SFG1729 V1 REV

World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project
Rural Road Subproject

Environmental Impact Statement

Sichuan Communication Surveying & Design Institute

April 2016

Contents

Foreword

The State Council issued *Overall Planning for Post-Lushan Earthquake Recovery and Reconstruction* on July 15, 2013. The *Overall Planning* pointed out, according to comprehensive assessment of resource and environmental bearing capacity and planning for main function zones, reconstruction zones should be divided reasonably, urban-rural distribution optimized and land resources saved and intensively utilized to provide basis for reconstruction site selection. However, under the effect of 4.20 Earthquake, Daozuo-Huojing Road in Qionglai (referred to as Dao-Huo Road), Hongshigou - Daqiaotou Section of Ying-Lu Road in Yingjing County, Ya'an City and Shi-Xin Road in Tianquan County, Ya'an City have suffered from collapse of upper slope and pavement damages. As a result, the road traffic conditions were poor, adversely affecting people's travel along the line and obstructing post-earthquake reconstruction, recovery and development. In order to improve the traffic and transport conditions in the project area, provide good traffic and transport support for post-earthquake recovery and reconstruction and promote post-earthquake recovery and reconstruction and development of the towns and townships along the line, Qionglai City Road Maintenance Section, Yingjing County Road Maintenance Section and Tianquan County Traffic Development Corporation plan to upgrade the above three roads through World Bank financing and self-raised funds of the Owner. Reconstruction of the three roads can improve the traffic conditions and promote post-earthquake economic recovery and development in the earthquake stricken area.

According to relevant provisions of *Environmental Protection Law of the People's Republic of China, Law of the People's Republic of China on Environmental Impact Assessment* and *Regulations on the Administration of Construction Project Environmental Protection*, Bureaus of Housing and Urban-Rural Development of Qionglai City, Tianquan County and Yingjing County entrusted Sichuan Communication Surveying & Design Institute with the project's EIA and preparation of Environmental Impact Statement. Upon acceptance of the commission, the Assessment Organization set up a project team to carry out work according to the principles, methods, contents and requirements specified in the *Technical Guidelines for Environment Impact Assessment.* With strong assistance of the local government, members of the project team conducted detailed site visit and environmental survey of environmental sensitive points including main residential areas in the project implementation area, listened to the opinions of relevant departments and general public and collected a wide range of data. They conducted detailed survey, consultation and exchanges with environmental protection authorities in the project site, authorities responsible for land acquisition and resettlement, city planning department, water service department, etc; enabled the masses directly impacted by the project to be included into the public participation; and carried out atmospheric environment, water environment and acoustic environment monitoring work. Finally, they completed this Statement in March 2016.

1.0 General

1.1 Project origin and construction necessity

1.1.1 Project origin

On April 20, 2013, a Magnitude 7.0 earthquake struck Lushan County, Ya'an City, its impact spreading to Tianquan County, Ya'an City and the areas under the jurisdiction of Qionglai City among others. The State Council issued *Overall Planning for Post-Lushan Earthquake Recovery and Reconstruction* on July 15, 2013. The *Overall Planning* pointed out, according to comprehensive assessment of resource and environmental bearing capacity and planning for main function zones, reconstruction zones should be divided reasonably, urban-rural distribution optimized and land resources saved and intensively utilized. However, under the effect of 4.20 Earthquake, Daozuo-Huojing Road in Qionglai (referred to as Dao-Huo Road), Hongshigou - Daqiaotou Section of Ying-Lu Road in Yingjing County, Ya'an City and Shi-Xin Road in Tianquan County, Ya'an City have

suffered from collapse of upper slope and pavement damages. As a result, the road traffic conditions were poor, adversely affecting people's travel along the line and obstructing post-earthquake reconstruction, recovery and development. In order to improve the traffic and transport conditions in the project area, provide good traffic and transport support for post-earthquake recovery and reconstruction and promote post-earthquake recovery and reconstruction and development of the towns and townships along the line, Qionglai City Road Maintenance Section, Yingjing County Road Maintenance Section and Tianquan County Traffic Development Corporation plan to upgrade the above three roads through World Bank financing and self-raised funds of the Owner. Reconstruction of the three roads can improve the traffic conditions and promote post-earthquake economic recovery and development in the earthquake stricken area.

Therefore, the three subprojects are included in the World Bank Loaned Post-Lushan Earthquake Recovery and Reconstruction of Rural Roads.

1.1.2 Construction necessity

I. Construction is needed to improve traffic conditions of the passage and ensure safe, smooth traffic.

Both the starting and end points (Daozuo Township and Huojing Town respectively) of the Dao-Huo Road Subproject were damaged by 4.20 Earthquake. Dao-Huo Road is the main access to and from Daozuo Township and Huojing Town. Existing Dao-Huo Road is 5.5m wide, with cement concrete pavement, many sharp turns, steep slopes, poor traffic quality and a lack of safe protection facilities. The 4.20 Earthquake aggravated road damages of the three subprojects. Under the effect of 4.20 Earthquake, these roads collapsed and falling stones damaged the pavement severely.

Through road reconstruction, the three subprojects will improve the road vehicle safety coefficient and the traffic conditions, provide good traffic and transport support for post-earthquake recovery and reconstruction and promote post-earthquake recovery and reconstruction and development of the towns and townships along the line.

II. To provide safe and convenient access roads to resettlement for earthquake victims

Some victims of the earthquake are resettled along the lines of all three subprojects, i.e. Dao-Huo Road, Shi-Xin Road and Ying-Lu Road subprojects, all of which are important accesses to the settlements. Improvement of road conditions will provide the relocated victims with safe and convenient traffic to the outside, boost their confidence in rebuilding a beautiful home and offer quality passages to the outside to rebuild homes after the earthquake.

III. To improve the quality of road network, build a multi-passage road network system, improve road network structure and increase emergency rescue capabilities of road network

Due to its low grade and poor traffic conditions, the existing three roads only serve people in towns/townships along the line as section roads. During the earthquake, access to the disaster area was severely obstructed, having a great impact on emergency rescue time. During recovery and reconstruction following the earthquake, the areas where the three subprojects are located have poor traffic conditions and are yet to be rectified with a lack of security facilities, poor flexibility and emergency response capability, not capable of earthquake resistance and can not form a ring road network with the east-west road network. Reconstruction under the three subprojects can increase emergency rescue speed, improve road network in the areas and the multi-passage road network structure as well as improve emergency rescue capability of the road network.

IV. To promote development of tourism in west Sichuan

The three subprojects under the Project are all located around the scenic spots in Western Sichuan. Construction of the Project will restore and improve road traffic conditions, improve the quality of road network in the ecotourism area in Western Sichuan and promote sustainable development of industries in the west ecotourism area of Qionglai and tourism in Ya'an City.

1.2 Purpose and principle of assessment

1.2.1 Purpose of assessment

As an environmental protection management system of construction project, the fundamental purpose of EIA is to implement the basic state policy of "environmental protection" and environmental management policy of "prevention crucial, prevention and treatment combined". In accordance with *Law of the People's Republic of China on Environmental Impact Assessment* and State Council Decree No. 253, EIA must be conducted on all new, expanded and upgraded projects in order to implement the strategy of sustainable development, prevent the unfavorable impact of planning and implementation of construction projects on environment, enhance environmental protection management of construction projects, strictly control new pollution and protection and improve environment. Specific purposes of this EIA are as follows:

(1) Achieve coordinated development between municipal infrastructure in this area and nature, economy and environment, i.e. guiding the project construction with the concept of "sustainable development".

(2) Analyze and demonstrate the rationality of project construction scheme from the perspective of environmental protection.

(3) Conduct predicative assessment of the impact on the surrounding environment during construction and operation periods by investigating and analyzing the status quo of the natural environment, social environment and ecological environment of the project site.

(4) Propose feasible environmental protection measures and suggestions based on the degree of impact of the project on environment to minimize the adverse effect on environment and to achieve coordination of project construction and environmental protection.

(5) Enable surrounding citizens to take part in environmental demonstration of project construction through public participation, making project construction and EIA more democratic and scientific. Guide the public into the supervision of environmental protection during project construction and operation periods and publicize related state environmental protection regulations and policies to some degree.

(6) Provide scientific basis for environmental management and monitoring during project construction and operation periods; demonstrate feasibility and rationality of project construction from the perspective of environmental protection to provide basis for reliable implementation of project, decision-making of authorities and project design.

1.2.2 Principles of assessment

(1) Conscientiously implement state and local environmental protection laws, regulations and relevant provisions and conduct site survey and EIA according to the requirements of relevant state technical specifications.

(2) Adhere to the principle of making full use of available data combined with site visit, site survey and status quo monitoring.

(3) Ensure an all-round assessment, highlight key points of assessment and fully reflect

the characteristics of regional environment and environmental impact of the project.

(4) Adhere to the principle of conduction EIA in an objective, just, scientific and practical manner.

1.3 Basis of preparation

1.3.1 Environmental protection laws, regulations and relevant documents

(1) *Environmental Protection Law of the People's Republic of China* (implemented on Jan. 1, 2015);

(2) *Law of the People's Republic of China on Promotion of Cleaner Production* (implemented on Sept. 1, 2003);

(3) *Law of the People's Republic of China on Prevention and Control of Pollution from Environmental Noise* (implemented on Mar. 1, 1997);

(4) *Law of the People's Republic of China on the Prevention and Control of Water Pollution* (implemented on Jun. 1, 2008);

(5) *Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution* (revised on Apr. 29, 2000 and implemented on Sep. 1, 2000);

(6) *Law of the People's Republic of China on Prevention and Control of Environmental Pollution by Solid Wastes* (implemented on Apr. 1, 1996);

(7) *Law of the People's Republic of China on Water and Soil Conservation* (implemented on Mar. 1, 2011);

(8) *Regulations on the Administration of Construction Project Environmental Protection* (Decree No. 253 of the State Council of the People's Republic of China) (implemented on Nov. 29, 1998);

(9) *Circular on Implementing Regulations on the Administration of Construction Project Environmental Protection* (HF [1999] No. 107 of State Environmental Protection Administration, implemented on Apr. 29, 1999);

(10) *Circular on Relevant Issues of Implementing EIA System for Construction Project* (HF [1999] No. 107 of State Environmental Protection Administration, implemented on Apr. 29, 1999);

(11) *Circular on Stepping up Environmental Protection for Construction Project* (HF [2001] No. 19 of State Environmental Protection Administration, implemented on Feb. 21, 2001);

(12) Classified Directory for Environmental Impact Assessment of Construction Project (implemented on Oct. 1, 2008);

(13) *Measures for Environmental Protection Management of Traffic Construction Project* (Decree No. 17 [1990] of Ministry of Communications, implemented in 1990);

(14) *Circular on Printing and Issuing the Regulations on Soil and Water Conservation in Highway Construction Project* (SB [2001] No. 12 Document of Ministry of Communications and Ministry of Water Resources, implemented in 2001);

(15) *Circular on Stepping up Regulation of Environmental Impact Assessment* (HB [2002] No. 88 of the State Environmental Protection Administration, implemented in 2002);

(16) *Sichuan Province's Regulations on Environmental Protection* (implemented on Sep. 24, 2004);

(17) *Urban and Rural Planning Law of the People's Republic of China* (implemented on

Jan. 1, 2008);

(18) *Law of the People's Republic of China on the Protection of Cultural Relics* (implemented on Oct. 28, 2002) and *Implementation Rules for the Laws of the People's Republic of China on the Protection of Cultural Relics*;

(19) *Guidelines for Developing Innovative Traffic Industry* (Ministry of Communications, Jul. 24, 2006);

(20) *Notice on Standardization of Acceptance of Construction Project Environmental Protection* (CHF [2003] No. 56);

1.3.2 Guidelines and technical specifications

(1) *Technical Guidelines for Environmental Impact Assessment - General Programme* (HJ 2.1-2011);

(2) *Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment* (HJ 2.2-2008);

(3) *Technical Guidelines for Environmental Impact Assessment – Surface Water Environment* (HJ/T 2.3-93);

(4) *Technical Guidelines for Noise Impact Assessment* (HJ 2.4-2009);

(5) *Technical Guidelines for Environmental Impact Assessment – Groundwater Environment* (HJ 610-2011);

(6) *Technical Guideline for Environmental Impact Assessment – Ecological Environment* (HJ 19-2011);

(7) *Technical Guidelines for Environmental Risk Assessment on Projects* (HJ/T 169-2004);

(8) *Technical Criterion for Eco-Environmental Status Evaluation (Trial)* (HJ/T 192-2006);

(9) *Regulation of Techniques for Comprehensive Control of Soil Erosion* (GB/T 16543.1~16453.6-2008);

(10) *Technical Code on Soil and Water Conservation of Development and Construction Projects* (GB 50433-2008);

(11) World Bank Operations Manual - OP4.01 World Bank Procedures on Environmental Impact Assessment;

(12) World Bank Operations Manual - BP4.01 World Bank Procedures on Environmental Impact Assessment;

(13) World Bank Operations Manual - OP4.04 World Bank Policies on Natural Habitat;

(14) World Bank Operations Manual - OP4.11 World Bank Procedures on Cultural Property;

(15) World Bank Operations Manual - OP4.12 World Bank Procedures on Involuntary Resettlement

1.3.3 Project-related documents

(1) *Feasibility Study Report on "Daozuo-Huojing Road" Works for World Bank Loaned Post-Lushan Earthquake Recovery and Reconstruction of Roads* (Chengdu Communication Surveying & Design Institute, Nov. 2015);

(2) *Letter on Approving Prior Survey and Design Bidding for "Daozuo-Huojing Road" Works for World Bank Loaned Post-Lushan Earthquake Recovery and Reconstruction*

of Roads (QFGH [2015] No. 36 of the Development and Reform Bureau of Qionglai City);

(3) *Statement on Soil and Water Conservation Scheme for "Daozuo-Huojing Road" Works for World Bank Loaned Post-Lushan Earthquake Recovery and Reconstruction of Roads* (Sichuan Kairing Engineering Investigation & Design Co., Ltd., Dec, 2015);

(4) *Overall Planning for Land Use in Qionglai City (2006～2020);*

(5) *Overall Planning for Qionglai City* (2012-2020)

(6) *Overall Planning for Land Use in Yingjing County, Ya'an City* (2006-2020)

(7) *Survey Report on Forest Resources Category II in Yingjing County* (2015)

(8) *Overall Planning for Yingjing County, Sichuan Province (2012-2030)*

(9) *Feasibility Study Report on World Bank Loaned Reconstruction and Expansion of Ying-Lu Road (Hongshigou – Daqiaotou) in Yingjing County, Ya'an City*

(10) *Soil and Water Conservation Scheme Report on World Bank Loaned Reconstruction and Expansion of Ying-Lu Road (Hongshigou – Daqiaotou) in Yingjing County, Ya'an City*

(11) *Report on Social Impact Assessment of World Bank Loaned Post-4.20 Lushan Earthquake Recovery and Reconstruction of Rural Roads*

1.3.4 World Bank security policy

1. 10 World Bank security policies and compliance analysis

World Bank has produced ten security policies on social and environmental operation. On the basis of the project nature, layout, scope of assessment determined by the EIA and site survey, the applicability of the ten policies to the Project is identified as shown in Table 1-1:

Table 1-1 Analysis of compliance of the Project with World Bank security policies

S/N	Security policy	Applicable or not	Compliance
1	OP/BP4.01 *Environmental Impact Assessment*	Yes	Category B project; Prepare complete *Environmental Impact Assessment* and *Environmental Management Plan*; Conduct two rounds of public consultation as part of the EIA procedure;
2	OP/BP4.04 *Natural Habitat*	Yes	This policy is implemented. None of the land areas and water areas in this project will involve a nature reserve, scenic spot or any other ecologically sensitive area, but this project will require bridge construction which may impact the aquatic ecosystem. The environmental assessment covers an ecological survey and the Environmental Management Plan covers habitat protection.
3	OP/BP4.36 *Forest*	No	This policy is not launched. The Project will not fund major transformation or degradation activities involving important areas or relevant key natural habitats defined in this policy.
4	OP/BP4.09 *Pest Management*	No	This policy is not launched. The Project will not purchase any insecticide or cause increased consumption of insecticides. No action will be required according to this policy.
5	OP/BP4.11 *Physical Cultural Resources*	No	The Project does not involve damages to physical resources.
6	OP/BP4.37 *Dam Safety*	No	This policy is not launched. There is no dam in the project area.
7	OP/BP4.10	No	This policy is not launched. No indigenous people live in the project

	Indigenous People		area nor are they affected.
8	OP/BP4.12 *Involuntary Resettlement*	Yes	It is applicable to resettlement and *Resettlement Action Plan* shall be prepared;
9	OP/BP7.50 *International Waterway Project*	No	This policy is not launched. The project does not involve any international waterway.
10	OP/BP7.60 *Disputed Area Project*	No	This policy is not launched. The Project does not involve any disputed site.

2. Analysis of project compliance with World Bank *EHS Guidelines* and relevant policies

World Bank *EHS Guideline* (general guideline) and *EHS Guideline for Toll Roads* apply to the Project. Mitigation measures included in the *Environmental Management Plan* of the Project are in full compliance with the above guidelines, especially the provisions related to construction management. It should be noted that provisions in the Guidelines are basically consistent with China's laws, regulations, guidelines and construction management codes.

Table 1-2 List of project compliance with *World Bank EHS Guidelines*

World Bank EHS Guidelines	**Compliance with Environmental Impact Assessment/ Environmental Management Plan**
If facilities or projects are close to identified ecologically sensitive regions (such as national park), reduce increase of pollution level as much as possible. In addition, appropriate mitigation measures include application of clean fuels and technologies and implementation of comprehensive pollution control measures.	There are no ecologically sensitive regions around the project area.
Dust or particles (PM) are the most common pollutants of unorganized emissions. Particles may be generated by certain operations (transportation and open storage of solid materials) and exposed soil surfaces (including unpaved roads).	During the construction period, apply dust control methods (including covering, water spraying or increasing water content of material stack in the open air) and use water spraying method to control delivered materials on paved or unpaved roads.

Table 1-3 List of project compliance with *World Bank EHS Guideline for Toll Roads*

EHS Guideline for Toll Roads	**Compliance with Environmental Impact Assessment/ Environmental Management Plan**
Under appropriate conditions, avoid important land and hydrophytic habitats (including old-growth forests, wetlands and fish spawning habitat) by selecting appropriate locations of roads and supporting facilities and applying existing traffic corridors.	The project area does not belong to important land and hydrophytic habitats.
During the construction period, reduce removal of local plants as much as possible and replant local plants in disturbed areas.	Prepare a water and soil conservation scheme specially and plant proper local herbaceous plants as per the water and soil conservation scheme.
Pave the road in dry days to prevent loss of asphalt and cement materials.	During the construction period, do not pave under strong wind, and confirm the construction site appropriately.
No matter whether much grease will be increased, oil-water separators shall be applied during treatment.	Machine oil-sewage collectors are arranged at the construction site for collecting oil and sewage. Collected oily water is delivered to the organization with treatment capacity for treatment. Do not directly discharge the oily water.
Prevent pollution caused by asphalt cleaning by the following measures: use vegetable oil instead of diesel as releasing agent and cleaning agent, prevent leakage of cleaning product and polluted asphalt,	Requirements on "storage of fuels, oils and dangerous and toxic substances" are specifically specified in the Contractor's specification. All fuels at the construction site shall be fenced and the capacity of storage area shall be

scrap before cleaning, and clean at the place far away from surface water or drainage facilities.	110% of that of fuel storage container. The fuel storage area shall not be close to any water source (namely, within 100m from the water source).
Take soundproof measures for surrounding buildings (replace windows generally). Use pavement with low pavement/tyre friction noise such as stone mastic asphalt pavement.	During the road operation period, limit functions of areas along the trunk road, plan buildings at road sides, optimize acoustic design and strengthen speed control management.

3. Analysis of compliance with China's laws and regulations

EIA documents have been prepared in full accordance with the above laws, regulations and guidelines. Compliance with China's regulations related to the Project is summarized in Table 1-4 below.

Table 1-4 List of compliance with China's laws and regulations

China's laws and regulations	Project compliance
Environmental Impact Assessment Law	● The complete EIA report was prepared by certified EIA consultants and project organizations with two rounds of public participation.
Circular on Strengthening EIA Management of Construction Project Financed by International Financial Institution	● EIA report and Environmental Management Plan comply with World Bank security policies.
Land Administration Law of the People's Republic of China	● Requirements of relevant planning for land use in *Overall Planning for Tianquan County* and *Overall Planning for Qionglai City*
Law of the People's Republic of China on the Prevention and Control of Water Pollution	Production wastewater is reused and domestic sewage properly treated.
Law of the People's Republic of China on Water and Soil Conservation	● Prepare the scheme for soil and water conservation, submit it to water service department having approval authority and take measures to prevent and control soil erosion according to the approved scheme for soil and water conservation. ● Sand, stone, soil, etc removed during construction are piled in the spoil ground determined by the scheme for soil and water conservation with measures taken to ensure no new hazard occurs. ● The scheme for monitoring soil erosion is prepared and monitoring results are reported regularly to the water service departments in Qionglai and Ya'an cities.
Law of the People's Republic of China on the Protection of Cultural Relics	Officially protected monuments and sites have not been discovered in the project area so far. During project construction, any organization or individual who discovers cultural relics shall protection the site and immediately report to local Cultural Relics Administration.
Law of the People's Republic of China on the Protection of Wild Life	Publicize the Law of the People's Republic of China on the Protection of Wild Life and enhance construction personnel's awareness of protection. Construction personnel must abide by *Law of the People's Republic of China on the Protection of Wild Life* and are forbidden to hunt wild life in and around the construction area.

1.4 Classification and scope of assessment

1.4.1 Classification of assessment

1. Ecological environment

There are no rare and endangered animal or plant species within the areas affected by three subprojects so that biodiversity loss and land nature changes will not be caused after the Project construction. According to the provisions of *Technical Guideline for Environmental Impact Assessment - Ecological Impact* (HJ19-2011), the assessment is classified as Grade III.

2. Acoustic environment

In the Project, three subprojects are located in rural areas with fewer decentralized distributed residents. Environmental impact will mainly be caused in construction period. Thus, according to the provisions of *Technical Guideline for Environmental Impact Assessment – Acoustic Environment* (HJ2.4-2009), acoustic environmental impact assessment of the Project is classified as Grade III.

3. Surface water environment

In the Project, a small amount of construction wastewater and domestic sewage will be discharged during construction of three subprojects; wastewater discharged from road and bridge during the Project operation period comes from pavement runoff in case of rainfall and pavement cleaning wastewater in case of a motor vehicle accident. The pavement runoff is of low quality complexity and is mainly composed of pollutants such as SS, COD and petroleum. Wastewater produced by water supply works may be recycled, while domestic sewage is used for irrigation and will not be discharged.

Thus, according to the provisions of *Technical Guideline for Environmental Impact Assessment – Groundwater Environment* (HJ/T2.3-93), water environmental impact assessment of the Project is classified as Grade III.

4. Atmospheric environment

Upon the Project completion, new roads will have an impact on atmospheric environment in such areas. According to *Technical Guideline for Environmental Impact Assessment – Atmospheric Environment* (HJ2.2-2008), three subprojects belong to rural highway reconstruction projects, and waste gas during the Project construction & operation period is mainly waste gas from vehicles, which mainly contains pollutants such as CO and NO_2 with ratio of maximum ground mass concentration to standard concentration being less than 10%. According to the Guideline, atmospheric environmental impact assessment is classified as Grade III.

5. Groundwater environment

According to HJ610-2011, the Project belongs to Class II project and groundwater environment of the Project area is sensitive – non-sensitive. After proper dewatering measures are adopted, the foundation pit excavation will not cause environmental, hydrological and geological problems. Therefore, according to the requirements of *Technical Guideline for Environmental Impact Assessment – Groundwater Environment* (HJ610-2011), groundwater environmental impact assessment of the Project is classified as Grade III.

See Table 1-7 below for classification of environmental impact assessment of main subjects this time.

Table 1-7 Classification of assessment of main subjects

Subject of assessment	Classification of assessment
Ecological environment	Grade III
Acoustic environment	Grade III
Surface water	Grade III
Groundwater	Grade III
Ambient air	Grade III

1.4.2 Scope of assessment

The scopes of assessment of ecological, acoustic, water, atmospheric and groundwater

environment elements shall be determined according to classification of the Project assessment.

1. Scope of assessment of social environment

The areas affected by the Project are directly-affected areas of the Project, and investigation and analysis of social environment will be extended to directly-affected areas. In the Project, main subjects suffering social impact are fewer peasant households and residents.

2. Scope of assessment of ecological environment

In the Project, the scopes of assessment of ecological environmental impact are areas within 200m respectively on both sides of proposed road centerlines of three subprojects.

3. Scope of assessment of acoustic environment

In the Project, the scopes of assessment of acoustic environmental impact are areas within 200m respectively on both sides of proposed road centerlines of three subprojects.

4. Scope of assessment of water environment

In the Project, the scope of assessment of water environment is surface water body involved by the Project – Xiaoxi River and Tonggou in Dao-Huo Road Subproject, Chenjiagou, Luocaogou and Shiyang Reservoir in Shi-Xin Road Subproject as well as Daihuanggou in Ying-Lu Road Subproject.

5. Scope of assessment of atmospheric environment

In the Project, the scopes of assessment of atmospheric environmental impact are areas within 200m respectively on both sides of proposed road & bridge centerlines of three subprojects.

6. Assessment scope of groundwater environment

In the Project, the scopes of assessment of groundwater environmental impact are areas within 200m respectively on both sides of proposed road centerlines of three subprojects.

In addition, according to the principle of Word Bank OP4.01 environmental assessment policy, environmental impact assessment shall cover the scope of potential project impacts. Ying-Lu Road Subproject: the whole Ying-Lu Road Subproject in Yingjing County (Hongshigou to Daqiaotou) is a reconstruction & expansion project based on the existing road, with no new road. This road starts from Hongshigou and ends at Daqiaotou in Sanhe Township, Yingjing County. It is totally 6km long. Works associated with the reconstruction & expansion works under the Ying-Lu Road Subproject (Hongshigou – Daqiaotou): the preceding section running from Sanhe Township Government to Hongshigou and the following section from Daqiaotou to Luding boundary. This subproject, upon completion, will be an important link between Yingjing County and Luding County of Ganzi Prefecture. These assessment subjects include activities financed and not financed by the World Bank. See Chapter II for specific analysis.

1.5 Assessment standard

1.5.1 Environmental quality standard

In the Project, applicable assessment standards are as follows:

1. Acoustic environment

Acoustic environment in three subprojects shall comply with Class II standard in *Environmental Quality Standard for Noise* (GB3096-2008). See the table below for various standard values:

Table 1.5-1 *Environmental Quality Standard for Noise* (GB3096-2008) (Unit: dB(A))

Standard class	Standard value	
	Day-time	Night-time
Class II	60	50

2. Ambient air

The assessment areas in three subprojects shall comply with Class II standard in *Ambient Air Quality Standard* (GB3095-2012); see the table below for its specific items and standard limits.

Table 1.5-2 Class II Standard in *Ambient Air Quality Standard* (GB3095-2012)

Pollutants	Time to get values	Concentration limits
		Grade II standard
Nitrogen dioxide (NO_2)	Daily average	80
	Hourly average	200
Total suspended particulates (TSP)	Daily average	300
$PM_{2.5}$	Daily average	75
Sulfur dioxide	Daily average	150
	Hourly average	500

3. Water environment

Quality assessment standard for groundwater environment in three subprojects shall be Class III standard in *Environmental Quality Standard for Surface Water* (GB3838-2002). See Table 1.5-3 for typical pollutant concentration limits.

Table 1.5-3 Environmental Quality Standard for Surface Water (Sel.) Unit: mg/L (except for pH)

Item	pH	COD	BOD_5	Petroleum	Ammonia nitrogen	SS
Class III standard	6.0~9.0	20	4	0.05	1.0	-

Groundwater in three subprojects shall comply with Class III standard in *Groundwater Quality Standard* (GB/T14848-93). See Table 1.5-4 for standard values.

Table 1.5-4 *Quality Standard for Groundwater* (GB/T14848-93) Unit: mg/L

Indicator	Class III water quality standard
pH (non-dimensional)	6.5~8.5
Total hardness	≦450
Permanganate index	≦3.0
NH_3-N	≦0.2
Volatile phenol	≦0.002

1.5.2 Emission standard of pollutants

1. Noise

Construction noise shall comply with various noise limits in *Emission Standard for Noise within the Boundaries of Construction Sites* (GB12523-2011). See Table 1.5-5 for details of specific standard limits.

Table 1.5-5 *Noise Limits for Construction Site (*GB12523-2011) Unit: dB(A)

Noise limits

Day-time	Night-time
70	55

Noise at site boundary shall comply with Class II standard in *Emission Standard for Noise within the Boundaries of Industrial Enterprises* (GB 12348-2008). See Table 1.5-6 for its specific standard limits.

Table 1.5-6 *Emission Standard for Noise within the Boundaries of Industrial Enterprises* (GB 12348-2008) Unit: dB(A)

Standard class	Standard value	
	Day-time	Night-time
Class II	60	50

2. Wastewater

Water discharged in three projects shall comply with Grade III standard in *Integrated Wastewater Discharge Standard* (GB8978-96) if failing to enter the sewage treatment plant; wastewater shall Grade I standard in *Integrated Wastewater Discharge Standard* (GB8978-96) if failing to enter the sewage treatment plant. See Table 1.5-7 below for its specific standard limits.

Table 1.5-7 Standard limit for sewage discharge (Unit: mg/L)

S/N	Pollutant	Applicable scope	Grade I standard	Grade III standard
1	pH	All discharge units	6 - 9	6 - 9
2	Suspended substance (SS)	Other discharge units	70	400
3	Chemical oxygen demand (COD_{cr})	Other discharge units	100	300
4	Petroleum	All discharge units	5	20

3. Waste gas

Waste gas during operation period and vehicle exhaust during operation period shall comply with Class II standard in maximum allowable emission concentration and maximum allowable emission rate in *Integrated Emission Standard of Air Pollutants* (GB16297-1996). See Table 1.5-8.

Table 1.5-8 Class II standard in *Integrated Emission Standard of Air Pollutants*

Pollutants	Emission concentration	Emission rate	Monitoring concentration threshold of fugitive emission
Particle	120mg/m^3	3.5kg/h (15m)	1.0mg/m^3
NO_X	240mg/m^3	0.77kg/h (15m)	0.12mg/m^3
Asphalt fume	75mg/m^3	0.18kg/h (15m)	The production equipment shall have no obvious fugitive emission.

1.6 Assessment prediction period

Dao-Huo Road Subproject: Project is scheduled to commence in June 2016 and start service in June 2017.

Ying-Lu Road Subproject: The project is planned to commence in October 2016 and be put into operation in November 2017, with construction period of 14 months.

Shi-Xin Road Subproject: The project is planned to commence in September 2016 and be put into operation in September 2017, with construction period of 1 year.

1.7 Assessment method

Based on the principle of "combining points and lines, giving priority to points and feeding back the whole line", investigation, monitoring and statistical analysis methods etc. shall be used for assessment of status quo; methods such as mode calculation and analog analysis are adopted for prediction and assessment. For noise, mode calculation and analog analysis are adopted for prediction and assessment; for atmosphere, analog analysis is adopted for prediction and assessment; water and soil loss in ecological environment is subject to estimation and analog; investigation analysis method is adopted for social economy and traffic environment.

1.8 Content and emphasis of assessment

1.8.1 Content of assessment

The main content of this assessment includes ecological environmental impact assessment, acoustic environmental impact assessment and social environmental impact assessment. In addition, surface water environmental impact analysis, ambient air impact analysis, public participation, environmental management and monitoring plan, environmental impact and economic profit & loss analysis, etc are also described in the Report.

1.8.2 Emphasis of assessment

According to the Project characteristics, emphasis of environmental impact assessment is: ecological environmental impact and construction dust & noise environmental impact during construction period; environmental impact from road traffic noise and solid wastes during operation period.

1.9 Conformity with industrial policies and planning

1.9.1 Conformity with industrial policies and planning

The Project belongs to urban transportation infrastructure construction project. According to Article 12 "rural highway construction" of "XXIV highway and road transportation" under the encouraged category I in *Guiding Catalogue of Industrial Restructuring* (2013 Edition) (Decree No. 9 of National Development and Reform Committee, June 1, 2011), the Project belongs to encouraged project and complies with current national industrial policies. As it does not belong to national restricted and prohibited land in *GTZF [2012] No. 98 Document Circular on Promulgating and Implementing the Catalogue of Restricted Uses of Land (2012 Version) and Catalogue of Prohibited Uses of Land (2012 Version)*, the Project complies with industrial policies.

1.9.2 Conformity with relevant planning design

1. Analysis on conformity with overall planning of Qionglai City

The State Council issued *Overall Planning for Post-Lushan Earthquake Recovery and Reconstruction* in July 2013. It is specified to spend three year to fulfill reconstruction recovery task so as to recover production & living conditions and economic & social development of disaster area and make the level exceed pre-earthquake level. The Project construction is beneficial to post-Lushan Earthquake recovery and reconstruction and complies with the requirements of *Overall Planning for Post-Lushan Earthquake Recovery and Reconstruction*.

2. Analysis on conformity with overall planning of Yingjing County

Ying-Lu Road Reconstruction and Expansion Project in Yingjing County of Ya'an City financed by the World Bank belongs to post-earthquake county-level road reconstruction project in Sanhe Township in *Overall Planning Document for Yingjing*

County (2012-2030), and is required by planning to be reconstructed in situ and belongs to 6-10m wide Grade III or Grade IV highway. The Project is reconstructed in situ along existing road, with no new section, with highway grade of IV. The subgrade width is 6.5m, and carriageway width is 6m, being in conformity with the overall planning. Thus, the Project construction conforms to urban overall planning of Yingjing County.

3. Analysis on conformity with overall planning of Tianquan County

According to *Guiding Catalogue of Industrial Restructuring* (2011 Version) (Decree No. 9 of National Development and Reform Committee in 2011), the Project belongs to rural highway construction project in "XXIV. highway and road transportation" under the encouraged category I and complies with current national industrial policies. By consulting urban construction departments and various township governments of Tianquan County, urban planning of Shiyang Town, Daping Township and Xinhua Township along the line is not involved in the Project and complies with overall planning of Tianquan County.

1.10 External environmental relation and environmental protection objects

1.10.1 External environmental relation

Three subprojects in the Project are rural highway reconstruction projects. Among them, Dao-Huo Road Subproject starts from Zhaigou Village at Dao-Huo Road, runs along existing Dao-Huo Road corridor through Shichangzi, Dashiqiao, Hualongmen, health station of Zhaigou Village and Shilongmen, and reaches Sanhe Village through Diaogang Mountain, then runs upstream along the Xiaoxi River through Qiangtougou, Lijiaba and crosses the river to Yapeng Village, continues extending northward through Yangpo, Hangou, Dayanqiang and Hanshiti and finally level crosses with Huojing Raochang Road at Hongyantou. The surrounding environments are mostly simple rural environments. The whole Shi-Xin Road Subproject is mainly located in rural areas or on the edge of town. According to investigation, these areas are not subject to corresponding environmental function zoning. Ying-Lu Road Subproject is mainly located in rural areas, with fewer residents along the line.

Settlement in Zhaigou Village at K2+400~K3+400

Settlement in Sanhe Village at K6+000~K7+900

Settlement in Yapeng Village at K8+100~K9+500

Settlement in Chuanwang Village at K10+400~K11+000

Settlement in Yantan Village at K12+170

Settlement in Yanwei Village at Z2K0+050~Z2K0+350

Fig 1.10-1 External environment of Dao-Huo Road

Hongshigou (starting point)

Cryptomeria fortunei saplings (southeast of the starting point and east of Hongshigou)

Quarry (K23+460)

Pot hole (K23+500)

Cryptomeria fortunei saplings beside road (K24+700)

Overflow pavement (K25+300)

Sanhui Power Station (K26+500)

Mozigou Power Station (K28+100)

Fig. 1.10-2 External environment of Ying-Lu Road

Fengxiang Xinmin at K0+300~K0+400

Group 1 of Xinmin Village at K1+100~K1+200

Dawo Group 3 at K2+400~K2+600

Dawo You'ai Hope Primary School at K3+100

	
Dawo Group 5 at K3+100~K3+200	Dawo Group 6 at K4+000~K4+200
	
Group 6 of Baishu Village at K11+000~K11+200	Group 6 of Liupai Village at K12+900~K13+100

Fig 1.10-3 External environment of Shi-Xin Road

In conclusion, the external environment of the Project area is relatively simple, without special environmentally sensitive areas distributed.

1.10.2 Environmental protection objects

Environmental protection objects for the Project shall be determined according to environmental functions of planned area and scope of possible impact after the Project completion.

1. Social environmental protection objects

Social environmental protection objects mainly refer to the residents impacted by land acquisition and house demolition in the vicinity of the Project and concentrated residential areas.

2. Ecological environmental protection objects

Main ecological protection objects for the Project are land resources, natural vegetations and landscapes along the line. See Table 1-16;

Table 1-16 Ecological environmental protection objects

S/N	Environmental elements	Environmental protection objects	Location	Environmental features	Environmental problems
1	Ecological environment	Vegetation and water & soil	Dao-Huo Road Subproject	Mainly rural environment	Land occupation and soil & vegetation deterioration
2	Ecological environment	Vegetation and water & soil	Ying-Lu Road Subproject	Mainly rural environment	Land occupation and soil & vegetation deterioration
3	Ecological	Vegetation and	Shi-Xin Road	Mainly rural environment	Land occupation and soil

	environment	water & soil	Subproject		& vegetation deterioration

3. Water environmental protection objects

See Table 1-17 for specific water environmental protection objects of the Project:

Table 1-17-1 Surface water environmental protection objects

S/N	Environmental elements	Environmental protection objects	Location	Environmental features	Remarks
1	Surface water environment	Xiaoxi River and Tonggou	Daozuo Township and Huojing Town in Qionglai City	Function of water body: irrigation	Dao-Huo Road Subproject
2		Daihuanggou	Yingjing County	Function of water body: irrigation and flood control	Ying-Lu Road Subproject
3		Chenjiagou, Luocaogou and Shiyang Reservoir	Tianquan County	Function of water body: irrigation and flood control	Shi-Xin Road Subproject

Table 1-17-2 Groundwater environmental protection objects

S/N	Environmental elements	Environmental protection objects	Location	Environmental features
1	Groundwater environment	Groundwater in the Project area	Within 200m around the Project construction area	No concentrated drinking groundwater source

4. Ambient air and acoustic environmental protection objects

Ambient air and acoustic environmental protection objects of the Project are mainly determined according to the characteristics of various works and distribution of sensitive points in project area.

The Project mainly involves three subprojects, Dao-Huo Road Subproject (including two associated projects), Ying-Lu Road Subproject and Shi-Xin Road Subproject. See Table 1-18 below for ambient air and acoustic environmental protection objects determined for the Project along the line.

Table 1-18-1 Ambient air and acoustic environmental protection objects of the Project (Dao-Huo Road Subproject)

S/N	Name and pile No.	Administrative area	Distance from the first row house to the highway center (m)	Affected households (Class II)	Class and grade of protection object	
					Acoustic environment	Atmospheric environment
1	Residential area of Zhaigou Village K2+400~K3+400	Daozuo Township	Right side 11	10	***Environmental Quality Standard for Noise***	**Class 2 area specified in *Ambient Air Quality Standard* (GB3095-1996), Class II standard**
2	Residential area of Sanhe Village K6+000~K7+900	Huojing Town	10 on the left and right sides	67		

S/N	Name and pile No.	Administrative area	Distance from the first row house to the highway center (m)	Affected households (Class II)	Class and grade of protection object	
					Acoustic environment	Atmospheric environment
3	Residential area of Yantan Village K12+170	Youzha Township	Right and left sides 10	15	**(GB3096-2008)** Class II functional area, Class II standard	

Table 1-18-2 Ambient air and acoustic environmental protection objects of the Project (Shi-Xin Road Subproject)

S/N	Protection objects	Administrative area	Class and grade of protection object	
			Acoustic environment	Atmospheric environment
1	Peasant households, residential areas and schools (totally 10 in quantity) along the line	Tianquan County	Class II functional area in *Environmental Quality Standard for Noise* (GB3096-2008), Class II standard	Class II functional area *Ambient Air Quality Standard* (GB3095-2008), Class II standard

1.11 Technical assessment procedures

See Fig. 1-1 for this technical assessment procedure.

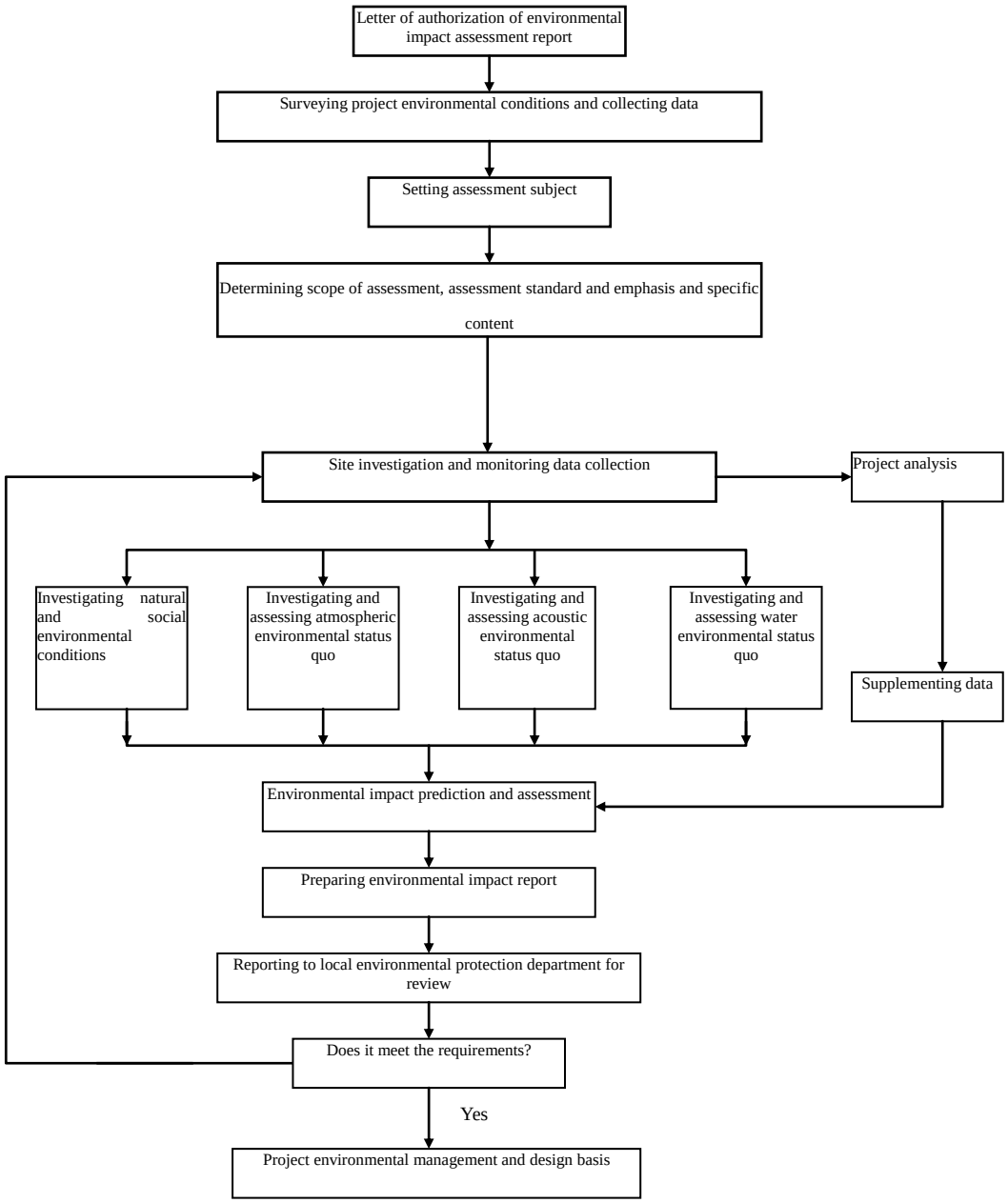


Fig. 1-1 Assessment procedures

2.0 Project Overview

2.1 Name, location and nature of the project

Project name: World Bank Loaned Post-4.20 Lushan Earthquake Recovery and Reconstruction of Rural Roads

Project location: Daozuo Township, Huojing Town and Youzha Township of Qionglai City; Hongshigou to Daqiaotou in Sanhe Township of Yingjing County; Shiyang Township of Tianquan County.

Construction contents and scale:

Dao-Huo Road Subproject: the Dao-Huo Road Subproject in Qionglai City includes the main line and two branch lines. In the recommended scheme for the main line, i.e. scheme K, the road is totally 12.172km long and is built based on Class III technical standard; its subgrade is 8.5m wide; it is a bidirectional road, with 2 lanes in each direction; the designed speed is 30km/h. This project contains one 146m long large bridge, i.e. the Zhaigou Bridge crossing the Tonggou River; of the two medium bridges, one is the 53.04m

long Shichang Bridge crossing the Tonggou River and the other is the 45.04m long Yapeng Bridge crossing the Xiaoxi River; of the two small bridges, one is the 25m long Lijiaba Bridge crossing the Tonggou River and the other is the 25m Hangou Bridge crossing the Hanggou River. These bridges are totally 294m long. The bridges account for 2.41% of the total length of the road. The road contains 65 culverts, i.e. 5.34 culverts per km. The two branch lines are rural roads which are rebuilt upon the original rural roads. One branch line is 775m long and the other 459m. The main line is a Class III road which is completely built with asphalt concrete pavement.

Ying-Lu Road Subproject: the Ying-Lu Road in Yingjing County (Hongshigou to Daqiaotou) is an expansion project based on the existing road, with no new road. This road starts from Hongshigou and ends at Daqiaotou in Sanhe Township. It is totally 6km long. (This project includes certain associated projects, among which the preceding section is from the Sanhe Township Government to Hongshigou and the following section is from Daqiaotou to Luding boundary. This subproject, upon completion, will be an import link between Yingjing County and Luding County of Ganzi Prefecture).

Shi-Xin Road Subproject: the rebuilt section has 6.5m wide subgrade and is 15.465km long; the newly built section is 1.09km long (Xinmin Group 1 and Xinhua Township) and comprises the main works and auxiliary works. The main works include subgrade, bridges, culverts and road crossings; the auxiliary works include spoil ground, stock ground, construction site and access road.

Ying-Lu Road Subproject and its associated projects are:

(1) Reconstruction of the section from Sanhe Township Government to Hongshigou in the Ying-Lu Road in Yingjing County: This road section starts from Sanhe Township Government at K15+600. It runs along the existing gravel road on the left bank of the Yinghe River and crosses the Jianzheng Channel; after the 280m long Jianzheng Tunnel in the expanded line, it still continues along the left of Yinghe River and then passes along the 615m long Shuanglin Tunnel; then it crosses the bridge at Yinghe River and then continues along the left bank of the Baoxinchang Channel; it then crosses the bridge at the Daihuanggou (about 400m upstream of the dam of Ziyan Power Station) and then continues along the right bank of the Daihuanggou; it finally ends at a location 500m upstream of Hongshigou where it connects to an existing gravel road. The end point is at K25+960. This road section is totally 10.360km long.

(2) Reconstruction of the section from Daqiaotou to Luding boundary in the Ying-Lu Road in Yingjing County: this road section starts from Daqiaotou in Sanhe Township at K31+120. It is first routed along the County Road X176 and passes Doudoudi at K34+000 and Jiubasuo at K45+200; it then reaches a coal mine at K46+500 and then continues up the slope there to return to the expanded line; it finally ends at the border between Sanhe Township and Ganzi Prefecture where the ending point is K58+167.454. It is totally 27.047km long.

Employer: maintenance of the road section in Qionglai City; maintenance of the road section in Yingjing County; Tianquan County Traffic Development Corporation

Construction nature: reconstruction/expansion of Dao-Huo Road; reconstruction/expansion of Ying-Lu Road; reconstruction of Shi-Xin Road.

Project investment: the total investment on Dao-Huo Road Subproject is estimated to be 183,576,500 yuan and the investment on environmental protection is 3,256,000 yuan. The total investment on Ying-Lu Road Subproject is 50,588,982 yuan and the investment on environmental protection is 1,080,000 yuan. The total investment on Shi-Xin Road Subproject is 77,870,000 yuan and the investment on environmental protection is 2,752,300 yuan. The fund is from both the World Bank and the Employer.

The geographical location of the project is shown below:

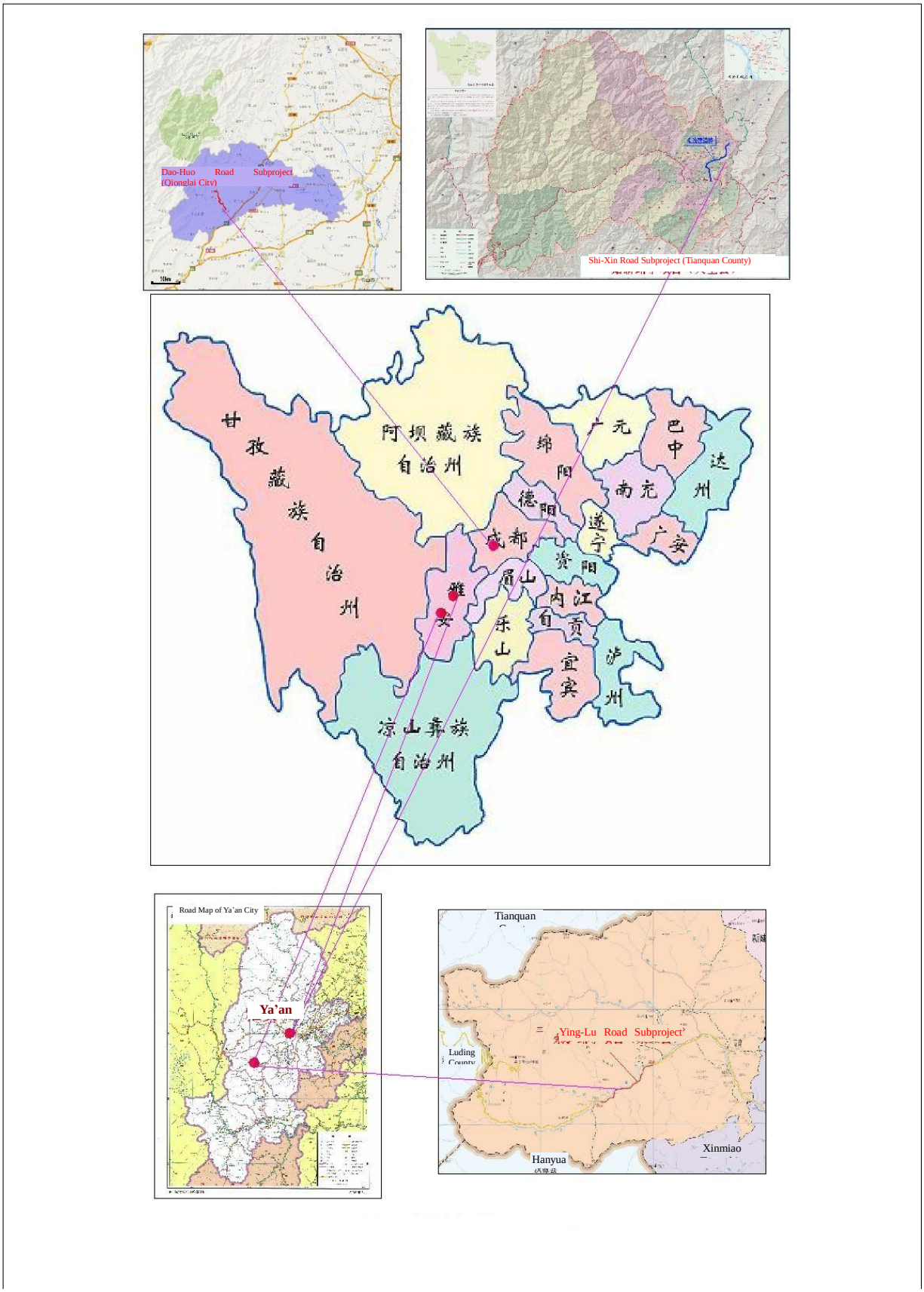


Fig. 2-1 Geological location of the Project

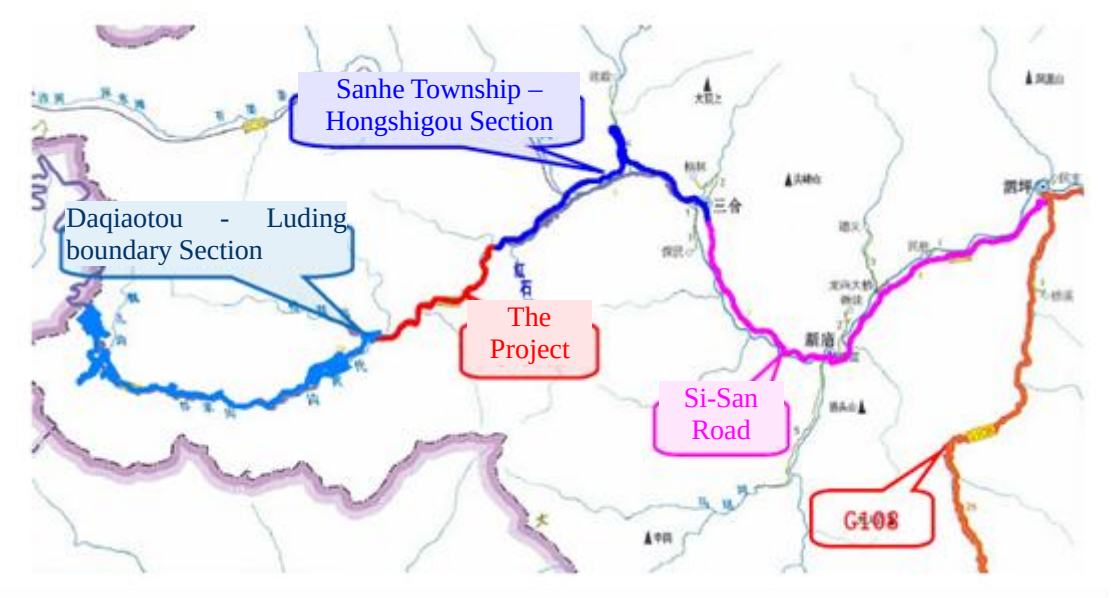


Fig. 2-2 Relation between the associated projects of Ying-Lu Road in Yingjing County

The relation between the Ying-Lu Road Subproject and the under-construction projects associated with it is as follows:

1 Preceding section (Sanhe Township Government to Hongshigou): in the Ying-Lu Road in Yingjing County, the rebuilt section from Sanhe Township Government to Hongshigou starts from the Sanhe Township Government at Pile No. K15+600 and ends at Hongshigou at Pile No. K25+960 which is connected to the starting point of this project. This subproject is scheduled to commence in early November 2016 and will be ready for traffic in May 2018. This subproject is funded by the government.

2 This project: (Hongshigou to Daqiaotou): the Ying-Lu Road Reconstruction and Expansion Project in Yingjing County of Ya'an City financed by the World Bank starts from Hongshigou of Sanhe Township in Yingjing County at Pile No. K23+260.000 at X176 and its starting point is connected to the end point of the Sanhe-Hongshigou Section. This road is built along a river. It ends at Daqiaotou where it is connected to the starting point of the Daqiaotou-Luding Section. The end point is at Pile No. K29+260.000. This road is totally 6.000km long. This project is scheduled to commence in early October 2016 and will be ready for traffic by the end of November 2017. The total investment on this project is estimated to be 50,588,982 yuan. This project will be funded by a loan from the World Bank.

3 Following section (Daqiaotou to Luding boundary): the rebuilt section from Daqiaotou to Luding boundary in the Ying-Lu Road in Yingjing County starts from Daqiaotou at Pile No. K31+120 where it is connected to the end point of the Hongshigou-Daqiaotou Section. It ends at Luding boundary at Pile No. K58+167.454 where it is connected to the existing X176. This subproject is scheduled to commence in early November 2016 and will be ready for traffic in May 2018. This subproject is funded by the government.

Table 2.1-1 Overview on the associated projects

S/N	Project name	Piles at starting and end points	Mileage (km)	Width (m)	Remarks
1	Reconstruction of the section from Sanhe Township Government to	K15+600.00~K25+960.00	10.360	6.5~7.5	

	Hongshigou in the Ying-Lu Road in Yingjing County				
2	Ying-Lu Road (Hongshigou to Daqiaotou) Reconstruction and Expansion Project in Yingjing County of Ya'an City	K23+260.00~K29+260.00	6.00	6.5	Broken chain installed at the connecting lines at start and end points
3	Reconstruction of the section from Daqiaotou to Luding boundary in the Ying-Lu Road in Yingjing County	K31+120.00~K58+167.454	27.04745	6.5~7.5	
Total			43.40745		

2.2 Project components

The works within the project scope financed by the World Bank are the following:

Table 2.2-1 Construction scale and works of Dao-Huo Road

Works		Construction contents and scale
Main works	Subgrade works	8.5m wide subgrade of main line, directional road with two lanes in each direction, subgrade cross section of 1.0m (shoulder)+ 2×3.25m (lane)+ 1.0m (shoulder); 5.5m wide subgrade of branch line, subgrade cross section of 0.5m (shoulder)+ 3.5m (lane)+ 0.5m (shoulder)
	Pavement works	**1 Main line:** Upper topping: fine-grain dense-graded modified asphalt concrete AC-13; middle topping: 7cm medium-grain asphalt concrete AC-20; base: 20cm cement stabilized macadam; sub-base: 25cm cement stabilized macadam; cushion: 20cm thick graded sand gravel cushion. **2 Branch line:** Upper topping: 4cmAC-13C modified asphalt concrete; middle topping: 5cmAC-20C plain asphalt concrete
	Bridge works	The whole line contains 5 bridges including 1 large bridge, 2 medium bridges and 2 small bridges which are all newly built.
	Culvert works	62 newly built bridges
	Level crossing	11 level crossings
	Traffic safety installations	The traffic safety installations include traffic signs, traffic markings, outlines, guardrail and speed bump
Temporary works	Production and living areas	3 construction sites will be furnished, occupying 0.63hm^2 of land area (0.34hm^2 farm land, 0.29hm^2 forest land); each construction site will contain fabrication yard and mixing station (cold mixing plan and batching plant)
		The construction camp will occupy rented private houses
	Spoil yard	2 spoil yards will be furnished which will temporarily occupy a land area of 3.14hm^2 (1.46hm^2 dry land, 1.68hm^2 forest land)
	Temporary surface soil storage yard	3 temporary surface soil storage yards will be furnished, occupying a land area of 0.70hm^2 (0.65hm^2 farm land, 0.05hm^2 forest land)
	Construction road	A 0.55km long and 6m wide access roads will be built. The road will temporarily occupy land area of 0.33hm^2 (0.24hm^2 dry land, 0.09hm^2 forest land)
Demolition and resettlement	Demolition of buildings	Demolition involves 6888.75m^2 of building area, including 2724.75m^2 of brick-concrete buildings, 2381m^2 of brick buildings and 1783m^2 of threshing ground; 4 tombs will be demolished.

	Residents resettlement	Demolition and resettlement in this project will be handled by the Qionglai City Government.

Table 2.2-2 Works in Ying-Lu Road Project

Works		Construction contents and scale
Main works	Subgrade works	The designed road length is 6km
		Total excavation volume is 103,800 m^3, including 42,900 m^3 of soil and 60,900 m^3 of rock. Total backfilling volume is 92,300 m^3 (rock) and borrowed material 31,400 m^3 (sand gravel); the surplus soil is planting soil which can be placed in the ambient farm land or transported to other work sites for land greening
		Before subgrade filling, the embankment base must be cleaned and compacted; the filled soil must be compacted in layers
		0.25m hard shoulder+ 3.0m lane+ 3.0m lane+ 0.25 hard shoulder, crown slope 1.5%, side ditch built of 40cm*40cm mortar blocks and pebbles; Based on the actual conditions of the original subgrade of the ordinary road, slope cutting plus facing wall or inclined cutting wall can be used at the left side, or widened subgrade plus bottom protection wall+ natural sloping or shoulder retaining wall can be used at the right side; special subgrade must be treated
	Pavement works	Plain cement concrete surface course is used; it is preliminarily proposed that the pavement structure layer is built of 22cm thick C30 cement concrete+ 20cm thick cement stabilized macadam base+ 20cm thick sand gravel cushion; the designed service life is 10 years under moderate traffic load; the concrete surface plate is 5m long; the maximum temperature gradient of the surface course is 88℃/m
	Bridge and culvert works	2 medium sized bridges in total length of 40m will be built and each bridge is built of single-span 20m pre-stressed hollow slab and gravity U-type abutment; at the medium bridge at K27+582.013, the designed flood level is 1522.5m and designed flood frequency 1/50; at the medium bridge at K27+808.171, the designed flood level is 1529.0m and designed flood frequency 1/50 The existing culverts in sound structural condition will be dredged and utilized, while the structurally damaged ones will be demolished and rebuilt; certain road sections will require additional culverts
	Crossing works	No major crossing will occur, but there will be 2 secondary crossings where the road will intersect tractor road or temporary road in residential area
	Traffic control	Traffic will be maintained by half-breadth construction method or intermittent passing; traffic control in the road construction sections must be put under overall planning, with intensified traffic organization to ensure traffic safety; prior to construction, the traffic control plan must be publicized; during construction, conspicuous signboards must be installed to inform the passing vehicles of the bypass routes
Temporary works	Construction site	1 construction site will be furnished at the K23+335 section. This construction site will occupy an area of 0.45 ha. in waste grassland and will contain parking lot, material storage yard and mixing field
	Construction road	A 246.2m long and 6.5m wide access road will be built, occupying an area of 0.16 ha. in waste grassland. This road will be used to transport the mixed material to the road construction area
Environmental protection works	Wastewater	1 latrine pit will be furnished; 1 construction site settling tank and 1 oil separation settling tank will be furnished; an interception and drainage system will be arranged along the construction road
	Waste gas	1 sprinkling truck and 1 car washing stand

Table 2.2-3 Works for Shi-Xin Road Subproject

Works		Construction contents and scale
Main works	Subgrade works	Rebuilt subgrade is 6.5m wide and 15.465km long; newly built road is 1.09km long (Xinmin Group 1 to Xinhua Township)
	Pavement works	Cement concrete 226,160m^2
	Bridge works	2 new bridges in 44m length

	Culvert works	33 new culverts
	Crossing works	14 level crossings
	Demolition and resettlement	Total demolished building area 2,194m^2
Auxiliary works	Construction site	4 construction sites, occupying 0.24hm^2 land area
	Traffic control	Road signs, markings
	Greening works	Grass planting on slope 2.86hm^2
	Protection works	Slope protection, side ditch, slope greening
	Spoil yard	2 spoil yards, occupying 2.62hm^2 land area

2.3 Overview of main works

Subgrade works: these include designed subgrade width, subgrade protection, subgrade/pavement drainage, bonding between old and new subgrade works, bridgehead subgrade, special subgrade, high-fill and deep-cut sections and subgrade greening.

Pavement works: these include main line pavement, branch line pavement and bridgehead pavement.

Bridges and culverts: bridge crossings will be arranged as it needs. The existing bridges will be repaired and utilized, but the damaged ones will be replaced. The structurally damaged bridges will be demolished and rebuilt. Certain road sections will require additional culverts.

Crossing works: Dao-Huo Road will have 3 level crossings; Ying-Lu Road has no major level crossing, but only 2 secondary level crossings; Shi-Xin Road has 14 level crossings.

2.4 Temporary works

The temporary works in this project include spoil ground, temporary soil storage yard, construction site (fabrication yard and mixing station) and access road.

Construction site: construction camp and construction plant

Access road: the spoil ground, mixing plant and the link between material transport road and the main line will require access roads.

Spoil ground: This project requires spoil yards. According to the applicable environmental protection laws and regulations, the spoil yardss in this project are subject to the following principles:

⑴ The spoil yards, with minimum occupancy of crop land, shall be far away from adverse geological conditions such as debris flow, landslide and collapse.

⑵ To minimize land occupancy by the haulage road, there should not be too great elevation difference between spoil pile and each road subgrade.

⑶ The spoil yard ground should be flat enough to meet the stockpiling requirements; the spoil amount shall be calculated section by section based on the type and quantity of excavated materials and the type and quantity of backfilling materials.

⑷ Based on the features of the road project, the distance to the spoil yard is to be no more than 15 km, so as to ensure that each construction lot has enough separate spoil yards and to avoid interference between different lots.

⑸ The spoils generated by blasting or other works and the spoils generated during excavation in temporary works, bridge excavation and cofferdam demolition must also be transported to and stockpiled in the spoil yards.

⑹ The spoil yards must keep a safe distance from the ambient buildings and farmland. Particularly when there is any important building, village or hydraulic facility downstream the spoil yard, the spoil yard must be located cautiously. Temporary land occupancy can be increased, if necessary, to prevent any major hazard or loss caused by destabilization of the spoil yard.

Temporary storage yard for stripped soil: during subgrade construction, this storage yard can be arranged at the locations along the subgrade line where the ground is flat and the elevation is approximate to the designed subgrade elevation or at the locations with level crossings within the land occupation scope. The surface soil storage yards will be concentrated to store the surface soil that is used for greening.

2.5 Earth-rock balance

The earth-rock balance principles for this project:

⑴ The earth-rock section balance nodes and the number of sections will be determined based on the landform and natural environmental features along the road and the cut/fill characteristics of the main works along the road.

⑵ In the case of a bridge at a river, if there is no nearby existing bridge crossing the river, this bridge is considered as a section node and the two Banks are separately considered for earth-rock balance.

⑶ Carry out as many reconstruction and expansion works as possible in this project, since there are numerous usable existing road sections and numerous urban/rural roads along the project line. Existence of such many roads makes it easy to optimize the earth-rock section balance nodes. In order to avoid overlong hauling distance for earth and rock which may increase construction difficulty and project investment, the spoil hauling distance should be reasonably reduced.

1 Dao-Huo Road

The total excavation volume of the whole road is 271,300m^3 (including 7,500m^3 of surface soil stripping), filling volume 87,100m^3, 7,500m^3 soil used for greening and disposed volume 176,700m^3 (natural soil). To convert the spoil volume to loose measure, the earth bulk factor is 1.33 and rock bulk factor 1.53. The total loose measure of spoil is 261,400m^3.

2 Ying-Lu Road

Total excavation volume is 103,800 m^3, including 42,900 m^3 of soil and 60,900 m^3 of rock. Total backfilling volume is 92,300 m^3 (rock) and borrowed material 31,400 m^3 (sand gravel). The total used volume is 42,900m^3 (soil). The surplus oil (42,900m^3) is planting soil which can be placed in the ambient forest land or transported to other work sites for land greening.

3 Shi-Xin Road

The total excavation volume of the whole road is 348,400m^3 (natural soil, same below), including 8,600m^3 stripped surface soil, 133,900m^3 excavated soil and 211,200m^3 excavated rock. The total backfilling volume is 237,700m^3, including 8,600m^3 recovered surface soil, 90,000m^3 locally excavated soil and 139,100m^3 locally excavated rock. The total spoil volume is 116,000m^3 (168,700m^3 loose measure), including 43,900m^3 disposed soil (53,400m^3 loose measure) and 72,100m^3

disposed rock (110,300m^3 loose measure). The stripped surface soil is mostly used for greening in the later stage of the project and the surplus rock volume will be used for subgrade protection and drainage.

2.6 Land occupation and resettlement

2.6.1 Land occupation

(1) Dao-Huo Road Subproject:

According to the feasibility report, the land types to be occupied by this project are dry land, vegetable field, forest land, waste land, rural residence land, existing roads and rivers. The recommended route of this project will occupy totally 25.24hm^2 land area. The permanently occupied land area is 20.44hm^2, including the 7.81 hm^2 land area of the existing roads and the 12.63 hm^2 of additionally occupied land area; the temporarily land area is 4.80hm^2.

(2) Ying-Lu Road Subproject:

This project will occupy 10.81hm^2 land area, including 10.20 hm^2 permanently occupied land and 0.61 hm^2 temporarily occupied land. The land area occupied by the existing roads is 2.70ha. and the additionally occupied permanent land area 7.50ha. Based on the field investigation, the land types to be occupied by this project are quite simple, including forest land, traffic land and waste grassland. The 7.5 ha. additionally occupied permanent land includes 3.95 ha. forest land and 3.55 ha. waste grassland; the 0.61ha. temporarily occupied land is all waste grassland. The preceding Sanhe-Hongshigou Section permanently occupies 384.87 *mu* land and the following Daqiaotou-Luding Section is 27.047km long; the additionally occupied land area is 0.6km^2.

(3) Shi-Xin Road Subproject:

The total occupied land area is 26.41hm^2, including 23.55hm^2 permanently occupied land (mostly occupied by subgrade and pavement which also account for bridges and culverts) and 2.86hm^2 temporarily occupied land (0.24hm^2 for 4 construction sites and 2.62hm^2 for 2 spoil grounds). The land types to be occupied by this project include miscellaneous land, farmland, forest land, residential land and traffic land. The miscellaneous land is 8.05hm^2, farmland 6.39hm^2, forest land 4.78hm^2, residential land 0.73hm^2 and traffic land 6.46hm^2.

2.6.2 Demolition and resettlement

1 The 3 subprojects will require demolition of totally 8,234m^2 building area. The Dao-Huo Road will involve demolition of totally 6,410m^2 building area, including 1,180m^2 of brick-concrete buildings, 4,920m^2 of brick-wood buildings and 310m^2 of makeshift houses. No building of earth-timber-structure will be demolished. Such demolition will affect 35 peasant households of 142 people. The Shi-Xin Road will involve demolition of totally 1,824m^2 building area, including 1,654m^2 of brick-concrete buildings and 170m^2 of makeshift houses. No building of frame structure, brick-wood structure or earth-timber-structure will be demolished. Such demolition will affect 15 peasant households of 70 people. The Ying-Lu Road will not involve any building demolition. The 2 associated projects in reconstruction/expansion of the Ying-Lu Road in Yingjing County, i.e. reconstruction of the section from Daqiaotou to Luding boundary and reconstruction of the section from Sanhe Township Government to Hongshigou, will not involve any building demolition.

2.7 Project schedule and construction organization

2.7.1 Project schedule

Construction of the Dao-Huo Road is scheduled to start from June 2016, with construction period of 12 months, and it will be completed for trial run in July 2017; construction of the Ying-Lu Road is scheduled to start from October 2016, with construction period of 14 months, and it will be in service in November 2017; construction of the Shi-Xin Road is scheduled to start from September 2016 and it will be completed in February 2018.

2.7.2 Construction organization

(1) Construction conditions

① Site conditions

The field investigation indicates that this project will be executed in flat areas with favorable construction conditions.

② Traffic conditions

The project area already contains several existing roads, thus this project will be supported by favorable traffic conditions where the purchased materials, food and equipment/machinery can be easily transported.

③ Effects of climatic conditions on construction

The project location is within the northern sub-tropic humid monsoon climate zone. As long as construction activities are properly scheduled, works can be carried in all four seasons, for the climatic conditions are benign for construction.

④ Road paving materials

The project area contains well developed road network where the paving materials can be transported to the work site via the rural roads in all directions. This project will consume large amount of materials and all materials must be sampled and tested. The sand, gravel, pebbles, cement and lime required can be purchased near the subproject locations. Both Qionglai and Ya'an cities can supply ample steel, timber, asphalt, lime, cement and sand.

(2) Construction organization and management

This project will be executed in long mileage. To guarantee high quality and fulfill the schedule, a proficient and efficient management body must be established to strictly control the construction progress and quality. The road sections will be divided in a number of construction units based on the work quantity, degree of difficulty and work schedule. The Construction Contractor will be hired through public bidding, in which way a highly qualified construction team will be employed to guarantee project quality and minimize project cost.

The project must follow the policy of "quality is always the top priority" and the quality-related national laws; the legal person responsibility system, bidding and tendering system, supervision system and contract management system will be implemented; quality management will be intensified by establishing an effective quality management system.

1 Legal person responsibility system

The legal person responsibility system is intended to enhance the responsibility awareness of the contractor and guarantee high quality.

2 Bidding and tendering system

⑴ Bidding scope

To guarantee high quality, fulfill the schedule and minimize costs, project design, civil works, equipment installation, traffic works and equipment procurement must all be executed in accordance with the national law on bidding and tendering and public bidding and tendering will be staged to hire the designer, contractor, supervisor and equipment manufacturer.

⑵ Bidding organization

Bidding will be organized by the Employer or his agent based on the actual conditions with the domestic bidding approach. The bid evaluation body will be constituted by the tenderee and the bid evaluation committee. Said committee will perform bid evaluation independently. The experts to constitute the survey and design bid evaluation committee will be randomly selected from the experts pool; the experts to constitute the construction bid evaluation committee will be randomly selected from the bid evaluation experts pool; the number of said experts will depend on the number of projects in each bidding and the project characteristics.

3 Project supervision system

According to the regulations of the Ministry of Transport on construction high-class roads, this project will require a supervision system as stipulated by the international FIDIC rules and the Supervisor will be hired through public bidding. The Supervisor must possess a valid qualification certificate and must assign proper supervision organization, personnel and equipment to the work site. The supervision personnel must possess proper certificates, must fulfill the supervision contract in accordance with the applicable laws, regulations, technical standards and norms and must abide by the professional ethics.

4 Contract management system

A stringent contract management system will be implemented to ensure the Construction Contractor executes construction in strict accordance with the contract, so as to guarantee high quality, fulfill the schedule and minimize investment and costs.

The Construction Contractor must possess the qualification and credit status required for the bidden project. A competent project management team will be established based on the contract and the technical norm of the project; a quality self-inspection system of “overarching, thorough and effective control” will be implemented; construction will be executed in accordance with the construction organization design and stage schedules; subtracting and illegitimate subletting are prohibited; the directives of the Supervisor must be faithfully executed.

3.0 Analysis of the Project and Comparison of the Schemes

3.1 Analysis of the environmental issues

This project consists of three subprojects: Dao-Huo Road in Qionglai City, Ying-Lu Road in Yingjing County of Ya’an City and Shi-Xin Road in Tianquan County of Ya’an City. The associated projects (the section from Sanhe Township Government and Hongshigou and the section from Daqiaotou to Luding boundary) of Ying-Lu Road will involve road reconstruction. In general, the environmental issues are mainly the adverse environmental impacts during construction and operation, including permanent and temporary occupancy of land by the project, effects of excavation on water bodies and vegetarian and the vehicle noise, vehicle exhaust and wastes present during construction and operation.

Table 3.1-1 Analysis on the pollution in the project

Stage	Impacted factors	Source and elements of impact	Main pollutants and impact factors	Impacted location	Impact level	Impact nature
Construction period	Ecological environment	Construction, land acquisition	Vegetation destruction, soil erosion and water/soil loss resulting from earth/rock works	Construction area	Serious	Short-term
	Acoustic environment	Transportation/construction machinery	Construction noise	Construction area	Severe	Temporary, during construction
	Atmospheric environment	Dust; exhaust gas from construction machinery	CO, NO_2, PM_{10}	Construction area	Severe	
	Water environment	Construction wastewater, domestic sewage, machinery discharged oily wastewater	SS, CODcr, petroleum	Construction road	Serious	
Operation period	Acoustic environment	Travelling vehicles	Traffic noise	Along the road, in parking lot	Severe	Long-term
	Atmospheric environment	Vehicle exhaust	CO, NO_2	Along the road, in parking lot	Serious	
	Water environment	Rainwater runoff on road surface	CODcr, SS, petroleum	Receiving water bodies along the road	Slight	
	Social environment	Utilization of land and resources; traffic network		Project impacted areas	Noticeable	
	Solid waste	Scattered during transportation	Spoil	Along the road	Slight	

3.2 Process flow in construction period

The road construction processes are the following:

Route selection—→survey and design—→land acquisition—→setting out—→subgrade excavation and filling—→bridge construction—→slope protection—→pavement works—→traffic works—→completed and ready for traffic—→operation and management

The processes and waste producing works are shown below.

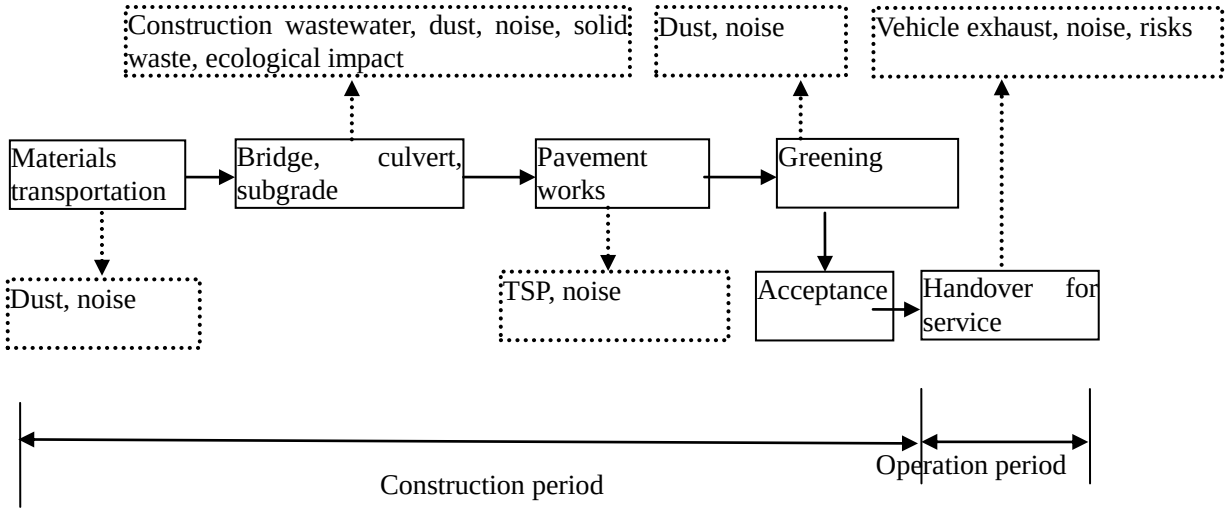


Fig. 3.2-1 Diagram of work processes and pollutant production

Road construction in the Project mainly includes land requisition, resettlement, earth and stone works, subgrade and pavement works, drainage works, greening works, etc. The construction processes and waste producing works in this project are as follows:

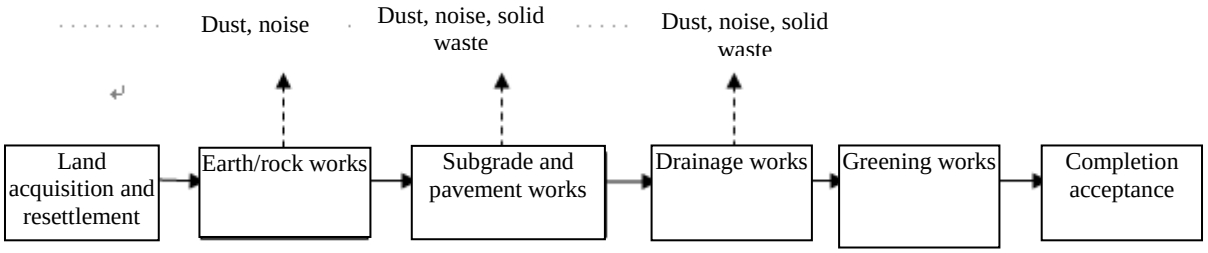


Fig. 3.2-2 Project road construction technology process and locations of pollutant production

The road construction works are summarized as follows:

(1) Earthworks and stoneworks for subgrade

The earthworks and stoneworks for subgrade is are primarily executed by machinery and secondarily by human labor.

The excavated road sections, with their lengths and work quantities determined, will be executed by bulldozers or excavators in multiple faces. The soil will be transported by loaders and dump trucks to the filling sections or temporary spoil ground; or carry-scrapers can be used to perform excavation and transportation continuously.

The filling road sections will be leveled by loaders or bulldozers with the help of human labor and will be compacted by road rollers.

(2) Pavement works

The materials for pavement will be mechanically mixed by the mixing station. The base and sub-base will be paved by the spreader layer by layer and compacted by the road roller; each surface course will be sprayed with layer-penetration oil by the oil distributor; the spreader will cast the asphalt mixture with the help of the dump truck and the paving material will be compacted by the road roller.

Environmental impacts of pavement works: the proposed project will use asphalt concrete pavement. Cooking, mixing and spreading of asphalt will produce asphalt fume which contains polyaromatic hydrocarbon, benzo a-pyrene and other hazardous substances, thus loss of asphalt during transportation will result in waste of resource

and environmental impact. Besides, the noise of hot mixing station and transport vehicles will generate noise.

(3) Bridge works

Bridge construction: the road bridges are usually built of prefabricated components, to reduce difficulty.

Bridge construction processes: construction site leveling→ foundation construction (hole drilling)→ bridge superstructure. The process to result in water/soil loss is excavation of the downstream abutment foundation. The bridges in this project are mostly built upon pile foundation. The processing of installing cast-in-situ bored piles is the pollutant producing process and the other processes are largely the same. The processes are shown below:

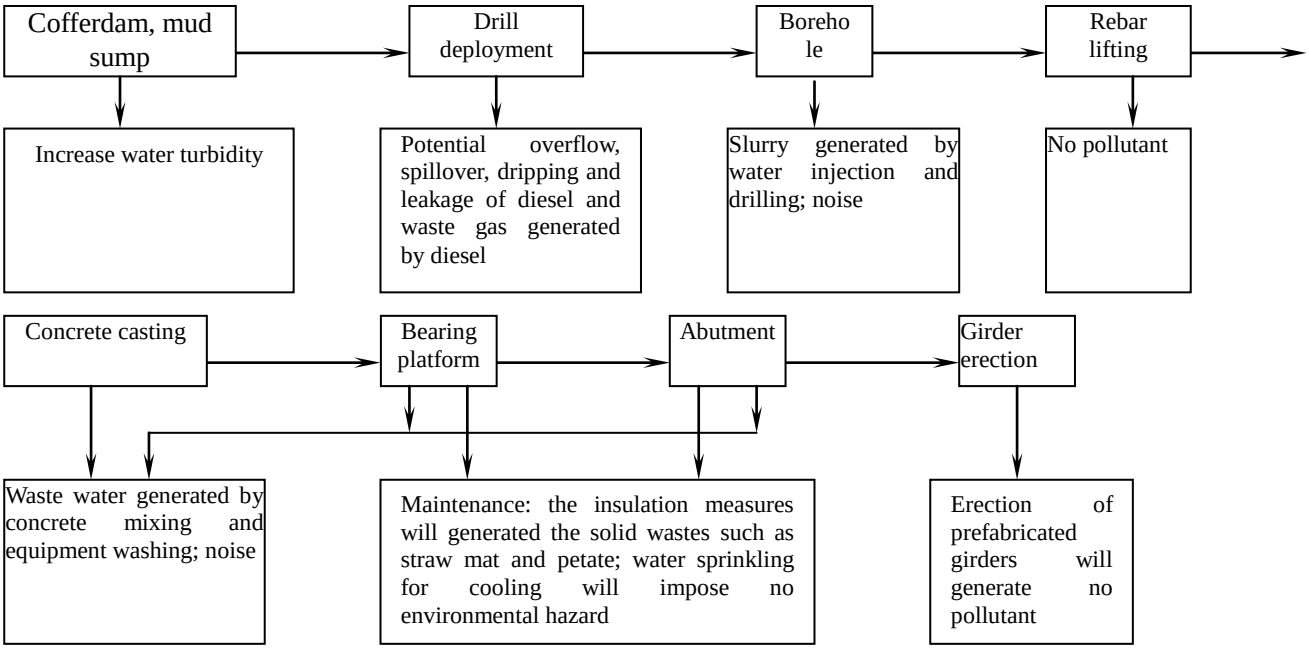


Fig. 3.2-3 Bridge construction process flow diagram

Bridge and culvert works should preferably be executed during dry seasons. The excavated materials must be transported to the specified spoil ground. The Daozuo-Huojing Road Subproject has two spoil yards. Spoil yard 1# is located to the left of pile K0+100 and spoil yard 2# is 200m to the right of the pile K9+700. The spoils from Zhaigou Bridge and Shichang Bridge are stored in spoil yard 1# and other spoils from other works are stored in spoil yard 2#. The Yingjing-Luding Road Subproject needs no spoil yard. The surplus rock will be used for backfilling and the surplus soil will be as planting soil for greening of the ambient area. To avoid and minimize the suspended solid pollutants in the surface runoff at the in-water bridge pier construction site, an intercepting channel will be built at the pile foundation construction site to divert the SS polluted water to the emergency settling tank for sedimentation and recycling. The bridge construction camp and materials storage yard shall not be located anywhere as can be inundated by river water, to prevent the domestic wastewater and production wastewater from entering and polluting the water body.

3.3 Process flow in operation period

This is a road construction project that does not involve any operation process.

3.4 Analysis on main impact sources in the construction period

3.4.1 Social environment

1 Land requisition and resettlement

The 3 subprojects will require demolition of totally 8,234m^2 building area. The Dao-Huo Road will involve demolition of 6,410m^2 building area, which will affect 35 peasant households of 142 people. Shi-Xin Road will involve demolition of 1,824 m^2 building area, which will affect 15 peasant households of 70 people. Ying-Lu Road will require no building demolition. The 2 associated projects in reconstruction/expansion of the Ying-Lu Road in Yingjing County, i.e. reconstruction of the section from Daqiaotou to Luding boundary and reconstruction of the section from Sanhe Township Government to Hongshigou, will not involve any building demolition.

2 Construction activities

Occupancy of the existing roads due to the access of construction vehicles will impact the residents' travel in the region, especially that some of the existing roads in the region will become the main road sections in the construction period; the construction vehicles in the Project will cause dust pollution which will reduce the living quality of neighboring residents; besides, construction noise and traffic noise will also impact the residents in the project area and the pipe network area. The project will mostly affect the residents within 100m around the construction area.

The project will primarily use the existing roads in the region to ensure the personnel's access to the project region. Emission of the industrial wastewater, domestic sewage, domestic refuse and domestic solid waste on the construction site and the behaviors of the construction personnel may have different levels of impact on the daily life of the local villagers.

3.4.2 Ecological Environment

The impact resulting from land occupation by the project is irreversible.

Earth/rock excavation and subgrade filling in this project will damage the vegetation along the road, disturb the vegetation and soil and leave the earth surface exposed, thus partially altering the ecological structure of the project area to certain extent. The exposed earth surface resulting from excavation will be subject to water/soil loss under the effect of rainwater and surface runoff.

During construction, the land temporarily occupied by this project is used for construction site and temporary soil storage yard. Such temporary land occupation for construction will directly disrupt the surface vegetation, thus reducing the biological diversity of the biocenosis.

There is small number of fish and few fish species in the surface water bodies, thus project construction will have little impact the fish, but will mostly impact the plankton and benthic organisms.

Greening and landscaping on both sides of the road will compensate for the vegetation loss to great extent.

3.4.3 Acoustic environment

Noise pollution during the construction mainly comes from construction machineries. The intensities of pollution sources are listed in Table 3.4-1 according to the measured data of common machineries.

Table 3.4-1 Tested noise values of road construction machineries

S/N	Machinery type	Model	Distance between the test point and construction machinery (m)	Maximum sound level L_{max}(dB)

S/N	Machinery type	Model	Distance between the test point and construction machinery (m)	Maximum sound level L_{max}(dB)
1	Wheel loader	XL40	5	90
2	Wheel loader	XL50	5	90
3	Grader	PY160A	5	90
4	Vibratory roller	YZJ10B	5	86
5	Duel-drum double-vibration roller	CC21	5	81
6	Three-wheel roller		5	81
7	Pneumatic tyre roller	ZL16	5	76
8	Bulldozer	T140	5	86
9	Hydraulic wheel excavator	W4-60C	5	84
10	Spreader (UK)	Fifond311ABG CO	5	82
11	Spreader (Germany)	VOGELE	5	87
12	Generator set (two sets)	FKV-75	1	98
13	Impact type well drill	22	1	87

The data listed above were measured under the full-load operation condition of the machineries.

Travels the transport vehicles during the construction period will be intermittent, thus their impact will only be temporary. Therefore, the added noise impacts above will be reduced or eliminated completion of construction.

3.4.4 Ambient air

1 Asphalt fume

Of the three subprojects, only the Dao-Huo Road Subproject has an asphalt concrete pavement; asphalt batching plant will not be provided on the construction site; asphalt concrete is directly outsourced. Asphalt fume is caused by hot oil evaporation during paving and has a small impact on the environment.

2 Dust pollution

Dust pollution mostly occurs during the works such as lime mixing, concrete mixing and earth/rock excavation and backfilling. Dust is generated by transport vehicles travelling on the roads, materials loading/unloading and works in construction area. The primary pollutant is TSP.

3.4.5 Water environment

The construction camp in this project will use the rented local private houses and the domestic wastewater generated by the construction personnel will be discharged into the existing drainage pipe network, thus imposing no pollution to the river water.

The production wastewater generated during construction mostly comes from the fabrication yard, construction machinery washing and concrete curing. The primary pollutant is SS and there is also small volume of petroleum. The construction wastewater will be treated in the oil separation and sedimentation processes and then will be used for concrete curing or directly discharged, thus causing only slight pollution to the water environment.

3.4.6 Solid waste

The solid wastes generated during construction are mostly waste soil/rock, construction garbage, river sludge and domestic refuse generated by the construction personnel. The structures to be demolished are mostly brick buildings, tile-roofed houses and fence walls.

The construction wastes generated from building demolition will be transported to the nearby urban wastes disposal center. If the maximum number of resident construction personnel in each subproject is 150 and domestic waste amount is 1.0kg per person, domestic waste will be generated at the rate of 150kg/d in each subproject.

3.5 Analysis on environmental impacts during operation period

3.5.1 Ambient air

During the operation period, the atmospheric pollutants are mainly exhausts of travelling vehicles. The average daily emission of the pollutants in vehicle exhaust can be calculated by the following formula:

$$Q_J = \sum_{i=1}^{3} 3600^{-1} A_i E_{il}$$

Where: Q_J—the intensity of pollutant source J discharged by vehicles travelling at certain speed, mg/(m·s).

A_i— traffic volume of i type vehicle per hour, Nr./h.

E_{il}—discharge coefficient of individual vehicle, i.e., quantity of pollutant J discharged by individual i type vehicle travelling at certain speed, mg/Nr.·m.

According to *Limits and Measurement Methods for Emissions from Light-duty Vehicles (Stages III and IV in China)* (GB18352.3-2005), if the currently applicable automobile emission standard is far more rigorous than the environmental impact assessment norm issued for the road construction project, the emission factor for individual vehicle is 50% of the value specified in Table D1 under Appendix D of JTG B03-2006, where NO_2 value is 80% of NOx value.

3.5.2 Acoustic environment

The noise pollution during the operation period mostly comes from the travelling vehicles. According to the *Specifications for Environmental Impact Assessment of Highways* (JTG B03-2006), the average noise radiation level of each type of vehicle travelling at various speeds is to be calculated by the formulas in Table 3.5-1.

Table 3.5-1 Average noise radiation level of each type of vehicle

Vehicle type	Average noise radiation level (dB)	Remarks
Large-sized vehicle	12.6+34.73lgVs	V_L—the average travelling speed of large-sized vehicle
Medium-sized vehicle	8.8+40.48lgVM	V_m—the average travelling speed of medium-sized vehicle
Small-sized vehicle	22+36.321gVL	V_s—average running speed of small-sized vehicle

The average noise radiation levels of small, medium and large sized individual vehicles calculated by the aforementioned formulas for the predicted time periods for this project are shown in Table 3.5-2 and Table 3.5-3.

Table 3.5-2 Individual vehicle speed calculated based on average traffic volume per hour in day and night (km/h)

Prediction year	2017		2023		2031	
Vehicle type	Day	Night	Day	Night	Day	Night
Small-sized vehicle	25.41	25.48	25.25	25.46	25.14	25.45
Medium-sized	17.60	17.34	17.91	17.43	18.07	17.48

vehicle						
Large-sized vehicle	17.65	17.47	17.88	17.53	18.00	17.56

Table 3.5-3 Average noise emission source intensity of each type of vehicle (dB)

Prediction year	2017		2023		2031	
Vehicle type	Day	Night	Day	Night	Day	Night
Small-sized vehicle	61.39	61.44	61.30	61.43	61.23	61.42
Medium-sized vehicle	59.22	58.96	59.53	59.05	59.68	59.10
Large-sized vehicle	67.28	67.12	67.49	67.17	67.59	67.20

3.5.3 Environment

In the operation period of the Project, the pollution to the nearby water areas mainly comes from pavement runoff. If a vehicle is in a poor maintenance condition, broken down or in an accident, it may leak gasoline or engine oil which pollutes the pavement. After rainfall, the rainwater will flow via the road drainage ditch into the nearby water areas, resulting in petroleum and COD pollution.

3.5.4 Solid waste

This project will not directly generate solid waste during its operation period, but the passing-by vehicles may leave garbage on the road. Such garbage will be cleaned by sanitation workers and transported to the nearest waste transfer station.

3.6 Comparison of the schemes

3.6.1 Comparison of the schemes for Dao-Huo Road Subproject

1 Line K scheme

The route starts from and is arranged along the existing road route. It passes Shichangzi, Dashiqiao, Hualongmen, Zhaigou Village, Shilongmen, Diaogang Mountain and Sanhe Village. Then it continues along Xiaoxi River and then passes Qiangtougou and Lijiaba. Then it crosses a river and reaches Yapeng Village. Then the route continues northward and passes Yangpo, Hangou and Hanshiti. Eventually it crosses with Huojing Raochang Road at Hongyantou. The route length is 12.172km.

2 Line A scheme

The route starts from Hualongmen and it passes Zhaigou Village and a tunnel in Diaogang Mountain. Then it ends at Xinfangzigoutou in Sanhe Village. The route is totally 1.962km long.

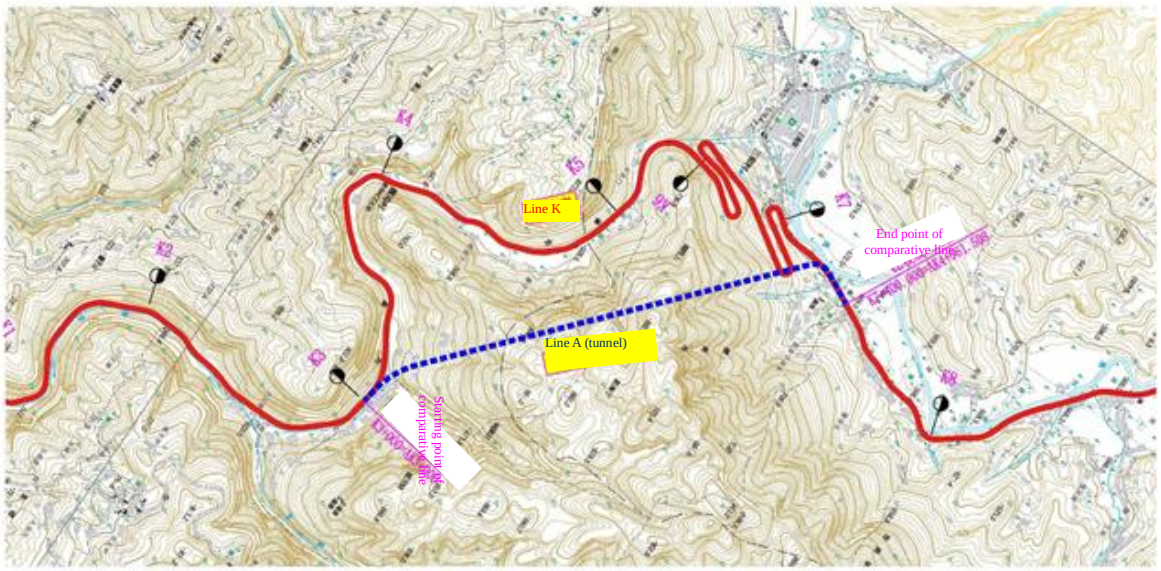


Fig. 3.6-1Routes of lines A and K

3 Line K scheme under line A scheme

The route starts from Hualongmen. It goes upward through Zhaigou Village and then goes downward in switch-back curves. It ends at Xinfangzigoutou in Sanhe Village. The route is totally 3.4km long.

4 Comparison between line A and line K

Line A scheme is based on an optimized route that minimizes environmental disruption and enhances the anti-seismic capacity of the road. The technical and economic indexes are given below:

Table 3.6-2 Construction scale and main technical and economic indexes of lines A and K

S/N	Project works		Unit	Line A scheme	Line K under line A scheme	Remarks
1	Start and end point pile No.			AK3+000.000~AK4+961.508	K3+000.000~K7+400.000	
2	Route length		km	1.962	3.4	
3	Maximum longitudinal slope		%			
4	Number of horizontal curves		Nr.			
5	Minimum radius of horizontal curve	Common curve	m			
		Switch-back curve	m			
6	Additional permanently occupied land		mu	2.0	187	
7	Demolition of buildings		m^2	1031	1171	
8	Priced earth and rock	Earth	10^4 m^3	0.41	2.70	
		Rock	10^4 m^3	1.62	10.79	
		Mixed filling of earth and rock	10^4 m^3	0.07	0.48	
9	Subgrade drainage and protection	Drainage	10^4 m^3	0.032	0.2913	
		Protection	10^4 m^3	0.1359	1.1323	
10	Pavement works		m^2	4120	36990	
11	Large bridge		m/Nr.			
12	Medium and small bridges		m/Nr.			
13	Culvert		m/Nr.	65.8/7	240.6/20	

S/N	Project works	Unit	Line A scheme	Line K under line A scheme	Remarks
14	Tunnel	m/Nr.	1547/1		
17	Traffic works and road installations	km	1.962	3.4	

Line K under line A scheme

⑴ Advantages:

① The existing roads are adequately utilized; ② it is easy for the villages in Zhaigou Village to travel; ③ less project investment is required.

⑵ Disadvantages

①There 4 switch-back curves at Diaogang Mountain and the route is poorly arranged and long; ②large quantity of subgrade works; ③immense environmental impact; ④ anti-seismic capacity of the road is poor.

Line A

⑴ Advantages:

①The route is shorter; ②the route is better arranged; ③the route passes through a tunnel in Diaogang Mountain and the road has better anti-seismic capacity; ④less environmental impact; ⑤less occupied land.

⑵ Disadvantages

① Project investment is higher; ② it is not easy for the villagers in Zhaigou Village to access Dao-Huo Road.

Result of comparison: line A is better arranged and shorter, it has less environmental impact and better anti-seismic capacity and it occupies less land. However, this route requires more one-time investment and it has less use for time he villagers in Zhaigou Village. Therefore this route can be treated as a long-term scheme. Based on the investment and funding plan for this project, line K is recommended.

3.6.2 Comparison of the schemes for Ying-Lu Road Subproject

1 This project is reconstruction of the existing road and the project area presents complex topographical and geological conditions. The original road route is arranged along a river. Its one side is a mountain and the other side is cliff. Due to the limitation of funding, it is impossible to change the route and only one route is feasible, thus there is no need for comparison of alternatives.

Based on the actual conditions of the road, the geographical characteristics of the project area and the experiences from similar projects, it is proposed to compare the schemes for subgrade width and pavement.

2 Comparison of subgrade widths

X176 starts from Sanhe Township and ends in Yingjing County. The current pavement is clay bound macadam, the current subgrade width is 3.5~6.5m and the subgrade width of most road sections is 4.5m. The feasibility study proposes two schemes: 4.5m wide subgrade plus turn-out lane or 6.5m wide subgrade.

(1) 4.5m wide subgrade plus turn-out lane

The whole route is a Class 4 single-lane road, the 4.5m wide subgrade comprises 0.25m hard shoulder+ 4.0m lane+ 0.25m hard shoulder, crown slope is 1.5% and side ditch is built of 40cm×40cm mortar blocks and pebbles.

Advantages:

① Adequate use of existing subgrade, less land occupation, less than environmental impact

② Few road sections need to be widened, hence less quantity of earth/rock works and protection works and less construction cost

Disadvantages:

① The 4.5m wide subgrade gives poor traffic conditions and bears small traffic volume, thus failing to meet the traffic requirements.

② The separated turn-out lanes result in high probability of traffic accident at those points where vehicles meet, particularly at a mountain road with poor visibility.

If the subgrade is 4.5m wide, the bridges, culverts and protection features existing along the route will be useless during construction of the provincial road S433 and demolition and reconstruction of such installations will be repeated works that result in serious waste of fund and exacerbate the environmental impact. From the aspect of environment protection, this is infeasible.

(2) 6.5m wide subgrade

The whole route is a Class 4 double-lane road, the 6.5m wide subgrade comprises 0.25m hard shoulder+ 3.0m lane+ 3.0m lane+ 0.25m hard shoulder, crown slope is 1.5% and side ditch is built of 40cm×40cm mortar blocks and pebbles.

Advantages:

① The 6.5m subgrade offers comfortable traffic conditions, thus meeting traffic requirements.

② On a double-lane road, vehicles meet without any rick, the road provides better traffic conditions and service and it is benign for the safety of vehicles and pedestrians.

③ This alternative is more conformant to *Common Provincial Road Network Planning of Sichuan (2013-2030)* and the approved *Feasibility Study Report on Siping-Luding Section of Provincial Road S433*. During upgrade of a county road to a provincial road, most of the existing bridges (the two bridges will be rebuilt to accommodate the 8.5m wide Class 2 road), culverts and subgrade protection features cal be utilized, to avoid repeated works and waste of fund; the secondary pollution and impact can be avoided, which is benign for environmental protection.

Disadvantages:

① Although the existing subgrade is fully utilized, the original road is too narrow, therefore it needs to be widened and requires slightly more land occupation, presenting slight environmental impact.

② Compared with the 4.5m subgrade, the widened road will increase earth/rock works and protection works, thus increasing cost.

Based on the actual conditions of this project and in order to in line with the regional road network development plan, to avoid waste of fund and secondary environmental pollution resulting from repeated works in upgrade of county road to provincial road, to enhance ride comfort and general service capacity of the road and to facilitate environmental protection, the 6.5m wide subgrade is recommended.

3.6.3 Comparison of the schemes for Shi-Xin Road Subproject

The Shi-Xin Road Project (Xinmin-Yong'an section) in Tianquan County is post-disaster reconstruction of the original road and only partial road sections will be redesigned and rebuilt to prevent subgrade scouring. Scheme K involving expanded line along existing road has a large longitudinal slope east of the road section in Daping Township, many switch-back curves and a great amount of relocation. To address these issues, another new road may be selected which is arranged as close to Daping Township as possible to facilitate long-term development of Daping Township. Therefore, the feasibility study recommends Scheme K.

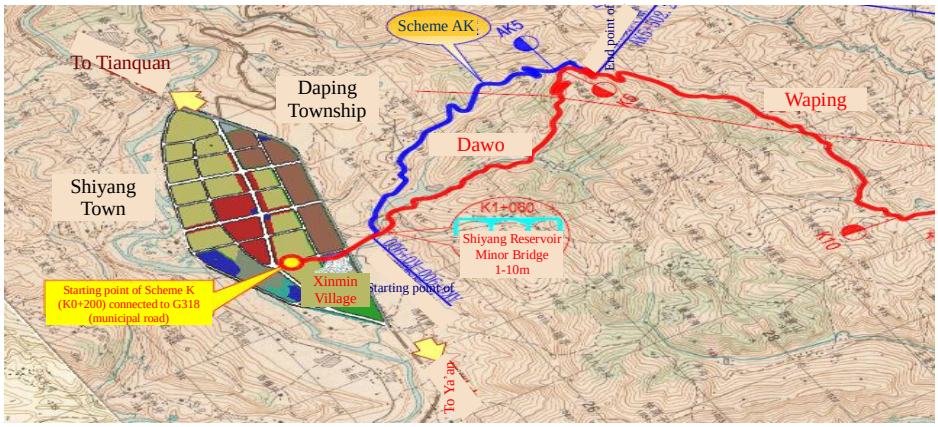


Fig. 3.6-2 Schematic diagram of comparison of Schemes AK with K

By comparison, AK route is 377.795m shorter than K route but with larger quantities of work and poorer construction conditions. Moreover, the recommended K route occupies less new land than AK route. From the perspective of environmental protection, Scheme K is apparently better than AK, thus recommending Scheme K.

Comprehensive comparison shows K route, though with a longer mileage than A route, has obvious advantages in terms of construction conditions, costs and promoting economy along the route, etc. After comprehensive consideration, K route is recommended.

Comparison of Schemes K with CK

Scheme C has some advantages in horizontal and longitudinal indicators, but in respect of connection of roads in Shiyang Town, Scheme K is more convenient, makes use of existing road and saves costs of civil works with less total investment. Meanwhile, Scheme K has a shorter route and can save land. The feasibility study recommends K route.

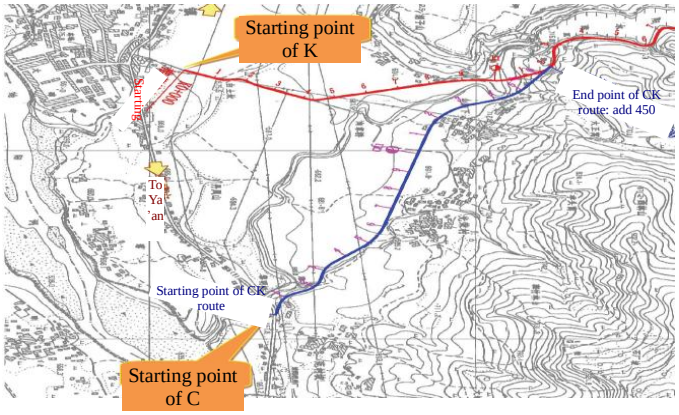


Fig. 3.6-3 Schematic diagram of comparison of Schemes CK with K

By comparison, K route is 450m shorter than CK route which has higher construction costs and larger quantities of earthwork. From the perspective of environmental protection, K route is apparently better than CK route, thus recommending K route.

Through comprehensive comparison, K route is recommended.

Comparison of Schemes K with B

The two schemes have basically the same construction costs. BK route is shorter, but taking into account the connection of the whole network, K route is more compliant with planning and more conducive to urban development and vehicle access. Therefore, the feasibility study recommends Scheme K.

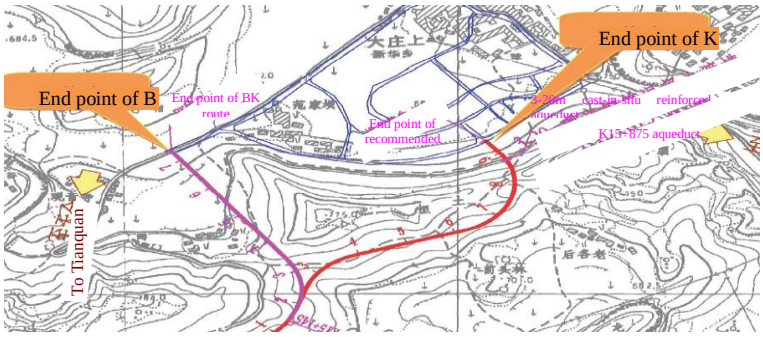


Fig. 3.6-4 Schematic diagram of comparison of Schemes BK with K

By comparison, K route has larger quantities of earthwork than BK route. In addition, the recommended K route occupies more land than BK route. From the perspective of environmental protection, BK route is better than K route, thus recommending B route.

Through comprehensive comparison, K route is recommended.

The feasibility study proposes the line K. This route is largely in south-north direction. It starts from G318 (pile No. K0+000.000) at Xinmin Village in Shiyang Town of Tianquan County. From south to north, it passes Shiyang Reservoir, Dawo and Apomiao. It ends at Xinhua Ring Road. It is totally 16.555km long. Rebuilt road is 15.465km and newly built road 1.09km.

From the aspect of environmental protection, reconstruction of the existing road results in less permanent land occupation, less earth/rock works and water/soil loss and less vegetation destruction. However, this scheme is limited by the geological hazards. For the sake of environmental protection, the proposed scheme is feasible.

4.0 Environmental Overview and Status Quo Assessment

4.1 Overview of natural environment

4.1.1 Geographical location

1 Qionglai City

Qionglai City is located in the middle region of Sichuan Province, to the southwest of Chengdu Plain, and its total area is 1,384km^2. The total population is 660,000. This city governs 18 towns and 6 townships. Daozuo Township is 25km distant from Qionglai City, it is located in a mountain area, its land area is 30.5 km^2 and its cultivated land area 8,657 mu; it governs 7 natural villages, 88 villager groups and 2516 households of 8,688 people. It is one of the old revolutionary base areas. Huojing Town is 31km to the west of Qionglai City, it is an important town in the tourist route to the Tiantai Mountain (a nation-level scenic spot) and it is one of the old revolutionary base areas and one of the ten ancient cultural towns in Sichuan. The land area of the town is 31.78km^2, the maximum elevation there is 1,175m and minimum elevation 564m.

2 Sanhe Township in Yingjing County

Sanhe Township is located at 102°53′31″~103°53′32″E and 29°53′48″~29°55′50″N. It

is located in the west region of Sichuan Province, to the southwest of Ya'an City and to the west of Yingjing County. It neighbors Xinmiao Township and Xinjian Township to the east, Xinmiao Township to the southeast, Sanjiao Township of Hanyuan County of Ya'an City to the south, Xinglong Township of Luding County of Ganzi Prefecture to the west and Lianglu Township of Tianquan County of Ya'an City to the north. The People's Government is set at Feishui Dam at Nanlin Village and is 51km distant from Yingjing County.

3 Tianquan County

Tianquan County is located at the western fringe of Sichuan Basin, at the eastern foot of Erlang Mountain and upstream of Qingyi River. Its geographic coordinates are 102°16′~102°55′E and 29°49′~30°21′N. It is 60km long in east-west direction and 50km wide in north-south direction. It neighbors Lushan County and Yucheng District of Ya'an City to the east, Yingjing County to the south, Luding County and Kangding County to the west and Baoxing County to the north. The county is 180km distant from Chengdu and 38km distant from Ya'an.

4.1.2 Overview of landform

Qionglai City is located in the mountainous area at the southwest fringe of Chengdu Plain. The road will cross geomorphic units. First one is a low mountain area that is featured with denudational-erosional landform; the valleys there cut deep and meander frequently; bank slopes and gullies are highly developed, forming in arborized shape; low-lying areas such as valleys are mostly covered by accumulative formation and relatively flat; the road will be routed along the flat area at the bottom of such valley. The other one is hilly area that is featured with erosional-denudational landform; it has flat terrain, with relative height difference of 5~25m; this area contains 2 rivers and Grade 1 terrace is developed on the river banks, where the terrace is level and 8~12m above the river water level. Tianquan County is located in the transition zone between Qinghai-Tibet Plateau and Sichuan Basin. It is largely high in the northwest and low in the southeast. Restrained geological structure, the mountains are distributed in south-north and north-east directions. This county has tectonically eroded deep-cut high and medium high mountains and very deep valleys, where the mountain elevation is mostly 2000~3000m.

4.1.3 Meteorological conditions

Qionglai City is located at the southwest fringe of Chengdu Plain. Huojing-Daozuo Road is routed at the western edge of Sichuan Basin that is in the subtropical humid monsoon climate region where winter is not too cold nor is summer too hot. That area is with mild climate where spring comes early, summer lasts long and fall has continuous rain. Winter still has ample rainfall. The four seasons are distinct, with annual average temperature of 16.8℃. July is the hottest month with average temperature of 26℃ and January the coldest month with average temperature of 5.9℃. The extreme maximum temperature is 39.4℃ and extreme minimum temperature -4.8℃. The annual rainfall in that region is more in the west than in the east, with annual average rainfall of 1,117.2mm. The rainy season lasts from June to August and rainfall in this period accounts for 59% of the annual total rainfall. The maximum annual rainfall is 2,367.2 mm. In the project area, the minimum annual rainfall is 755.4mm and maximum annual rainfall 512.4mm. The annual average frost-free period is 285 days and annual number of fog days is 33.

Yingjing County is located in the inland subtropical humid climate region in the middle latitude zone where monsoon climate prevails. Winter and spring are mostly affected by arid and cold the westerlies weather system, while summer is mostly affected by the warm and humid subtropical weather system. In spring and fall, the aforesaid two weather systems appear alternately and come with significant climatic changes, which are

categorized as continental climate in warm temperate monsoon region which is characterized with distinct four seasons, concurrence rainy and hot weathers in same season, ample sunshine and long frost-free period. Annual average is 11.7℃. The average temperature in January is -3.5℃ and extreme minimum temperature -29.8℃ (December 25, 2011); the average temperature in July is 23.7℃ and extreme maximum temperature 25.6℃. The annual average rainfall is 1,516.1mm, annual average evaporation 1,027.9mm, annual extreme maximum rainfall 1,752.3mm (2008) and annual extreme minimum rainfall 843.6mm (1988).

Tianquan County is located at the eastern slope of Qinghai-Tibet Plateau where there is great elevation difference and temperature difference between the western and eastern regions, thus having the mountain climate with vertical changes; the atmospheric circulation there is controlled by the monsoon, placing Tianquan County in the mountain climate zone based in the subtropical monsoon climate. In 2010, the annual average temperature was 15.1℃, average temperature in January 5℃, average temperature in August 23.7℃ and annual average rainfall 1,735.6mm. The time with sunshine was 860.2 hours and the frost-free period 241 days.

4.1.4 Hydrological condition

The ground water beneath Qionglai City is categorized in two types: loose accumulational pore water and bedrock fissure water. These two types of water exist in separate aquifers.

The trunk stream of Yingjing River in Yingjing County is a Class 1 branch of Qingyi River. It passes Jizigang and converges with Qingyi River at the east of Ya'an City. As a result of neotectonic movement, activity of the Qinglong Fault intensified and consequently the south end of the Ya'an syncline upwarped, forming Jizigang. Thus Yingjing River became a beheaded river .It flows through the Tianfeng anticline and converges with Tianquan River, becoming a Class 2 branch of Qingyi River. The remain downstream river segment became the Fenjiang River as it is today. The upstream segment of Yinghe River passes through Sanhe Township and it flows from west to east and converges into Qingyi River. Its branches are 24km long Daihuanggou, 16km long Chahe River and 8km long Lengshui River which form a tree-like pattern.

The surface water system in Tianquan City belongs in the Qingyi River water system. The road will not cross any river. The rivers in the road corridor are Qingyi River and its branches Tianquan River and Lushan River.

4.1.5 Engineering geology

The preceding section (K0+000~K7+000) of Dao-Huo Road passes through denudational-erosional landform where most bed rocks are exposed and the rock mass is largely intact; the slopes are stable; partial areas show small collapsed blocks; no landslide is found there. The following section (K7+000~K12+127) of the road passes through erosional-denudational landform that is featured with flat terrain and minor elevation difference; collapse, debris flow and landslide are not found there.

Yingjing County is located in the east of Sichuan Province. Most area of the county is in the south section of the north-east Longmenshan Fold Belt, while its south area is at the Emeishan Fault Block; the west area neighbors the south-north Kangdian Axis. The stratums in the county are largely intact. Except the metamorphic rocks in carboniferous system, Tertiary system and Presinian system, the stratums in the other systems are all exposed. The quaternary system has no stratum development and only small-area stratums exist in the river valleys along Yinghe River, Jinghe River and Yingjing River. The exposed stratums are mostly composed of sedimentary rock and they are marine stratums from Paleozoic erathem and continental stratums from mesozoic erathem. The seismic intensity in the county is 6~7°.

Tectonically, the Shi-Xin Road Subproject area is located at the southwest end of the platform-margin fault-fold belt at Longmen Mountain and Daba Mountain which are the secondary tectonic units at the western edge of Yantze Platform. The project area neighbors Kangdian Axis to the west, Sichuan Depression to the east and Songpan-Ganzi geosyncline fold system to the north-west. The project area is located to the east of the "Y" structural confluence area that comprises the NE Longmenshan Fault Zone, NW Xianshuihe Fault Zone and SN Anninghe Fault Zone. Specifically, it is located within the southwest section of Longmenshan Fault Zone.

4.1.7 Aquatic organism

Daozuo-Huojing Subproject will affect Xiaoxi River and Tonggou; Ying-Lu Road Subproject will affect Yinghe River; Shi-Xin Road will affect Qingyi River and its branches Tianquan River and Lushan River. The water areas assessed in the project area contain only small number of plankton and have no fish or rare aquatic organism.

4.2 Overview of the ecological environment

4.2.1 Land utilization

1 Dao-Huo Road Subproject

According to O*verall Planning for Land Use in Qionglai City (2006-2020)*, the total land area of Qionglai City is 137,663 ha., including 119,978 ha. agricultural land which accounts for 87.15% of the total land area, 14,640 ha. construction land which accounts for 10.63% of the total land area and 3,045 ha. Other land which accounts for 2.21% of the total land area.

Table 4.2-1 Land utilization in the project assessment area

Land type	Area (hm^2)	Percentage (%)
Forest land	170.55	75.92
Cultivated land	47.41	21.10
Shrub and grass land	0.39	0.17
Water area	0.87	0.39
Construction land	5.42	2.41
Total	224.64	100.00

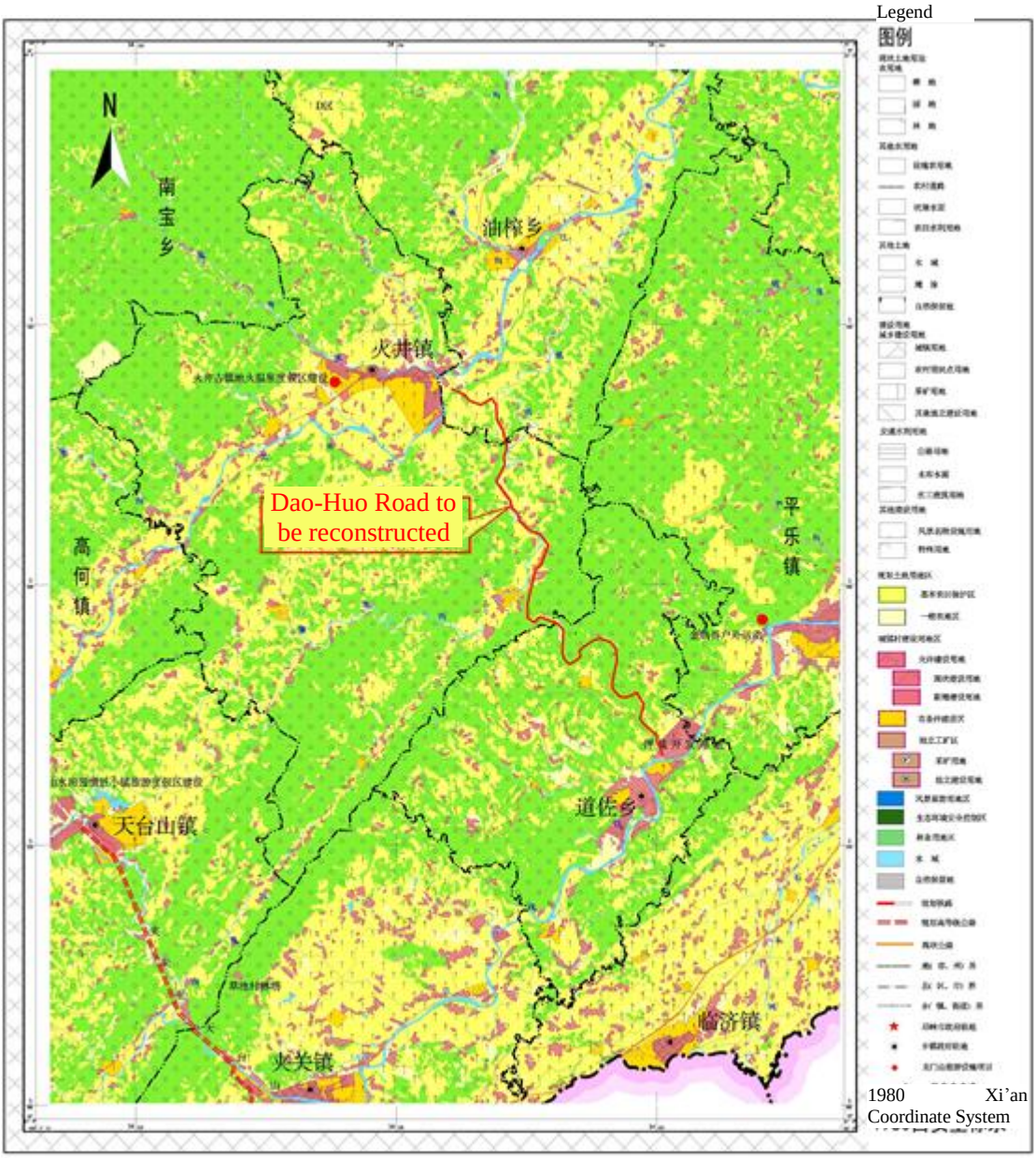


Fig. 4-1 Land use and planning for Dao-Huo Road Subproject

2 Ying-Lu Road Subproject

The total land area of Yingjing County is 178,104.13 ha., including 171,941.17 ha. agricultural land which accounts for 96.54% of the total land area, 2,033.93 ha. construction land which accounts for 1.14% of the total land area and 4,129.03 ha. other land which accounts for 2.32% of the total land area.

Land is mostly use for agriculture, in which the forest land accounts for a large proportion which is 87.59% of the total land area. The county has small cultivated land; the land cultivation ratio is 5.07%; the per-capita cultivated land area is only 0.06 ha.; the land types are mostly forest land, water area and river shoal.

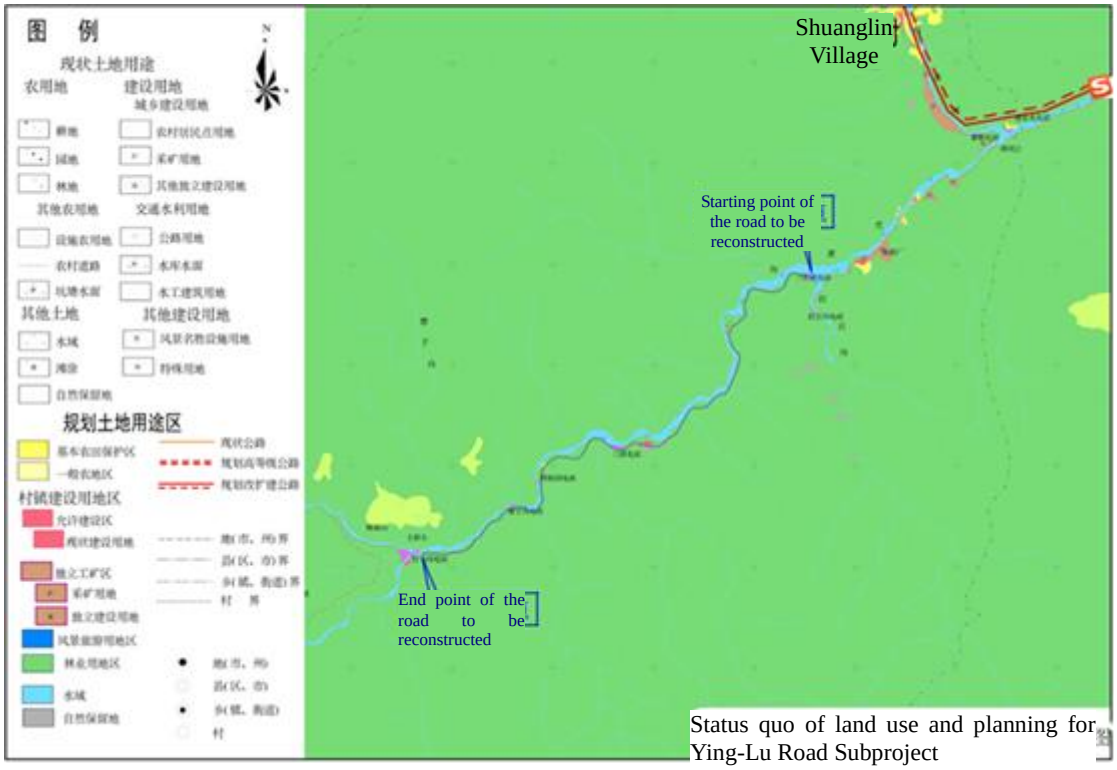


Fig. 4-2 Status quo of land use and planning for Ying-Lu Road Subproject

原文	
图例	Legend
现状土地用途	Current land use
农用地	Farmland
建设用地	Construction land
城乡建设用地	Land for urban and rural development
耕地	Cultivated land
农村居民点用地	Land for rural settlement
园地	Orchard land
采矿用地	Mining land
林地	Forest land
其他独立建设用地	Other independent land for construction
其他农用地	Other farmlands
交通水利用地	Land for traffic and conservancy
设施农用地	Land for agricultural facilities
公路用地	Right of way of road
农村道路	Rural road
水库水面	Reservoir water area
坑塘水面	Pond water area
水工建筑用地	Land for hydraulic architecture
其他土地	Other lands
其他建设用地	Other construction lands
水域	Waters
风景名胜设施用地	Land for scenic spot facilities
滩涂	Mudflat
特殊用地	Land for special purpose

自然保留地	Nature reserve
规划土地用途区	Planned land use area
基本农田保护区	Basic farmland protection zone
现状公路	Exiting road
一般农地区	General farmland area
规划高等级公路	Planned high-class road
村镇建设用地区	Land for village/town development
规划改扩建公路	Planned upgraded road
允许建设区	Allowable construction zone
现状建设用地	Existing construction land
地(市、州)界	地(市、州)界
独立工矿区	Separate industrial and mining area
县(区、市)界	County (district and city) boundary
采矿用地	Mining land
乡(镇、街道)界	Township (town and street) boundary
独立建设用地	Independent construction lands
村　界	Village boundary
风景旅游用地区	Land for scenic spots
林业用地区	Forest land
地(市、州)	地(市、州)
县(区、市)	County (district and city)
水域	Waters
自然保留地	Nature reserve
乡(镇、街道)	Township (town and street)
村	Village

3 Shi-Xin Road Subproject

The total land area of Tianquan County is 3,600,000 mu, including 136,922 mu farm land (57,730 mu crop field and 79,192 mu land), 2,152,320 mu forest land, 56,115 mu water area and other land types such as grass land, garden land, traffic land and mines. The total population of Tianquan County is 150,000; per-capita cultivated land area 0.913 mu and per-capita forest land area 14.349 mu. In terms of land resource, Tianquan County is in shortage of farm land, thus land utilization must be economized.

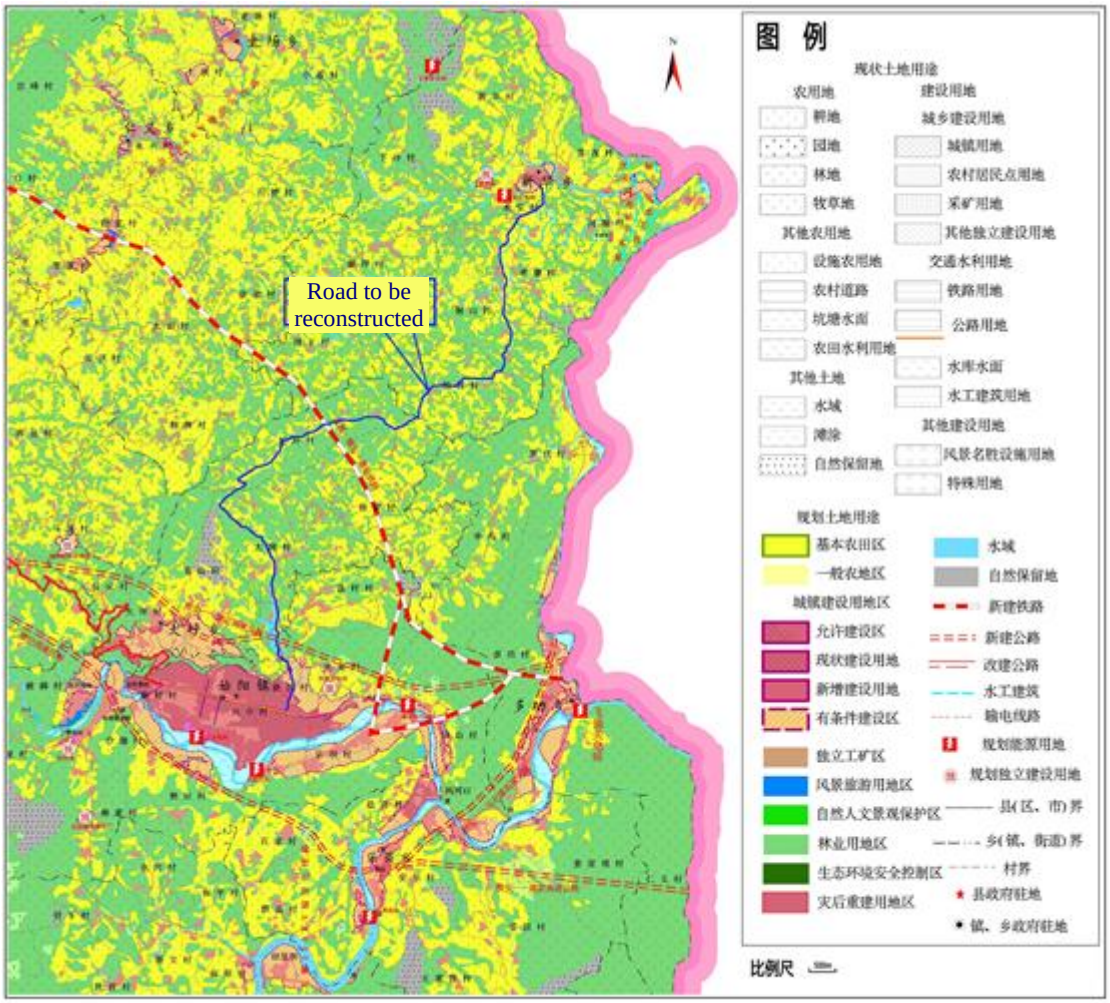


Fig. 4-3 Status quo of land use and planning for Shi-Xin Road Subproject

原文	
图例	Legend
现状土地用途	Current land use
农用地	Farmland
建设用地	Construction land
耕地	Cultivated land
城乡建设用地	Land for urban and rural development
园地	Orchard land
城镇用地	Urban land
林地	Forest land
农村居民点用地	Land for rural settlement
牧草地	Grassland
采矿用地	Mining land
其他农用地	Other farmlands
其他独立建设用地	Other independent construction lands
设施农用地	Land for agricultural facilities
交通水利用地	Land for traffic and conservancy
农村道路	Rural road
铁路用地	Right of way of railway
坑塘水阀	Pond water area
公路用地	Right of way of road

农田水利用地	Land for irrigation and water conservancy
其他土地	Other lands
水库水面	Reservoir water area
水工建筑用地	Land for hydraulic architecture
滩涂	Mudflat
其他建设用地	Other construction lands
风景名胜设施用地	Land for scenic spot facilities
自然保留地	Nature reserve
特殊用地	Land for special purpose
规划土地用途	Planned land use
基本农田区	Basic farmland area
水城	Waters
一般农地区	General farmland area
自然保留地	Nature reserve
城镇建设用地区	Land for urban development
新建铁路	New railway
允许建设区	Allowable construction area
新建公路	New road
现状建设用地	Existing construction land
改建公路	Reconstructed road
新增建设用地	Additional construction land
水工建筑	Hydraulic architecture
有条件建设区	Conditionally-permitted construction area
输电线路	Power transmission line
独立工矿区	Separate industrial and mining area
规划资源用地	Planned resources land
风景旅游用地区	Land for scenic spots
规划独立建设用地	Planned independent construction lands
自然人文景观保护区	nature and artificial scenery protection zone
县（区、市）界	County (district and city) boundary
林业用地区	Forest land area
乡（镇、街道）界	Township (town and street) boundary
生态环境安全控制区	Eco-environment safety control zone
村界	Village boundary
灾后重建用地区	Land for post-earthquake reconstruction
县政府驻地	County government seat
镇、乡政府驻地	Town and township government seats
比例尺	Scale

4.2.2 Vegetation, animal and plant resources

1 Dao-Huo Road Subproject

Qionglai City has abundant plant resources, particularly the economically valuable specialty resources, officinal plants and forage resources. This county has 438 species of ligneous plants in 93 families, including 33 species in 9 families in gymnosperm phylum, 391 species in 81 families in dicotyledon class and 14 species in 3 families in monocotyledon class. Qionglai City has many rare ancient trees such as metasequoia, machilus, Chinese yew, dove tree and spinulose tree fern. The assessed area contains 2 species of national Class 1 protected plants, i.e. metasequoia and gingko, and 1 species of national Class 2 protected plants, i.e. camptotheca acuminate. These 3 plant species grow along the Dao-Huo Road route or in the residential courtyards along the

route. They are numerous and are all artificially planted.

The assessed area mostly consists of bamboo forest ecosystem, farm land ecosystem and human settlement ecosystem. This area contains few animal species which are mostly birds, beasts and amphibians, very few reptiles and no protected wildlife.

2 Yingjing Road Subproject

Yingjing County is located in the sub-frigid zone. The plants there are mostly cold-resistant shrub and herbaceous plants, among which bashania fangiana, rhododendron parvifolium, juniperus chinensis, nutgrass flatsedge, club moss and moss are particularly common. The cold-temperate coniferous forest is distributed at the 2600m~3100m elevation and is mostly composed of firs. The temperate broadleaf-conifer forest is distributed at the 2100m~2600m elevation AIS mostly composed of firs, oaks, red birch, gingerbread tree and maple. The northern subtropical soft-hard broadleaf forest is distributed at the 1800m~2100m elevation. This is mainly composed of castanopsis fargesii, oak, birch, eurya plant, banian, camphor tree and wild walnut tree.

This county has 295 species (including subspecies) in 76 families (subfamilies) in 32 orders in vertebrata phylum, including 53 species in 22 families in 7 orders in the mammalian class, 124 species in 38 families in 14 orders in the aves class, 19 species in 5 families in 2 orders in the reptilian class, 12 species in 5 families in 2 orders in the amphibian class and 87 species in 15 families in 7 orders in the pisces class.

3 Shi-Xin Road Subproject

The natural vegetation along the proposed road reconstruction line is mostly sinocalamus affinis and also includes the quick-growth weeds growing in fields and beside ditches, such as miscanthus floridulu, horseweed herb, cogon, mother chrysanthemum, white clover, crofton weed, alternanthera philoxeroides, nilgiri nettle, field horsetail, eleusine indica, pteris vittata and arthraxon lanceolatus. The national Class 1 protected plants along the road line are metasequoia and gingko; the national Class 2 protected plants are Phoebe zhennan and camptotheca acuminate which are artificially grown.

The wild animals in Tianquan County are mammals, birds, reptiles, amphibians and fish, totally 211 species in 70 families in 27 orders and 5 classes, among which 22 species are national protected animals. There are very few species and quantity of wild animals living along the proposed road reconstruction line and such animals are common species in Tianquan County and include no rare or protected animal. The wide animals living along the road line are boar, ferretbadger, streptopelia orientalis, cuckoo, crow, etc.

4.2.3 Water and soil loss

1 Qionglai City

The total land area of Qionglai City is 1,384km^2, including 793.31km^2 water/soil loss area which accounts for 57.32% of the total area; the annual erode soil quantity is 3,563,200t and the soil erosion modulus is 3,250t/km^2.a, making this region a light-medium eroded region. The water/soil loss type along the road line is mostly hydraulic erosion. Based on the investigation of regional water/soil loss, the remote sensing data on soil erosion, the 1:10000 topographic map of the project area, the land use types, area, slope and vegetation coverage determined by the field survey in the project area and the geomorphic, edaphic and climatic features of the project area, the erosion intensity values under different land use types in the project units are calculated in accordance with *Standards for Classification and Gradation of Soil*

Erosion (SL190-2007). Then, based on the water and soil conservation data provided by the local water and soil conservation test station, the background value of the soil erosion modulus corresponding to the various land use types in the project units is calculated. The average background value of the soil erosion modulus for the road line is calculated to be 831t/km^2.a.

2 Yingjing County

The soil erosion investigation indicates that the soil erosion area in Yingjing County of Ya'an City is 1,781km^2. Water and soil loss is mainly incurred by natural factors and human factors. According to the field investigation, most sections in the project area have gentle surface slopes and forest/grass vegetation coverage is less than 50%. According to *Standards for Classification and Gradation of Soil Erosion* (SL190-2007), the erosion intensity is light erosion. The project area is in the southwest earth-rock mountain region and its permissible soil loss amount is 500t/km^2·a.

Based on the investigation, the erosion classification criteria in *Standards for Classification and Gradation of Soil Erosion* (SL190-2007) and the geomorphic condition, soil, vegetation and the other natural factors that affect water/soil loss, the water/soil loss background value of the project land area is 4,733t/km^2·a and the annual erosion amount is 511.68t.

3 Tianquan County

The land area disturbed by this project is 26.12hm^2 and the water/soil loss area cause thereby is 26.12 hm^2. The water/soil loss prevention responsibility scope covers the construction area and directly affected area which is totally 26.12hm^2. Construction activity will occupy the land area of 26.12hm^2.

4.3 Overview of social environment

4.3.1 Population and administrative division

1 Qionglai City

Qionglai City governs 18 towns, 6 townships, 202 administrative villages and 62 communities (residential committees). The total registered population counted at the end of the year is 657,100, including 248,700 non-agricultural population and 408,400 agricultural population. The newly-born population in the year is 5,275, with birth rate of 8.03‰; the dead population is 4,536, with mortality rate of 6.9‰; the natural population growth rate is 1.13‰. The family planning rate in the year is 91.84%. Daozuo Township governs 7 natural villages, 88 villager groups, 2516 households and 8,688 people. Huojing Town governs 10 administrative villages, 79 village groups, 3,610 households and 13,786 people.

2 Yingjing County

This county governs 18 towns, 6 townships, 202 administrative villages and 62 communities (residential committees). The total registered population counted at the end of the year is 657,100, including 248,700 non-agricultural population and 408,400 agricultural population. The newly-born population in the year is 5,275, with birth rate of 8.03‰; the dead population is 4,536, with mortality rate of 6.9‰; the natural population growth rate is 1.13‰. The family planning rate in the year is 91.84%.

Sanhe Township governs 4 administrative villages (Shuanglin Village, Jianzheng Village, Nanlin Village and Baomin Village), 22 communes, 891 peasant households and 2503 people. In 2014, Shuanglin Village had 88 households and 258 people which were all agricultural population, including 118 labor population which

accounted for 45.74% of the total population.

3 Tianquan County

This county governs 2 towns (Chengxiang Town and Shiyang Town) and 13 townships. In 2014, the county had 155,400 people, including 122,300 population which accounted for 78.70% of the total population; the population density was 65 people/km^2.

4.3.2 Natural resources

1 Water resources

Qionglai City has many rivers, with abundant water resource. Nanhe River, Chuyin River, Xiejiang River, Pujiang River and Yuxi River flow through this city and the total length of these rivers is 217.15km. The western region has abundant potassium-rich brine water (hot spring); the annual surface water runoff volume is 991,000,000 m^3, of which 532,800,000 m^3 is utilizable; the water diverted from outside the region is 628,200,000 m^3, so the total utilizable water volume is 1,160,000,000 m^3 which is 3.0 times the water volume demanded by the agriculture in Qionglai. The annual extracted ground water volume is over 106,000,000 m^3.

The water bodies to be crossed in this project are Tonggou River, Xiaoxi River and Hangou River, which are all a part of the Baimu River system.

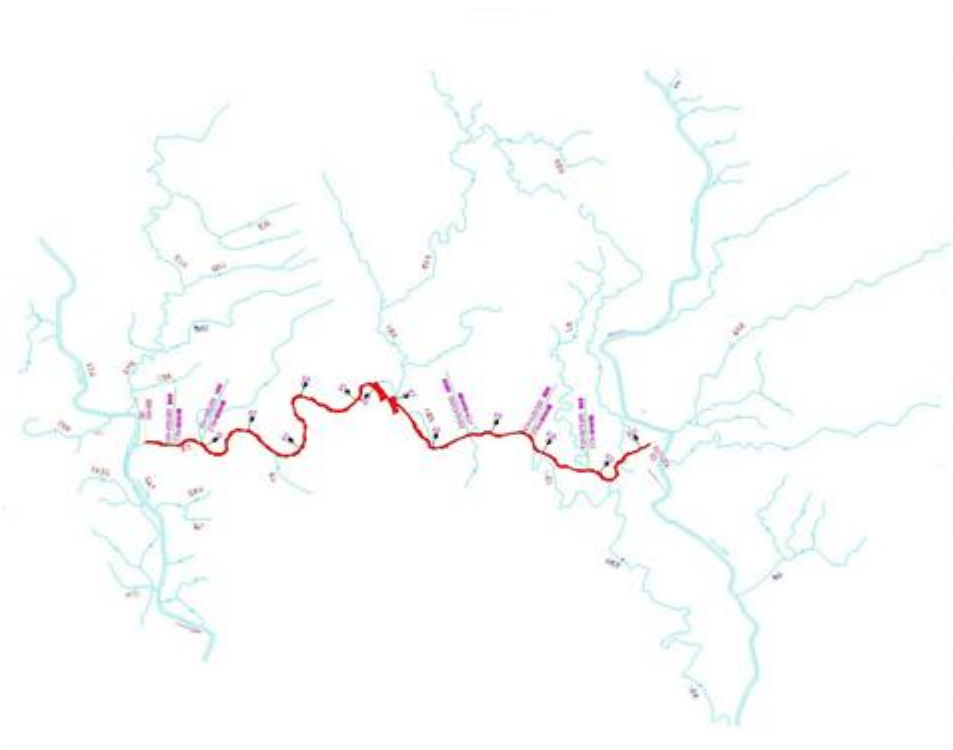


Fig. 4-4 Water system in the area of Dao-Huo Road Subproject

Yingjing River is a Class 2 branch of Qingyi River which belongs to the Minjiang River water system. Yinghe River, i.e. Qijiagou, the real origin of this river, originates from southeast foot of Dakuang Mountain and west foot of Yeniu Mountain located at the border between Yingjing County and Luding County. Daihuanggou flows eastward to the Shuanglin Village where it converges with the Chahe River from the northeast; then it continues eastward to the Jianzheng Village of Sanhe Township where it converges with the Sancha River from the Tuanling Mountain; at the location of Sanhe Township Government, it converges with the Waqiangou River from Xianglu Mountain; then it flows southeastward. It is 28.2km long. Jinghe River is a

major branch of Yingjing River. The road route is very close to the river, with abundant water resource. The water body involved in this project is Daihuanggou River.

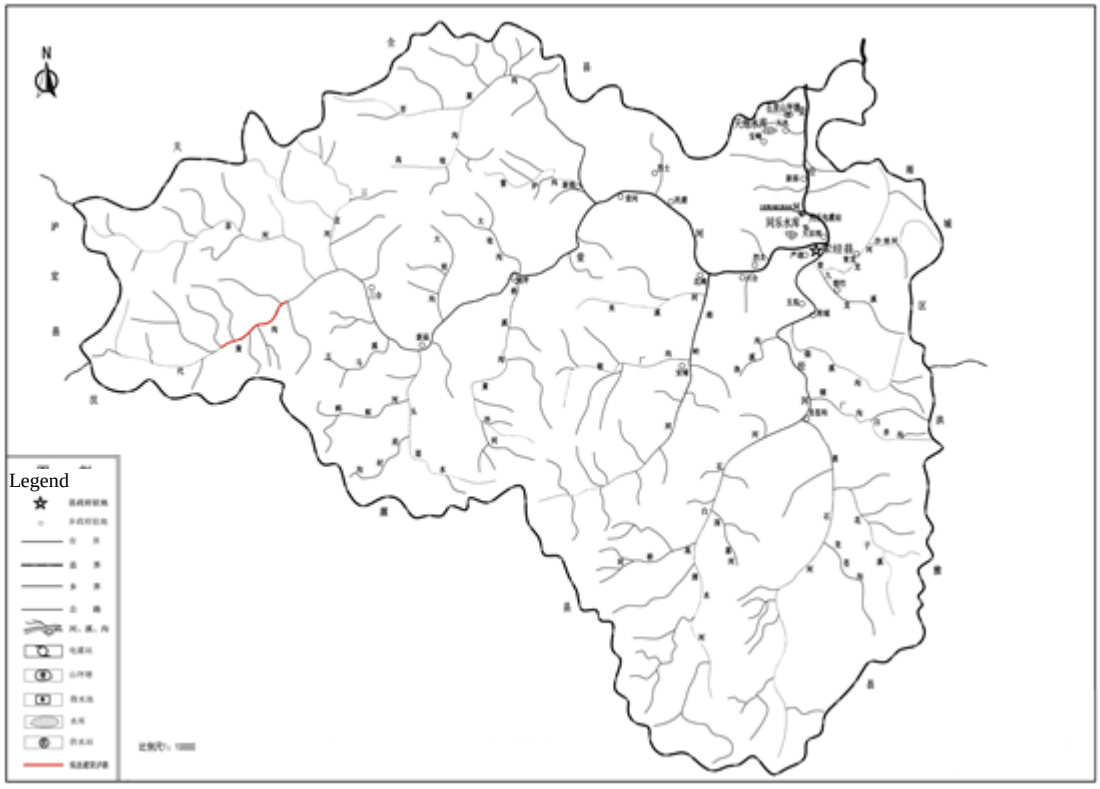


Fig. 4-5 Water system in the area of Ying-Lu Road Subproject

The annual average surface runoff volume in Tianquan County is 3,771,000,000 m^3, average runoff volume 1,576mm and total natural water volume 6,714,000,000 m^3. The surface water system in the project area belongs in the Qingyi River water system. The road will not cross any river. The rivers in the road corridor are Qingyi River and its branches Tianquan River and Lushan River.

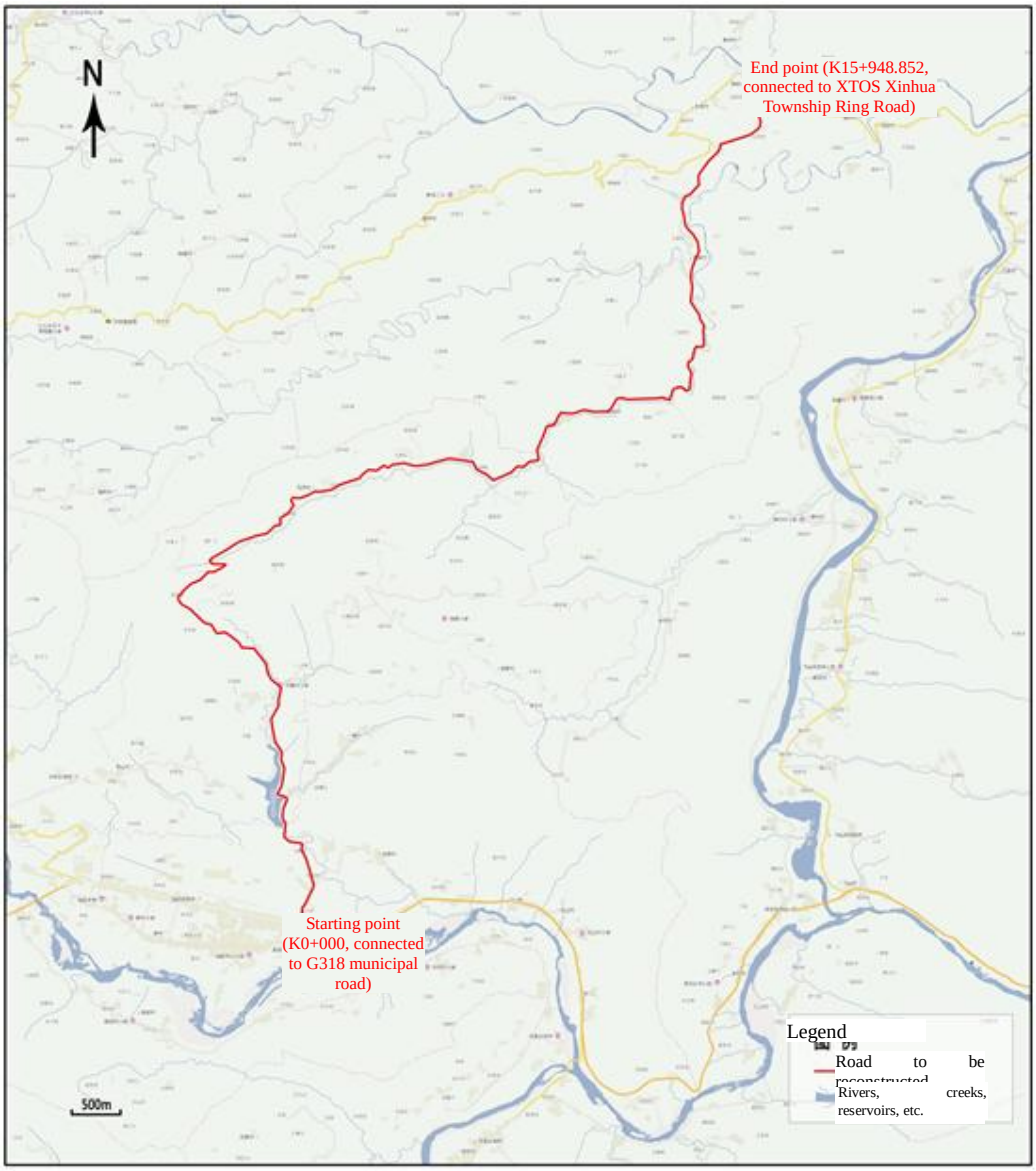


Fig. 4-6 Water system in the area of Shi-Xin Road Subproject

2 Mineral resources

The mineral resources in Qionglai City are gold, copper, siderite, coal, glauberite. This city has particularly abundant reserves of natural gas and petroleum. The proven minerals in Tianquan County are coal, granite, marble, iron pyrite and lime, including 70 million ton of coal and 9 million ton of iron pyrite that contains 35% sulfur content. There is large outcrop area of granite and the granite reserves is over 3,000,000,000 m^3 which mainly includes red granite, green granite and grey granite in over 30 varieties. The exploitable amount of limestone at Qingshi Township and Xiaohe Township alone is over 2,000,000,000 ton which contains 51% calcium content and less than 1% magnesium content. The proven reserves of glauberite are 2.87 billion ton. The exploitable minerals in Tianquan County are coal, lead, metallurgical quartzite, refractory clay, iron pyrite, mirabilite, gypsum, limestone for cement production, shale for brick production, decorative granite, decorative killas and shale for cement batching.

3 Forest resource

Qionglai City has forest coverage of 42% and has many plant species. The vegetation

mainly comprises evergreen broad-leaf forest, evergreen coniferous forest and mountain shrub. The primary plant species include ficus microcarpa, ligustrum lucidum, aspen, sinocalamus affinis, coriaria sinica and vitex negundo, which provides abundant plant resources. The economically valuable specialty resources, officinal plants and forage resources are particularly abundant.

According to *Forestry Ecology General Information Supervision Platform Project of Yingjing County—Survey Report on Forest Resources Category II in Yingjing County* (Sichuan Forestry Inventory and Planning Institute, 2015), Yingjing County has 88,272.47 ha. of public welfare forest which accounts for 55.6% of the forest land area in the county. The national public welfare forest is 88,235.94 ha. and provincial public welfare forest is 36.53 ha. The national public welfare forest includes 39,221.76 ha. of Class 1 protected forest (44.5%) and 49,014.18 ha. of Class 2 protected forest (55.5%). Sanhe Township has totally 22,664.70 ha. of public welfare ecological forest which is all of national level. The forest land on both sides of the proposed road reconstruction line is Class 2 national public welfare forest.

Tianquan City, with abundant forest resource, is one of the forestry counties of Sichuan and is also one the first counties to implement the Tianbao Project. The forest land area is 143,488 ha., standing tree reserves 18,000,000 m^3 and forest coverage 50.23%.

4 Animal and plant resources

This county has 438 species of ligneous plants in 93 families, including 33 species in 9 families in gymnosperm phylum, 391 species in 81 families in dicotyledon class and 14 species in 3 families in monocotyledon class. Qionglai City has many rare ancient trees such as metasequoia, machilus, Chinese yew, dove tree and spinulose tree fern. The subproject assessment area has few wild animal species which are mostly birds; beasts, amphibians and reptiles are much less; there is no protected wild animal.

Yingjing County has wild plants, with 357 species in 200 genuses in 90 families of trees and shrub plants. These include 24 species in 18 genuses in 8 families of gymnosperm plants, 333 species in 182 genuses in 82 families of angiosperm plants and 24 species in 7 genuses of bambusoideae plants. There are 7 national protected rare plant species, i.e. dove tree, C.omeiensis, gastrodia elata, euptelea, salix magnifica, cinnamomum mairei and Phoebe zhennan. These are 87 species in 15 families. This county has 295 species (including subspecies) in 76 families (subfamilies) in 32 orders in vertebrata phylum, including 53 species in 22 families in 7 orders in the mammalian class, 124 species in 38 families in 14 orders in the aves class, 19 species in 5 families in 2 orders in the reptilian class, 12 species in 5 families in 2 orders in the amphibian class and 7 orders in the pisces class. These animals include Sichuan monkey, macaca arctoides, serow, blue sheep, otter, lady amherst pheasant, golden pheasant and silver pheasant.

Tianquan County has 259 tree species. The advantageous tree species, in the rank of reserves, are fir, oak, spruce, hard broad-leaf tree, soft broad-leaf tree, birch, cedar and masson pine. As for national protect tree species, Class 1 includes dove tree, Class 2 includes incense tree, tetracentron sinense and eucommia ulmoides and Class 3 includes aucuba japonica, Magnolia wilsonii, euptelea, cinnamomum mairei and Mangnolia officinalis. The ancient rare trees in the county mostly grow in the western primeval forest. Along the road route, the national Class 1 protected plants are metasequoia and gingko and the national Class 2 protected plants are Phoebe zhennan and camptotheca acuminate. According to incomplete statistics, the wild animals living in Tianquan County are mammals, birds, reptiles, amphibians and fish, with

211 species in 70 families in 27 orders in 5 classes. Among the 22 national protected species, the Class 1 species are giant panda, takin and golden monkey and the Class 2 species include macaque, red panda, golden cat, leopard, sambar deer and Tragopan temminckii.

5 Tourism resources

Qionglai City has abundant tourism reserves. Daozuo Township has the unique false karst cave group, Zhaigou scenery and Shiheyan. Huojing Town is 31km to the west of Qionglai City, it is an important town in the tourist route to the Tiantai Mountain (a nation-level scenic spot) and it is one of the old revolutionary base areas and one of the ten ancient cultural towns in Sichuan.

The tourism reserves of Yingjing County include Wawu Mountain, Tongwa Temple, Tiewa Temple and the Canglonggou National Forest Park that is 30km distant from the county. Besides, this county also has the world's largest wild dove tree forest and the Niubei Mountain, one of the most pleasant sightseeing platforms in China.

4.3.3 Socioeconomic development

1 Qionglai City

Based on the preliminary accounting, the gross regional production of this city in 2014 was 18.385 billion yuan which was 10.3% growth compared to the prior year. Daozuo Township annual produces 20,000t of commodity bamboo; has 1,000 mu of tangerine field that annually produces 2,000t of tangerines; it has 2,000 mu of south early-maturing pear trees that annually produce 500t of high-quality pears; it has 2,500 mu of pollution-free vegetable field that annually produces 10,000t of pollution-free vegetables. This county is renowned for its rich production of natural gas and sylvite.

2 Yingjing County

In 2014, the economy of Yingjing County maintained steady growth and its comprehensive strength was further improved. The gross regional production of this city in that year was 5.613 billion yuan which was 11.8% growth compared to the prior year and the per-capita gross regional production was 37,545 yuan which was 11.4% growth compared to the prior year. The proportions of added values of three industries are adjusted from 11.7:62.9:25.4 to 11.4:63.0:25.6. Private economy keeps growing, with its economic increment accounting for 76.3% of GDP.

3 Tianquan County

In 2014, regional domestic product of entire Tianquan County reached 4,418,280,000 yuan, increased by 13.58% from a year earlier. Among which, agriculture has an increment of 623,850,000 yuan, increased by 7.58%; industry has an increment of 2,759,580,000 yuan, increased by 14.99%; service sector has an increment of 1,034,850,000 yuan, increased by 13.67%. The industrial structure is further improved, with GDP per capita of 32,017 yuan, increased for 1,506 yuan and by 13.42% from a year earlier. In 2014, disposable income of urban residents is 21,875 yuan, and net per capita income of peasants is 8,272 yuan.

4.4 Investigation and assessment of environmental state

4.4.1 Socioeconomic state

1 Qionglai City

The industry in this city covers high-quality white spirit, food, beverage, biological medicine, household chemicals, new paints and other important products; the

industrial parks house 91 industrial enterprises above designated size; this city has 27 construction enterprises above designated qualification level and the annual increment of the construction industry is 1.301 billion yuan. The annual crop field is 662,500 mu and oil crop field is 246,500 mu. The annual total grain output is 275,800t, total oil output 40,900t, total vegetable output 288,300t, meat production 129,000t, bird egg production 11,600t, milk output 32,700t and aquatic product output 11,300t.

By the end of the year, there 34 verified safe high-quality agricultural products. These include 6 pollution-free agricultural products, 10 green food products and 18 organic food products.

2 Yingjing County

In 2014, the economy of this county maintained steady growth and its comprehensive strength was further improved. The gross regional domestic product of this county in that year was 5.613 billion yuan which was 11.8% growth compared to the prior year. The private economy kept growing, with its economic increment accounting for 76.3% of GDP. The private economy has become the primary impetus for economic growth of this county. The economic value added of the private economic in that year was 4.281 billion yuan which was 12.5% growth compared to the prior year and accounted for 76.3% of the GDP. The added value of the primary industry was 188 million yuan, with 0.6% growth; the added value of the secondary industry was 3.19 billion yuan, with 13.4% growth; the added value of the tertiary industry was 903 million yuan, with 11.3% growth.

3 Tianquan County

In 2014, the regional domestic product of entire Tianquan County reached 4,418,280,000 yuan, increased by 13.58% from a year earlier. Among which, agriculture has an increment of 623,850,000 yuan, increased by 7.58%; industry has an increment of 2,759,580,000 yuan, increased by 14.99%; service sector has an increment of 1,034,850,000 yuan, increased by 13.67%. T he industrial structure is further improved, with GDP per capita of 32,017 yuan, increased for 1,506 yuan and by 13.42% from a year earlier. In 2014, disposable income of urban residents is 21,875 yuan, and net per capita income of peasants is 8,272 yuan.

4.4.2 Investigation and assessment of ecological environment

4.4.2.1 Land utilization

Land utilization state is shown in 4.2.1.

4.4.2.2 Distribution of animal and plant species

See 4.3.2

4.4.2.3 Assessment of ecological environment

According to the field survey, the Dao-Huo Road assessment area has 2 national Class 1 protected plant species, i.e. metasequoia and gingko, and 1 national Class 2 protected plant species, i.e. camptotheca acuminate. These plants are all artificially grown and not protected wild plants. There is no public welfare forest in that area. The vegetation in the assessment area is mostly artificially planted; farm land includes dry fields and paddy fields, where the paddy fields mostly grow paddy rice and the dry fields mostly grow commodity nursery stocks such as rape, radish, cabbage, osmanthus fragrans, gingko and Cryptomeria fortunei. The assessment area has few wild animal species which are mostly birds; beasts, amphibians and reptiles are much less; there is no protected wild animal.

The plant species in Ying-Lu Road assessment area are commonly and widely seen species

that include no national or provincial protected or endangered plant species.

The Shi-Xin Road project area has national Class 1 protected plant species, i.e. metasequoia and gingko, and national Class 2 protected plant species, i.e. Phoebe zhennan and camptotheca acuminate. These plants are all artificially planted and not wild plants, but they have been free from human interference during their growth and have gained certain ecological conservation value. As a result of many years of operation of the original road and frequent human activities, the wild animals living along the proposed road reconstruction route have been decreasing in both species and numbers and these animals are all commonly seen species in Tianquan County and include no protected animal.

4.4.3 Investigation and assessment of current environmental quality

4.4.3.1 Monitoring over ambient air

1 Dao-Huo Road

(1) Monitoring points and monitored factors

1 monitoring point is arranged that is at Group 8 of Yapeng Village and the 4 factors to be monitored are SO_2, TSP, $PM_{2.5}$ and NO_2.

(2) Monitoring time

Chengdu Integrated Rock & Mine Testing Center of Sichuan Bureau of Geology & Mineral Resources performed monitoring for 7 consecutive days from December 5 to 11, 2015.

(3) Assessment standard

The assessment of current ambient air quality is done in accordance with Class II standard in *Ambient Air Quality Standards* (GB3095-2012).

(4) Monitoring method

The sampling and monitoring analysis methods for each monitoring item comply with *Manual Methods for Ambient Air Quality Monitoring* (HJ/T194-2005).

(5) Results of ambient air monitoring

Table 4.4-2 Statistical results of current ambient air quality monitoring

Monitoring site	Monitoring item	Hourly average concentration	Daily average concentration
		Concentration range (mg/m^3)	Concentration range (mg/m^3)
Group 8, Yapeng Village	NO_2	0.015~0.021	0.017~0.018
	SO_2	0.013~0.031	0.019~0.023
	TSP	/	0.073~0.089
	$PM_{2.5}$	/	0.027~0.032

Table 4.4-3 List of pollution indexes from current ambient air assessment

Monitoring site	Monitoring item	Hourly average concentration		Daily average concentration	
		Assessment criteria C_{0i} (mg/m^3)	Ratio to standard concentration Pi (%)	Assessment criteria C_{0i} (mg/m^3)	Ratio to standard concentration Pi (%)
Group 8, Yapeng Village	NO_2	0.20	11	0.08	23
	SO_2	0.50	6	0.15	15
	TSP	/		0.30	30

	$PM_{2.5}$	/		0.075	43

According to the monitoring results, the monitoring point at Group 8 of Yapeng Village gives the result that the hourly average concentration and daily average concentration of NO_2, SO_2, TSP and $PM_{2.5}$ all have the ratio to standard concentration less than 1, which meets the Class II standard of Ambient Air Quality Standard (GB3095-2012). This indicates that the ambient air quality in the project area is in sound condition.

2 Ying-Lu Road

(1) Monitoring time

December 8~14, 2015

(2) Monitoring point position

1 current ambient air quality monitoring point is arranged in the middle of the road, as shown in Table 9.

Table 4.4-4 Current ambient air quality monitoring point

No.	Name of monitoring point	Pile No.	Remarks
1	Sanhui Power Station	K26+300	About 200m downstream of the Sanhui Power Station

(3) Monitoring factor

TSP, NO_2 and PM_{10}

(4) Monitoring frequency, contents and requirements

The monitoring frequency, contents and requirements are given below.

Table 4.4-5 Monitoring frequency, contents and requirements (GB3095-2012)

Monitoring factor	Monitoring period	Monitoring contents	Relevant requirements
NO_2	7 consecutive days	Daily average concentration	Average value in 24 hours, average concentration value of at least 20 hours or sampling time of at least 20 hours
		Hourly average concentration	Sampling time in each hour is at least 45min
			Concentration value in 2nd, 8th, 14th and 20th hours
TSP	7 consecutive days	Daily average concentration	Daily sampling time is 24 hours
PM_{10}	7 consecutive days	Daily average concentration	Average value in 24 hours, average concentration value of at least 20 hours or sampling time of least 20 hours

(5) Assessment standard

Class 2 standard of *Ambient Air Quality Standard* (GB3095-2012)

(6) Analysis on monitoring results

The monitoring results are shown below.

Table 4.4-6 Statistical results of current ambient air quality survey and monitoring

Date		TSP(mg/m^3)	NO_2(mg/m^3)	PM_{10}(mg/m^3)
Class II standard in GB3095-2012		0.300	0.080	0.150
2015.12.08	Monitored value	0.101	0.017	0.056
	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.09	Monitored value	0.093	0.017	0.050

	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.10	Monitored value	0.098	0.017	0.059
	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.11	Monitored value	0.095	0.018	0.055
	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.12	Monitored value	0.103	0.018	0.046
	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.13	Monitored value	0.104	0.017	0.052
	Up to standard or not	Up to standard	Up to standard	Up to standard
2015.12.14	Monitored value	0.094	0.018	0.054
	Up to standard or not	Up to standard	Up to standard	Up to standard

The monitoring results indicate that the local ambient air quality is in sound condition and meets the requirements of the ambient air functional zone and the Class II standard in *Ambient Air Quality Standard* (GB3095-2012).

3 Shi-Xin Road

(1) Monitoring points

Based on the project characteristics, 1 ambient air quality monitoring point will be set at the Dawo You'ai Hope Primary School at K3+100 for this environmental assessment. The location of the monitoring point is shown in "Fig. 6 Layout of environmental quality monitoring points".

(2) Monitoring item

The monitoring items are conventional items, i.e. PM_{10}, NO_2 and TSP.

(3) Monitoring period and frequency

The atmospheric environment monitoring in the project assessment area lasted for 7 consecutive days from November 28 to December 4, 2015.

(4) Sampling and analysis method

The ambient air sampling, analysis, quality control and data processing were all done in accordance with the applicable national technical standards and norms.

(5) Statistical result of monitoring

The statistical results of atmospheric environment monitoring are shown below:

Table 4.4-8 The statistical results of atmospheric environment monitoring

Date / Monitoring item	Monitoring result (mg/m^3)						
	11.28	11.29	11.30	12.01	12.02	12.03	12.04
NO_2	0.016	0.017	0.017	0.017	0.018	0.017	0.017
TSP	0.172	0.163	0.166	0.169	0.165	0.169	0.165
PM_{10}	0.138	0.134	0.134	0.132	0.135	0.139	0.131

(6) Assessment method

Based on the results of monitoring over PM_{10}, NO_2 and TSP, the assessment was done by the single pollutant index method recommended in "Guidelines" in accordance with the Class II standard of *Ambient Air Quality Standards* (GB3095-2012). The assessment formula is not presented here.

(7) Results of ambient air quality assessment

Table 4.4-9 List of pollutant indexes for atmospheric environment monitoring

Date / Monitoring item	Monitoring result						
	11.28	11.29	11.30	12.01	12.02	12.03	12.04
NO_2	0.20	0.21	0.21	0.21	0.23	0.21	0.21
TSP	0.57	0.54	0.55	0.56	0.55	0.56	0.55
PM_{10}	0.92	0.89	0.89	0.88	0.90	0.93	0.87

NO_2: daily average value 0.016~0.018mg/m^3, I_{max}=0.23<1, within the limit value in Class II standard;

PM_{10}: daily aver value 0.131~0.139mg/m^3, I_{max}=0.57<1, within the limit value in Class II standard;

TSP: daily average value 0.163~0.172mg/m^3, I_{max}=0.93<1, within the limit value in Class II standard.

The daily average concentration values of NO_2, TSP and SO_2 in this project are all within the limit value specified by the Class II standard in *Ambient Air Quality Standards* (GB3095-2012) and the current ambient air quality is in sound condition.

4.4.3.2 Investigation of water environment

1 Dao-Huo Road

(1) Monitoring site

Take water from groundwater wells in Yapeng Village.

(2) Monitoring factors

pH, total hardness (calculated $CaCO_3$), total dissolved solids, sulfate, chloride, nitrate(calculated N),nitrite (calculated N), ammonia nitrogen, fluoride, and total coliforms

(3) Monitoring period and frequency

Monitoring period and frequency: 2 consecutive days, 1 sampling cycle per day

(4) Sampling and analysis method

Sampling and analysis were done in accordance with *Quality Standard for Ground Water* (GB/T14848-93).

(5) Monitoring results and assessment

① Assessment standard

Groundwater environment quality assessment is subject to Class III standards in *Quality Standard for Ground Water* (GB/T14848-93).

Monitoring results and assessment are shown below

Table 4.4-10 Results of groundwater monitoring and assessment

Monitoring item	Unit	1# well at Yapeng Village							
		December 10				December 11			
		Monitored	Standard	P_i	Times	Monitored	Standard	P_i	Times

		value	value	value	exceeding the standard	value	value	value	exceeding the standard
pH value	Dimensionless	7.88	6.8~8.5	0.587	——	7.93	6.8~8.5	0.620	——
Total hardness	Dimensionless	221	≤450	0.491	——	220	≤450	0.489	——
Total dissolved solids	mg/L	305	≤1000	0.305	——	272	≤1000	0.272	——
Sulfate	mg/L	1.35	≤250	0.005	——	1.34	≤250	0.005	——
Chloride	mg/L	1.05	≤250	0.004	——	1.03	≤250	0.004	——
Nitrate (calculated N)	mg/L	1.35	≤20	0.068	——	1.34	≤20	0.067	——
Nitrite (calculated N)	mg/L	Not detected	≤0.02	——	——	Not detected	≤0.02	——	——
Ammonia nitrogen	mg/L	0.038	≤0.2	0.190	——	0.038	≤0.2	0.190	——
Fluoride	mg/L	0.091	≤1.0	0.091	——	0.088	≤1.0	0.088	——
Total coliforms	Nr./L	<3	≤3.0	——	——	<3	≤3.0	——	——

The table above indicates that the monitored factors at 1# monitoring point all comply with the Class III standard in *Quality Standard for Ground Water* (GB/T14848-93) and the groundwater quality of that area is in sound condition.

2 Ying-Lu Road

(1) Monitoring time

December 8~10, 2015

(2) Layout of monitoring section

Only 1 monitoring section is arranged in the assessment area and its position is shown below.

Table 4.4-11 Surface water environmental quality monitoring section

S/N	Monitoring site	Pile No.	Remarks
1	Daihuanggou	K23+260	Water in Daihuanggou at north

(3) Monitoring factors

Water temperature, pH, COD, permanganate index, BOD5, DO, SS, ammonia nitrogen, petrolic substances

(4) Monitoring frequency

3 consecutive days, once each day

(5) Assessment standard

Assessment is done in accordance with Class III standard in *Environmental Quality Standard for Surface Water* (GB3838-2002).

(6) Analysis on monitoring results

The monitoring results are shown below.

Table 4.4-12 Results of surface water quality assessment

Test items	Unit	Sampling time	Survey results	Standard limit	Up to standard or not	Max. times exceeding the standard	Over standard rate (%)
Water temperature	℃	12.08	11.2	——	——	——	——
		12.09	11.3		——	——	——
		12.10	11.5		——	——	——
pH	Dimensionless	12.08	7.89	6~9	Up to standard	0	0
		12.09	8.08		Up to standard	0	0
		12.10	8.25		Up to standard	0	0
CODcr	mg/L	12.08	<10	≤20	Up to standard	0	0
		12.09	<10		Up to standard	0	0
		12.10	<10		Up to standard	0	0
Permanganate index	mg/L	12.08	Not detected	≤6	Up to standard	0	0
		12.09	Not detected		Up to standard	0	0
		12.10	Not detected		Up to standard	0	0
BOD_5	mg/L	12.08	0.6	≤4	Up to standard	0	0
		12.09	0.9		Up to standard	0	0
		12.10	1.1		Up to standard	0	0
DO	mg/L	12.08	8.3	≥5	Up to standard	0	0
		12.09	8.7		Up to standard	0	0
		12.10	8.9		Up to standard	0	0
SS	mg/L	12.08	5	≤30	Up to standard	0	0
		12.09	3		Up to standard	0	0
		12.10	4		Up to standard	0	0
NH_3-N	mg/L	12.08	0.044	≤1.0	Up to standard	0	0
		12.09	0.059		Up to standard	0	0
		12.10	0.077		Up to standard	0	0
Petroleum	mg/L	12.08	Not detected	/≤0.05	Up to standard	0	0
		12.09	Not detected		Up to standard	0	0
		12.10	Not detected		Up to standard	0	0

The table indicates that the water quality in Daihuanggou complies with the Class III standard in *Environmental Quality Standard for Surface Water* (GB3838-2002).

3 Shi-Xin Road

(1) Layout of monitoring section

In this environmental assessment, 2 monitoring sections were set at K4+400 where Chenjiagou and Luocaogou converge. The 1# converging point is 100m upstream and 2# converging point is 500m downstream. The locations of the monitoring sections are shown in Fig. 6 for Shi-Xin Road Subproject.

(2) Sampling time and period

Sampling was done December 2~4, 2015

(3) Monitoring item

9 items (pH, water temperature, suspended substance, permanganate index, COD, DO, BOD, ammonia nitrogen, BOD_5, petrolic substances)

(4) Sampling and analysis method

The surface water sampling, analysis, quality control and data processing were all done in accordance with the applicable national technical standards and norms. Analysis was done by the method specified in the national standard GB3838-2002

(5) Statistical result of monitoring

Table 4.4-14 Statistical results of surface water monitoring (mg/L)

Monitoring sections	Date	Water temperature	pH	BOD_5	COD	Ammonia nitrogen	SS	Permanganic acid index	Petroleum	DO
Shiyang reservoir	December 2	8.6	7.72	1.0	16.0	0.559	6	3.33	0.01	6.8
	December 3	8.3	7.78	1.6	10.0	0.447	5	3.60	0.01	7.0
	December 4	8.3	7.73	1.4	18.0	0.418	8	3.56	0.02	6.6

(6) Assessment method

Surface water environment assessment was done by the single pollutant index method recommended in the "Guidelines". The mathematical model is not presented here. Assessment of the water quality in the monitored river segment is done in accordance with Class III standard in *Environmental Quality Standard for Surface Water* (GB3838-2002).

(7) Results of surface water environment assessment

Table 4.4-15 Pollution indexes for surface water along the road

Monitoring sections	Date	pH	SS	COD	DO	BOD_5	Ammonia nitrogen	Petroleum	Permanganic acid index
Shiyang reservoir	December 2	0.8	/	0.05	1.51	0.25	0.56	0.2	0.56
	December 3	0.65	/	0.08	1.57	0.4	0.45	0.2	0.60
	December 4	0.65	/	0.07	1.46	0.35	0.42	0.4	0.59

As indicated in the table, except that the water pollution index for DO is greater than 1, the pollution index for every other factor is less than 1, which is within the Class III standard in *Environmental Quality Standard for Surface Water* (GB3838-2002) and water environment quality is ordinary.

The project assessment area has no drinking water source protection zone.

4.4.3.3 Investigation of acoustic environment

Dao-Huo Road

⑴ Monitoring points

Noise monitoring points are arranged based on the scale and importance of the sensitive points and are arranged uniformly along the road route. Based on the field survey and the characteristics of the sensitive points, 4 environmental noise monitoring points and 1 traffic noise section monitoring point are set. The locations of these monitoring points are shown in Table 4.4-1 and Fig. 4.4-2.

Chengdu Integrated Rock & Mine Testing Center of Sichuan Bureau of Geology & Mineral Resources performed acoustic environment monitoring on December 5, 2015.

Table 4.4-16 Layout of acoustically sensitive monitoring points

S/N	Sensitive spot	Pile No.	Road type	Minimum distance to the centerline of auxiliary road	Location of monitoring points	Remarks
1	Sanhe Village	K6+100~K7+100	Subgrade	Left side of road	Layer 1 in row 1, 1m outside window	The main noise source is the traffic noise from the existing Dao-Huo Road; the road section is newly built
2	Yapeng Village	K7+550	Subgrade	Right side of road	Layer 1 in row 1, 1m outside window	The main noise source is the traffic noise from the existing Dao-Huo Road
3	Chuanwang Village	K10+650	Subgrade	Left side of road	Layer 1 in row 1, 1m outside window	The main noise source is the traffic noise from the existing Dao-Huo Road
4	Dayanqiang	K11+050	Subgrade	Left side of road	150m to the left side of road	Monitoring over background noise
5	Noise attenuation section of Dao-Huo Road	1 hour of monitoring at the points that are 20m, 40m, 60m, 80m and 120m from the road shoulder; traffic volume and vehicle types are recorded				

Note: the distances between the traffic noise monitoring sections and the road shoulder are 20 m, 40m, 60 m, 80 m and 120m.

⑵ Monitoring factor: equivalent continuous A sound level LAeq.

⑶ Monitoring method: continuous monitoring for 1 day, once in the daytime and once in the nighttime.

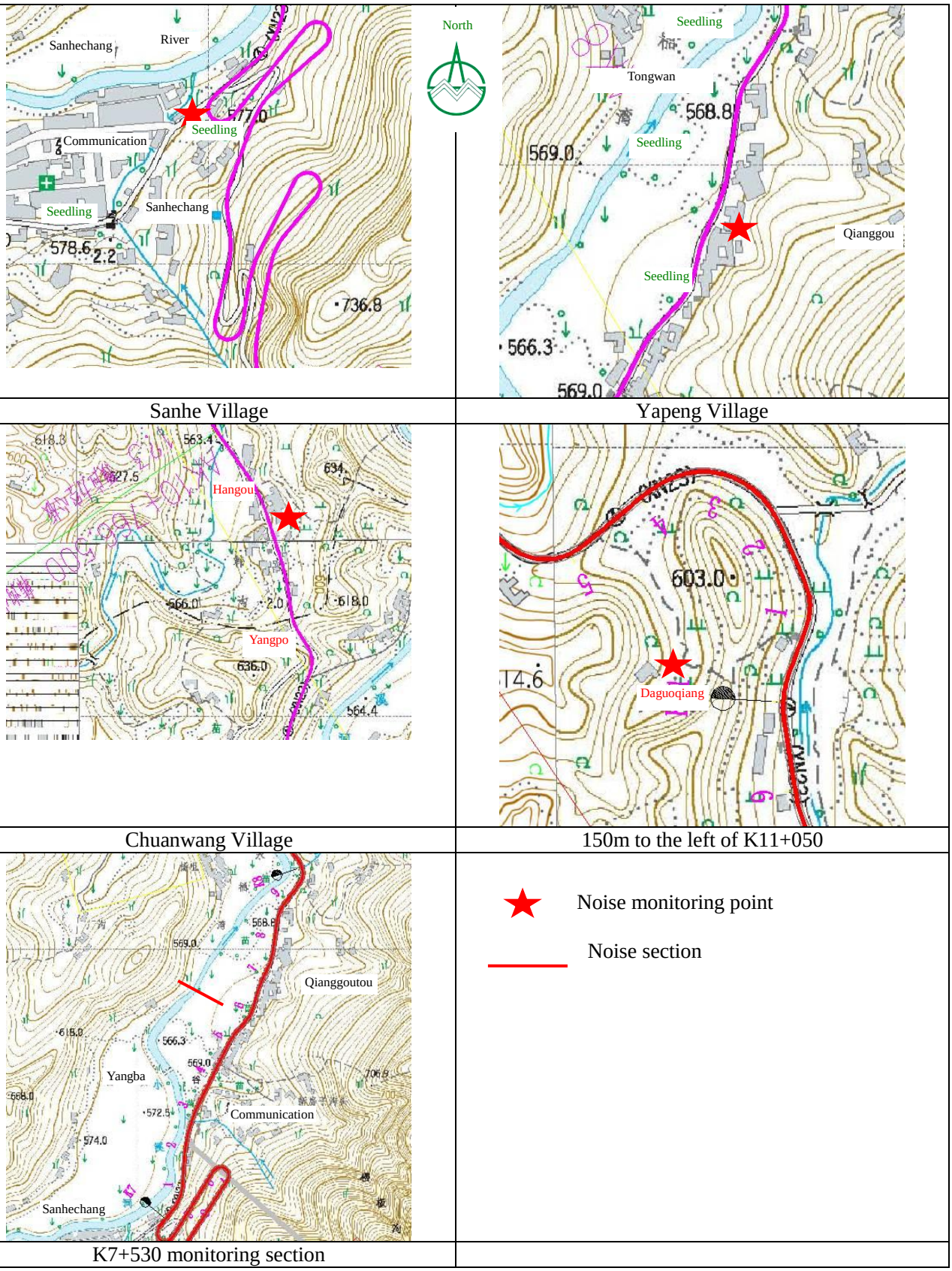


Fig. 4.4-2 Layout of acoustic environment monitoring points

⑷ Results of environmental noise monitoring

The environmental noise monitoring results from the sensitive points are shown noise Table 4.4-17 and the monitoring results from the traffic noise section in Table 4.4-18.

Table 4.4-17 Environmental noise monitoring results from the monitoring points (dB)

S/N	Monitoring point	December 5		Environmental standard	Over standard
		Day	Night		
1	Sanhe Village	48.7	41.9	Class II	/
2	Yapeng Village	49.2	42.3	Class II	/
3	Chuanwang Village	47.6	3.7	Class II	/
4	Dayanqiang	42.5	41.6	Class II	/

Table 4.4-18 Traffic noise section monitoring results (dB)

S/N	Monitoring point	Distance to road shoulder	Date	Traffic volume (Nr./h)		Measured value (dB)	
				Day	Night	Day	Night
1	Existing Dao-Huo Road	20m	December 5	34	7	46.5	42.5
		40m	December 5	34	7	45.3	41.8
		60m	December 5	34	7	44.2	41.2
		80m	December 5	34	7	43.5	40.8
		120m	December 5	34	7	43.4	40.3

The environmental noise monitoring result indicates that the monitoring points in the project assessment area show good quality and that the acoustic noise levels at all the monitoring points conform to the Class 2 standard in *Environmental Quality Standard for Noise* (GB3096-2008).

The traffic noise section monitoring result indicates that the proposed road project area is subject to small traffic volume and light noise pollution and that the traffic noise at the monitoring points 20m distant from the road shoulder conforms to the Class 2 standard in *Environmental Quality Standard for Noise* (GB3096-2008).

Generally, the monitoring points in the project assessment area show good acoustic environmental quality and the acoustic noise levels at all the monitoring points conform to the Class 2 standard in *Environmental Quality Standard for Noise* (GB3096-2008).

2 Ying-Lu Road

(1) Monitoring time

December 8~9, 2015

(2) Monitoring point

There is no acoustically sensitive point along the road route. 3 monitoring points are arranged, as shown below.

Table 4.4-19 Acoustic environment quality monitoring points at sensitive points

S/N	Monitoring sites	Pile No.	Location of monitoring point	Remarks
1	Hongshigou	K23+260	Start point of road, 1.2m elevation	Ambient noise
2	Sanhui Power Station	K26+600	1m before road-side building of the power station, 1.2m elevation	Ambient noise
3	Daqiaotou	K29+260	End point of road, 1.2m elevation	Ambient noise

(3) Monitoring factors

Equivalent continuous A sound level L_{Aeq}

(4) Monitoring period and frequency

2 consecutive days, four times/day, twice in the day time and once at night; 20 minutes for each measurement

(5) Assessment standard

Class 2 standard of *Environmental Quality Standard for Noise* (GB3096-2008)

(6) Analysis on monitoring results

The monitoring results are shown below.

Table 4.4-20 Results of acoustic environment monitoring

Monitoring point	Monitoring date		Period	Measured value	Leq average value (dB(A))	Standard value	Assessment result
Hongshigou (1#)	12.08	Day	10:18-10:38	42.4	42.3	60	Up to standard
			13:52-14:12	42.2			
		Night	23:36-23:56	37.3	37.6	50	Up to standard
			23:09-23:29	37.9			
	12.09	Day	10:43-11:03	42.2	42.4	60	Up to standard
			15:04-15:24	42.5			
		Night	23:27-23:47	37.6	37.5	50	Up to standard
			00:05-00:25	37.3			
Sanhui Power Station (2#)	12.08	Day	11:00-11:20	42.1	42.2	60	Up to standard
			14:31-14:51	42.2			
		Night	23:37-23:57	37.3	37.3	50	Up to standard
			00:51-01:11	37.2			
	12.09	Day	09:52-10:12	42.3	42.2	60	Up to standard
			15:55-16:15	42.1			
		Night	22:02-22:22	37.4	37.4	50	Up to standard
			00:48-01:08	37.3			
Daqiaotou (3#)	12.08	Day	11:45-12:05	42.2	42.0	60	Up to standard
			14:55-15:15	41.7			
		Night	22:02-22:22	37.2	37.2	50	Up to standard
			00:16-00:36	37.2			
	12.09	Day	11:31-11:51	41.6	41.8	60	Up to standard
			14:34-14:54	42.0			
		Night	22:43-23:03	37.1	37.2	50	Up to standard
			01:31-01:51	37.3			

The table above indicates that project area has good acoustic environment quality and conforms to the Class 2 standard in *Environmental Quality Standard for Noise* (GB3096-2008).

3 Shi-Xin Road

(1) Noise monitoring points

In this monitoring, environmental noise monitoring was done at 4 sensitive points and traffic noise monitoring at 1 sensitive point. 1 traffic noise section was monitored. The monitoring points are shown below.

The locations of the monitoring points are shown in Fig. 6 for Shi-Xin Road Subproject.

Table 4.4-21 Layout of acoustic environment monitoring points

Category	S/N	Description	Pile No.	Monitoring location
Environmental noise monitoring point	1#	Group 1 of Xinmin Village	K0+500	1m before the window of the first row of roadside house in the village, 1.2m elevation
	2#	Dawo You'ai Hope Primary School	K3+100	1m before the window of the first row of roadside house in the village, 1.2m elevation

	3#	Group 1 of Waping Village	K9+100	1m before the window of the first row of roadside house in the village, 1.2m elevation
	4#	Group 3 of Wangjia Village	K13+900	1m before the window of the first row of roadside house in the village, 1.2m elevation
Traffic noise monitoring point	1#	G108	K0+000	1m before the window of the first row of roadside house in the village, 1.2m elevation

(2) Monitoring item

Equivalent continuous A sound level L_{Aeq} at the monitoring points in day and night

(3) Monitoring period and frequency

Site monitoring from November 28, 2015 to December 4, 2015, monitoring 2 times for each day (once in the daytime and once in the nighttime)

(4) Monitoring method and data processing

Monitoring was done in accordance with the technical specifications in *Technical Specifications for Environmental Monitoring (Noise)* and *Environmental Quality Standard for Noise* (GB3096-2008) issued by State Environmental Protection Administration.

(5) Monitoring results

The statistical results of noise monitoring are shown in Table 4.4-21 and traffic noise monitoring results in Table 4.4-22.

Table 4.4-22 Results of environmental noise monitoring (Leq:dB(A))

S/N	Monitoring site	November 28		November 29	
		Day	Night	Day	Night
1#	Group 1 of Xinmin Village	48.6	43.8	48.5	43.2
2#	Dawo You'ai Hope Primary School	48.3	45.1	48.2	45.3
3#	Group 1 of Waping Village	53.6	48.7	53.2	47.3
4#	Group 3 of Wangjia Village	48.7	44.5	48.3	43.3

Table 4.4-23 Results of traffic noise monitoring (Leq:dB(A))

Monitoring point		24-hour continuous monitoring	
		Day	Night
G108	K0+000	63.2	56.8

(6) Analysis on representativeness of environmental noise monitoring results

For the environmentally sensitive points that were not monitored, their environmental noise values will be determined based on the nature and scale of the sensitive points and the similarity between the environmental features. See the details below.

Table 4.4-24 Analysis on representativeness of environmental noise monitoring results

S/N	Monitoring site	Pile No.	Representative sensitive point	Representativeness analysis
1#	Group 1 of Xinmin Village	K0+500	Fengxiang-Xinmin , Group 1 of Xinmin Village	Similar environmental features
2#	Dawo You'ai Hope Primary School	K3+100	Dawo Group 3, Dawo You'ai Hope Primary School Dawo Group 5 and Dawo Group 6	Similar environmental features
3#	Group 1 of Waping Village	K9+100	Group 1 of Waping Village, Group 6 of Baishu Village	Similar environmental

				features
4#	Group 3 of Wangjia Village	K13+900	Group 6 of Liupai Village, Group 3 of Wangjia Village	Similar environmental features

(7) Acoustic environment assessment

According to the assessment based on the monitoring result and the noise assessment standard, the measured traffic noise levels at the residential areas beside the road are all within the Class 2 functional zone standard limit specified in *Environmental Quality Standard for Noise* (GB3096-2008).

The environmental background noise monitoring result indicates that the environmental background noise levels at the residential areas beside the road are all within the Class 2 functional zone standard limit specified in *Environmental Quality Standard for Noise* (GB3096-2008).

The traffic noise section monitoring result indicates that the existing road bears small traffic volume and traffic noise levels at the points with different distances from the road are all within the Class 2 functional zone standard limit specified in *Environmental Quality Standard for Noise* (GB3096-2008).

In conclusion, the assessment area along the road route has good acoustic environment quality.

5.0 Environmental Impact Assessment

5.1 Assessment of impact on the social environment

5.1.1 Impact on social and economic development

Dao-Huo Road starts from Daozuo Township and ends in Huojing Town, both of which are afflicted areas in the 4.20 Earthquake, and Dao-Huo Road is also the main aisle for the internal and external traffic of the two areas. Existing Dao-Huo Road is 5.5m wide, with cement concrete pavement, many sharp turns, steep slopes, poor traffic quality and lack of safety protection facilities. The after-disaster reconstruction work of Shi-Xin Road (from Xinmin to Yong'an) is located in Tianquan County, and is an important part of the Post-Lushan Earthquake Recovery and Reconstruction Project. Ying-Lu Road is the lifeline for the economic development of Yingjing County, Siping Town, Xinmiao Township and Sanhe Township. The right of way of the road will boost industrial and economic development. The improvement of traffic conditions will promote development of land in the project area and improvement of investment environment. The Project will increase the safety factor of road traffic, improve traffic conditions and provide good guarantees for traffic and transportation required for post-earthquake recovery and reconstruction along the line to promote post-earthquake reconstruction and development of towns along the line. Regional economic development will also be accelerated. It brings direct benefit to both economy and society. But the main social and environmental impacts are caused by traffic jam. Therefore, the traffic coordination should be properly done, especially for the road smoothness and traffic safety.

5.1.2 Impact on the living quality of people along the way

During the construction, a large number of labors and a lot of construction materials are required, which will be a good opportunity to solve the surplus labor force in the engineering area and activate the local material exploration and processing market. After the Project is completed, the regional traffic condition in the engineering area will be dramatically improved and agriculture, industry and tourism in the region will all be promoted. In addition, various exchanges in technology, culture, education, sport, health,

telecommunications, recreation, etc. will become more frequent and the cultural and educational causes will be further developed.

The Project execution process will inevitably affect the regional social environment, for example, the construction vehicle passing in and out will occupy the existing roads in the region and affect regional residents' daily traffic, the construction land acquisition will bring in a lot of resettled people, the construction vehicle and equipment will emit exhausted gas, produce noise and fly ash, which will have impact on the nearby people's living quality, and the improperly treated waste water from the construction will impact the local surface water. For all of these, strict measures are called for from the Employer and the Construction Contractor.

Based on the project design data and the field survey, this project line will involve the following infrastructures and corresponding measures thereof:

This project will cross multiple roads. The road sections will not progress synchronously, thus the design of the next phase must be coordinated with the management authorities the aforementioned road roads, so as to make proper connection between this project and the other roads.

This project is a major passage in the project area and is crucial to travel of the local residents and transportation of materials. In order minimize impact on travel of the local residents along the road line, the Project Employer must formulate a regional traffic control plan for the construction period, to avoid travel inconvenience to the residents in the project area; besides, it is recommended to execute works on one side of each road section, while keep the other side clear for traffic.

5.1.3 Analysis of impact of land requisition, demolition and resettlement

5.1.3.1 Conditions of land requisition and demolition

The Project's permanent land area occupied in Qionglai is 20.44hm^2, including the arable land of 2.77hm^2, forest land 8.73hm^2, and land for traffic and transport purpose 7.81 hm^2; the temporary land area occupied is 4.8 hm^2. The Ying-Lu Road Subproject occupies a permanent land area of 10.20 hm^2, and a temporary land area of 0.61 hm^2, including the occupation of the original road area of 2.70ha, and occupation of the new permanent area of 7.50ha. The Shi-Xin Road Subproject occupies a permanent land area of 23.26hm^2, and a temporary land area of 2.86hm^2, and the area of house demolition reaches 2194m^2. 1 In the two affiliated projects of the Ying-Lu Road Reconstruction and Expansion Project in Yingjing County, the permanent land area acquired for the reconstruction work from Sanhe Township Government to Hongshigou along Ying-Lu Road totals 88.7 hm^2, and the land for the reconstruction work from Daqiaotou to Luding Boundary along the same road is 60 hm^2 of forest land (all of the forest land is owned by the state).

(1) Analysis of impact on land from permanent land occupation by the Project

The Project's impact on agricultural production is mainly from the permanent occupation of arable land and the occupied arable land will lose its agricultural output capability, which will cause loss to the agricultural production. The total permanent arable land that is needed by the Project is about 1.1ha (16.5mu). To reduce the impact of land occupation on the agricultural production, the land management law shall be strictly followed, and economic compensation should be made for all the acquired land.

(2) Analysis of impact of temporary land occupation by the Project

The impact of temporary land occupation by the Project on agricultural production during the construction shall be eliminated by artificial restoration of the land's

original use functions. So, the arable land that should be temporarily acquired should have the ground layer (30cm of the topsoil) piled aside before the usage and after the construction work is done, the land can easily be restored to its original functions. Then the impact on agricultural production would be minor.

5.1.3.2 Analysis of impact of demolition and resettlement

According to the policies and regulations of the state and the municipal government on land requisition, demolition and resettlement, the Project will give once-for-all subsidy in a monetary form to the relocated as a kind of resettlement compensation, with the specific resettlement work arranged by the local government. In the demolition and resettlement process, construction wastes and garbage will certainly be produced, mainly including various discarded stones and soil, wood material, bricks, cement blocks, rubbles, etc. These construction wastes should be cleaned in time to the Qionglai City Construction Waste Treatment Ground for treatment and at demolition, the site shall be watered to quench dust.

5.2 Assessment of impact on ecological environment

5.2.1 Analysis of impact on vegetation and wildlife

5.2.1.1 Impact on vegetation

(1) Impacts on plants during construction period

① Damages to vegetation and impact on productivity of land

The temporarily occupied land for the construction can have its vegetation restored or arable land reclaimed through various greening measures after the completion of the construction, and therefore such temporary land occupation will just cause a temporary and recoverable impact on the vegetation along the road, and the impact it caused can be eliminated gradually after the completion of the construction. However, the permanent land occupation will have unrecoverable impact on the damages to vegetation, which can not be eliminated but will only be relieved through certain subsidies. The following section of Ying-Lu Road (from Daqiaotou to Luding Boundary) must be guaranteed free from damages to the non-commercial forest along the way.

② Impact on ecosystem structure

Although the highway construction work will require some forest land, it will not cause change to the vegetable type and distribution conditions and forest community structure along the way. For forest plants, the highway will not produce some barrier to their distribution, so through pollen plants, their gene exchange will not be affected nor their seed production and seed bank updating will be interrupted. Therefore, the Project will not affect the plant community strains and the community structure is always quite simple, the ecosystem structure composed of different plant communities will not be changed either. Then the ecosystem functions and the ecological relations in the system will be continued as usual.

③ Impact on national key protected plants and ancient and rare trees

The three subproject assessment areas contain no national protected wild plants or ancient and precious trees. According to field survey indicates, the consultation with the forestry authorities of Qionglai and Ya'an and the local forestry annals, the road line in the assessment scope is accompanied by Class I national protected plants, metasequoia and gingko, and Class II national protected plants, i.e. nanmu and camptotheca acuminate. Consultation with the

local forestry authority and the residents living along the project line, these protected plants are mostly artificially cultivated plants, in-courtyard plants, shade tree or economic trees and none of them is naturally grown wild plants, so none of them is covered by national protection. However, there are numerous metasequoia trees along the road line, some of them being very old; the small number of nanmu trees are in-courtyard trees in vicinity of the road, their grow has been long free from human interference so that they have developed certain ecological value and their proximity to the road makes them susceptible to impacts of road works, therefore it is recommended that the Project Employer should avoid, replant or enclose these trees and protect them from destruction.

(2) Impact on plants during the operation period

① Impact of edge effect

After the highway reconstruction is completed, all the forest plants in the permanent occupation land area of the section will be damaged and replaced with pavements and auxiliary facilities for the traffic and transport purpose. The Project is executed on the basis of the original road, so the edge effect is already there, though its impact would be on the small side.

② Impact of alien species on local ecosystem

Through the engineering personnel in and out the assessment scope, and the access and exit of construction materials and vehicles, alien species will be brought to the region intentionally or unintentionally and because alien species are always more adaptable to the interfered environment than local species, the local existing species will drop in number and the trees will be fewer. Alien species will invade the region and form a monodominant community, thus affecting the local plant community's natural evolution and damaging regional biodiversity.

However, due to the small quantities of work under the three subprojects and the limited scope involved, the source of alien species brought to the area is single. Therefore, alien species only have a very limited impact on the local eco-system.

5.2.1.2 Impact on wildlife

(1) Impact on terrestrial animal

The construction process and mechanical noise will affect to some extent the animals living in the surrounding environment, and trees cutting and weeding in local areas and dust and waste water at the construction site will change and damage the original habitat of animals. With the permanent and temporary land occupation for construction, animal migration will be caused. Although the construction work during the construction period will reduce the variety and number of wildlife in the occupied area and affected area, it has only limited impact on the species and number of terrestrial animals in the entire project area and none of the affected animals are animals under protection, i.e. rare animals. This project is intended to rebuild and upgrade the existing roads. The area in 300m from the road line shows no presence of Class I national protected animals such as panda, takin and golden monkey or the Class II national protected animals such as macaque, lesser panda, golden cat, leopard, sambar and tragopan temminckii. Thus the project will not impact any protected wild animal.

(4) Analysis of impact on aquatic organism

There are relatively few fish variety and number in the assessment area, and there is no rare aquatic organism under protection, and therefore the work has little impact on the regional fish, and the impact is mainly focused on plankton and benthos in the construction period, for the water and soil loss, worker's domestic waste water and mechanical oil leakage will cause the water body turbid. But in the operation period, nearly there is no effect on the aquatic organism.

The Project occupies just a small water area and the domestic waste water will not be drained outside, and the aquatic organism has high survival rate and the water body has self-cleaning capacity, thus only certain essential environmental protection measures are needed, e.g. construction of wading piers is avoided in the fish breeding season from March to July; construction materials are stockpiled at a location far away from water source and other water bodies and free from scouring of storm runoff; ecological restoration is conducted after project completion, to minimize the impact of vegetation damage and water and soil loss on the aquatic organisms; the construction processes and machineries are rationally arranged and the construction personnel are given necessary education on ecological protection.

After the completion, with the dilution and water body self cleaning, the water quality will pick up soon and the aquatic organism will generally recover to the level before the Project construction.

5.2.2 Impact on agro-ecology

The Project occupies some arable land, and will change its original agricultural purpose, but the occupied land can be balanced in the village and after that the reduction of land per capita will be lower. After the project is completed, an industrial belt along the way will be formed, and the agricultural economy will turn from planting to feature agriculture and tertiary industry. And farmers losing their land can participate in the employment training offered by the local government and relevant departments to find a job themselves, and then their production work and living standards will not be affected by the seizure of the land.

5.2.3 Impact on regional landscape

During the construction, the impact on the regional landscape is mainly the damages to vegetation, terrain and landform of the digging and filling work, which will increase the landscape homogeneity in the construction work area, reduce the diversity and execrate the landform and terrain fragmentation.

5.2.3.1 Impacts on regional landscape of engineering construction

The impacts of project land requisition on the landscape are mainly represented by the effects of the Project on the regional vegetation and geomorphologic landscapes.

(1) Impacts of project permanent land occupation on landscapes

The damage brought by the project permanent land occupation (mainly the occupation for road) to the original ground vegetation is unrecoverable. The permanently occupied land in the three subprojects amounts to 54.19hm^2, of which the biggest proportion is attributable to land for traffic and transportation largely due to the reconstruction nature of the Project which mainly occupies existing right of way of the road. In addition, other lands, cultivated land, forest land, residential land and traffic & transportation land are also occupied. On the whole, various types of land permanently occupied in the Project account for a small proportion of the total land amount of directly affected areas. Therefore, construction of the three subprojects will not cause major changes to the land use structure in the directly affected areas.

In consideration of the large population living in limited areas along the line, the strained cultivated land resources and the high value of land use, land occupation in the Project will adversely affect the land resources to some degree, which will further increase the pressure on cultivated land in towns/townships along the line. The Project has a strong impact on the vegetation and landscapes of the project area and the impact mainly takes the forms of ground surface excavation, vegetation deterioration, terrain fragmentation in the construction area, etc. which will give people a strong visual contrast.

(2) Impacts of land occupation by temporary works on landscapes

Land occupation by temporary works mainly includes the land occupation by temporary soil storage yard, construction area and so on. Since temporary works mostly serve to implement the Project, they may require favorable topographical and traffic conditions where the land and vegetation are pretty good. But the construction will forcefully disturb the ground vegetation, landforms and so on in the operation area. Such disturbance mainly includes environmental pollution by production and sanitary waste, air pollution due to flying dust, and likely occurrence of scorching or mechanical damage of plants because of too much dust collected on their branches and leaves, resulting in visual pollution. However, landscapes along the land occupied by temporary works will not be affected significantly, because the land used temporarily for the project has better fertile soil layer and can be easily used for reclamation and the land area occupied temporarily for construction will be used as an area for implementation of landscape works where landscape planting will be carried out upon completion of project construction.

5.2.3.2 Impacts on regional landscape upon completion of the Project

There are no scenic spots and cultural relics in the assessment scope of the Project, and the engineering design, after meeting the design standards and being economical and reasonable, should comply with the design alignment and terrain, with the curves and straight lines properly handled, and road route position and direction clear, and wide in the driver's vision. Meanwhile, the regional road landscape and riverbank landscape formed through regional greening and beautifying shall echo the surrounding landscape, which will reduce the land requisition-caused landscape damage and form new and dynamic regional city landscape, making the region full of vigor and vitality. It also plays an active role in improving the regional ambient air quality. In general, the Project work is positively beneficial for the environment.

5.2.4 Analysis of rationality of temporary work arrangements

1. Construction site

The Project construction site mainly includes the precast yard and the mixing field. According to the construction experience of tertiary highways of Sichuan, we know the precast yard is mainly to cast the prefabricated members of medium and large bridges on highways, and under general conditions, the precast yard should be arranged in the scope of the subgrade requisition land of the bridgeheads of medium and large bridges, and new temporary land shall be used as the precast yard only when the work can not be done in the scope of the subgrade requisition land.

2. Construction road

Most parts of the Project are reconstruction and expansion works, which have many usable sections on the roads, and the delivery of construction materials is convenient. But the waste disposal area, mixing unit, material transportation roads and some individual places and junctures should new construction roads and clay bound

macadam pavements. The construction roads shall be built along the mountain and should strike a balance of civil work and stonework digging and filling of the roads. After the completion of the construction, newly constructed construction roads shall principally be reclaimed or afforested, and if the construction roads should be maintained for people's living and economic development along the way, both the Employer and the Construction Contractor shall level them for local use and the construction roads shall not be incorporated into the local highway network construction plan.

5.3 Assessment of impact on acoustic environment

5.3.1 Prediction of impact on acoustic environment during construction

5.3.1.1 Prediction method

The noise during construction is mainly produced by construction machines and transportation vehicles. The *Emission Standard for Noise within the Boundaries of Construction Sites* (GB12523-2011) shall be complied with for the noise during construction.

All the construction devices are point sound sources and the noise prediction mode is:

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

Where, Li and L0 are equipment noise levels of the distances Ri and R0; and ΔL is the additional attenuation generated by obstacles and vegetations.

For the impact of multiple construction machines on a certain predicted point, acoustic repetition should be conducted, with the prediction pattern as:

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

5.3.1.2 Prediction results

Noise pollution sources during the construction are mainly caused by construction machineries. The intensities of pollution sources are listed in Table 5.3-1 according to the measured data of common machineries.

Table 5.3-1 Noise level of construction machinery of the Project

S/N	Machinery type	Model	Distance between the test point and construction machinery (m)	Maximum sound level L_{max}(dB(A))(m)
1	Wheel loader	ZL40	5	90
2	Wheel loader	ZL50	5	90
3	Grader	PY16A	5	90
4	Vibratory roller	YZJ10B	5	86
5	Duel-drum double-vibration roller	CC21	5	81
6	Three-wheel roller		5	81
7	Pneumatic tyred roller	ZL16	5	76
8	Bulldozer	T140	5	86
9	Hydraulic wheel excavator	W4-60C	5	84
10	Generator set (two sets)	FKV-75	1	98
11	Impact type well drill	22	1	87
12	Conical drum reversing concrete	JZC350	1	79

	mixer			

Table 5.3-2 Prediction results of construction machinery noise standard distance

S/N	Machinery type	Model	Standard value (dB)		Radius of influence (m)	
			Day-time	Night-time	Day-time	Night-time
1	Wheel loader	ZL40	70	55	50	270
2	Wheel loader	ZL50			50	270
3	Grader	PY160A			50	270
4	Vibratory roller	YZJ10B			32	180
5	Duel-drum double-vibration roller	CC21			18	100
6	Three-wheel roller				18	100
7	Pneumatic tyred roller	ZL16			10	56
8	Bulldozer	T140			32	180
9	Hydraulic wheel excavator	W4-60C			25	141
10	Impact type well drill	22			7	40
11	Spreader	fifond311 ABG CO			20	112
12	Spreader	VOGELE			36	199
13	Generator set (two sets)	FKV-75			25	141
14	Conical drum reversing concrete mixer	JZC350			3	16

5.3.1.3 Impact analysis

At the day time, the min. distance of 50m of construction machinery at full load can meet the construction boundary environmental noise emission standard limit and at night time, the min. distance of 270m can meet the construction boundary environmental noise emission standard limit. During the construction, the major noise sources are construction machinery and transportation vehicles, which generally have the noise value range of 75-105dB. In addition, the distance attenuation in the table calculation is a theoretical conception. Due to the terrain limit, the altitude difference between the work site and the sensitive points, the obstacles of the spreading routes, discontinuous daily work hour, different machineries on the subgrade and pavement construction, etc. actually, the noise influence radius and extent will be lower than the theoretical calculations, letting along the noise impact would be short-term without accumulation and the noise will disappear with the completion of the Project.

At the preceding section (from Sanhe Township to Hongshigou) of the Ying-Lu Road Subproject there are four environmentally sensitive points, i.e. Sanhe Primary School, Sanhe Township, Group 3 of Nanlin Village and Group 4 of Nanlin Village. Though they are not within the scope of the Project assessment, a notice shall be issued to the local residents if the Construction Contractor should conduct night time construction due to the limitations of the construction techniques and other factors, and the suggested noise-reduction measures should be taken to reduce the construction site noise, for example, through the erection of the temporary enclosure.

5.3.2 Prediction of noise impact during operation period

5.3.2.1 Dao-Huo Road

According to the Project features, site conditions, temporary work conditions, environmental characteristics along the way and the design traffic volume, etc. the assessment adopts the highway noise prediction pattern recommended in the *Technical Guidelines for Environmental Impact Assessment-Acoustical Environment* (HJ2.4-2009) for the prediction. The environmental noise of any point on the ground should be the

overlay or superposition of the noise energy from the line source spread to the point and the background noise energy of that point.

1. The prediction mode of equivalent noise level of type i vehicles

$$L_{eq}(h)_i = (\overline{L_{0E}})_i + 10\lg\left(\frac{N_i}{V_i T}\right) + 101g\left(\frac{7.5}{r}\right) + 101g\left(\frac{\psi_1 + \psi_2}{\pi}\right) + \Delta L - 16$$

Where, $L_{eq}(h)_i$ — equivalent sound level per hour of type i vehicle, dB(A);

$(\overline{L_{0E}})_i$ --the speed of the type i vehicle is Vi, km/h, energy average sound level A at the horizontal distance of 7.5m, dB(A);

N_i --Night time, average per hour volume of type i vehicle passing at certain prediction point at night, vehicles/h;

r --Distance from the center line of the lane to the prediction point, m; noise prediction applicable to the prediction point with r>7.5m.

V_i --Average speed of type i vehicle, km/h;

T – Time for calculation of equivalent sound level, 1h;

ψ_1、ψ_2 --Field angle and radiation of prediction point to two ends of limited sections;

ΔL --Correction caused by other factors, dB(A), which can be calculated as per following formulae:

$$\Delta L = \Delta L_1 - \Delta L_2 + \Delta L_3$$

$$\Delta L_1 = \Delta L_{坡度} + \Delta L_{路面}$$

$$\Delta L_2 = A_{atm} + A_{gr} + A_{bar} + A_{misc}$$

Where,

ΔL_1 --Correction caused by route, dB(A);

$\Delta L_{坡度}$ —Correction of highway vertical slope, dB(A);

$\Delta L_{路面}$ --Correction caused by the road surface material, dB(A);

ΔL_2 --Attenuation caused by the acoustic wave propagation path, dB(A);

ΔL_3 --Correction caused by reflection etc., dB(A).

2. Equivalent sound level of total traffic stream is:

$$(L_{eq})_{交} = 10\lg[10^{0.1(L_{Aeq})_{大}} + 10^{0.1(L_{Aeq})_{中}} + 10^{0.1(L_{Aeq})_{小}}]$$

Day time or night time environmental noise prediction value at the prediction point should be calculated according to the formula as follows:

$$(L_{eq})_{预} = 10\lg\left[10^{0.1(L_{Aeq})_{交}} + 10^{0.1(L_{Aeq})_{背}}\right]$$

Where, $(L_{eq})_{预}$--day time or night time environmental noise prediction value at the

prediction point, dB;

$(L_{Aeq})_{背}$ -background noise level at predicted point, (dB)

3. Determination of forecast mode parameters

(1) Average noise level of vehicle radiation $\overline{(L_0)_E}$

The noise level (source intensity) of vehicle driving radiation is concerned with the vehicle speed, vehicle type and pavement property. For the corresponding coefficient relationship of average noise level f vehicle driving radiation at a distance of 7.5m and the vehicle speed, refer to Table 3.6.2-3.

(2) Traffic flow per hour (Ni)

The traffic flow per hour in various assessment years calculated on the basis of the traffic flow predictions presented in the Project engineering feasibility report is shown in Table 5.3-1.

(3) Additional attenuation (ΔS)

The additional attenuation varies with the difference in the sectional subgrade patterns, pavement and ground relative altitude, terrain and surface features on the subgrade two sides, and therefore shall be calculated section by section and point by point according to the sensitive points' conditions.

(4) Estimation of highway subgrade attenuation

The road to be constructed requires both filling and digging works, and high embarks and deep cuttings may have additional attenuation to the traffic noise spreading. For the calculation of the additional attenuation is as follows:

$$N = \frac{2\delta}{\lambda} = \frac{f}{170} \times \delta \quad ; \qquad \delta = a + b - c$$

Where, δ—path difference (see Fig. 4.3-1);

f—highway traffic noise frequency, f=500Hz;

N—Fresnel number.

With the Fresnel number N, you can find the sound screen noise attenuation calculation curve (omitted here) and obtain the noise attenuation made by embankments and cuttings.

Table 5.3-3 Predicted values of traffic flow per hour of various sections along the road Unit: Vehicles/h

Section	Vehicle type	2017		2023		2031	
		Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
Dao-Huo Road	Small-sized vehicle	72	18	151	38	196	49
	Middle-sized vehicle	3	1	7	2	9	2
	Large-sized vehicle	1	0	1	0	2	1

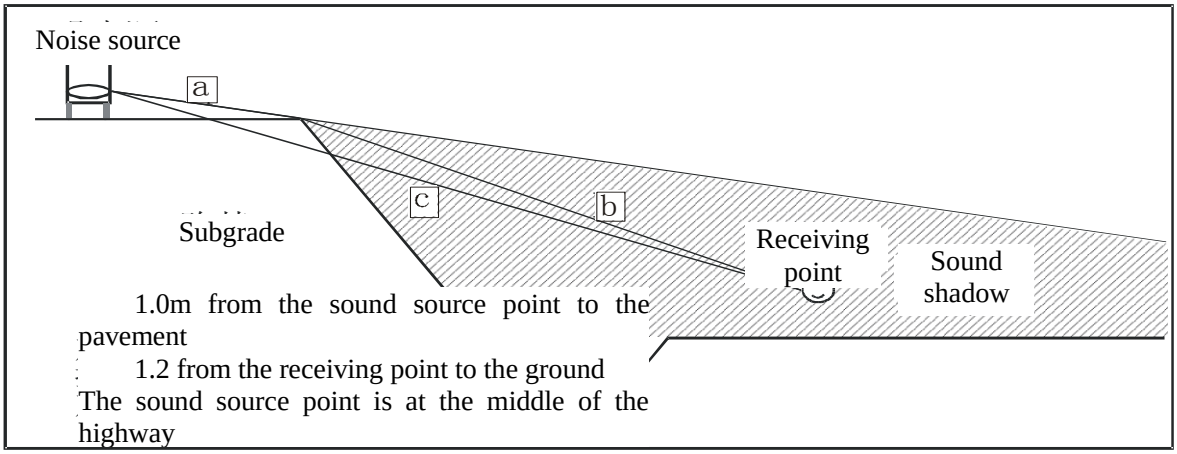


Fig. 5.3-1 Schematic diagram of calculated high embankment noise attenuation

(5) Calculation of additional noise attenuation by rural houses

The additional noise attenuation by rural houses should be calculated based on Table 5.3-2.

Table 5.3-4 Calculation of noise attenuation by rural houses

Row of houses	Floor area of house	Noise attenuation (dB)
First row	40~60%	3
	70~90%	5
Remaining rows	For each row of houses added	Increasing 1.5
	Row of continuously added houses	10 at the maximum level

4. Prediction of traffic noise

Traffic noises at different times and distances are shown in Table 5.3-5, and the standard distance for traffic noise Class II is included in Table 5.3-6.

Table 5.3-5 Predicted value of traffic noise Unit: dB

Prediction period	2017		2023		2031	
Distance from the road red line	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
10m	47.99	41.48	51.24	44.76	52.41	45.96
20m	45.68	39.16	48.93	42.45	50.09	43.64
30m	44.18	37.66	47.42	40.94	48.59	42.14
40m	43.06	36.54	46.31	39.83	47.47	41.02
50m	42.17	35.65	45.42	38.94	46.58	40.13
60m	41.43	34.91	44.68	38.20	45.84	39.39
70m	40.80	34.28	44.05	37.56	45.21	38.76
80m	40.24	33.73	43.49	37.01	44.66	38.21
90m	39.75	33.24	43.00	36.52	44.17	37.71
100m	39.31	32.79	42.56	36.08	43.72	37.27
110m	38.91	32.39	42.16	35.67	43.32	36.87
120m	38.54	32.02	41.79	35.31	42.95	36.50
130m	38.20	31.68	41.45	34.96	42.61	36.16
140m	37.88	31.37	41.13	34.65	42.29	35.84
150m	37.59	31.07	40.83	34.35	42.00	35.55
160m	37.31	30.79	40.56	34.07	41.72	35.27
200m	36.34	29.83	39.59	33.11	40.76	34.31

Table 5.3-6 Standard distance from the traffic noise source to the highway central line Unit: m

Section	Standard value	2017		2023		2031	
		Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
Daozuo-Huojing	Class II	1	1	1	1	1	1

From the prediction results it can be seen that if only the distance, ground attenuation are considered, and given the actual conditions of the highway, the noise of the Project at 1m in the near, medium and far future will reach the Class II of the *Environmental Quality Standard for Noise*.

5. Prediction of traffic noise impact on sensitive points

Environmental noise at predicted point P is:

$$(L_{Aeq})_{预} = 10 \lg\left[10^{0.1(L_{Aeq})_{交}} + 10^{0.1(L_{Aeq})_{现}}\right] \quad (dB)$$

Where, $(L_{Aeq})_{预}$—present value of environmental noise at prediction points (the site monitoring value will be adopted here).

Different noise type shall be adopted for the different distances from the sensitive points to the highway. Various sensitive points shall be calculated and the sound sensitive points' out of range conditions are shown in the following table.

Table 5.3-7 Prediction results of environmental noise at sensitive points along the Dao-Huo Road Subproject

S/N	Description and stake mark	Distance from the first row of houses to the highway center (m)	Distance from the first row of houses to the highway red line (m)	Range of altitude difference (m)		Affected households (Class II)	Prediction period	Environmental background value		Contribution value		Predicted value		Standard value		Over standard		Present value		Predicted value-present value	
								Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
1	Residential area of Zhaigou Village K2+400~K3+400	Right side 11	7	-1	1	10	Short-term	42.5	41.6	44.6	38.1	46.7	43.2	60	50	-	-	-	-	-	-
							Medium term	42.5	41.6	46.0	38.6	47.6	43.4	60	50	-	-	-	-	-	-
							Long-term	42.5	41.6	46.8	38.7	48.2	43.4	60	50	-	-	-	-	-	-
2	Residential area of Sanhe Village K6+000~K7+900	Right and left sides 10	6	0	0	67	Short-term	48.7	41.9	45.0	38.5	50.1	43.4	60	50	-	-	48.7	41.9	1.4	1.5
							Medium term	48.7	41.9	46.4	39.0	50.6	43.9	60	50	-	-	48.7	41.9	1.9	2
							Long-term	48.7	41.9	47.2	39.1	50.9	43.9	60	50	-	-	48.7	41.9	2.2	2

S/N	Description and stake mark	Distance from the first row of houses to the highway center (m)	Distance from the first row of houses to the highway red line (m)	Range of altitude difference (m)		Affected households (Class II)	Prediction period	Environmental background value		Contribution value		Predicted value		Standard value		Over standard		Present value		Predicted value-present value	
								Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
3	Residential area of Yapeng Village K8+100~K9+500	Right side 10	6	0	0	55	Short-term	49.2	42.3	45.0	38.5	50.6	43.8	60	50	-	-	49.2	42.3	1.4	1.5
							Medium term	49.2	42.3	46.4	39.0	51.0	44.0	60	50	-	-	49.2	42.3	1.8	1.7
							Long-term	49.2	42.3	47.2	39.1	51.3	44.0	60	50	-	-	49.2	42.3	2.1	1.7
4	Residential area of Chuanwang Village K10+400~K11+000	Right and left sides 10	6	0	1	20	Short-term	47.6	43.7	45.0	38.5	49.5	44.8	60	50	-	-	47.6	43.7	1.9	1.1
							Medium term	47.6	43.7	46.4	39.0	50.0	45.0	60	50	-	-	47.6	43.7	2.4	1.3
							Long-term	47.6	43.7	47.2	39.1	50.4	45.0	60	50	-	-	47.6	43.7	2.8	1.3
5	Residential area of Yantan	Right and left	6	-1	0	15	Short-term	42.5	41.6	45.0	38.5	46.9	43.3	60	50	-	-	-	-	-	-

S/N	Description and stake mark	Distance from the first row of houses to the highway center (m)	Distance from the first row of houses to the highway red line (m)	Range of altitude difference (m)	Affected households (Class II)	Prediction period	Environmental background value		Contribution value		Predicted value		Standard value		Over standard		Present value		Predicted value-present value	
							Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time	Day-time	Night-time
	Village K12+170	sides 10				Medium term	42.5	41.6	46.4	39.0	47.9	43.5	60	50	-	-	-	-	-	-
						Long-term	42.5	41.6	47.2	39.1	48.5	43.5	60	50	-	-	-	-	-	-

From the table above it can seen that after the completion and operation of the Dao-Huo Road, all the near-, mid- and long-term noise will not exceed the standard level and is in compliance with the *Environmental Quality Standard for Noise* (GB3096-2008)-Type II. Therefore, traffic noise in operation period of the subproject will have little impact on acoustic environment of the area.

5.3.2.2 Ying-Lu Road

After the highway is completed, the regional road conditions will improve, the traffic flow will increase (see Table 5.3-8), and the impact of traffic noise on the regional acoustic environment and quality will surge year on year. But at the 5m distance from the two sides of the road, the *Environmental Quality Standard for Noise* (GB3096-2008)-Class II can be reached and there is no sensitive point near the Project, and so the Subproject may have no big influence on the regional acoustic environment during the operation period.

Table 5.3-8 Daily traffic volume of various prediction years (vehicle/d)

Year	Day-time			Night-time			Total
	Small-sized vehicle	Middle-sized vehicle	Large-sized vehicle	Small-sized vehicle	Middle-sized vehicle	Large-sized vehicle	
2017	100	28	14	25	7	4	178
2020	124	36	18	31	9	4	222
2030	227	65	32	57	16	8	405

5.3.2.2 Shi-Xin Road

The total length of the project route is 16.55km, constructed according to the Class IV highway technical standards, with design speed of 20km/h, subgrade width of 6.5m, two-lane, and cement concrete pavement.

The applicable scope of highway traffic noise forecasting mode in the *Technical Guidelines for Environmental Impact Assessment-Acoustical Environment* (HJ2.4-2009) includes two-way six-lane and below express highways, first-class highways and second-class highways, with the average driving speed of 48-140km/h. The Project is a low-class township fourth-class highway, and is not applicable to the mode as aforesaid, but there is no comparison with other similar-conditioned highway works, so the assessment this time should adopt above recommended noise forecasting mode in the guidance as a reference for noise forecasting.

From the prediction mode recommended in the guideline, the following

prediction results are derived:

Table 5.3-9 Predicted traffic flow per hour at each prediction year Unit: vehicle/hour

Prediction year	Day-time			Night-time		
	Small-sized vehicle	Middle-sized vehicle	Large-sized vehicle	Small-sized vehicle	Middle-sized vehicle	Large-sized vehicle
Short-term	4	6	1	2	3	0
Medium term	6	8	1	3	4	0
Long-term	8	11	1	4	6	1

Table 5.3-10 Traffic noise impact values at different distances from the road centerline during the operation period Unit: dB(A)

Operation period	Period	Traffic noise at different distances from the highway centerline at the two sides					
		10m	20m	40m	60m	80m	120m
Short-term	Day-time	44.7	40.4	35.2	32.9	31.4	29.4
	Night-time	38.9	34.6	29.4	27.1	25.6	23.7
Medium term	Day-time	45.5	41.2	36.0	33.7	32.2	30.2
	Night-time	39.7	35.4	30.2	27.9	26.4	24.5
Long-term	Day-time	46.1	41.8	36.6	34.3	32.8	30.9
	Night-time	40.4	36.1	30.9	28.6	27.1	25.1

Table 5.3-11 Prediction results of environmental noise at sensitive points along the Shi-Xin Road Subproject

S/N	Sensitive point	Distance from the road centerline (m)	Altitude difference (m)	Period	Background value	Prediction of traffic noise (dB)			Prediction of environmental noise (dB)			Over standard (dB)			Executive standard d)
						Short-term	Medium term	Long-term	Short-term	Medium term	Long-term	Short-term	Medium term	Long-term	
1	Fengxiang-Xinmin	15 from the right side of the road	0	Day-time	48.6	41.4	42.2	42.8	49.4	49.5	49.6	0	0	0	60
				Night-time	43.8	35.6	36.4	37.1	44.4	44.5	44.6	0	0	0	50
2	Group 1 of Xinmin	9 from	0	Day-time	48.6	47.1	47.9	48.5	50.7	51.1	51.4	0	0	0	60

		the left side of the road		Night-time	43.8	41.3	42.1	42.8	46.8	47.0	47.2	0	0	0	50
		9 from the right side of the road	0	Day-time	48.6	47.1	47.9	48.5	50.7	51.1	51.4	0	0	0	60
				Night-time	43.8	41.3	42.1	42.8	46.8	47.0	47.2	0	0	0	50
3	Group 3 of Dawo	9 from the left side of the road	0	Day-time	48.3	47.1	47.9	48.5	50.7	51.1	51.4	0	0	0	60
				Night-time	45.3	41.3	42.1	42.8	46.8	47.0	47.2	0	0	0	50
		9 from the right side of the road	0	Day-time	48.3	47.1	47.9	48.5	50.7	51.1	51.4	0	0	0	60
				Night-time	45.3	41.3	42.1	42.8	46.8	47.0	47.2	0	0	0	50
4	Dawo You'ai Hope Primary School	8 from the left side of the road	0.5	Day-time	48.3	46.3	47.1	47.8	50.4	50.8	51.1	0	0	0	60
				Night-time	45.3	40.6	41.4	42.0	46.6	46.8	47.0	0	0	0	50
5	Group 5 of Dawo	8 from the left side of the road	0.5	Day-time	48.3	47.6	48.4	49.0	51.0	51.3	51.7	0	0	0	60
				Night-time	45.3	41.8	42.6	43.3	46.9	47.2	47.4	0	0	0	50
		8 from the right side of the road	0.5	Day-time	48.3	47.6	48.4	49.0	51.0	51.3	51.7	0	0	0	60
				Night-time	45.3	41.8	42.6	43.3	46.9	47.2	47.4	0	0	0	50
6	Group 6 of Dawo	55 from the left side of the road	2	Day-time	50.8	35.9	36.7	37.4	48.5	48.6	48.6	0	0	0	60
				Night-time	44.6	30.2	31.0	31.6	45.4	45.5	45.5	0	0	0	50

7	Group 1 of Waping Village	8 from the left side of the road	0	Day-time	53.6	44.9	45.7	46.4	54.2	54.3	54.4	0	0	0	60
				Night-time	48.7	39.2	40.0	40.7	49.2	49.2	49.3	0	0	0	50
8	Group 6 of Baishu Village	9 from the left side of the road	0	Day-time	53.6	44.9	45.7	46.3	54.1	54.2	54.3	0	0	0	60
				Night-time	48.7	39.1	39.9	40.6	49.2	49.2	49.3	0	0	0	50
		9 from the right side of the road	-3	Day-time	53.6	44.4	45.2	45.9	54.1	54.2	54.3	0	0	0	60
				Night-time	48.7	38.7	39.5	40.1	49.1	49.2	49.3	0	0	0	50
9	Production Team 6 of Liupai Village	11 from the left side of the road	3	Day-time	48.7	43.3	44.0	44.7	49.8	50.0	50.2	0	0	0	60
				Night-time	44.5	37.5	38.3	39.0	45.3	45.4	45.6	0	0	0	50
		11 from the right side of the road	1	Day-time	48.7	43.5	44.3	44.9	49.8	50.0	50.2	0	0	0	60
				Night-time	44.5	37.7	38.5	39.2	45.3	45.5	45.6	0	0	0	50
10	Production Team 3 of Wangjia Village	25 from the right side of the road	3	Day-time	48.7	30.5	31.3	31.9	48.8	48.8	48.8	0	0	0	60
				Night-time	44.5	24.7	25.5	26.2	44.5	44.6	44.6	0	0	0	50

Analysis of prediction results

From the prediction results of Table 5.3-11, it can be seen that the reconstructed road is a low-class highway, with a small traffic volume, and the 10 sensitive points in the highway assessment scope will not have any over standard impact during the operation period.

Summary: After the highway reconstruction, with the improvement of the road condition, the environmental noise positive effect will become obvious. And there will be no over standard conditions in the assessment scope. Therefore there will not be over standard impact

on the environmental sensitive points near the roads involved in Shi-Xin Road Subproject.

5.4 Assessment of impact on water environment

5.4.1 Analysis of impact on surface water environment during the construction period

5.4.1.1 Analysis of impact of construction waste water on surface water environment

(1) Bridge and culvert construction

Dao-Huo Road Subproject involves 5 new bridges, including 3 wading bridges with 5 wading piers, i.e. Zhaigou Major Bridge (with 3 wading piers) at K0+455.0, Shichang Medium Bridge (with 1 wading pier) at K0+905.0 and Yapeng Medium Bridge (with 1 wading pier) at K9+620.5.Wading bridges in the Project are built on bored cast-in-place pile foundation; the superstructure is fabricated in precast yard.

Ying-Lu Road Subproject involves reconstruction of 2 medium bridges (neither of them wading bridge) constructed with 20m-span prestressed hollow slab and gravity U-type abutment.

Shi-Xin Road Subproject involves building one 28m medium bridge (Shiyang Reservoir Minor Bridge) with a cast-in-situ solid slab structure and one 16m minor bridge (Xiaolian Medium Bridge) with precast simply-supported hollow slab structure beam and 33 new culverts.

Potential pollutants with biggest impacts on the water body from bridge construction are boring cuttings from construction of bored cast-in-place pile and the mud used to protect the wall, followed by construction wastewater from the precast yard and batching plant. The pollution factor is mainly SS. In addition, the washing water from construction machinery contains a small amount of petroleum. Bridge construction debris generally need to be transported to designated spoil area with certain protective measures while construction wastewater is subject to sedimentation and reused in concrete batching. The improperly treated construction debris and production wastewater or those directly discharged into the rivers will affect the water quality of these rivers.

During construction of bridge foundation, construction processes including cofferdam sinking, positioning and removal will disturb river water and bottom sludge, increasing SS concentration and affecting river water quality. The impact of rise in SS concentration on water quality is analyzed as follows:

① Boring construction is carried out in the cofferdam and isolated from surface water, so it will not affect river water quality.

② Cofferdam sinking and positioning will disturb riverbed, causing suspension of a small amount of bottom sludge which will, under the effect of such factors as flow expansion, increase the content of sand and mud in the water and water turbidity. During cofferdam removal, slurry and wastewater discharged from the cofferdam to the rivers will also cause an increase of SS in a short time. In addition, cofferdam construction will have an impact on water quality in a limited period of time within a limited scope which will disappear as construction period comes to an end.

③ The water to be discharged in the foundation pit of cofferdam comes from percolating water and precipitation. During construction in dry season, the water to be discharged in the foundation pit of cofferdam comes mainly from percolating water; in flood season, the water to be discharged in the foundation pit of cofferdam comes mainly from precipitation. Drainage of foundation pit of cofferdam has a slight impact on SS.

④ According to analogy analysis of monitoring data on cofferdam drainage in similar projects, the Project is expected to cause a maximum SS increase of 250mg/L in a scope of 150m downstream.

The above analysis shows construction of wading bridges would have certain impacts on the water bodies where such bridges are under construction, especially, the disturbance to river bottom and boring cuttings mud will cause a sharp increase in the concentration of suspended substances in local water bodies. However, since the water body flows slowly, it would soon recover from such disturbance and such substances would settle within a short distance and would not change the water quality of water body beyond 200m downstream.

In addition, in formwork installation during construction of piers and abutments, mud will come out of the sealing joints between formwork connections. Before concreting for the pier and abutment bodies, the top surfaces of foundations need to be rinsed and the laitance on such surfaces, which may cause local water body pollution once falling into the water, shall be chipped away. It is recommended to intensify construction management by recycling washing waste water during piers construction instead of discharging such water into surface water bodies.

(2) Impact of construction material delivery and stockpiling

All the subgrade filling and construction and construction material delivery, etc. will cause dust, which will fly to the water body beside the road, especially the water body within 200m from the road side. And the oil, stains, cement, and other construction materials with rain wash will also do something adversely to the surface water body along the way.

5.4.1.2 Analysis of impact of construction staff domestic waste water on surface water environment

In the environmental assessment, it is suggested that the Construction Unit using nearby rented farmer's house as the construction camp or use the relocated houses. The staff dining and cleaning should be managed in a concentrated way, so as to reduce the domestic waste water amount. Improved septic tank should be set up at the construction camp, separating excrement sewage from cuisine cleaning for collection, with the former for farmland and the latter for ground cleaning and watering through treatment.

5.4.1.3 Analysis of impact of project construction on surface water drinkable source and aquatic organisms

There is no concentrated surface water drinkable source intake in the Project assessment scope, and therefore the Project construction has no impact on the regional drinkable water. There are few suspended matters in the water assessment scope of the Project construction area, without any rare aquatic organisms. The Project construction river dredging will disturb the water body and cause some suspended matters and may have certain impact on the plankton, but it will not cause water cutout and since it is temporary, after the completion of the construction, the impact will disappear too.

The Ying-Lu Road Subproject preceding section (from Sanhe Township to Hongshigou) includes Sancha River, Chahe River and the Daihuanggou involving both the preceding and following sections of the Subproject. The three parts are all objectives of agricultural irrigation water environmental protection and the construction should have possibly low impact on the water environment of the three areas.

5.4.2 Analysis of impact on surface water environment during the operation period

After the roads enters into operation, impact on the water environment by road rainwater as the main pollutant is mainly from emission of vehicle exhaust, tyre friction particles, road dust and dripping oil which flow into the river with the pavement rainwater, causing pollution to the water body. The concentration of pollutant of road runoff depends on such factors as rainfall capacity and rainfall duration, traffic volume and degree of atmospheric pollution, time interval between two rainfalls and road width, with great randomness and contingency. Therefore, it's hard for the concentration of the pollutant of rainwater runoff to get draw general rule and unified calculation method for application. According to the statistics of domestic research data and assessment data, the pollution of road runoff to the water body mostly occurs at the initial stage of a rainfall, and as the duration of rainfall prolongs, the pollutant content in the runoff will be less and the pollution to the water body will decrease. Thus, it will not cause significant influence on the water body.

After the project is completed, the pavement becomes hard water-proof asphalt

concrete pavement. The road runoff sewage is basically close to the national emission standard in the non-accidental state, which will not cause pollution to the environment. However, bad maintenance of vehicles, faults and accidents etc. could leak gasoline and engine oil that contaminate the road. After rainfall, rainwater flows into the municipal sewage pipe network through the sluiceway inlet, causing pollution by petroleum and COD. Traffic management measures shall be taken to avoid similar accidents and reduce the impact of incident waste water on the regional surface runoff.

5.5 Assessment of impact on atmospheric environment

5.5.1 Analysis of impact on atmospheric environment during the construction period

5.5.1.1 Construction dust

1. Analysis of pollution sources

The flying dust pollution produced by construction vehicles during construction is rather severe and covers a wide range of area. Flying dust pertains to dust fall with smaller particle size (10~20μm). The particle size distribution of dust on road surface (earth) not paved is: dust with particle size less than 5μm accounting for 8%, that with particle size between 5~30μm accounting for 24% and that with particle size greater than 30μm accounting for 68%. Hence dust is likely to be kicked up from the road under construction. But flying dust is less harmful than the fine dust produced from lime-soil mixing, and the impact period of the former is also shorter. Flying dust pollution can be reduced by watering.

Earth & stone excavation and filling during construction are the main works that bring flying dust. In the process of paving the road, much fine dust will be produced by lime-soil mixing which can be divided into two kinds of processes, i.e. road mixing and plant mixing according to the method of mixing. The former is the mixing on construction site and the latter refers to centralized mixing before the finished products are transported to the construction section. By comparison, the impact of plant mixing is bigger in quantity and wider in area and the pollution scope can reach 150m in the downwind direction, while the pollution resulting from road mixing is less both in quantity and in area but the line polluted is long. It even may impact the air of the environmental sensitive points not covered in the assessment area. Therefore during the construction period, appropriate lime-soil mixing method shall be adopted according to the actual conditions to reduce the TSP pollution.

2. Control measures for flying dust pollution

(1) When the wind speed is above level IV and fugitive dust is likely to occur, the Construction Contractor is recommended to suspend the earth excavation and take such effective measures as covering the

stacked materials and moistening so that flying dust pollution can be reduced;

(2) Construction waste needs to be promptly removed and transported. For the construction waste that cannot be removed and transported for the moment, measures such as covering shall be taken. The vehicles for transporting sand, stones, cement, earth and other substances which are liable to produce dust must be well covered and no spilling or leakage is allowed.

(3) The construction site shall be cleaned immediately after the completion of the Project. Construction site shall be afforested or recovered and used as arable land to plant crops, in addition to being cleaned in time.

(4) A lime-soil mixing method shall be selected rationally based on the actual situations and fugitive dust pollution shall be reduced by watering.

(5) In the process of excavation, drilling and demolition & relocation, water shall be sprinkled to maintain certain moisture in the operation; the loose and dry surface soil in construction site shall be watered to prevent and treat fine dust; at the time of earth backfilling, the surface soil shall be watered properly if it is dry, so as to prevent fine dust from flying.

(6) The management of backfill storage yard shall be strengthened. Measures such as earth surface compaction, regular water spray and covering shall be developed; the needless earth, building materials and muck shall be carried away in time and should not be stacked for a long time.

(7) Earth-moving trucks and building-material transport vehicles shall come complete with spilling-prevention equipment and should not be surcharged, so as to ensure no scattering during transport; the running routes and time of transport vehicles shall be well planned to avoid running in sensitive areas such as the downtown district, traffic concentration area and residential area whenever possible.

(8) Transport vehicles shall be overcanopied and be rinsed before leaving the loading and unloading places, so that the amount of earth carried by wheels and chassis and scattering on the pavement can be reduced.

(9) Earth falling on the pavement during transport shall be swept up without delay to reduce flying dust during running of vehicles.

(10) In the process of construction, using abandoned building materials as fuels to burn is strictly forbidden.

5.5.1.2 Construction waste gas

Waste gas during construction of the project mainly comes from exhaust gas produced by construction machinery and transport vehicles. With small produced volume, such gas is discharged intermittently and dispersedly and its impacts are negligible.

5.5.1.3 Asphalt fume

The pavement of proposed road of the Project is under the pavement construction stage. Asphalt fume mainly occurs in the process of road paving in Dao-Huo Road Subproject, and the maximum discharge of asphalt fume comes from the process of asphalt cooking. Main toxic and harmful substances in asphalt fume are THC, phenols and 3.4-benzpyrene. The influence area of asphalt fume pollution is 100m in the downwind direction. Asphalt required for the project is commercial asphalt purchased in local and no asphalt mixing station is built. The EIA requires that special vehicles for canned asphalt be used for transport, so as to prevent asphalt from spilling along the road and polluting the environment. Thus the asphalt fume, with relatively low emission concentration, can meet the requirement of maximum allowable emission concentration of asphalt fume in *Integrated Emission Standard of Air Pollutants* (GB16297-1996) and has few impacts on the surrounding environment.

5.5.2 Analysis of impact on atmospheric environment during operation period

During the operation period, the flying dust and emitted automobile exhaust from the vehicles will cause certain air pollution, with the major pollutants of CO, NO_X and PM_{10}. The quantity of pollutant discharged is in proportion to the increase of traffic volume, involving the factors of vehicle type and automobile driving conditions. With the increase of the traffic volume, impact of NO_2 discharged in the automobile exhaust will increase too. According to the analogy prediction on roads of the same type, under the circumstance of traffic volume during near term of operation of this Project, the predicted daily average concentration of at NO_2 and PM_{10} at 10m distance meet the requirement of grade II standard of the *Ambient Air Quality Standard*.

Measures suggested for reducing air pollution during the operation period are as follows:

1. Improving greening measures, optimizing greening tree varieties, greening structure and layer, improving the greening effect and reducing impact of gaseous pollutants on surrounding environment

2. Improving traffic management, controlling the speed and reducing accidents

3. Watering, cleaning regularly to reduce flying dust

4. Limiting the speed and executing the speed policies specified in the

Project strictly.

5. Vehicles with dangerous articles are strictly forbidden to drive on the road.

5.6 Assessment of impact of solid waste pollution

5.6.1 Analysis of impact of solid wastes during construction period

Solid wastes during construction mainly include earth/stone work and construction wastes and constructor domestic wastes. Solid wastes in the construction period should be collected in a concentrated way, treated according to their types and recycled as possible. The wasted earthwork or stonework should be treated at the waste disposal area, and the demolished house and building wastes shall be used for the leveling of the construction camp and the temporarily used area, with the remaining solid wastes and living wastes collected uniformly and then taken away at the living waste treatment area for uniform treatment.

5.6.2 Analysis of impact of solid wastes during operation period

No solid wastes will be produced directly from the operation period, but few window trashes. The Employer is advised to establish a road maintenance department or authorize related environmental sanitation department to clean any trash, which then should be transmitted to the nearest waste transfer station for clearing.

5.7 Environmental risk impact assessment

5.7.1 Risk identification and determination of assessment grade

5.7.1.1 Identification of risk source and hazards

The environmental pollution of traffic accidents is that when there is a highway passing across or along the water course, the accident will cause water pollution to the region and the water pollution accidents are mainly:

(1) Gasoline (or diesel) and engine oil leakage due to a traffic accident and discharge of them into the nearby water body;

(2) Chemical dangerous articles leakage due to chemical dangerous article vehicle accident and discharge into the nearby water body;

(3) A motor vehicle with goods falling into the water body when a traffic accident occurs on the bridge surface

According to the relevant regulations of the *Risk Material Standards*, *Major Hazard Identification* (GBl8218-2000), *Occupational Exposure Poison Damage Classification* (GBZ230-2010), the Project, after completion should have the accident impact analysis made on the basis of the involved hazard of

diesel oil.

5.7.1.2 Physicochemical characteristics of dangerous materials

Generally, dangerous materials for highway transportation have following features: combustible, explosive, fluid, volatile, easily accumulative of electrostatic, thermal expansive, toxic.

5.7.1.3 Classification of assessment

According to the *Technical Guidelines for Environmental Risk Assessment on Projects* and *the classification of environmental risk assessment,* the Project doesn't have any dangerous materials and functional danger sources and the risk may only be led by indirect actions. Since the Project is a highway work, not a heavy-pollution work, the environmental risk assessment is decided to be Class II.

5.7.1.4 Forecasting formula and parameters of accident probability

After an accident of transportation vehicle for combustible and explosive materials, limited staff injury and death and property loss will ensue, causing partial temporary impact on the environment. The accident of transportation vehicle for toxic gas would not cause any injury or death as long as timely personnel evacuation is organized due to its total amount of discharge. But there is no method to treat any toxic gas discharged into the air already.

The assessment mainly analyzes the pollution impact onto the water body or the residential spot brought by traffic accidents when vehicles carrying harmful substances passing across rivers and residential area sections.

According to the survey materials and the mode, the probability of dangerous substance vehicle traffic accident after the highway in question has been completed and opened to public traffic can be calculated. Traffic accident probability of dangerous chemical substance carrying vehicles can be calculated according to the following formula:

$$P = R \times Q \times L \times D \times K_1 \times K_2$$

Where, P--predicted probability of dangerous chemical substance accidents at the section of the water course in a year;

R—probability of major accidents such as vehicle collision or overturn, in reference to the probability of the traffic accidents in the similar region, and for this Project Q_1=0.32 times (million vehicles· km);

Q—Daily absolute traffic volume in the predicted year (vehicle/day);

D—days in a year, 365 (days/year);

L—Mileage of sensitive sections (km);

K_1—proportions of the freight transport in the total traffic volume (%), and for this Project, they should be 32.46 for 2017, 31.92 for 2023 and 31.50 for 2031, respectively.

K_2: proportion of hazardous chemical transport in the total volume of freight (%), and for this project, the proportion is 15.

5.7.2 Prediction of hazardous materials transport accident rate at the project sensitive sections

1 Shi-Xin Road

According to the site survey and topographic analysis, the Shiyang Reservoir in the Shi-Xin Road Subproject of the Project shall be identified as a sensitive section for dangerous material risk analysis (see Table 5.7-1).

Table 5.7-1 Statistics of main water body sensitive section of the highway along the river

S/N	Protection object	Object features	Relevant relation	Length of sensitive section (km)
1	Shiyang Reservoir	Agriculture & irrigation Water quality: Class III	K1+300~K2+600 is a riverside section	1.30

According to the chemical hazard transportation traffic accident probability formula, the predicted probability of hazard accident at various sensitive sections has been calculated in Table 5.7-2.

Table 5.7-2 Prediction of hazardous materials transport accident rate at the project sensitive sections of the reconstructed road Unit: time/year

S/N	Water body name	Length of sensitive section (km)	Prediction results		
			2018	2024	2032
1	Shiyang Reservoir	1.30	0.000102	0.000145	0.000194

From Table 5.7-2 it can be seen that the probability of hazard transportation accident for the sensitive sections of the reconstructed road is about 1.02×10^{-4}~1.94×10^{-4} times per year. If the medium-term in the operation period should be considered, the probability of hazard transportation accident for the whole Project should be about 1.45×10^{-4} times per year. The probability of heavy chemical hazard vehicle traffic accidents leading to water body pollution at the sections of the water area during the project operation period will be extremely low. Although from the prediction results, the probability of hazard transportation accidents of

the entire length of the reconstruction high is low, once a hazard transportation leakage or overturn accident takes place, serious pollution and damage to the water environment will be caused. Therefore, to completely avoid such a risk accident, alarming signs should be set, road transportation risk prevention awareness improved, and road transportation management and bridge anti-collision design strengthened.

2 Dao-Huo Road

Through survey of the Dao-Huo Road, 5 cross-river sections have been selected as sensitive sections for the hazard risk analysis, and its accident probability prediction is included in Table 5.7-3.

Table 5.7-3 Prediction of hazardous materials transport accident rate at the sensitive sections of the proposed highway Unit: time/year

S/N	Cross-river sections and pile No.	Length of sensitive section (m)	Prediction results		
			2017	2023	2031
1	Zhaigou Large-sized Bridge	146.1	0.0011	0.0024	0.0031
2	Shichang Medium-sized Bridge	53.04	0.0004	0.0009	0.0011
3	Lijiaba Small-sized Bridge	25.04	0.0002	0.0004	0.0005
4	Yapeng Medium-sized Bridge	45.04	0.0004	0.0007	0.0010
5	Hangou Small-sized Bridge	25.04	0.0002	0.0004	0.0005
6	Z1K0+661.3 Stone Arch Bridge	24	0.0002	0.0004	0.0005
7	Z2K0+383.6 Stone Arch Bridge	100	0.0008	0.0016	0.0021
8	Total		0.0033	0.0068	0.0088

According to the table above, the following conclusions are reached:

(1) The sections the most prone to accident are Zhaigou Large-sized Bridge and Z2K0+383.6 Stone Arch Bridge, because their cross-river length are far longer than other sections in the region.

(2) Each section’s accident probability increases each year, so as the risks.

(3) Single section’s accident probability is relatively low, less than 0.05, and the probability of serious accidents as a result of leakage, explosion or fire is still lesser, so the possibility of water body pollution due to vehicle overturn and falling into the water is really very low. But for whole project, the accident probability should be paid attention to, which are estimated at 0.0033 in 2017, 0.0068 in 2023 and 0.0088 in 2031.

(4) After the Project is completed, the main water bodies for the transportation vehicles are Xiaoxi River, Zhaigou, Hangou, etc. The goods for the section vehicle transportation during the operation include oil goods, fertilizers and other hazardous goods, and once there is a overturn or leakage accident, the water environment will be polluted and damaged, and therefore the transportation risk for hazardous materials shall be reduced with effective measures and protection measures and emergency plans shall be drawn for hazard transportation accident pollution risk control.

5.7.2 Protection measures and emergency plan

5.7.3.1 Protection measures

Anti-collision measures shall be strengthened for the main cross-river water body and for the two sides of the riverbank sections along the way of the Project, so as to prevent the falling of accident vehicle into the water.

Highway management departments shall improve the hazard transportation management and strictly implement the *Rules of Transportation of Dangerous Goods by Automobile* (JT3130-88) issued by the Ministry of Communications for hazard transportation.

⑴ Strengthening of education and training pertaining to hazardous material regulations

Drivers and managers engaged in hazard transportation should strictly abide by the hazard material transportation safety technical regulations and operation procedures, and should learn and understand related regulations and rules issued by relevant state departments. Those rules and regulations mainly include:

① *Regulations on the Safety Administration of Dangerous Chemicals* issued by the State Council, ② *Rules of Transportation of Dangerous Goods by Automobile (Order of the Ministry of Communications, 1999 No. 5),* ③ *Civil Explosives Management Regulations of the People's Republic of China*, ④ Safety management regulations on highway transportation of hazardous goods issued by the Sichuan Provincial Government, etc.

⑵ Strengthening of regional dangerous goods transportation management

① The local bureau of communications should establish a network for dangerous goods transportation and agency in the area; ② certify the qualifications of the freight agency and the carrier; ③ For the dangerous goods transportation, the "permit", "driving license" and "escorting qualification" should be needed, and vehicles for the dangerous goods transportation should bear uniform signs and should subject to fixed-point examinations. ④In the process of dangerous goods transportation, both

drivers and passengers shall not smoke, and when the vehicle stops, no one should draw closer to open fire and high-temperature places. During the transportation process, drivers should concentrate in mind and carefully observe the road signs, without stopping en route randomly; ⑤ for highly toxic chemical transportation, the “permit for highly toxic chemical highway transportation" issued by the public security bureau should be needed; ⑥ under poor weather conditions, for example, strong winds, no dangerous goods vehicles shall be allowed in; ⑦ Visible signs shall be set at the sensitive spots, such as the resident settlements to arouse the attention of dangerous goods drivers. At emergency conditions, such as oil, dangerous chemical, toxic and harmful article leakage, the section shall be closed and the emergency plan launched to treat the leakage; ⑧ after an accident, the driver, escorts should report all the related important matters; ⑨ the report shall be submitted to the communications management departments and highway management departments and the Muli County People’s Government Office and the emergency plan should be launched immediately.

⑶ Drivers engaged in dangerous goods transportation should have regular training on avoidance of dangerous goods transportation traffic accidents, in order to enhance their awareness of risk, and minimize the possibility of accidents relating to the dangerous goods transportation.

⑷ Although the possibility of emergency accidents and toxic and harmful article risk accidents is low, they should be highly regarded, for once such an accident occurs, the danger and loss would be huge, or even irrecoverable. Therefore, active measures shall be taken to reduce the dangerous goods transportation risks, and risk mitigation measures and emergency measures for the dangerous goods transportation accident pollution should be formulated, and various links in the transportation process, from highway design to operation period starting examination, en route transportation, stoppage and accident handling should all be strengthened so as to prevent the accident or the escalation of the accident-related environmental pollution.

⑸ The sign boards of “reduced speed now, for safe driving” should be set up at important sections. Dangerous goods transportation vehicles shall keep a safe distance between them, without overtaking or speeding.

⑹ Emergent environmental pollution accident control and commanding system

An emergent environmental pollution accident control and commanding system is recommended to be set up.

⑺ Formulation of emergency plans

The *Traffic Safety Law of the PRC* shall be strictly followed, and risk

accident emergency management plans for the actual conditions of the highway transportation shall be drawn up. The plans should include such contents as the commanding center's duties and responsibilities, selection of emergency techniques and handling process, setup and arrangement of equipment and instruments, assurance and assignment of manpower and material flow, and dynamic monitoring of accidents, etc.

5.7.3.2 Emergency plans

1 Emergency treatment program

According to the division principles in the national public emergency rapid response system of the Master Plan for Rapid Response to Public Emergencies (January 8, 2006) issued by the State Council, the Project should prepare the Local Rapid Response Plan for Public Emergencies and the Rapid Response Plan for Public Emergency Departments. The emergency treatment program shall mainly cover following 4 aspects of contents:

(1) Information submission

After a serious accident or public emergency, information should be submitted to the superior emergency commanding center as well as related area committee and departments, with the latest time period of not more than 4 hours. In the emergency treatment process, the relevant condition reporting shall be done in a timely manner.

(2) Early-stage handling

After a public emergency occurs, when the serious accident or public emergency information shall be submitted in time, corresponding response plan shall be launched according to the duties and powers to timely and effectively handle the accident at the early stage so as to keep the situation from worsening.

(3) Early warning response

For extremely serious public emergencies without being controlled effectively after the early-stage handling, the rapid response plan shall be launched immediately with the superior commanding center managing the uniform commanding or directing work for related departments in the affected area.

The site emergency commanding center should manage the site emergency handling. Multiple associated departments shall engage themselves in the public emergency handling process, with the competent department as the leader assisted by other departments.

(4) End of emergency

After the extremely serious public emergency ends or related risk factors eliminated, the site emergency commanding center should be dissolved.

2 Emergency plan for hazard transportation accident

(1) General requirements

After observing strictly the risk prevention measures drawn at the design stage, the section highway management center during the operation period should formulate the emergency plan according to relevant national regulations and execute the steps in the plan.

The dangerous goods transportation accident emergency leader's group should be set up, and current regional emergency system should be considered to prepare emergency plans, which shall mainly include the emergency center establishment, facility setup, personnel allocation and training, accident prevention, emergency management policy implementation, etc.

All dangerous goods transportation vehicles shall have the "three certificates", i.e. the driving license, escort permit and transportation permit. Rainwater leakage of the dangerous goods leading to water body pollution should be prevented. Sides of the dangerous goods transportation vehicles shall have the uniform signs and the vehicles shall follow the designated route and park in the designated area.

(2) Emergency center setup and staffing

① Superior Commanding Center

The highway superior commanding center founded by the Qionglai City Communications Management departments, Public Security Bureau, Environmental Protection Bureau, etc. And the highway route management sub-center director shall be a member of the commanding center.

② Emergency Rescue Commanding Team

The Management Center shall establish a Safety Accident Emergency Rescue Commanding Team, with director and vice director as the managerial staff.

③ Office of Emergency Leaders Team

The Management Center Office of Emergency Leaders team is located at the Management Center Office, managed by the office director.

④ Safety Management Monitoring Team

The Management Center has an Accident Safety Management Team managed by the team leader.

⑤ Safety Managers

Selected from staff members of the Management Center

⑥ Internal Coordination Management Department

The Qionglai City Bureau of Communications and the Road Management Departments should set up an emergency office as the emergency action coordination center in charge of the dangerous goods transportation management and emergency handling. The emergency center network composition is shown in Fig. 5.7-1.

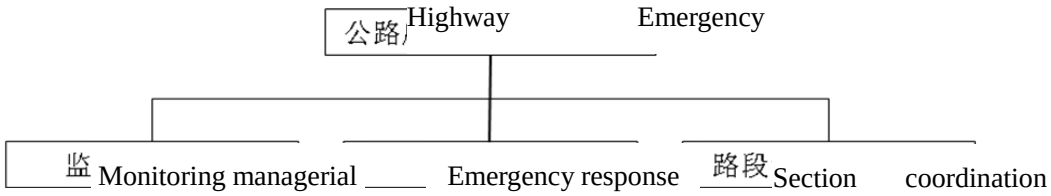


Fig. 5.7-1 Accident emergency directing organization chart

(3) Duties and labor division of the Management Center

① The duties of the Superior Commanding Center shall be determined by the regional emergency system, and the Report mainly determines the staff duties and labor division of the Management Center.

The Commanding Group Leader should take the full responsibility for the safety management work and the safety accident emergency rescue general commanding.

② Deputy Head of the Commanding Leading Group should urge and oversee the examination, implementation and rectification of the security work, and should assist the group leader in doing a good job of each piece of safety accident emergency rescue work. In addition, the deputy head shall carry out safety inspections on the highway protection facilities or equipment regularly and then submit the inspection results to the Superior Commanding Center.

③ The Office Director shall manage the daily safety management and should be in charge of the safety production accident emergency rescue liaison and coordination, while urging the leaders to carry out safety education and skill training for the staff.

④ The Safety Management Team Leader should manage the highway emergency facility checks and daily management work.

⑤ The safety managers should carry out daily management of the emergency facilities and road protection facilities in the highway range and should manage the maintenance.

⑤ After the accident, its content and level should be reported to the center emergency monitoring person on duty in terms of the exact accident place, number and goods type, and then the person on duty should report the condition to the leaders group which will launch the emergency plan after verification and should notify in time the department confirmed in the emergency plan report and ask for any needed external assistance.

⑥ The external coordination departments include firefighting, traffic police, public security, etc.

⑦ In case of serious accident, its conditions shall be reported to the Superior Commanding Management Center for the purpose of arranging relevant coordination department to carry out timely emergency rescue.

(4) Incident report system

When an accident occurs, effective alarming measures shall be adopted to report to relevant departments, and the Highway Management Department should set up emergency contact telephone in the sensitive spots along the road, for once dangerous goods transportation accident occurs, such telephone shall be used to report to the emergency office or leaders group. The accident emergency plan information process is shown in Fig. 5.7-2.

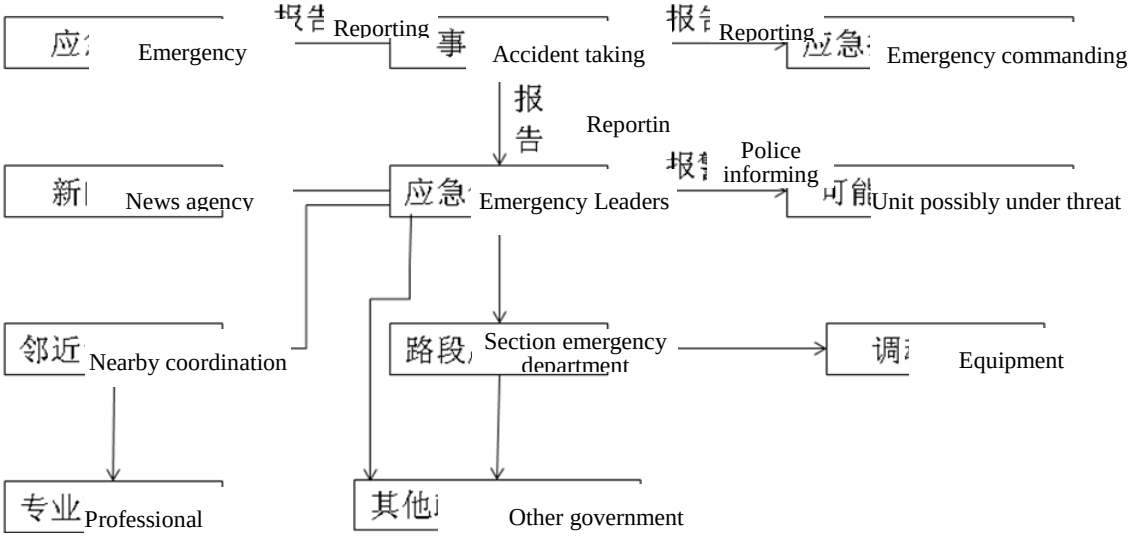


Fig. 5.7-2 Information flow chart of accident emergency plan

(5) Accident reporting content and handling procedures

◆ Reporting requirements

Content of the report of the safety managers of the center and the accident site personnel:

① The reporter should state clearly the accident location and goods type, with the location to be as exact as possible;

② For a fire or fire-led explosions, the personal injury and death and the damage to the goods shall be stated explicitly;

③ The reporter or informant name, telephone number and other contact means shall be well kept. And if an accident occurs to a densely populated area, the evacuation alarm may be issued to the public according to the air pollution degree.

◆ Protection facilities

① Monitoring devices shall be installed at water bodies of the sensitive spots and some devoted channel for telecommunications network should be set up at the monitoring & control center. The communications channel shall be kept smooth all the time to detect any transportation vehicle accident at the earliest possible time and to realize high-speed information transmission.

② Management measures for banning, restricting and guiding dangerous chemical vehicle passage shall be formulated.

5.7.3 Conclusion of environmental risk assessment

The Project is a reconstruction work of a rural road which is featured by a small traffic volume, a short length and an extremely low possibility of traffic accidents. And with the adoption of relevant protection measures, the impact and damage that would be caused by any traffic accidents would be minimized to negligible. From the perspective of environmental risk and impact, the Project is totally practicable and feasible.

6.0 Water and Soil Conservation

6.1 Forecast results of water and soil loss

Dao-Huo Road Subproject:

According to the investigation and analysis, the average background value of the soil erosion modulus for the road line is 1,200t/km^2.a. Predicted as 2 years, the project includes 1 year of construction period and 1 year of natural restoration period. The area of original landform disturbed and such land and vegetation as are damaged by the Project is 25.24hm^2; the spoil volume along the whole project line is 261,400 m^3 (loose measure). In accordance with the forecast result statistics of water and soil loss, the quantity of water and soil

loss within the area disturbed by the project construction during the forecast period will be 3130t, including 482t of natural background loss and 2648t of increased loss resulting from project construction, and water and soil loss in various construction part may reach strong to severe degree, if water and soil conservation measures are not taken. The analysis of water and soil loss intensity in all regions shows that the maximum increased water and soil loss, which is 2088t, is in the region of main works and accounts for about 78.85% of the total increased loss; the increased water and soil loss in the spoil area is 408t, accounting for approximately 15.42% of the total increased loss; the increased loss in temporary soil storage yard is 92t, about 3.47% of the total increased loss; that in the construction site is 38t, around 1.43% of the total increased loss; that in the construction access road is 22t, around 0.83% of the total increased loss. As the main parts of water and soil loss, the region of main works and the spoil area shall be regarded as the key control areas. The analysis of time interval of water and soil loss indicates that the increased water and soil loss during construction period is 2563t and the predicted loss during construction period accounts for 96.79% of the total predicted loss, thus the construction period is the main period of time of water & soil loss and water & soil loss control shall be well exercised during construction.

Ying-Lu Road Subproject:

The area of original landform disturbed by the Project is 10.81hm² and the area of water and soil conservation facilities damaged is 10.81 hm². The regional vegetation and its original water and soil conservation function shall be restored upon completion of civil works and during natural restoration period as soon as possible. The comprehensively used earth volume is 42,900m^3 (earth). The surplus soil in the Project is planting soil which can be used to cover the ambient farmland or transported to other work sites for land greening. Such soil in the Project shall be comprehensively used. The total quantity of water and soil loss that is likely to occur during construction of the Project is predicted and calculated as 1450.95t and the increased water and soil loss on the corresponding surface is 631.28t. Including: 1198.25t of total water and soil loss that is likely to occur during construction period, with increased water and soil loss on the corresponding surface being 584.25t; 252.70t of total water and soil loss that is likely to occur during natural restoration period, with increased water and soil loss on the corresponding surface being 47.03t.

Shi-Xin Road Subproject:

The area of original landform disturbed by the Project is 26.12hm² and the damaged water and soil conservation function area is 26.12 hm². The regional vegetation and its original water and soil conservation function shall be restored upon completion of civil works and during natural restoration period as soon as possible. The waste earth volume is 116,000 m^3 (converted as 168,700m^3 loose measure), and the surplus earth and rock are transported to the nearest spoil area for concentrated storage. There are a total of 2 spoil areas arranged along the whole project line and the capacity of the spoil areas meets the project requirements. The spoil transport distance is not more than 3km.

The total quantity of water and soil loss that is likely to occur during construction is 2,166.8t and the increased water and soil loss on the corresponding surface is 1,922.57t. The results of erosion intensity and loss quantity indicate that the erosion intensity generally presents a downtrend after sharp increase and is exacerbated from slight erosion to severe erosion.

6.2 Water and soil conservation conclusions and suggestions

(1) Conclusions

It can be seen clearly through the preparation of water and soil conservation schemes for the three subprojects that the construction of the Project is certain to cause increase of water and soil loss, but it can be controlled effectively by taking various control measures. Therefore, the Project is feasible in general.

(2) Suggestions

The approved water and soil conservation measures shall be incorporated into the design of main works which shall also be supplemented with the overall design scheme of greening; the Construction Contractor shall strengthen the awareness of water and soil conservation and make great efforts to limit the water and soil loss in the Project to a minimum; the supervisor for water and soil conservation shall strictly control the quality of water and soil conservation works, construction progress and engineering investment, so as to ensure that the water and soil conservation works and the main works can be constructed and put into service simultaneously; the monitoring consultant for water and soil conservation shall conduct monitoring work and the monitoring results shall be used as the basis for up-to-standard supervision, inspection and acceptance; the Employer shall actively perform the legal obligations with respect to water and soil conservation and achieve the objective of water and soil conservation in accordance with the principles and measures mentioned in the water and soil conservation schemes.

7.0 Public Participation

Public participation is an integral part of EIA on a construction project, a form of mutual exchange between the employer and assessing organization of a project and the public. Through public participation, the construction parties can determine practical environmental measures based on the environmental problems concerned by the public so that the EIA of the construction project will be more democratic and public. The participation of the public directly or indirectly involved in the project in EIA can guarantee transparency and reliability of assessments and decision and higher suitability of conclusions to actual circumstances, so that the project can successfully realize its expected social and economic benefits.

In project design and assessment, the Employer and the EIA Consultant have, according to the requirements of laws and regulations such as the *Law of the*

People's Republic of China on Environmental Impact Assessment and on the principle of "taking account of people's needs and constructing a harmonious society", conducted door-to-door visiting, online publication, issuing questionnaires, etc. in surrounding residential areas. This environmental assessment proceeded with three rounds of online publicity: the first round publicized the project overview; the second round publicized the initial draft of the project proposal; the third round publicized the whole content of the environmental impact report. Public exchange meetings were also held to solicit opinions from parties involved in the Project and local residents, especially those on significance of environmental protection and suggestions for the Project in this regard.

7.1 Purposes of public participation

(1) Ensure that the public understands the objective, scale, site and other basic information about the Project, the environmental impacts possibly caused during and after the Project is constructed and the countermeasures taken for these adverse impacts so as to gain full understanding, support and cooperation of the public. The public has the right to know about the Project as well as air their opinions;

(2) Analyze characteristics of environmental pollution of local areas and current quality of environmental elements based on personal experiences and direct feelings of local residents about their living environment. Ensure objectivity of environmental impact assessment and protect fundamental interest of the public;

(3) As the public is familiar with natural ecology, economic development, values of living materials and other resources important to EIA, by inviting them to determine protective measures for environmental resources in the form of public participation and understanding their specific demands, the environmental measures provided based on EIA of the Project will be more practicable, feasible, reasonable and effective;

(4) Ensure that the public has the opportunity to participate in determining the feasibility of the Project and economic, social and environmental benefits of the Project can be well combined.

7.2 Investigation for public participation

7.2.1 Scope and object of investigation

The scope of investigation for public participation is the areas directly affected by the Project, i.e. Tianquan County, Shiyang Town, Daping Township, Xinhua Township, Yingjiang County, Sanhe Township and adjacent areas. The object of investigation includes the residents affected by the Project and personnel from enterprises and public institutions involved in the Project.

7.2.2 Content of investigation

The content of investigation for public participation includes:

1. The attitude of the public toward the Project;

2. The identification of the public on environmental impacts of the Project;

3. Opinions and suggestions of the public on environmental protection measures to be taken for the Project.

Refer to the attachment for the Questionnaire on public opinions on the Project.

7.2.3 Investigation method

The investigation was mainly conducted by way of issuing questionnaires. When issuing the questionnaires for public opinion, the investigation personnel introduced basic information about the proposed project to the objects of investigation, including construction scale, route and positive and negative effects possibly brought to local areas. The respondents voluntarily filled in the questionnaires for public opinion, or their oral opinions were truthfully recorded by the investigators. Meanwhile, the employer, home address, sex, age, education background and other information about the respondents were indicated. Finally, the EIA consultant arranged, analyzed and summarized the questionnaires collected during investigation.

Meanwhile, we have made other efforts to enhance the public survey during this public participation: give site publication at the project location; call surrounding masses together to join a field conversazione for this Project. All such efforts have resulted in ideal effects.

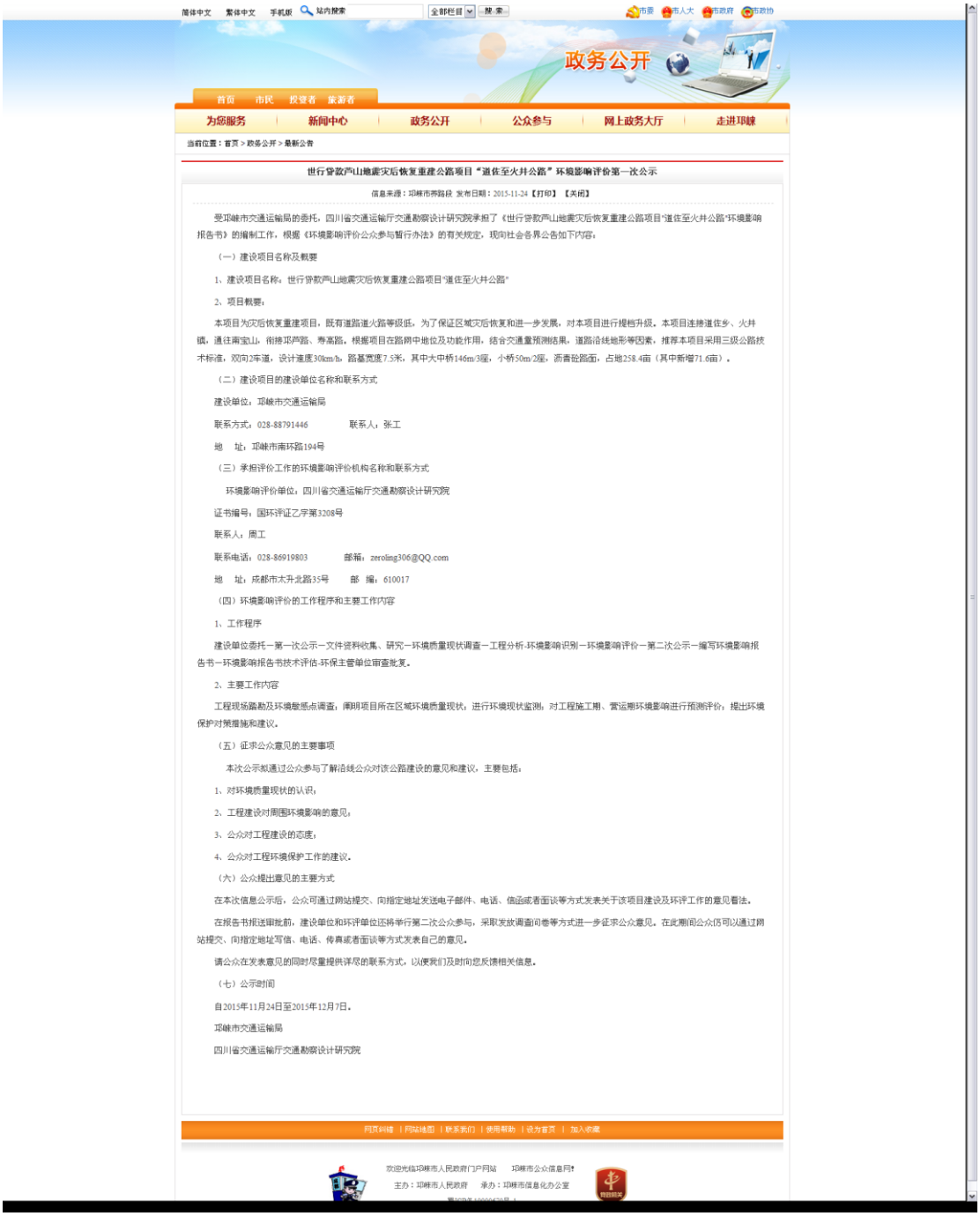
7.2.4 Implementation of investigation

1. Dao-Huo Road Subproject

(1) First-round online publication

According to *Interim Measures for Public Participation in Environmental Impact Assessment*, the assessment consultant was entrusted to carry out the first round of online publication of the brief introduction of the Daozuo-Huojing Subproject of the World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project on the government website of Qionglai City (http://egov.qionglai.gov.cn/index.php?cid=46&tid=47121) during November 24, 2015 and December 7, 2015. Refer to Fig. 7.2-1 for details. The contents publicized included main environmental problems possibly brought by the Project, the Employer and its contact information, the EIA Consultant and its contact information, the way for the public to offer opinions, etc. Meanwhile, the services

of inquiring, looking up, consulting, explaining, etc. were provided to the public as well.



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世行贷款芦山地震灾后恢复重建公路项目“道佐至火井公路”环境影响评价第一次公示

信息来源：邛崃市养路段 发布日期：2015-11-24 【打印】 【关闭】

受邛崃市交通运输局的委托，四川省交通运输厅交通勘察设计研究院承担了《世行贷款芦山地震灾后恢复重建公路项目“道佐至火井公路”环境影响报告书》的编制工作，根据《环境影响评价公众参与暂行办法》的有关规定，现向社会各界公告如下内容：

（一）建设项目名称及概要

1、建设项目名称：世行贷款芦山地震灾后恢复重建公路项目“道佐至火井公路”

2、项目概要：

本项目为灾后恢复重建项目，既有道路道火路等级低，为了保证区域灾后恢复和进一步发展，对本项目进行提档升级。本项目连接道佐乡、火井镇，通往南宝山，衔接邛芦路、寿高路。根据项目在路网中地位及功能作用，结合交通量预测结果，道路沿线地形等因素，推荐本项目采用三级公路技术标准，双向2车道，设计速度30km/h，路基宽度7.5米，其中大中桥146m/3座，小桥50m/2座，沥青砼路面，占地258.4亩（其中新增71.6亩）。

（二）建设项目的建设单位名称和联系方式

建设单位：邛崃市交通运输局

联系方式：028-88791446　　联系人：张工

地　址：邛崃市南环路194号

（三）承担评价工作的环境影响评价机构名称和联系方式

环境影响评价单位：四川省交通运输厅交通勘察设计研究院

证书编号：国环评证乙字第3208号

联系人：周工

联系电话：028-86919803　　邮箱：zeroling306@QQ.com

地　址：成都市太升北路35号　　邮　编：610017

（四）环境影响评价的工作程序和主要工作内容

1、工作程序

建设单位委托→第一次公示→文件资料收集、研究→环境质量现状调查→工程分析→环境影响识别→环境影响评价→第二次公示→编写环境影响报告书→环境影响报告书技术评估→环保主管单位审查批复。

2、主要工作内容

工程现场踏勘及环境敏感点调查；哪些项目所在区域环境质量现状；进行环境现状监测；对工程施工期、营运期环境影响进行预测评价；提出环境保护对策措施和建议。

（五）征求公众意见的主要事项

本次公示拟通过公众参与了解沿线公众对该公路建设的意见和建议，主要包括：

1、对环境质量现状的认识；

2、工程建设对周围环境影响的意见；

3、公众对工程建设的态度；

4、公众对工程环境保护工作的建议。

（六）公众提出意见的主要方式

在本次信息公示后，公众可通过网站提交、向指定地址发送电子邮件、电话、信函或者面谈等方式发表关于该项目建设及环评工作的意见看法。

在报告书报送审批前，建设单位和环评单位还将举行第二次公众参与，采取发放调查问卷等方式进一步征求公众意见。在此期间公众仍可以通过网站提交、向指定地址写信、电话、传真或者面谈等方式发表自己的意见。

请公众在发表意见的同时尽量提供详尽的联系方式，以便我们及时向您反馈相关信息。

（七）公示时间

自2015年11月24日至2015年12月7日。

邛崃市交通运输局

四川省交通运输厅交通勘察设计研究院

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主办：邛崃市人民政府　承办：邛崃市信息化办公室

Fig. 7.2-1　First-round online publication of the proposed project

(2) Second-round online publication

After the draft for the EIA Statement was prepared by the EIA Consultant, the second round of publication was carried out on Qionglai’s public information website

(http://www.qionglai.gov.cn/index.php?cid=46&tid=47738) during December 23, 2015 and January 6, 2016. The content of publication included the entire EIA Statement for the Daozuo-Huojing Subproject of the World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project the Employer and its contact information, the EIA Consultant and its contact information, the way for the public to offer opinions, etc. Refer to Fig. 7.2-2 for details.

Fig. 7.2-2 Second-round online publication of the proposed project

(3) Third-round full-text publication

After having prepared the draft for the EIA Statement, the EIA Consultant published the EIA Statement of Rural Road Subprojects of World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project on Qionglai's public information website (http://www.qionglai.gov.cn/index.php?cid=46) on January 28, 2016. Refer to Fig. 7.2-3 for details.

Fig. 7.2-3 Full-text publication of the proposed project

(4) Public exchange meeting and public participation investigation

After the second round of online publication of the draft for the EIA Statement, the EIA Consultant and the Employer visited local residents and committees of the towns, townships and villages affected by the Project as well as functional departments including environmental protection, water conservancy, forestry, traffic administration, etc. Exchange meetings were called upon in Zhaigou Village (Daozuo Township), Yapeng Village (Huojing Town), Chuanwang Village (Youzha Township), etc. along the proposed road, during which discussions on problems concerned by the affected villages were conducted and opinions of the public were collected. Investigation was also conducted on local residents in the form of public opinion questionnaire. After the respondents received the questionnaires, the investigators informed them of the basic information of the Project and the respondents filled in the questionnaires by answering the questions. Meanwhile, the employer, home address, sex, age, education background and other information about the respondents were indicated. Finally, the respondents signed on the questionnaires.

Exchange meetings called upon in the villages along the road

(5) Results of questionnaire investigation

To ensure the investigation can truly reflect the attitude, opinions and suggestions of the public toward the Project and ensure the objects of investigation are representative, totally 102 questionnaires (90 for individuals and 12 for groups) were issued to the groups and residents possibly affected by the Project on December 22, 2015. All 12 questionnaires for groups were recovered and 81 effective questionnaires for individuals were recovered. The results basically reflected the attitude, opinions and suggestions of the organizations of Qionglai City as well as the residents of Daozuo Township, Huojing Town and Youzha Township.

2. Ying-Lu Road Subproject

(1) Online publication

Totally two rounds of online publication were carried out. The first round was carried out during December 1 – 14, 2015 and the second round was carried out during December 18 – 31, 2015. And the third-round full-text publication was carried out on January 28, 2016.

On December 1, 2015, the first round of publication of the project was carried out on Ying Jing Zhi Chuang, the official website of Yingjing People's Government. Refer to Fig. 7.2-4

(http://www.yingjing.gov.cn/govopen/show.cdcb?id=26109). On December 18, 2015, the second round of publication of the project was carried out on Ying Jing Zhi Chuang, the official website of Yingjing People's Government. Refer to Fig. 7.2-5 (http://www.yingjing.gov.cn/govopen/show.cdcb?id=26789). The full-text publication was carried out on the website of Yingjing County Environmental Protection Bureau on January 28, 2016. Refer to Fig. 7.2-6 for details (website: http://hbj.yingjing.gov.cn/govInfo.cdcb?ID=28123).

Fig. 7.2-4 First-round publication of Ying-Lu Road Subproject

Fig. 7.2-5 Second-round publication of Ying-Lu Road Subproject

荥经县环境保护局
http://hbj.yingjing.gov.cn

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今天是:2016年1月28日 10:59:26 星期四 关键词:

索 引 号	742294538/2016-00038	主题分类	部门公告
发布机构	县环保局	发文日期	2016-01-27 14:43
名 称	荥经县环境保护局关于2016年1月27日受理建设项目环境影响报告书的公示		
文 号	无	主 题 词	

荥经县环境保护局关于2016年1月27日受理建设项目环境影响报告书的公示

来源：县环保局 点击数：25 次 字体：大 中 小 | 背景色：

根据建设项目环境影响评价审批程序的有关规定，荥经县环境保护局于2016年1月27日受理《世行贷款芦山地震灾后重建及减灾项目农村道路子项目环境影响报告书》。现将受理情况予以公示。

联系电话：0835-7633700

传 真：0835-7633700

通讯地址：荥经县荥兴路东二段56号

邮 编：625200

项目名称	建设地点	建设单位	环境影响评价机构	附件
世行贷款芦山地震灾后重建及减灾项目农村道路子项目	荥经县三合乡双林村红石沟至大桥头；邛崃市道佐乡、	荥经县公路养护段、邛崃市公路养护段、	四川省交通运输厅交通勘察设计研究院	报告书全本

Fig. 7.2-6 Full-text publication of Ying-Lu Road

(2) Exchange meetings

On December 24, 2015, an exchange meeting was held in the conference room of Sanhe Township People's Government which was organized by the Employer with the assistance of the preparing organization and attended by resident representatives of Sanhe Township. About 15 people, including the randomly elected representatives from four administrative villages (Shuanglin, Jianzheng, Nanlin and Baomin) of Sanhe Township and representative from the township government attended the meeting. During the meeting, the Employer introduced basic information of the Project, possible environmental impacts and corresponding environmental protection measures to the attendants. The preparing organization supplemented and explained the introduction of the Employer, and issued the public participation questionnaires for the project (as shown below).

Scene of the exchange meeting and questionnaire filling-out

(3) Results of questionnaire investigation

To ensure the investigation can truly reflect the attitude, opinions and suggestions of the public toward the Project and ensure the objects of investigation are representative, totally 35 questionnaires (30 for individuals and 5 for groups) were issued to the groups and residents possibly affected by the Project on December 22, 2015. Totally 34 effective questionnaires were recovered, with the recovery rate of 97.14%. The results basically reflected the attitude, opinions and suggestions of residents of Yingjing County and Sanhe Township.

3. Earthquake reconstruction project—Shi-Xin Road in Tianquan County

(1) Online publication

In preparation of the EIA Statement, the first round of EIA publication was carried out on the government website of Tianquan County from November 26, 2015 to December 9, 2015 (10 working days) according to *Interim Measures for Public Participation in Environmental Impact Assessment. The EIA work conducted by us was publicized to the public.* The screenshot of the publication is shown in Fig. 7.2-7. From December 22, 2015 to January 5, 2016 (10 working days), the second round of online publication was carried

out on the government website of Tianquan County. The screenshot of the publication is shown in Fig. 7.2-8. On January 27, 2016, the full-text publication of the Project was carried out on the government website of Tianquan County. The screenshot of the publication is shown in Fig.7.2-9.

Fig. 7.2-7 First-round publication of Shi-Xin Road Subproject

Fig. 7.2-8 Second-round publication of Shi-Xin Road Subproject

Fig. 7.2-9 Full-text publication of Shi-Xin Road

(2) Exchange meetings

In EIA of the subproject, the Employer organized exchange meetings in Shiyang Town, Daping Township and Xinhua Township with participation of the public. The meetings were attended by peasants and government staff of the areas. The following pictures show the scene of the exchange meetings.

(3) Results of questionnaire investigation

To ensure the investigation can truly reflect the attitude, opinions and suggestions of the public toward the Project and ensure the objects of investigation are representative, totally 90 questionnaires (80 for

individuals and 10 for groups) were issued to the groups and residents possibly affected by the Project on December 24, 2015. Totally 86 effective questionnaires were recovered, with the recovery rate of 95.56%. The results basically reflected the attitude, opinions and suggestions of residents of Tianquan County, Shiyang Town, Daping Township and Xinhua Township.

7.3 Statistic analysis of investigation results

Refer to the attachment for the list of respondents in public participation.

7.3.1 Results of public participation investigation and analysis

1. Dao-Huo Road Subproject

According to public opinion investigation conducted on social groups of Daozuo Township and Huojing Town of Qionglai City, the project area has good environmental quality, and the Project will cause positive effects on local development in energy, traffic, employment and other public courses as well as on the exploration and utilization of forest and land resources. The restraining factors of the Project may only be reflected in master planning for urban construction, and no other environmentally sensitive factors to be considered. In sum, the advantages of the Project far outweigh its disadvantages. Therefore, the social groups are supportive for the Project.

As investigation shows, the government agencies, enterprises, public institutions, social groups and residents of Daozuo Township and Huojing Town of Qionglai City have had some basic knowledge of the Project and 100% supportive for the Project. According to field investigation and consultation with competent authorities, the Project complies with the master plan for Qionglai development and is not restrained by such plan or any other environmentally sensitive factors. The EIA requests the Employer to attach importance to the concerns about and suggestions for the Project put forward by various social groups and residents of Daozuo Township and Huojing Tow in this investigation, and ⑴ prepare proper construction scheme to minimize the damage of and impact on forest; ⑵ timely restore temporarily acquired land; conduct proper assessment on the risks of geological disasters; ⑶ taking environmental protection measures, including planting road green belts, locating construction sites and access roads far away from residential areas, forbidding construction activities at night, watering construction access roads, etc. to reduce negative effects of the Project.

2. Ying-Lu Road Subproject

According to results of public opinion investigation on social groups of Yingjing County and Sanhe Township, the project area has high-quality environment, and the Project will cause positive effects on local

development in energy, traffic, employment and other public courses as well as on the exploration and utilization of forest and land resources. The restraining factors of the Project may only be reflected in master planning for urban construction, and no other environmentally sensitive factors to be considered. Main environmental problems are noise and water and soil loss as a result of the construction activities. In addition, water pollution, solid waste pollution and damage of vegetation may also occur to some extent. In sum, the advantages of the Project far outweigh its disadvantages. Therefore, the social groups are supportive for the Project. In addition, the social groups have put forward the following requirements and suggestions: ⑴ prepare proper construction scheme to minimize the damage of and impact on forest; ⑵ timely restore temporarily acquired land; conduct proper assessment on the risks of geological disasters.

3. Earthquake reconstruction project—Shi-Xin Road in Tianquan County

According to public opinion investigation conducted on social groups of Shiyang Town, Daping Township and Xinhua Township, the project area has good environmental quality, and the Project will cause positive effects on local development in energy, traffic, employment and other public courses as well as on the exploration and utilization of forest and land resources. The restraining factors of the Project may only be reflected in master planning for urban construction, and no other environmentally sensitive factors to be considered. In sum, the advantages of the Project far outweigh its disadvantages. Therefore, the social groups are supportive for the Project.

As investigation shows, the government agencies, enterprises, public institutions and social groups of Tianquan County, Shiyang Town, Daping Township and Xinhua Township and residents of Shiyang Town, Daping Township and Xinhua Township have had some basic knowledge of the Project and 100% supportive for the Project. According to field investigation and consultation with competent authorities, the Project complies with the master plan for Tianquan County development and is not restrained by such plan or any other environmentally sensitive factors. The EIA requests the Employer to attach importance to the concerns about and suggestions for the Project put forward by various social groups and residents of Shiyang Town, Daping Township and Xinhua Township in this investigation, and ⑴prepare proper construction scheme to minimize the damage of and impact on forest; ⑵timely restore temporarily acquired land; conduct proper assessment on the risks of geological disasters; ⑶ take environmental protection measures, including planting road green belts, locating construction sites and access roads far away from residential areas, forbidding construction activities at night, watering construction access roads, etc. to reduce negative effects of the Project.

7.3.2 Results of online public investigation

During the first round of online publication of Dao-Huo Road Subproject from November 24, 2015 to December 7, 2015, no opinions or suggestions from any institutions or individuals were received. During the second round of online publication of Dao-Huo Road Subproject from December 23, 2015 to January 6, 2016, no opinions or suggestions from any institutions or individuals were received. The publicity of EIA Statement of Rural Road Subprojects of World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project was carried out on Qionglai's public information website (http://www.qionglai.gov.cn/index.php?cid=46) on January 28, 2016.

For the post-earthquake reconstruction project—Shi-Xin Road in Tianquan County and Ying-Lu Road Subproject, the first round of publication of this EIA was respectively made on the government website of Tianquan County from November 26, 2015 to December 9, 2015 (10 working days), and on Ying Jing Zhi Chuang, the official website of Yingjing People's Government during December 1 – 14, 2015 (10 working days). As of December 14, 2015, no feedbacks were given. For the above two projects, the second round of publication was respectively made on the government website of Tianquan County from December 22, 2015 to January 5, 2016, 2015 (10 working days), and on Ying Jing Zhi Chuang, the official website of Yingjing People's Government during December 18 – 31, 2015 (10 working days). As of January 5, 2016, no feedbacks were given. Full-text publication of Shi-Xin Road Subproject and Ying-Lu Road Subproject was carried out respectively on the government website of Tianquan County on January 27, 2016 and on the website of Yingjing County Environmental Protection Bureau.

7.3.3 Adoption and processing of suggestions from the public

This public participation survey involves a wide range, and the respondents are mainly from such residential areas, government organizations and so on as are mostly affected by the Project and they are fairly representative groups of people. The survey methods conform to the standards and the public participation questionnaires have a higher rate of recovery. As to the opinions of the public, the EIA group of the Project timely reported to and communicated with the Client. Coordination has been made with the Client the Designer, the Employer and local government. Meanwhile, the EIA group timely summarized the opinions and requirements of interviewed residents and institutions and conducted in-depth analysis of important issues. The principles and a preliminary scheme for environmental protection was put forward and fed back to the Employer. The Employer gave its opinions on these issues and the suggestions of the EIA Consultant.

(1) Pay attention to the environmental impacts caused by project construction, and perform all environmental protection work by taking all environmental protection measures proposed in the Environmental Impact Report.

(2) Closely cooperate with local cultural relic protection administration in designing of next stage to protect the existing and possibly discovered cultural relics in the project area.

(3) The Construction Contractor shall sign a civilized construction contract. The temporary access roads shall be built in advance during construction of the road sections crossing the existing roads, so as to avoid traffic jam or segmentation. Meanwhile, supervision and management on the construction team shall be strengthened to avoid construction quality problems. Side ditches shall be excavated in advance of construction of riverside road sections. If necessary, retaining walls shall be constructed to prevent construction slurry, excavated soil and rock and wastewater from entering into water bodies and pollute water. Fences and warning signs shall be put up around construction sites.

(4) The Project Construction Department shall listen to the comments given by the affected masses along the way carefully, and minimize the occupation of cultivated land to reduce the damage on agriculture.

Through the public participation survey of the Project, the comments of the residents in the area are collected effectively, and lots of important information is fed back. This public survey is fair, open and just. It can reasonably and effectively reflect the opinions and comments of the affected masses in the area on the Project.

8.0 Environmental Protection and Management and Environmental Monitoring

8.1 Environmental protection and management

8.1.1 Environmental protection and management system and procedure

Refer to the following block diagram (Fig 8.1-1) for composition of the environmental protection and management system of the Project.

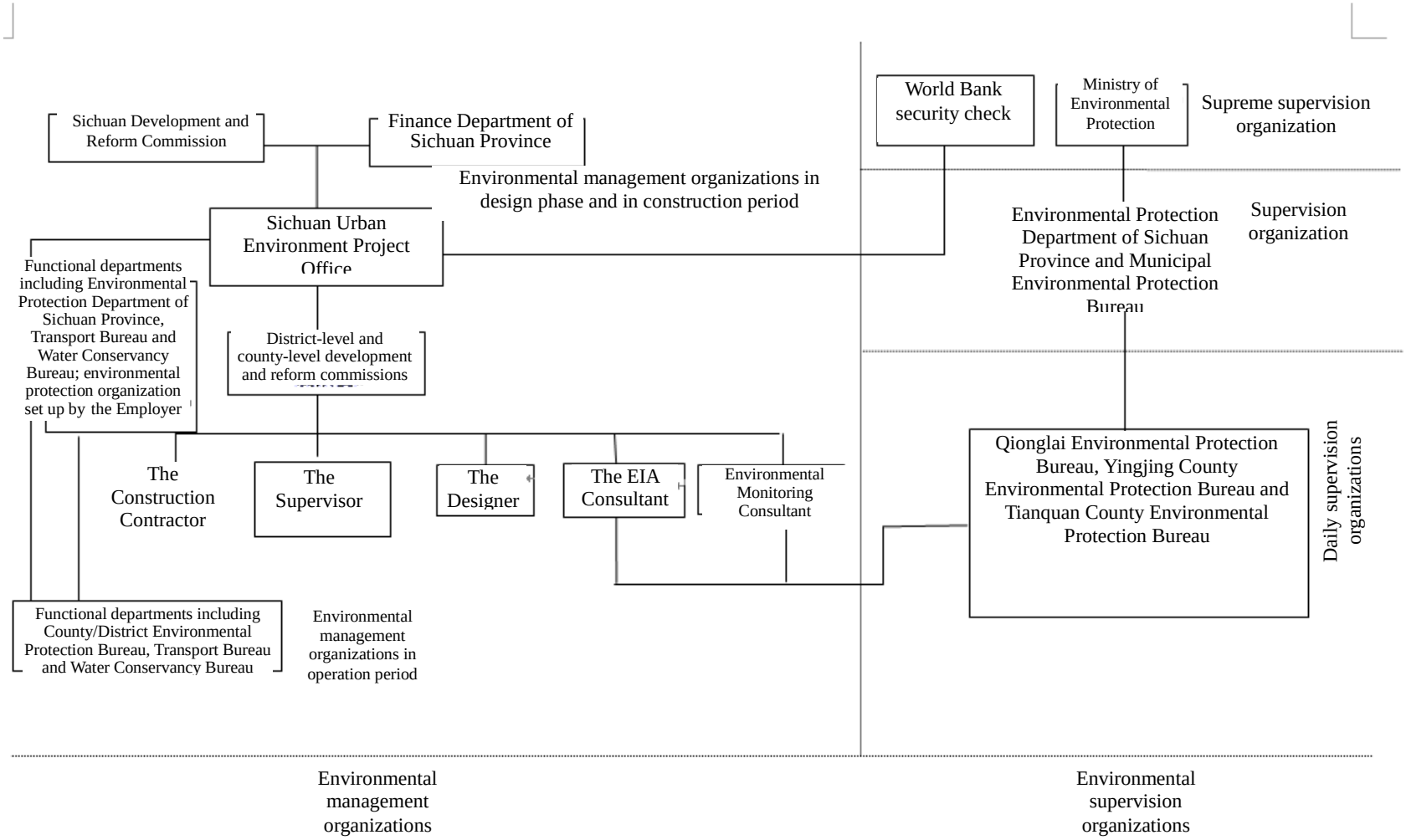
Sichuan Development and Reform Commission
Finance Department of Sichuan Province
Environmental management organizations in design phase and in construction period
Sichuan Urban Environment Project Office
Functional departments including Environmental Protection Department of Sichuan Province, Transport Bureau and Water Conservancy Bureau; environmental protection organization set up by the Employer
District-level and county-level development and reform commissions
The Construction Contractor
The Supervisor
The Designer
The EIA Consultant
Environmental Monitoring Consultant
Functional departments including County/District Environmental Protection Bureau, Transport Bureau and Water Conservancy Bureau
Environmental management organizations in operation period
World Bank security check
Ministry of Environmental Protection
Supreme supervision organization
Environmental Protection Department of Sichuan Province and Municipal Environmental Protection Bureau
Supervision organization
Qionglai Environmental Protection Bureau, Yingjing County Environmental Protection Bureau and Tianquan County Environmental Protection Bureau
Daily supervision organizations
Environmental management organizations
Environmental supervision organizations

Fig. 8.1-1 Block diagram of composition of the environmental protection and management system

The organizations shall separately undertake the following main responsibilities:

① Implementation and execution of national and provincial guidelines, policies and regulations for environmental protection;

② Supervision on preparation of environmental protection plans as well as implementation of the environmental protection measures specified in the EIA Statement;

③ Supervision on preparation of the pollution accident handling plans; investigating and handling pollution accidents;

④ Conducting environmental protection-related research and training inside the organization; improving environmental protection skills of personnel of the organization.

8.1-1 Table of environmental management system and procedure

Project stage	Content of environmental protection	Implementing organization of environmental protection measures	Environmental protection and management department	Environmental protection and supervision department
Construction period	Implement environmental protection measures and handle environmental emergencies	The Construction Contractor	Environmental protection bureau of each county/district and the Employer	The Supervisor, provincial and municipal environmental protection bureaus
Operation period	Implement environmental protection measures and environmental management	The Employer or Operation Management Organization	Environmental protection bureaus of each county/district	Provincial and municipal environmental protection bureaus

8.1.2 Environmental management organizations and their responsibilities

1. Environmental protection and management organizations

Environmental protection and management organizations and their responsibilities are shown in Table 8.1-2.

Table 8.1-2 Environmental management organizations and their responsibilities

Name	Responsibilities	Remarks
Sichuan Urban Environment Project Office	Coordinate and manage the work of World Bank Loaned Lushan Earthquake Reconstruction and Risk Reduction Project and ensure that environmental protection meets the requirements of WB security policies.	It is proposed to arrange Environmental Supervisor (Engineer) in construction period to carry out supervision of environmental protection measures in each lot throughout the process based on EMP and bidding documents for construction.
Environmental Protection Department of Sichuan Province and municipal	Instruct the Employer to implement national environmental protection laws and regulations and be responsible for approval; supervise the implementation of various environmental protection measures for the	Chengdu Municipal Environmental Protection Bureau and Environmental Protection Bureau of Ya'an City are responsible for the

environmental protection bureaus in the project area	proposed project; take overall charge of the inspection and acceptance of environmental protection for the proposed project.	approval of all subproject EIA reports.
County/District Transport Bureau	Take charge of detailed work in supervision and management of environmental protection measures for the road subprojects under its jurisdiction in operation period.	
County/District Water Resources Bureau	Take charge of detailed work in supervision and management of environmental protection measures for the river control subprojects under its jurisdiction in operation period.	
County/District Environmental Protection Bureau	Take charge of detailed work in supervision and management of environmental protection measures for the World Bank Loaned Project under its jurisdiction in operation and construction periods.	

8.1.3 Supervision organizations

Environmental protection supervision organizations and their responsibilities are shown in Table 8.1-3.

Table 8.1-3 Environmental protection supervision organizations and their responsibilities

Name	Responsibilities	Remarks
Environmental Protection Department of Sichuan Province	Be responsible for: review and approval of EIA documents for the proposed project; supervision of the implementation of various environmental protection and management measures for the proposed project; inspection and acceptance of environmental protection for the proposed project.	Sichuan Environmental Protection Administration
Municipal environmental protection bureaus	Carry out supervision and management of environmental protection work for the construction project; organize and coordinate relevant agencies to provide service for environmental protection work; supervise the implementation of EMP; take charge of completion acceptance of environmental protection facilities of the project; confirm environmental regulations and standards applicable to the project; instruct County/District Environmental Protection Bureau on environmental supervision and management in construction and operation periods; accept, investigate and coordinate the handling of public complaints about environment and supervise improvement of environmental protection facilities and measures.	Environmental Protection Bureaus of Chengdu City and Ya'an City
3 County/District Environmental Protection Bureaus	Accept work instructions from environmental protection department at a higher level, supervise the Employer's implementation of EMP and relevant environmental management regulations and standards; coordinate various departments to carry out environmental protection work; take charge of inspection, supervision and management of construction, completion	Environmental protection bureaus of Qionglai city, Yingjing County and Tianquan County

Name	Responsibilities	Remarks
	and operation of environmental protection facilities under its jurisdiction; accept, investigate and coordinate the handling of public complaints about environment and supervise the improvement of environmental protection facilities and measures.	
External Environmental Monitoring Consultant	Environmental supervision in project preparation period includes: review provisions on environmental protection in the *Project Construction Organization Plan* prepared by the Construction Contractor; check whether the environmental protection system established by the Construction Contractor is reasonable; participate in the approval of the submitted *Unit Project Commencement Report*; conduct engineering supervision of construction of pollutant treatment works. Environmental supervision in construction period includes: prepare *Key Points of Environmental Protection Work* based on construction organization design for each lot; publicize environmental protection to the Construction Contractor; point out sensitive spots vulnerable to environmental pollution for the Construction Contractor; propose detailed environmental protection measures based on major pollutants in the construction process; review the *Scheme for Environmental Protection during Project Construction* submitted by the Construction Contractor; inspect whether the Construction Contractor's environmental protection system operates normally; check the implementation of environmental protection measures; supervise the construction of water and soil conservation measures. Environmental supervision in operation period includes: review the *Final Report on Environmental Protection during Project Construction* prepared by the Construction Contractor; compile completion documents on environmental protection; carry out acceptance of environmental protection work for the project; prepare the *Final Report on Environmental Supervision*, etc.	At the next stage, determine External Monitoring Consultant through bidding.

8.1.4 Environmental management plan

The environmental management plan of this project is shown in Table 8.1-4. The environmental management plan of the Daozuo-Huojing Road Subproject is under the jurisdiction of Environmental Protection Department of Sichuan Province, Chengdu Municipal Environmental Protection Bureau and Qionglai Municipal Environmental Protection Bureau; the environmental management plan of Yingjing-Luding Road

Subproject is under the jurisdiction of Environmental Protection Department of Sichuan Province, Ya'an Municipal Environmental Protection Bureau and Yingjing County Environmental Protection Bureau; the environmental management plan of Shiyang-Xinhua Road Subproject is under the jurisdiction of Environmental Protection Department of Sichuan Province, Ya'an Municipal Environmental Protection Bureau and Tianquan County Environmental Protection Bureau.

Table 8.1-4 Environmental management plan for road project

Stage	S/N	Environmental issues	Description of environmental management	Executed by:	Administered by:
I. Design stage	1	Route deciding	● A proper routing scheme shall be selected to minimize land acquisition and the number of wading structures.	Designer	Construction Headquarters
	2	Noise and air pollution	● The impacts of noise, dust, etc. on environmentally sensitive sites shall be considered in site selection. ● For sensitive sites with out-of-limit noise levels, noise-reduction measures shall be designed depending on actual noise levels, including sound-proof wall, acoustic barrier, etc. to minimize the impacts of traffic noise during the operation period.	Designer	
	3	Landscape protection	● Landscaping design shall be carefully conducted to reduce the adverse impacts on natural landscapes along the road.	Designer	
	4	Water pollution	● In scheme design for bridge pier foundation construction, proper comparisons shall be made between earth-rock cofferdam and steel cofferdam taking account of the construction period, water level, water depth, environmental impact, etc.	Designer	
II. Construction period	1	Air pollution	● Proper measures including sprinkling water shall be taken at the sites near residential areas to reduce dust nuisance and atmospheric pollution during the construction period. The frequency of sprinkling water shall be based on local soil and climate conditions. ● Piled-up materials and stockyards shall be at least 300m away from residential areas and covered up or wetted by sprinkling water to prevent dust pollution. Trucks transporting building materials shall be covered up with canvas, etc. to reduce spillage. ● In dry seasons, periodical water	Contractor	Construction Headquarters

Stage	S/N	Environmental issues	Description of environmental management	Executed by:	Administered by:
			sprinkling shall be conducted at the construction site and on access roads to reduce flying dust.		
	2	Soil erosion	● Trees and grass shall be planted in three months after subgrade is completed. ● Slope protection shall be carried out for subgrade slopes to prevent water and soil loss due to rainwater scouring. Drilling residues and spoil shall be well used to minimize water and soil loss.	Contractor	
	3	Water pollution	● Oil-separation sedimentation tanks shall be built to recycle properly treated water. It is not allowed to discharge production wastewater into the rivers. ● A proper construction scheme shall be prepared for bridge pier construction, which takes environmental protection as a priority. Management shall be enforced in construction. A sedimentation tank shall be built before construction of cast-in-site bored pile foundation is carried out. ● Measures shall be taken to prevent construction materials, oil or garbage from falling into rivers and cause water pollution. ● Leaked mechanical oil or dumping waste oil into water bodies will result in water pollution. Thus, environmental management and environmental protection education shall be enhanced. ● Construction materials should not be piled up near the Tuojiang River. Temporary covering canvas shall be provided to prevent materials from being blown into water bodies by rainstorm and strong wind.	Contractor	
	4	Noise	● Noise standards shall be strictly abided to protect construction personnel from any injury caused by noise. Workers working close to intensive sound sources shall wear earplugs and helmet with limited working hours. ● Machines and vehicles shall be properly repaired and maintained to ensure low-noise level.	Contractor	

Stage	S/N	Environmental issues	Description of environmental management	Executed by:	Administered by:
			● If such equipment as a pile driver, excavator, concrete pump, etc. that may produce noise pollution is to be employed, the Construction Contractor shall submit a report to local environmental protection administration 5 days in advance of commencement, indicating the project mane, construction location, the noise-producing equipment to be used, possible noise level and the preventive and controlling measures for noise pollution, etc. ● High-noise machines shall not be operated at noon (12:00-2:30) and night (22:00-6:00). Where it is necessary to carryout out construction activities at noon or night due to technological conditions or under other special circumstances, the Construction Contractor shall obtain opinions from the authorities and announce the situation to adjacent residents. ● Construction shall not be carried out during official and legal holidays whenever possible.		
	5	Landscape protection	● Landscaping in coordination with the surroundings shall be conducted based on proper landscape designs for road medians, roadsides and slopes.	Contractor	
	6	Protection for ecological resources	● Construction shall be carried out within the road boundary and land outside the range of acquisition shall not be disturbed. ● Drilling residues in bridge construction shall be delivered to an appointed site for comprehensive use instead of being randomly dumped. ● Topsoil shall be stripped and properly utilized.	Contractor, Employer and administrations of reserved areas	
	7	Transportation management	● Consultation shall be made with the traffic control and public security authorities for the guidance on traffic arrangement. Measures shall be taken to prevent traffic jam and poor transportation efficiency during construction. ● Proper plans for transportation of building materials shall be made to avoid rush hours of existing	Contractor	

Stage	S/N	Environmental issues	Description of environmental management	Executed by:	Administered by:
			roads.		
	8	Construction supervision	● Environmental supervision during the construction period shall be conducted according to the approved EIA report and the construction drawing.	Supervisor	
	9	Cultural relics	The Construction Contractor shall adequately protect the site and contact the cultural relics administration to discuss the protection measures, so as to ensure success of the Project and safety of the cultural relics.	Contractor	
III. Operation period	1	Noise	● Traffic control shall be enhanced. Excessively loud old vehicles shall not get on the road.	Road administration	Road administration, environmental protection administration and administrations of reserved areas
	2	Air pollution	● The inspection system for car emission shall be implemented strictly. Car emission shall be spot checked. Vehicles having excessive emission of exhaust are not allowed to get on the road.	Traffic control and environmental protection administrations	
	3	Hazardous material management	● An emergency leading group shall be formed to handle accidents related to spillage of hazardous materials. In case of accidental spillage of hazardous materials, it is required to follow the emergency plan, notify the authorities and take emergency measures. ● The three certificates issued by the public security department shall be obtained for transportation of hazardous goods, which are the permit for transportation, driver's license and security certificate. Marks for hazardous goods shall be provided on vehicles transporting such goods, and special travelling route and parking site shall be designed for these vehicles. ● In case of accidental spillage of hazardous materials, it is required to follow the emergency plan, notify the authorities and take emergency measures. Meanwhile, a monitoring group will be formed to deal with such accident. ● Patrol examination on deck runoff collection system and emergency handling tank of the Dunzi River.	Road administration, public security department and administrations of reserved areas	
	4	Road greenbelt	● Road greenbelt shall be properly maintained.	Road administration	

8.2 Environmental monitoring plan

8.2.1 Objective of monitoring

The implementation of the environmental monitoring plan can facilitate good understanding of environmental conditions of the construction and operation periods and provide solid basis for taking pollution control measures.

8.2.2 Monitoring consultant and items

Environmental monitoring in the construction and operation periods of highway works shall be undertaken by an organization qualified for national environmental quality monitoring and certifying. As a lot of subdivisional works are involved in the Project, monitoring plans will be made for the construction and operation periods of each item of works.

8.2.3 Monitoring plan

1. Dao-Huo Road Subproject

The main targets of monitoring include atmospheric conditions, surface water quality and noise levels. Monitoring shall be carried out by combining fixed-point and mobile monitoring methods as well as regular and irregular spot checks. Refer to Table 8.2-1 and Table 8.2-2 for specific monitoring plans.

Table 8.2-1 Environmental monitoring plan for the construction period (Dao-Huo Road)

Environmental elements	Monitoring point	Monitoring item	Monitoring frequency, cycle and time of sampling	Executed by:	Administered by:
Surface water	Yapeng Medium-sized Bridge K9+535 (the Xiaoxi River)	pH, COD, suspended solids, petrolic substances	Once every two months, 1 day/once; random check	Entrusted environmental supervision station	Qionglai Road Maintenance Section, Qionglai Environmental Protection Bureau
Atmosphere	Group 8, Yapeng Village	PM_{10}, TSP, NO_2	Twice every year (considerably intensified during construction rush hours), 12 consecutive hours each time		
Noise	Sanhe Village (K6+100~K7+100) (left side of the road), Yapeng Village (K7+550) (right side of the road), Chuanwang Village (K10+650) (left side of the road)	LAeq	Once every quarter, 2 day/once, sampling twice a day, one in day time and one at night; random check		

Table 8.2-2 Environmental monitoring plan for the operation period (Dao-Huo Road)

Monitoring item		Monitoring point	Monitoring frequency	Executed by:	Supervised by:
Noise	LAeq	Sanhe Village (K6+100~K7+100) (left side	Twice/year, 2 day/once	Entrusted environmental	Qionglai Environmental

		of the road), Yapeng Village (K7+550) (right side of the road), Chuanwang Village (K10+650) (left side of the road)		supervision station	Protection Bureau
Surface water	pH, COD, suspended solids, petrolic substances	Yapeng Medium-sized Bridge K9+535 (the Xiaoxi River)	One time each for the dry and ample periods each year; emergency monitoring		

2. Shi-Xin Road Subproject of Tianquan County

All impacts of reconstruction of Shi-Xin Road will occur during the construction period. Therefore, there is no necessity to make a monitoring plan for the operation period.

Table 8.2-3 Environmental monitoring plan for the construction period (Shi-Xin Road)

Environmental elements	Monitoring point	Monitoring item	Monitoring frequency, cycle and time of sampling	Executed by:	Administered by:
Surface water	The influx of Chenjiagou and Luocaogou, 100m upstream of K4+400, 500m downstream of the influx	pH, COD, suspended solids, petrolic substances	Once every two months, 1 day/once; random check	Entrusted environmental supervision station	Ya'an Road Maintenance Section, Tianquan Environmental Protection Bureau
Atmosphere	Dawo You'ai Hope Primary School	PM_{10}, NO_2, TSP	Twice every year (considerably intensified during construction rush hours), 12 consecutive hours each time		
Noise	Group 1 of Xinmin Village (K0+500), Dawo You'ai Hope Primary School (K3+100), Group 1 of Waping Village (K9+100), Team 3 of Wangjia Village (K13+900), G108(K0+000)	LAeq	Once every quarter, 2 day/once, sampling twice a day, one in day time and one at night; random check		

3. Ying-Lu Road Subproject

All impacts of reconstruction of Ying-Lu Road will occur during the construction period. Therefore, there is no necessity to make a monitoring plan for the operation period.

Table 8.2-4 Environmental monitoring plan for the construction period (Ying-Lu Road)

Environmental elements	Monitoring point	Monitoring item	Monitoring frequency, cycle and time of sampling	Executed by:	Administered by:

Surface water	Daihuanggou water body in the north of the start, K23+260 (Daihuanggou)	pH, COD, suspended solids, petrolic substances	Once every two months, 1 day/once; random check	Entrusted environmental supervision station	Ya'an Road Maintenance Section, Ya'an Environmental Protection Bureau
Atmosphere	About 200m downstream of the Sanhui Power Station	TSP, NO_2, PM_{10}	Twice every year (considerably intensified during construction rush hours), 12 consecutive hours each time		
Noise	Hongshigou (K23+260) (beside the road section at the start) with the height of 1.2m, 1m at the roadside structure of the Sanhui Power Station(K26+600) with the height of 1.2m, Daqiaotou (K29+260) (beside the road section at the terminal) with the height of 1.2m	LAeq	Once every quarter, 2 day/once, sampling twice a day, one in day time and one at night; random check		

8.2.4 Monitoring report system

The monitoring report system of the Project is as shown in Fig. 10.2-1. The Monitoring Consultant shall submit a report after each monitoring, which will be submitted level by level.

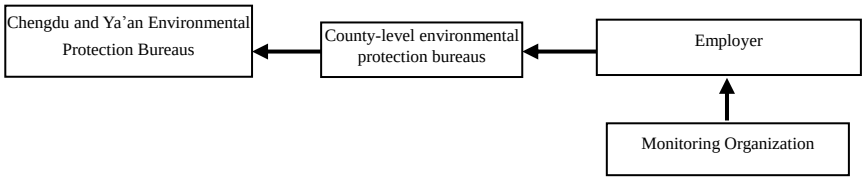

Figure 10.2-1 Schematic drawing of the monitoring report procedure

8.2.5 Monitoring costs

No monitoring instruments and equipment will be purchased under the Project, which shall be prepared by the Monitoring Consultant itself. Assuming a construction period of 1 year and the supervision costs is 60,000 yuan/year, the total costs will be 60,000 yuan/year. The monitoring costs of the operation period shall be estimated to be 30,000 yuan/year. The Monitoring Consultant shall prepare monitoring reports based on the environmental monitoring results during the construction and operation periods of the Project, and submit the reports to the authorities, including Chengdu Environmental Protection Agency, Qionglai Environmental Protection Bureau, Ya'an Environmental Protection Bureau, Qionglai Road Maintenance Section, Tianquan County Transportation Development Co., Ltd and Yingjing County Road Maintenance Section, as a record.

8.3 Environmental supervision

8.3.1 Principles for environmental supervision

Environmental supervision shall be conducted on the basis of law-abiding, integrity, fairness and scientificity. Environmental supervisions shall be integrated into the management system of engineering supervision, of which the significance shall not be

weakened. In supervision, the correlations among the Employer, the Construction Contractor, the Engineering Supervision Organization, the Environmental Supervision Organization, the Environmental Monitoring consultant and administrative departments in charge of environment protection of the government shall be well coordinated to create favorable environment for environmental supervision.

The Supervisor shall consider characteristics of the Project and set down a standardized supervision system consistent with actual condition of the Project so that supervision activities can be carried out in an orderly manner.

8.3.2 Scope of environmental supervision

Scope of environmental supervision: the project area and the areas affected by the Project.

Scope of work: construction sites, auxiliary facilities and the areas suffering environmental pollution and ecological damages due to construction activities carried out in the above-mentioned scope.

Working stages: 1) environmental supervision in the construction preparation stage; 2) environmental supervision in the construction stage; 3) environmental supervision in the guarantee period (handover and defect liability period).

8.3.3 General procedures for environmental supervision

(1) Preparing the environmental supervision scheme of the construction period;

(2) Preparing detailed rules on environmental supervision according to progress of the Project and the environmental measures provided;

(3) Conducting environmental supervision of the construction period based on the detailed rules;

(4) Participating in environmental protection acceptance and providing opinions on environmental supervision;

(5) Submitting documents of environmental supervision to the legal representative of the Project after supervision is completed.

8.3.4 Specific working methods for environmental supervision

(1) Reviewing preliminary engineering design and verifying proper implementation of the environmental protection measures contained in the approved EIA Statement in designing the construction drawing;

(2) Assisting the Employer in providing trainings for construction, design and management personnel regarding environmental protection;

(3) Reviewing the provisions related to environmental protection in Bid Documents, Contract, etc.;

(4) Supervising the measures for protection of the ecosystem, water, air and acoustic environments and reduction of environmental impacts of the Project during construction as well as construction quality of environmental protection works; carrying out staged acceptance and signing related documents following standard procedures;

(5) Fully recording environmental impacts and effects of environmental protection measures of the Project and construction quality of environmental protection works;

(6) Bringing problems regarding environmental protection design and construction accident to the attention of the environmental supervision leading group and providing suggestions;

(7) Drafting environmental supervision work plan and summary.

8.3.5 Working system for environmental supervision

A complete working system shall be established for environmental supervision, which shall include work records, personnel training, report, correspondence, routine meetings, etc.

8.3.6 Environmental supervision organization

Engineering environmental supervision over the implementation of the environmental protection measures specified in the design documents shall be carried out by an organization which is entrusted by the Employer, qualified for engineering supervision and has been trained for environmental protection business. To ensure full execution of the supervision plan, the Employer shall sign an environmental supervision contract for the construction stage with the Supervisor before works are carried out.

8.3.7 Technical essentials for environmental supervision

Refer to Table 8.3-1 for the supervision plan of the construction period.

Table 8.3-1 Environmental supervision plan of the construction period

Item of supervision	Site of supervision	Time and frequency of supervision	Executed by:	Supervised by:
Ecological environment	Subgrade slopes, construction sites, etc.	Spot check at any time	An organization qualified for engineering supervision and trained for environmental protection business	Qionglai Environmental Protection Bureau
Water environment	Yapeng Medium-sized Bridge	Spot check at any time		
Water and soil conservation	Subgrade slopes, bridge pile foundations, tunnel entrances and exits, construction sites, etc.	Spot check at any time, with rainy seasons being the main object of supervision for slope protection		
Landscape	Along the road	Spot check at any time		
Acoustic environment	Environmentally sensitive sites along the road	Spot check at any time		
Ambient air	Material stockyards, material batching plants, excavated and filled sections, etc.	Spot check at any time		

The Environmental Supervision Organization shall collect all information about the proposed road, including basic introduction of the Project, the EIA Statement (including the Water and Soil Conservation Scheme, designs for environmental protection, equipment, production method and management of the Construction Contractor, environmental conditions at the construction sites, blowdown patterns of construction process, preventive and controlling measures, etc.

The environmental supervision plan of the construction period shall be prepared according to basic project conditions and construction methods adopted. The key items as well as methods of inspection at different times shall be determined according to construction schedule and blowdown behaviors. The technical essentials for supervision of the Project include: in the preliminary stage, the focus shall be on vegetation protection measures; in the medium term, the focus shall be on construction protection measures for pier piles of wading bridges, construction noise, discharge of construction wastewater, spoiling

activities and protection works, etc.; in the later stage, the focus shall be on restoration of vegetation in the project area.

(1) Inspection on vegetation protection at construction sites

The protective measures prepared by the Construction Contractor shall be reviewed, and proper on-site inspections shall be conducted. As the original harmonious landscape has been changed in construction, it is required to take measures for vegetation restoration and landscaping to reduce the adverse impacts.

(2) Inspection on piling-up of drilling residues during bridge construction

Drilling residues and slurry from bridge construction shall be removed and transported to an appointed site for subgrade filling. Meanwhile, the removing and transporting means shall be inspected, with proper treatment method for dust during transportation being adopted as required.

(3) Inspection on water and soil conservation during construction

Patrol inspections are required for water and soil conservation of subgrade slopes. The application forms and quality certificates of the engineering materials, seeds and saplings to be mobilized submitted by the Contractor shall be reviewed, and spot checks shall be conducted on mobilized materials, seeds and saplings by way of parallel inspection or witnessing sampling.

(4) Inspection on wastewater discharge

1. Water quality inspection

It is also important to check if construction wastewater has been fully recycled after oil separation and sedimentation, and treated wastewater satisfies relevant discharge standards. Visual inspections shall be conducted on discharged wastewater for anomalies of apparent properties. If any problems are found, the Construction Contractor shall be immediately notified.

2. Inspection on water usage process and equipment

First, inspection shall be conducted on whether any banned technology6or equipment which may cause water pollution is adopted. Secondly, improper aspects in water resources utilization shall be inspected, and the blowdown organization shall be urged to improve its technology, equipment and production management to save water and reduce wastewater discharge.

3. Inspection on discharging poisonous substance into water bodies

It is strictly prohibited to discharge any pollutant into water bodies according to Article 27 – Article 40 of *Law of the People's Republic of China on the Prevention and Control of Water Pollution, thus such behavior shall be a key object of inspection.*

4. Inspection on wastewater treatment

Quantity and quality of treated water as well as operational management and treatment effect of water treatment facilities shall be inspected.

(5) Inspection on construction noise

1. Inspection on noise-producing equipment

Check if the noise-producing equipment belongs to those outdated of which the production, selling, import and use are prohibited by the state.

2. Inspection on management of noise-producing equipment

The Construction Contractor shall be supervised to maintain equipment and replace worn components to reduce noise. The management of noise-producing equipment shall also include proper arrangement of production schedule. To reduce environmental impact of noise, high-noise construction machines shall not be operated at noon, night or during school time if the construction site is adjacent to any residential area. Inspection shall be conducted on noise monitoring records of the Construction Contractor. Any problems found shall be informed to the Construction Contractor for immediate correction.

3. Inspection on traffic noise

Proper measures shall be taken if the level of traffic noise exceeds corresponding functional standard, including strengthening traffic management, enhancing vehicle annual verification, taking noise control measures, etc.

(6) Inspection on control of atmospheric pollution

Dedusting devices shall be provided at construction sites where dust pollution can be easily caused, and proper supervision shall be conducted to ensure the devices work normally.

Construction dust mainly consists of the dust generated from traffic, construction sites and stockyards. The Construction Contractor is required to provide dust control equipment in warehouse storage or packaged storage, and conduct watering to reduce dust at any time necessary.

It is expected that one full-time environmental supervision personnel is required to carry out supervision of the Project. Assuming that the annual working costs of each environmental supervision personnel is 60,000 yuan and the construction period is 1 year, the environmental supervision costs of the proposed road during the construction period will be 60,000 yuan.

8.4 Environmental as-built acceptance

After the Project is completed, the Employer shall entrust a qualified organization to investigate the environmental protection measures taken for the Project and new environmental issues caused by operation of the Project, who shall prepare an investigation report on environmental as-built acceptance.

8.5 Investment estimate on environmental engineering

Environmental investment shall include the costs for environmental protection facilities, equipment, environmental monitoring, water and soil conservation, etc. The investment estimate on environmental protection measures of the Project is made as follows according to environmental features of the environment along the proposed road as well as the environmental protection measures and suggestions for the design, construction and operation periods specified in this statement.

1. Dao-Huo Road Subproject

Refer to Table 8.5-1 for the investment estimate on environmental protection measures of the Dao-Huo Road Subject. As shown in the table, the amount of the initial investment on environmental protection of the subproject is around 3.256 million yuan, accounting for 1.77% of total investment of the Project.

Table 8.5-1 Investment estimate on environmental protection measures for upgrading and reconstruction of Daozuo-Huojing Road

Item of environmental	Specific measures	Qty.	Amount (10,000 yuan)	Remarks

protection works					
Protection and restoration or ecological environment	Construction Period	Subgrade and surface drainage engineering and protection works	Entire road	Investment on water and soil conservation is not included in environmental investment of current stage.	According to the report on water and soil conservation, the additional investment on water and soil conservation is estimated to be 3.5254 million yuan.
		Bridge engineering and protection works	——		
		Protection for waste disposal area and vegetation restoration	2 waste disposal areas		
		Protection for construction camp and access roads and vegetation restoration	——		
		Temporary water and soil conservation in the construction period	——		
		Ecological monitoring and investigation in the construction period	——	5	Provisional
		Putting up signboards and fencing for plant conservation	——	8	Provisional
	Road planting and landscaping		Entire road	60	Provisionally 50,000 yuan/km
Noise control	Construction period	Noise control measures	—	8	Provisional
	Operation period	Operation tracking and monitoring	5 places	20	Provisional
Water pollution control	Construction period	Production wastewater sedimentation tank at construction site	3 places	6	20,000 yuan/place
	Operation period	Anti-collision piers and speed-limit warning signs	——	10	Provisional
		Preparation of the emergency plan for hazard transportation accident	——	10	Provisional
		Emergency rescue equipment and apparatus	1 set	20	Provisional
Ambient air pollution control	Construction period	Road sprinkler (6,000 L)	3 Nr.	30	For 3 road sprinklers and 3 dry months a year, the cost for water sprinkling is around 400 yuan/Nr.-day (1 year).
		Costs for water sprinkling in dry seasons	3 months	3.6	
Environmental engineering design	Design period		——	50	Provisional
Environmental supervision	Environmental supervision in the construction period		1 year	40	Environmental supervision plan
Environmental monitoring	Environmental monitoring in the construction period		1 year	10	Environmental monitoring plan
	Environmental monitoring in the trial-operation period		1 year	5	
Environmental	Expenditures for conferences,		——	40	Provisional

engineering acceptance	document preparation, monitoring, etc.			
Total	——	——	325.6	The investment on water and soil conservation is excluded.

2. Ying-Lu Road Subproject of Yingjing County

The subproject has a total investment of 50,588,982 yuan, including an investment of 1,080,000 yuan on environmental protection that accounts for 2.1% of the total amount of investment. Refer to Table 8.5-2 for details of environmental investment estimate of the subproject.

Table 8.5-2 Investment estimate on reconstruction works of Ying-Lu Road

S/N	Item of investment		Unit	Qty.	Amount of Investment (10,000 yuan)	Remarks
I	Investment on environmental pollution control					
1	Control of surface water pollution					
1.1	Treatment of domestic sewage	Septic tank, drainage pipe	Place	1	2	
1.2	Treatment of construction wastewater	Sedimentation tank	Place	6	24	
1.3	Bridge & culvert works wastewater collection system	Cofferdam, drainage ditch, etc.			10	
1.3	Vehicle washing	Vehicle washing platform, sedimentation tank	Place	1	2	
1.4	Road surface sprinkling and cleaning in the construction period				5	
2	Ambient air pollution control					
2.1	Dedusting measures in the construction period	Cost for water sprinkling	Month	12	10	
3	Acoustic pollution control					
3.1	Tracking and monitoring		Times	5	5	10,000 yuan/once, once per year, totally 5 years
4	Pollution control of solid wastes					
4.1	Transfer of waste soil				20	
II	Investment on ecological protection					
1	Measures for ecological protection				5	
2	Grass planting and textile covering for subgrade and slopes				20	
3	Landscaping and grass-seed sowing for temporarily acquired land, including construction site, etc.				5	
Subtotal					108	

3. Shi-Xin Road Subproject of Tianquan County

Refer to Table 8.5-3 for the investment estimate on environmental protection measures taken for earthquake reconstruction of Shi-Xin Road (Xinmin-Yong'an Section) of Tianquan County. As shown in the table, the subproject has a total engineering investment of 78,047,900 yuan, including an investment of 2.7523 million yuan on environmental engineering (containing the investment on water and

soil conservation of 1.6368 million yuan) that accounts for 3.53% of total engineering investment of the subproject.

Table 8.5-3 Investment estimate on environmental protection measures taken for earthquake reconstruction of Shi-Xin Road (Xinmin-Yong'an Section) of Tianquan County

Item of environmental protection works	Specific measures		Qty.	Amount (10,000 yuan)	Remarks
Protection and restoration or ecological environment	Construction period	Subgrade and surface drainage engineering and protection works	Entire road	160.72	According to the report on water and soil conservation, the additional investment on water and soil conservation is estimated to be 1.6072 million yuan.
		Bridge engineering and protection works	—		
		Protection for waste disposal area and vegetation restoration	2 waste disposal areas		
		Protection for construction site and access roads and vegetation restoration	—		
		Temporary water and soil conservation in the construction period	—		
	Road planting and landscaping		Entire road	2.96	According to the report on water and soil conservation, the cost for road planting is 29,600 yuan.
Noise control	Construction period	Noise control measures	—	5.0	Estimated
	Operation period	"No Horn" signboards	2 places	1.2	Estimated
Water pollution control	Construction period	Sedimentation tank	4 places	8.0	Estimated as per 20,000 yuan/place
		Septic tank or latrine pit	4 places	4.0	Estimated as per 10,000 yuan/place
		Oil trap and oil-water separator	4 places	16.0	Estimated as per 40,000 yuan/place
	Operation period	Anti-collision barrier	—	10.0	Estimated
		Preparation of the emergency plan for hazard transportation accident	—	5.0	Estimated
		"Slow down" warning signboards	8 pcs	0.8	Estimated
Ambient air pollution control	Construction period	Watering by watering cart to reduce dust	2 Nr.	10.0	Mainly around concentrated residential areas along the road
Solid wastes	Centralized collection of solid wastes in garbage bins provided at the construction camp		2 places	1.0	Estimated
Environmental supervision and personnel training	Personnel training		3 people	3.0	10,000 yuan/person, estimated
	Environmental supervision		——	22.55	Estimated
Environmental engineering acceptance	——		——	25.0	Estimated
Total				275.23	

9.0 Analysis of Economic Profit and Loss due to Environmental Impact

On the basis of EIA and analysis of mitigation measures of the Project, this Chapter provides the estimate on costs for main items of work, including environmental protection design, environmental protection measures and environmental management during the

construction and operation period, management during the operation period, etc., and analyzes the economic benefits of these works.

9.1 Purpose of analysis of economic profit and loss due to environmental impact

From the perspective of environment, social production is a process of requesting resources from nature and discharging wastes into the environment. Improved production capacity means greater possibility for requesting resources and discharging wastes, resulting in greater impact on the environment. Therefore, for a construction project, the environmental and social benefits shall also be taken account of in addition to its economic benefits. The main purpose of analyzing economic profit and loss of environmental impact is to study the effectiveness of the environmental protection investment made for a construction project. The environmental benefits of the costs for environmental protection and the economic effects of such investment of a project will be determined with the economic assessment methods for environmental impact.

9.2 Analyzing method of economic profit and loss due to environmental impact

The analysis of economic profit and loss due to environmental impact is an important part of EIA of a construction project. It is an important basis for us to decide whether the environmental investment on a construction project can compensate the possible environmental loss due to the project, or how well can such investment compensate the possible environmental loss due to the project. Different from engineering economic analysis, in analyzing economic profit and loss due to environmental impact, besides calculation of the investment and costs required for treating and controlling pollution, it is also required to verify possible economic benefits, social benefits and pollution loss due to environmental impact. Thus, the social benefits and economic benefits due to environmental impacts of a project will be comprehensively reflected in the analysis of economic profit and loss of the project.

9.3 Analysis of social and economic benefits

9.3.1 Social benefits of the Project

Upgrading and reconstruction of the Dao-Huo Road will, by upgrading the road, increase the safety coefficient for road travelling, improve traffic conditions, provide transportation guarantee for earthquake reconstruction of the areas along the road, provide high-quality external traffic path for earthquake home reconstruction and thus promote restoration, reconstruction and further development of towns and townships along the road. The Dao-Huo Road is linked to Huojing and Nanbao disaster areas in the west, Daozuo and Linji disaster areas in the east and the imminent Dao-Lin Road to form an important transverse passage in the south and west of the city. It is linked directly to Qiong-Ming Expressway with 15 minutes of drive, thus increasing emergency rescue speed. The starting and end points of Dao-Huo Road are also linked to county roads, Shou-Gao Road and Qiong-Lu Road to form a ring road network in the area, thus improving the multi-passage road network structure and emergency rescue capability of the road network.

Construction of the Project will restore and improve road traffic conditions, improve the quality of road network in the west ecotourism area and promote sustainable development of industries in the west ecotourism area of Qionglai. Currently, the Daozuo-Linji Road and the Linji Interchange is under construction, and the Ganxi (Pujiang County)-Linji Road is in planning. The Gan-Lin Road, Dao-Lin Road, Dao-Huo Road and You-Yu Road will form a new path between west areas of Qionglai and Lushan/Pujiang, which is significant for cooperation between these areas.

After its completion, it will bring convenience of traffic to the local residents. With the improvement of the traffic conditions, it will promote various towns and townships' economic development along it and will improve the tourism development of the Niubeishan Scenic Spot, becoming an important part of regional cooperation and regional economic development. It is beneficial both for economy and society. Right of way can stimulate the industrial-development-driven economic growth and the improvement of the traffic conditions can enhance the regional land development of the Project and even improve the environment of investment.

The earthquake reconstruction of Shi-Xin Road of Tianquan County will greatly promote traffic, social and economic development of the region, drive the resources and tourism development of Tianquan County as well as improve living quality of the residents. The social and economic benefits will be significant.

9.3.2 Economic benefits

The Dao-Huo Road Subject has a total investment of 183,576,500 yuan with FIRR of 12.92%, which is greater than the social discount rate of 8%. The expected after-tax investment payback period is 14.37 years. As the financial net present value is greater than zero, the profit is expected to be good. The risk-resistance capability of the subject is quite high. In general, the subproject is in response to the needs of the market and for national economic development, and plays an important role in driving regional economic development, reducing comprehensive logistics costs and improving comprehensive benefits of enterprises. In sum, the subproject has a significant economic effect.

9.4 Analysis of economic profit and loss due to environmental impact

9.4.1 Estimate on environmental investment

The environmental protection measures for the Project include water pollution control, atmospheric pollution control, noise control, emergency measures, landscaping measures, etc. The investment on environmental protection of upgrading and reconstruction of Daozuo-Huojing Road is about 6.5262 million yuan, accounting for 0.84% of total investment of the subproject.

The total engineering investment on earthquake reconstruction of Shi-Xin Road (Xinmin-Yong'an Section) of Tianyuan County is 78,047,900 yuan, including an investment of 2.7523 million yuan on environmental protection (1.6368 million yuan for water and soil conservation) that accounts for 3.53% of total engineering investment of the subproject.

The total investment on Ying-Lu Road Subproject is 50,588,982 yuan, with the investment on environmental protection estimated to be 1.08 million yuan, accounting for 2.1% of total investment.

9.4.2 Analysis of environmental benefit

The environmental protection measures proposed for the Project can effectively reduce discharge of pollutants and minimize environmental impacts so as to create considerable environmental benefits. In addition, for pollution control of the port, it is not only required to invest in pollution control facilities, but also necessary to cultivate the awareness of environmental protection of the employees to properly carry out waste reduction and resource recovery. Advanced technologies are adopted to prevent pollution from the source, and proper end treatments for pollution are conducted as well. Excellent environmental protection will establish a good reputation and image for the port, beneficial for operation of the port and improvement of economic benefits as well as increase of government tax.

9.5 Analysis of economic profit and loss due to environmental impact of the Project

9.5.1 Environmental loss caused by the Project

The environmental loss caused by a road construction project is mainly reflected in reduced area of arable land, the change in utilization pattern of land resource as well as the biomass loss and changes in ecological and other environments as the result of permanent and temporary land acquisition of the project.

(1) Reduced area of arable land

In the recommended design scheme, the area of permanent land acquisition is 25.24 hm^2, including 5.46 hm^2 of arable land. The arable land permanently acquired by a road construction project will lose its functions for agricultural production for ever, and a considerable amount of economic loss will be caused. In addition, it is inevitable to occupy some arable land in project construction, which will affect agricultural production of some villages located along the road to different degrees and bring economic losses to the peasants. Some villages will suffer even greater influence from road construction.

(2) Varied utilization pattern of land resource

Besides arable land, some forest land, building land, waters and other types of land will also be occupied by the proposed road. Although temporarily occupied land will be planted or restored after construction activities are finished, a considerable area of land will still be occupied, resulted in changes in the pattern of regional land use. As a result, the change in utilization pattern of land resources caused by the Project is inescapable.

After the road is completed, land types will change, and the area of forest land will be reduced and building area (mainly including the area occupied by the road) will be increased as a result. From the perspective of environmental protection, such change in utilization pattern of land resources will carve up and damage the original ecological environment. From the perspective of economic effects of land use, areas along the road will experience quick and promising development in social and economic aspects. The value of the land resources occupied in road construction will be increased. However, such increase in use value of land is realized at the price of local or temporary loss of the environment.

(3) Biomass loss

According to calculations of Table 5.1.2, the area of arable land occupied by the Project accounts for 21.63% of the total area of arable land, resulting in 43.68 t/a and 428.05 t/a of losses in arable land and forest land productions respectively. After the Project is commenced, the loss in vegetation biomass is mainly reflected reduced biomass of forest vegetation, accounting for 77.61% of total loss (biomass) of the Project. However, comparing with total biomass of the areas within the scope of assessment, the biomass loss caused by land occupation of the Project has only a very small proportion in total biomass of the scope. Therefore, the impact of the Project on vegetation biomass within the scope of assessment is minor.

In a road construction project, the types of land occupied in construction mainly include paddy field, dry land and forest land. Permanent acquisition of such land by road construction will result in a considerable loss of agricultural crops and vegetation of various kinds. From the perspective of the change in the economic value of land use, land resources occupied in road construction are value-added, at the price of local

or temporary loss of the environment.

(4) Demolition loss

The total demolition building area of the Project is 6,888.75m^2, mainly including brick-concrete stored houses and brick houses. Demolition of residential housing will cause certain influences on normal life of the affected. Demolition of infrastructures will affect normal production and life of relevant regions in certain period of time.

(5) Loss of ambient air and acoustic environment

During the construction and operation periods, loss of ambient air and acoustic environment will be caused along the road. The loss of ambient air is quite minor. Regarding the acoustic environment, some residents along the road will suffer certain loss.

(6) Water environment and risk accident

Pollution of water bodies distributed around the construction sites along the road will become more serious. Once leakage of a vehicle transporting chemicals occurs during the operation period, the water bodies and agricultural land will be polluted.

9.5.2 Environmental benefits caused by the Project

(1) Direct benefits

Living quality of workers in the plant areas will be affected by car exhaust, dust emission, production noise and radiation during the operation period of the Project, and certain adverse impacts will be caused to local ecological environment. However, these adverse impacts are rather complicated and involve many aspects. The economic losses recovered each year, i.e. the direct benefits from the investment on environmental protection, is obvious after operable and practical environmental measures are taken. However, the benefits can hardly be measured in the form of money at present. Rough estimates may be conducted on economic losses regarding physical health, living quality, etc. due to the changes in ecological, water and acoustic environments and ambient air quality caused by the Project. Alternatively, the direct economic benefits reflecting the effect of environmental investment can be subject to qualitative analysis.

In Table 9.5-1, qualitative assessment is conducted on comprehensive environmental benefits due to the environmental protection measures taken for the Project. Meanwhile, qualitative quantified analysis is conducted on economic profit and loss due to environmental impact of the Project with the compensation method and expert scoring method. Refer to Table 9.5-2 for results of analysis.

Table 9.5-1 Qualitative analysis of comprehensive profit and loss due to environmental protection measures

Environmental protection measures		Environmental benefits	Social and economic benefits	Comprehensive benefits
Dust pollution control	Road watering; Planting for the anacoustic zone	Prevention of atmospheric pollution	Protection of living and production environments of working staff; protection of physical health of the public	Protection of the atmospheric environment and public health
Wastewater treatment	Building domestic sewage pre-treatment facilities; setting up sewage pipe network	Protection of water quality of the Jialing River channel where the quay is located	Water resources protection; guarantee for production and property safety of the public	Water resources protection

	joining facilities			
Noise control	Distance decay, planting for isolation, etc.	Reduction of quay noise	Protection of living environment of plant workers	Protection of environmental quality and physical health
Environmental management	Environmental supervision, training for environmental protection knowledge, environmental protection publicizing, etc.	Monitoring environmental quality of neighboring areas; protection for living environment nearby; cultivating good awareness of environmental protection	Protection of living environments for both humans and animals	Guarantee for coordinated development of economy and environment

Table 9.5-2 Analysis of economic profit and loss due to environmental impact

Environmental elements	Description of the extent of impact	Score of benefits	Remarks
Ambient air	Certain impact	-2	Scores of 1, 2 and 3 are separately given in the ascending order of the extent of impact: "+" indicates positive effects; "-" indicates negative effects.
Acoustic environment	Certain impact	-1	
Water environment	No obvious negative impact	0	
Human health	No significant negative impact; convenient traffic	+1	
Mineral resources and special products	Favorable for development of resources	+3	
Tourism resources	No significant negative impact	0	
Agricultural population	No obvious negative impact	0	
Landscaping	Increased environmental investment and improved quality of regional environment	+2	
Urban planning	No significant negative impact	0	
Land value	Convenient logistics and increased value of industrial land	+3	
Direct social benefits of the Project	Saved time, reduced transport costs, lowered oil consumption and improved safety	+3	
Indirect social benefits of the Project	Improved investment environment, accelerated economic development and enhanced environmental awareness	+3	
Environmental protection measures	Increased investment	-1	
Total	Positive effects: (+15); negative effects: (-4); positive/negative effects=3.75		

(2) Indirect benefits

The following indirect benefits will be brought about with effective environmental protection measures taken: guaranteeing living quality and normal life of working staff in the plant areas of the Project; maintaining environment-related psychological health of working staff and reduce uneasiness of local residents; reducing inducing factors of social instability, etc. At present, it is hard to measure these indirect benefits in the form of money. However, it can be sure that they are the main components of the social benefits from the investment on environmental protection.

In sum, most environmental effects produced by the Project are positive, and thus the Project is feasible from the perspective of environmental protection.

10.0 EIA Conclusions

10.1 Project overview

1. Dao-Huo Road Subproject

The World Bank loaned Daozuo-Huojing Road Subproject for earthquake reconstruction of Lushan includes a main line and two branches. In the recommended scheme for the main line, i.e. Scheme K, the road is totally 12.172 km long and is built based on Class III technical standard; its subgrade is 8.5m wide; it is a bidirectional road, with 2 lanes in each direction; the design speed is 30 km/h. This project contains 1 major bridge of 146m length and 4 medium/minor bridges in total length of 148m and the bridges account for 2.41% of the total length of the road. The road contains 65 culverts, i.e. 5.34 culverts per km. The two branch lines are rural roads which are rebuilt upon the original rural roads. One branch line is 775m long and the other 459m. The main line of the road is constructed with asphalt concrete pavement while the branches are constructed according to existing standards for rural roads. The total investment is 183,576,500 yuan and the engineering costs for building and installation is 107,392,900 yuan.

This subproject includes road reconstruction. The road starts at Zhaigou Village along the Dao-Huo Road and is arranged along the existing road route, passing Shichangzi, Dashiqiao, Hualongmen, Zhaigou Village Health Station, Shilongmen, crossing the Diaogang Mountain and then arriving at Sanhe Village. Then, the road continues against the Xiaoxi River, passes Qiangtougou and Lijiaba, crosses a river and reaches Yapeng Village, where it extends northwards, passes Yangpo, Hangou and Hanshiti, and eventually intersects with the circling road of Huojing Town at Hongyantou. Main line of the road is 12.172 km in full length and branch line 1.239 km in full length.

2. Shi-Xin Road Subproject of Tianquan County

The earthquake reconstruction works for Shi-Xin Road (Xinmin-Yong'an Section) of Tianquan County is within the borders of Cida Township, Daping Township and Xinhua Township of Tianquan County. The subproject is not only the quick path between Shiyang Town and Xinhua, but the A-shaped link between G318 and G351, which crosses the zone enclosed by G318, G351 and Lishan Road. In the future, Shi-Xin Road will probably be escalated to a county-level road in the 12^{th} Five-year Plan for Traffic Improvement of Tianquan County.

The road starts at Shiyang Town, Tianquan County (G318). It runs from south to north, passes the Shiyang Reservoir, Dawo and Apomiao, and ends at the ring road of Xinhua, with a total length of 16.555km (including the broken chainage). A section of 15.465 km is to be rebuilt on the existing road and a section of 1.09 km will be newly constructed.

The subproject is constructed according to technical standards for Grade IV roads with a design speed of 20 km/h, subgrade width of 6.5m and cement concrete pavement. Along the road is built 1 small bridge (16m) and 1 medium bridge (28m), with no large bridges needed; totally 33 culverts (393m), all of which to be newly built are included, with no tunnels. Total excavation volume of the road is 348,400 m^3 (natural measure, same below). Total filling volume and spoil disposal volume are separately 237,700 m^3 and 116000 m^3 (including the workload of 168,700 m^3 for loose measure removal). The subproject has a total coverage of 26.12 hm^2, including 23.26 hm^2 of permanently acquired land and 2.86 hm^2 of temporarily acquired land. The area of housing demolition is 2,194m^2.

The subproject is proposed to be officially commenced in September 2016 and completed and opened for traffic in September 2017, including a one-year period of construction. The total investment is 78,047,900 yuan, including an investment of 57,645,700 yuan on civil works. That is, the construction cost per km is 3.4820 million yuan.

3. Ying-Lu Road Subproject

The reconstructed and expanded Ying-Lu Road (Hongshigou-Daqiaotou) of Yingjing County, Ya'an City loaned by World Bank is a Grade IV road which completely runs through the existing road without new sections to be constructed. The road starts at Hongshigou, Sanhe Township of Yingjing County (starting point stake No.: K23+260.000, X176), runs along the river and ends at Daqiaotou, where it joins the existing muddy gravel road, with the terminal stake No. of K29+260.000. The total length of the road is 6 km. The road is a Grade IV road with a design speed of 20 km/h, subgrade width of 6.5m and traffic lane width of 6m. It is a bidirectional two-lane road with cement concrete pavement. There are 2 medium sized bridges. Each bridge is built of single-span 20m pre-stressed hollow slab and gravity U-type abutment; at the medium bridge at K27+582.013, the designed flood level is 1,522.5m and designed flood frequency 1/50; at the medium bridge at K27+808.171, the designed flood level is 1,529.0m and designed flood frequency 1/50. There are 27 culverts with a total length of 220m. No primary crossing will occur, but there will be 2 secondary crossings where the road will intersect tractor road or temporary road in residential area. The total investment on this subproject is 50,588,982 yuan, where the environmental investment is 151,760 yuan which accounts for 0.3% of the total investment. The project is planned to commence in October 2016 and be put into operation in November 2017, with a construction period of 14 months.

In reconstruction of the road, main, temporary and environmental works are required. Main works include subgrade works, pavement works, crossing works and bridge & culvert works; temporary works include construction sites, etc.; environmental works include treatment works for pollutants during the construction period, including wastewater, exhaust gas, noise, etc.

10.2 Compliance with industrial policies and plans

The Project belongs to urban transportation infrastructure construction project. According to Article 12 "rural highway construction" of "XXIV. highway and road transportation" under the encouraged category I in *Guiding Catalogue of Industrial Restructuring* (Edition 2013) (Decree No. 9, 2011 of National Development and Reform Committee, June 1. 2011), the Project belongs to encouraged project and complies with current national industrial policies. It does not fall under the national catalogue of projects of restricted or prohibited land use according to GTZF [2012] No. 98 Document *Circular on Promulgating and Implementing the Catalogue of Restricted Uses of Land* (2012 Version) *and Catalogue of Prohibited Uses of Land* (2012 Version).

According to *Guiding Catalogue of Industrial Restructuring (Edition 2011)* (Revision 2013) (Decree No. 9, 2011 of National Development and Reform Committee, June 1. 2011), the Project falls under encouraged category I of Article 4 "Construction of Urban Road and Smart Traffic System", Article 11 "Urban Garden Landscaping and Construction of Ecological Communities" and Article 23 "Construction of Urban Public Traffic" in Clause 22 "Urban Infrastructures and Real Estates" as well as Article 7 "Sludge Clearing and Dredging of Rivers, Lakes and Reservoirs" in Clause 2 "Water Conservancy". The Project is encouraged by the state and complies with existing industrial policies and the strategy for sustainable development of the country.

In preparing the EIA Statement of the Project, investigations and verifications have been conducted for each natural reserve, scenic spot, drinking water reserve, fisheries genetic resources reserve, forest parks and other environmentally sensitive areas which may be affected by the Project. The results show that none of the above environmentally sensitive areas are involved in the Project.

According to consultation with urban development authorities of Tianquan County and town and township governments of different levels, no overall urban planning has been conducted for Daliucao Township and Cida Township where the road passes. Except a section of 1.09 km which is to be additionally built, the rest part of the road will be reconstructed on the existing road, of which the subgrade is only 6.5m wide after reconstruction. Therefore, there will be no adverse impacts of the Project on development of towns and township and urban planning for the areas along the road.

10.3 Environmental status quo

10.3.1 Social and economic status quo

1. Qionglai City

   The gross regional domestic product of Qionglai City in 2014 is 18.385 billion yuan, increased by 10.3% from a year earlier. Among which, output of agriculture increased 3.246 billion and by 4.8% from a year earlier; output of industry increased 8.490 billion and by 12.5% from a year earlier; output of service sector increased 6.649 billion and by 9.7% from a year earlier. The proportions of agriculture, industry and service sector are 17.6:46.2:36.2. The per capita regional domestic product is 29,778 yuan, i.e. 4,866 US dollars converted at the exchange rate of current year. The increment of private economy throughout the year is 12.254 billion yuan, with a year-on-year growth of 12.6%, accounting for 66.7% of GDP and with the economic contribution rate of 72.6%.

2. Yingjing County

   In 2014, national economy of Yingjing County remained steady growth and comprehensive strength of the county is further improved. The county has achieved a regional domestic product of 5.613 billion yuan, increased by 11.8% from a year earlier. Among which, agriculture has an increment of 640 million yuan, increased by 4.4%; industry has an increment of 3.534 billion yuan, increased by 13.5%; service sector has an increment of 1.439 billion yuan, increased by 10.5%. The contribution rates of three industries to economic growth are separately 9.86%, 65.98% and 24.16%. The per capita regional domestic product is 37,545 yuan, increased by 11.4%. The proportions of increments of three industries are adjusted from 11.7:62.9:25.4 to 11.4:63.0:25.6. Private economy keeps growing, with its economic increment accounting for 76.3% of GDP.

3. Tianquan County

   In 2014, regional domestic product of entire Tianquan County reached 4,418,280,000 yuan, increased by 13.58% from a year earlier. Among which, agriculture has an increment of 623,850,000 yuan, increased by 7.58%; industry has an increment of 2,759,580,000 yuan, increased by 14.99%; service sector has an increment of 1,034,850,000 yuan, increased by 13.67%. The industrial structure is further improved, with GDP per capita of 32,017 yuan, increased for 1,506 yuan and by 13.42% from a year earlier. In 2014, disposable income of urban residents is 21,875 yuan, and net per capita income of peasants is 8,272 yuan.

10.3.2 Status quo of ecological environment

Due to the productive and living activities of humans for a long time, there are no wildlife reserves, virgin forest, large area of forest land or large wild animals in the project area. Most wild animals found currently are insects and mice. There are no precious wild animals of national and regional significance living in this area. As land development and utilization has long been carried out in the areas where the road passes, most natural vegetations are replaced by artificial vegetations. Forest is rare, and vegetations are mostly herbaceous plants and bushes. There are no precious or ancient trees and rare plants growing in this area. No precious and rare aquatic organism are found within the scope of assessment on water bodies around the project area.

10.3.3 Status quo of acoustic environment

As shown in monitoring results, noise levels detected at monitoring sites can satisfy the requirements for Class 2 of *Environmental Quality Standard for Noise*. Therefore, the acoustic environment of the project area is ideal.

10.3.4 Status quo of water environment

As shown in monitoring results, the index for water pollution monitored in status-quo water environment along the road is less than 1, and all water quality indicators can meet Class III requirements of *Environmental Quality Standard for Surface Water (*GB3838-2002*).* Therefore, surface water environment of the project area is ideal.

10.3.5 Status quo of atmospheric environment

As shown in monitoring results, the daily average concentration of PM_{10} at each monitoring site within the scope of assessment can satisfy Class II of *Ambient Air Quality Standard* (GB3095-2012); hourly average concentration of SO_2 and NO_2 can also satisfy Class II of *Ambient Air Quality Standard* (GB3095-2012). Therefore, air quality of the project area is ideal.

10.3.6 Status quo of soil environment

Concentrations of all assessment factors for sediment soils detected at 2 monitoring sites within the scope of assessment are within the limits. All indices comply with Class II of *Environmental Quality Standard for Soils* (GB15618-1995).

10.4 Estimate on environmental impacts

10.4.1 Impact on social environment

Upgrading and reconstruction of the Dao-Huo Road will, by upgrading the road, increase the safety coefficient for road travelling, improve traffic conditions, provide transportation guarantee for post-earthquake reconstruction of the areas along the road, provide high-quality external traffic path for post-earthquake home reconstruction and thus promote restoration, reconstruction and further development of towns and townships along the road. The starting and end points of Dao-Huo Road are also linked to county roads, Shou-Gao Road and Qiong-Lu Road to form a ring road network in the area, thus improving the multi-passage road network structure and emergency rescue capability of the road network. Construction of the Project will restore and improve road traffic conditions, improve the quality of road network in the west ecotourism area and promote sustainable development of industries in the west ecotourism area of Qionglai. Currently, the Daozuo-Linji Road and the Linji Interchange is under construction, and the Ganxi (Pujiang County)-Linji Road is in planning. The Gan-Lin Road, Dao-Lin Road, Dao-Huo Road and You-Yu Road will form a new path between west areas of Qionglai and Lushan/Pujiang, which is significant for cooperation between these areas.

The construction of Shi-Xin Road of Tianquan County will greatly promote traffic, social and economic development of the region, drive the resources and tourism development of Tianquan County as well as improve living quality of the residents. The social and economic benefits will be obvious. Meanwhile, the subproject will greatly improve travel conditions for residents living along the road from Shiyang Town to Xinhua Township and change the conditions of the existing road. The positive effects are significant. As some arable land of residents will be occupied in construction of the Project, living conditions of these residents will be affected to some degree. However, such adverse impact can be mitigated by proper allocation of surrounding land resources by local government.

Most land acquired for reconstruction and expansion of Ying-Lu Road is abandoned land grown with weeds. As no arable land is occupied and no residential houses are acquired, land use of the subproject will not cause adverse impacts on adjacent residents. Besides, the project site is far away from residential areas, cultural relic sites, tourism resources, cultural relics, scenic spots, natural reserves and other objects of environmental protection, the social impact will be minor. However, during road construction, travelling of local residents will be to some degree affected. The road from Yingjing County to the Niubei Mountain through X176, a famous tourist site, may be easily blocked. The social impact of the project is mainly reflected in traffic blocking. Therefore the traffic coordination should be well done, especially for the road smoothness and traffic security.

10.4.2 Impact on ecological environment

As most road construction activities are carried out during the construction period, the impacts on and damages to the ecological environment during this period mainly including occupation and carving-up of land by main works, changes in nature of land use, reduced arable land, lowered plant coverage rate, reduced forest area, greater pressure in utilization of arable land, etc. Besides, subgrade filling and excavation, construction of borrow pits and dump sites, etc. will change surface vegetation, landform and topography of related areas, resulting in water and soil loss in a certain period of time and in certain areas. As a result, fertility and massive structure of soil will be altered. In addition, engineering activities will disturb the original natural ecology and environment as well as cause certain adverse impacts on growth, distribution, inhabitation and moving of animals and plants in the assessment area.

10.4.3 Impact on acoustic environment

Due to heavy workload during the construction period, the noises produced by construction machines will cause some impacts on surrounding environment, which are usually short-time, temporary and local. Therefore, low-noise construction machinery and process shall be selected and used whenever possible; construction time and site management shall be rationally arranged and construction with high-noise construction machines and tools in the nighttime is strictly forbidden; the high-noise mechanical equipment whose location is relatively fixed, such as mixing plant, shall be arranged in a place far away from the residential area. As shown in the results of acoustic environment assessment, indicators of environmentally sensitive sites are within the limits during the operation period. “No Horn” signs are provided on both sides of the road sections near Daliucao Township Central Complete Primary School and Xinsheng Village. If the protective measures for acoustic environment in this statement are strictly implemented, the impact of the Project will be mitigated.

After the proposed road is finished, quality of acoustic environment of the environmentally sensitive site along the road will be deteriorated. However, in general, noise levels in the short, medium and long terms of these sites are within the limits and meet the requirements for Class 2 of *Environmental Quality Standard for Noise* (GB3096-2008).

10.4.4 Impact on water environment

During the construction period, wastewater mainly comes from the processes of concrete batching, washing at the construction machinery repair sites and domestic sewage from the construction camp. As the concrete batching wastewater contains high level of suspended solids and quantity of such wastewater is usually small, measures including sedimentation, filtration and recycling can be taken to avoid adverse impact on water environment. Washing wastewater is collected and treated in oil traps and oil-water separators. With small quantity, up-to-standard discharge of such wastewater will not cause major impact on water environment. Domestic sewage is collected through septic tanks or latrine pits and properly treated before used as fertilizer, which will not cause any impact on water environment. Any risk accident happening during the operation period will cause severe impact on water environment. Therefore, the awareness of preventing risks shall be enhanced and the measures for road transport management shall be taken.

10.4.5 Impact on atmospheric environment

Pollution will be generated during earth excavation, embankment filling, foundation excavation for artificial structure, material transportation, batching, paving and other construction procedures and thus influence atmospheric quality. The main atmospheric pollutant during the construction period is dust.

Waste gas generated during the construction period consists of construction dust, transport dust, waste gas from fuels of machines and waste gas from canteen.

To control construction dust, construction activities shall be arranged properly. Special personnel shall be assigned to water the site and proper enclosing and retaining measures shall be taken. To control transport dust, construction vehicles and transport routes shall be properly selected. To limit waste gas generated by fuels of machines, equipment shall be properly maintained. Machines shall be stored properly and construction time shall be arranged properly to reduce the number of people being affected. Waste gas from canteen shall be purified through small smoke cleaner and introduced to roof of the building at construction site for exhausting.

10.4.6 Solid waste

Solid waste during construction period of the road mainly comes from the muck such as abandoned earth and stone generated from subgrade excavation and filling, domestic garbage on construction camps, abandoned road building materials, and building waste after demolition within the land occupied.

Auxiliary facilities for road such as service area and toll gate are not provided in this Project. Therefore, the solid wastes during the operation period only include scattered road building materials generated during routine maintenance. Due to small quantity of these wastes, there will be no impact on the environment when they are locally recycled or timely collected.

10.5 Conclusions to Soil and Water Conservation Scheme

By comparing the schemes for main works and analyzing and assessing construction layout, construction organization design and construction technologies, the following contents have been decided as the key objects of design and comparison in designing and layout determination for main works: reduction of newly acquired land, reduction of disturbed area, maintenance of ecological environment, etc. The sites where water and soil loss may occur during this stage include the subgrade, excavated and disturbed area by crossing works, topsoil stockyard, construction site, etc. In route recommendation and construction layout of main works, the requirements for water and soil conservation have been taken

full account of. In designing, certain water and soil conservation measures are taken to reflect the concept of water and soil conservation in design and mitigate water and soil loss and the damages resulting therefrom from the source. However, no planning has been made for temporary topsoil stockyards or no protective measures have been taken in designing of main works. No preventive measures have been provided for construction sites in planning. The statement will supplement and complete the water and soil conservation measures provided in the design for main works based on actual conditions and specific objects of control from all respective with multiple means to establish a complete and comprehensive water and soil loss control system.

10.6 Environmental protection measures

10.6.1 Environmental protection measures during the construction period

(I) Protective measures for ecological environment

1. Permanently and temporarily acquired land of the Project shall have been approved by authorized government agencies according to regulations on land use management. For approved acquisition of arable land in the area, besides paying all the taxes for the acquired land, the user of land shall also pay the fees for land restoration of the arable land acquired on the principle of "restoring all acquired area" as there is no dry land suitable for cultivation. The fees will be used to construct new arable land to maintain overall stability of area of arable land of the project area.
2. For trees affected by land acquisition within the land boundary of the Project, those have good potentials for dry land and no diseases and insect pests shall be transplanted to dry land.
3. There are no scenic spots or cultural relics located within the project area. The artificially formed green belts and landscapes around river courses will blend with the surrounding urban scenes and thus reduce landscape damages due to construction of the Project.

(II) Water and soil conservation measures

The developer shall conserve water and soil resources, and conduct controlling measures for existing water and soil losses. According to *Technical Code on Soil and Water Conservation of Development and Construction Projects* (GB/T 50433-2008), the scope of work of water and soil loss control shall include the permanently acquired land and directly affected areas of the Project.

(III) Other environmental protection measures and suggestions for the construction period

1. It is not allowed to store solid wastes on river banks or directly discharge wastewater into the environment. Domestic sewage from construction sites shall be properly treated with existing wastewater treatment facilities. Mechanical equipment shall be maintained and washed in a centralized manner. Oil-bearing washing wastewater shall be recovered after oil separation and sedimentation. Sedimentation tanks shall be provided at concrete batching plants, with wastewater produced during batching recycled after sedimentation instead of being discharged into the environment.
2. In addition to construction supervision on the Project, the supervision on environmental protection facilities shall also be carried out, that is, the supervision on environmental protection facilities shall be included into construction supervision.

3. A proper method for mixing lime soil shall be adopted according to actual condition. Reduce dust pollution by sprinkling water. Transport vehicles shall be well managed and arranged. Civilized construction shall be carried out as required by relevant specifications to reduce dust pollution.

4. Low-noise equipment shall be selected by the construction department. Certain bridge members shall be prefabricated and then delivered to the site for assembling. The construction department shall properly arrange the time and place for construction and periodically maintain the equipment in addition to standardizing relevant operational codes. High-noise mechanical equipment shall be operated during day time whenever possible. Mechanical construction shall not be carried out at night in residential areas.

10.6.2 Environmental protection measures during the operation period

(I) Protective measures for acoustic environment during the operation period

1. Green belt shall be planted on the roadside close to the river to reduce pollution of car exhaust and the impact of noise.

2. Signs for speed limit shall be put up on both sides of the road. Sings of "No Horn" shall be put up in sections of good visual angle to control and reduce traffic noise during the operational period.

(II) Protective measures for water environment during the operation period

After completion of the proposed road, the main influence caused by precipitation to rivers near the road is the runoffs formed in the first hour of precipitation. In case of leakage of hazardous chemicals due to traffic accident of vehicles transport such substances, adverse impact will be caused water quality of Class II water bodies along the road. The following measures shall be taken accordingly:

1. An emergency sand setting buffer pool shall be provided near a water-crossing bridge to introduce rainwater from the drainage holes on both sides of the bridge into the PVC drainage pipe. Rainwater from the bridge deck is collected into the surface catchpit and then discharged to the sand-setting buffer pool through the transverse drainage ditch instead of being directly discharged into any water bodies. An emergency sand setting buffer pool shall also be provided for the subgrade section within a range of 200m from any water body. Water shall not be directly discharged into any water body.

2. When a reconstructed road crosses or runs near a river, for the purpose of protecting water quality of water bodies, trucks having oil leakage, without provision of covering canvas as well as overloaded trucks are not allowed to start off. Spillage of oil and cargoes onto the road will result in pollution of surface water bodies along the road and potential safety risks. Vehicles loaded with coal, lime, cement and other bulk materials that may cause flying dust shall be properly covered before starting off, otherwise the surface runoff formed by spilled materials will pollute the water.

3. The rainwater drainage system of the road shall be subject to regular inspection to ensure it is in good, blockage-free working condition.

4. When the road crosses a river, warning signs of "Speed Limit", "No Overtaking", etc. shall be put up on both sides of the bridge or in prominent positions of the subgrade to remind the drivers and passengers of environmental protection and request vehicles transporting hazardous goods to pass the bridge at a limited speed. To prevent adverse impacts on water quality of rivers and other water

bodies along the road caused by pollution of hazardous chemicals (mainly petrochemical products, building materials and minerals), continuous anticollision piers and wastewater collection facilities shall be constructed for the subgrade section within a range of 200m from the deck of the water-crossing bridge and the water body. In the subgrade section, the piers shall be arranged on the water body side.

(III) Measures suggested for reducing air pollution during the operation period

Atmospheric pollution during the operation period of the proposed road project is mainly caused by car exhaust. The following are the specific controlling measures taken:

1. Landscaping shall be strengthened on roadside, especially near sensitive points. Vegetation can not only absorb the pollutants from vehicle tail gas, but beautify the scene along the road.
2. Traffic control shall be enhanced. Vehicles with excessive emission of tail gas shall be forbidden to drive on the road.
3. Road surface shall be cleaned up periodically.

10.7 Public participation

According to the investigation on public participation of the project area, local ordinary people and affected residents support the Project and hold no opposition against the Project.

10.8 Analysis of economic profit and loss

The environmental loss caused by the Project is mainly reflected in the change in utilization pattern of land resource as well as the biomass loss and changes in ecological, social and other environments as the result of permanent and temporary land acquisition of the project. However, after completion, the Project will bring along considerable economic and social effects.

10.9 Overall conclusions

In general, the Project complies with relevant laws and regulations on environmental protection and national industrial policies. The route selected is reasonable. The road is of low grade with small quantities of works and minor impacts on the environment which are mainly noise, vegetation damage and water and soil loss. After completion, the Project will effective improve traffic facilities of Qionglai City, Tianquan County and Yingjing County and produce considerable economic and social effects. As along as the environmental measures specified in this statement are actually and strictly implemented, the Project is quite feasible from the perspective of environmental protection.

10.10 Suggestions

1. After the Project is put into operation, the transportation department shall give priority to management of the proposed road and carry out pavement and subgrade maintenance of the road in time. Road works shall be subject to regular inspection and timely maintenance. Water drainage facilities of road and bridges shall be cleaned properly to prevent blockage and ensure discharge of wastewater.
2. The environmental protection responsibility of all construction contractors shall be confirmed in the bidding phase of construction; and the pollution control measures during project construction must be designed, constructed and put into operation together with the project to be constructed.

3. The environmental protection and water and soil conservation measures specified in this statement shall be implemented as quickly as possible to prevent the adverse impacts on the ecological environment as well as water and soil loss.
4. In the actual construction, strengthen promotion of environmental laws for the construction contractor and field personnel, heighten the awareness of environmental protection of people and make environmental protection really be a conscious activity in the project construction and an internal demand of achieving harmonious development between humans and environment.
5. A construction management system shall be established and perfected; the environmental protection responsibility system shall be incorporated to the construction bidding contract; and full-time staff for environmental protection shall be appointed during construction supervision, so as to ensure the implementation of environmental protection measures during the construction period.