPB) will be contracted by the PIU to implement the external environmental monitoring program described in this EMoP (Annexure 4). The ES will supervise this monitoring. The EMS will report to the local EPB and the PMO.

Project Implementation Unit (PIU)

1033. The PMO shall implement the ADB loan at the corporate level and the PMO will be supported for implementation activities through the LBECZ's Project Implementing Unit (PIU). Separate PIU has been created for the LBECZ project. The PIU of LBECZ will assume primary responsibility for the environmental assessment as well as implementation of EMP and EMoP through Construction contractors or third party consultants. The project implementation unit will be staffed with experienced professionals (a PIU coordinator, environment Supervision Consultant (ESC)) to handle day-to-day project management.

1034. Project Implementation Unit (PIU) includes experienced staff and is headed by senior officers will undertake day-to-day project planning and implementation activities and manage the site activities – for example, the PIU or its appointed technical consultants will conduct routine visual inspections of construction activities, including site pegging, vegetation clearance, earthworks, etc. Full-time project managers with qualified staff will be appointed to supervise projects under each component. The PIU will be responsible for overall project planning and implementation, including procurement, accounting, quality assurance, social and environmental issues and coordination with concerned agencies. For management of EMP, PIU will conduct overall coordination, preparation, planning, implementation, and financing of all field level activities.

1035. To enhance the planning implementation, environment safeguard skills at the PIU level, PIU staff shall be sent for capacity building training programs periodically by. These trainings will be identified by PMO in consultation with ADB.

Loan Implementation Environment Consultant (LIEC).

1036. LIEC will be hired under the loan implementation consultancy services. The LIEC will be international national environmental specialists. The LIEC is essential to completion of environmental pre-construction activities and should be recruited as soon as possible after loan effectiveness. The LIEC will assist the PMO-ES with the following:

- Assist the PMO and PIU to integrate the EMP mitigation and management measures into construction contracts and arrangements;
- Ensure that relevant sections of the project EMP are incorporated in the construction contract documents;
- Assist the PMO to establish and publicize the grievance redress mechanism (GRM);
- Develop procedures to (i) monitor and report on the EMP implementation progress; and

(ii) record and collate complaints and resolution under the GRM;
- Provide support and training to PMO, PIU, CSCs and contractors on the specific requirements of the EMP as required;
- Assess the environmental readiness of project components prior to first civil works, and regularly thereafter, based on indicators defined in Section D;
- Conduct regular EMP compliance assessments, undertake site visits, identify any environment-related implementation issues, and propose necessary responses in corrective action plans;
- Assist PMO to prepare annual environmental monitoring progress reports for submission to ADB;

1037. The loan implementation consultancy services will also include but not limited to, water and wastewater specialists, river ecology/hydrology specialists, and ecology experts. In addition, separate contracts will be awarded to consulting firms specialised in municipal waste management (including O&M); forest management (including irrigation); and climate adaptation. The specialists will assist in the detailed design, construction and initial operation of project facilities components and TORs for the positions are defined in the Project Administration Manual (PAM).

Construction Contractors, Equipment Suppliers, and Other Service Providers

1038. LBECZ will ensure that contractors engaged for each project are engaged in regular EMP monitoring and implementation. Construction contractor will have primary responsibility for environmental management, and worker health and safety at project construction sites under their control. They will be required to adhere to all national and state level environmental, health, and safety (EHS) guidelines and implement relevant project environmental management measures prior to and during construction.

1039. Construction Contractor is required to employ a qualified environment specialist for project monitoring and reporting.

1040. **Post Construction Monitoring**: A monitoring team will engaged by LBECZ operation for one year before commissioning and for a span of 3 years post commissioning.

Stakeholders

1041. LBECZ will coordinate with LEPB to designate the staff at project site who can assist LBECZ and also supervise Construction contractor work.

9.10 Performance indicators

1042. Performance indicators which will describe the desired outcomes as measurable events to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods will be designed and implemented. Once it is in place the performance monitoring shall be done by Project in Charge of the LBECZ. General project Performance monitoring indicators are mentioned in Table 9.18 whereas Table 9.11 (Aquatic Monitoring Plan and performance measures during construction and operations) and Table 9.12 (Terrestrial Monitoring Plan and performance measures during construction and operations) respectively.

Table 9.18: Performance Indicators of Environmental Management prior to Construction

Indicator	Measurement Methods	Measurement	
Public Disclosure and consultations	Issues relating to resettlement settled by PIU before start of the construction.	Yes	No
	Appropriate rounds of public consultation completed periodically.	Yes	No

	Grievance Redress Mechanism established with contact points and implemented by PIU and Government	Yes	No
Bidding documents and contracts consistent with EMP requirements	Bidding documents and contracts incorporating the environmental activities and safeguards listed as loan assurances	Yes	No
	Bidding documents and contracts incorporating the Environmental mitigation and management provisions of the EMP	Yes	No
Contract Awards documents	EMP and Environment Monitoring requirements included in contract documents for construction contractors.	Yes	No
	Development of Green Belts/Tree replantation plans included in contracts and reported	Yes	No
External Experts/PU Environmental staff for monitoring and supervision	Reports from the external Environmental Expert (individual or firm) engaged by IA for ADB Category A project developed periodically. PIU Environment Supervisor hired and periodic reporting of ADB Environment Monitoring Reports submitted.	Yes	No
Chance find/Cultural heritage procedure	PIU engineers trained by Environmental Supervisor in procedures	Yes	No
EMP financial support	Environment Mitigation measures fulfilled by construction contractors according to the financial plan.	Yes	No
	Environment Monitoring requirements for Flora and Fauna in the project area fulfilled by construction contractor/OIU as per EMP	Yes	No

Sources: PPTA Team and PMO. Note: ADB = Asian Development Bank, EMP = environmental management plan.

1043. The ESC working with LIEC will define more quantitative indicators jointly with the Construction companies before start of construction.

10.0 CONCLUSION AND RECOMMENDATION

1044. This report assessed various existing environmental parameters in and around the sub-project and the actions planned to minimize any significant negative impact. As part of Outputs 1-4, the project will support physical construction of LBECZ. The sub-project sites are not located near any sensitive areas as well no significant historical and cultural areas.

1045. Impacts are manageable and can be managed cost effectively - Environmental impacts are likely to result from the proposed construction of buildings, roads, bridges etc. Careful mitigation and monitoring, specific selection criteria and review/assessment procedures for subprojects have been specified to ensure that minimal impacts take place. The detailed design would ensure inclusion of any such environmental impacts that could not be specified or identified at this stage are taken into account and mitigated where necessary. Those impacts can be reduced through the use of mitigation measures such as correction in work practices at the construction sites, or through the careful selection of sites and access locations.

1046. Environment impact analysis have been done with various criteria like demographic factors, climate and natural habitat, community and employee health and safety etc. based on the impact analysis. The environment impacts associated with sub projects can be mitigated through a set of recommended measures and adequate provision for environment and social impact which cover monitoring, measuring and mitigation. The main project impacts are associated with clearing of digging, waste management and excavation and movement of soils. An Environment Management Plan (EMP) has been prepared and responsibilities for implementation have been assigned. The anticipated environmental impacts can be readily mitigated through the implementation of EMP.

1047. Following is the conclusion of Environmental Quality Status of the project area after extensive environmental due diligence:

- Environment and Air: Such contents as TSP, PM_{10}, SO_2, NO_x and CO within the evaluation area can meet Ambient Air Quality Standard (GB3095-2012), and contents of ammonia and hydrogen sulfide are up to the standard of maximum allowable concentration of Hygiene Standard for the Design of Industrial Enterprises (TJ36-79). Therefore, the region possesses good quality of ambient air.
- Acoustic Environment: According to the monitoring result, all noise background values measured at all monitoring spots at daytime and night meet provisions of Class 2 of Environmental Quality Standards for Noise (GB3096-2008).
- Water Environment: The project area is close to such surface water bodies as the Nanting River and the Qingshuihe River, and it is indicated by the monitoring results that monitored factors of monitoring sections of the Project can meet requirements on water of Class III of Environmental Quality Standards for Surface Water (GB3838-2002); the water environment quality is comparatively good.
- Ecological Environment: In the evaluation area, no national or provincial key protected wild plants, regional endemic plants or wild plant resource with important economic values has been found. The evaluation area is not a suitable habitat for large wild animals, and the wild animals found are mostly small animal's cohabitating with humane with a strong ecological adaptability. No wild animal with conservation value has been found in the evaluation area.

1048. Reliable baseline information of water air and noise /vibration in these areas with respect to Project subcomponents is available. The Construction contractor/LBECZ will monitor changes of the quality of water, air, soil and noise during the construction and operation periods as per **Annexure 5**.

1049. The proposed project will have number of positive impacts and negative impacts to the existing environment as follows:

- Environment pollution due to cut and fill operations, transportation of construction materials, disposal of debris, disturbance to the construction activities, nuisance from dust, noise, vehicle fumes, vibration etc. due to construction activities are the short term negative impacts due to proposed project.

- During the construction period, the social and living environment will be affected, such as traffic barrier, land acquisition, noise and vibration caused by construction, construction dust, earthwork excavation and so on, which will affect the residents' normal life, rest and learning environment. But after the completion of the project a new traffic environment will be provided, which will change the poor transport condition with traffic congestion of the original urban road.

- The construction of the Project is in accordance with relevant policy orientations and the overall planning of Mengding Qingshuihe River Port Economic Zone, Lincang Economic Cooperation Zone. The implementation of the Project can accelerate the infrastructure construction in the Lincang Border Economic Cooperation Zone, complete the road network structure in the area, save energy, improve the service levels of social undertakings such as education, medical, environment, sanitation etc. and promote the rapid economic development in the area. On the basis of the practical conditions and local conditions, the project construction has considered not only the practical interests in the near future, but also the needs of long-term sustainable development, and will bring about a considerable social, environmental and economic benefit.

- During construction of bridge and river rehabilitation subcomponents due to erection of piers on the river embankment, there will be some impacts that would result from construction material deposits, sediment run off to aquatic environment. Such impact will be in short term and would be minimized by maintaining good practices during earth excavation and construction. However, the operation of these project subcomponents will not have direct impact on aquatic environment or organisms.

1050. In terms of ecology, construction of LBECZ will have an impact on 47,324 rubber trees, 5,300 shrubs, grasslands and agriculture. There are no critical habitats present along the proposed LBECZ area. A majority of species observed in the project affected area are species that show a wide distribution in the southern zone of People's Republic of China. Impacts on the terrestrial and aquatic environment from the proposed project will be due to the project activities will be as follows:

- Generally, the terrestrial flora has low conservation values due to the extensive human intervention and occupation. Seven terrestrial fauna including five national protected animal species and two 'Vulnerable' species by the IUCN Red List, such as Soft-shell Turtle *Pelodiscus sinensis* and King Cobra *Opiophagus hannah*, were recognized as the vulnerable by IUCN RedList.
- The Nanting River has the four endemic fish species of conservation values, such as *Neolissochilus baoshanensis*, *Bagarius yarrelli*, *Anguilla nebulosa* and *Balitora nantingensis*.

- The integrated biodiversity Assessment Tool (IBAT) was accessed to determine the category of documented flora and fauna affecting the project. The description of the Nanting River area and Nangunhe national reserve are attached in **Annexure 9**. This shows there is no EN or CR variety of fish and fauna in the project areas.

- The Nanting River and the surrounding area are not only the important migration pathway of migratory fishes from Salween River and India Sea, but also the important spawning sites for fishes laying floating-eggs. The stream of proposed Nanting Bridge would be important spawning sites for fishes laying floating-eggs. The number of river beaches with area of over 10 hectares exceeds 43 sites, which provide good foraging habitats and spawning habitats for fish laying sticky demersal eggs.

- The rubber plantation does not support the majority of the tropical avifauna in the project area. However, the recent researches revealed that the mistletoes in old rubber trees can provide abundant nectars and fruits for nectarivorous and frugivorous birds. There are the two patches of teak forests in the project construction area.

1051. EMP and Environment Monitoring Plan has been prepared and attached as **Annexures 3 and 4** respectively. Two rounds of public consultations were conducted. The results indicate broad support for the project based on perceived economic and social benefits. The limited project impacts are associated with drainage congestion/water logging, dust and noise pollution, occupational health hazards, risk from poor sanitation system, and management of labor at the site. Moreover, most of the associated impacts are expected to be limited to the construction phase, and will therefore be temporary in nature. Regular monitoring of the recommended mitigation measures shall also be carried out during the implementation phase of the project.

1052. Proper GRM will have to be implemented through PMO/LEPB/Lincang Municipal Government to overcome public inconvenience during the proposed project activities. The project will ensure that meaningful consultations are continued with communities and affected persons and all relevant information is disclosed in a timely manner, in languages understood by communities and in places easily accessible to them.

1053. LBECZ will benefit local communities with direct and immediate benefits to the local communities such as road, rail, infrastructure, schools, housing, and hospital development including long term and casual labor work during project construction. Therefore, it is essential that the project avoids any possible harmful effects on its local populations and if possible the project should share part of its benefits with the local communities to enhance their standards of living and social wellbeing. Improvements to small village infrastructure, building vocational and technical skills of unemployed youth etc. are some of the ways in which the project implementing agency can support the local communities to benefit from this mega development project.

1054. The project may cause some involuntary land acquisitions as the land required for the project will be obtained through acquisition. The details are provided in the RP and the social details in the Social and Poverty Analysis. Construction of the Project greatly promotes comprehensive development of Lincang BECZ, national unity in the minority area and harmony among border people of China and Myanmar. The Project will stimulate the development of local education, community and economy, which will facilitate the building of the area into a new modern zone featuring a prosperous economic culture, a beautiful and comfortable living environment, complete service facilities, standardized and orderly management, a harmonious community and a good public security.

1055. The LBECZ Project refers to the Infrastructure Construction and Comprehensive Development Project of Yunnan Lincang Border Economic Cooperation Zone, which is in line with industrial policies. The project construction is in accordance with the Regulatory Detailed Plan for Mengding Qingshuihe River Area of Lincang Border Economic Cooperation Zone (2015-2035) and Overall Planning of Lingcang Mengding City (2011-2030); no proven mineral resources or mineral overburden has been found within the scope of construction land of the planned project by now; the Project does not involve

any nature reserve, scenic spot, drinking water source conservation area, basic farmland preservation area or other areas requiring special protection. Therefore, the construction of the project conforms to the national industrial policy and the relevant planning.

1056. The Project features a reasonable functional layout in view of its sub-projects. The operation of the Project will bring some impacts on ambient air, water environment, acoustic environment and ecologic environment, but will not change the local environmental functions. Strictly implementing the requirements in this report can avoid and solve those impacts. Exhaust, noise, solid waste and wastewater arising from the operation of the Project can all be treated with relevant treatment measures. All emission up to standard limits can be realized at each source of pollution. The project construction, on the premise of strictly implementing various pollution control measures and strategies based on the three-synchronism policy (i.e., design, construction and production in synchronization), is consistent with the social, economic and environmental coordinated development policy and the principles of assessment in China, and will be feasible for environmental protection.

1057. In accordance with the ADB's SPS 2009, the proposed construction of LBECZ falls under Category A. Thus, an EIA report has been prepared for the project for meeting ADB's SPS 2009 guidelines.