

SFG3301 V2



**Guiyang Rural Road Project (P129401)
Financed by the World Bank Loan**

ENVIRONMENTAL CODE OF PRACTICES

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July 2013 · Guiyang

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Abbreviation:

1. WB --- the World Bank
2. EA --- Environmental Assessment
3. EIA --- Environmental Impact Assessment
4. ECOPs --- Environmental Code of Practices

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1 Preface

1.1 Background of project

Objective of the project of Guiyang Rural road Project financed by the World Bank loan is to provide improved transport accessibility in select areas of Guiyang, in a sustainable manner.

Per the request of the Guiyang Municipal Government, the proposed Project will partly support the implementation of the activities under Guiyang Rural Roads Development 12th Five-Year-Plan, with a particular focus on the upgrading/improvement of existing lower class roads and the rehabilitation of county and township roads in poor condition. In addition, the Project will help build the capacity for rural roads maintenance. To this end, the Project will include the following four components:

Component A: Upgrading/improving county and township roads (~RMB 1.113 billion: 57% of the total project cost) will provide all-season roads to villagers and increase transport capacity in key corridors. Physical outputs include: (1) upgrading one county road from Class IV to Class II; and (2) improving unclassified county and township roads to Class IV.

Component B: Rehabilitation of county and township roads (~ RMB 755 million: 39% of the total project cost) supports the rehabilitation of deteriorated county and township roads. The physical outputs of the component include rehabilitated roads, with improved safety and drainage features.

Component C: Rural road maintenance pilot (~ RMB76 million: 5% of the total project cost) will enable the Guiyang Municipal Transport Bureau to test and verify methods that could improve the cost efficiency and efficacy of the Guiyang Municipality rural road maintenance program. The component comprises three distinct parts: (a) Development of the rural road maintenance pilot design; (b) Implementation of the rural road maintenance pilot; and (c) Improvement of the Guiyang Rural Road Management Information System.

Component D: Technical assistance (TA) (~RMB 6 million: <1% total project cost) supports the implementation of two technical assistance programs that contribute to the longer term sustainability of the rural road program: (a) Rural road network plan and (b) Training and study tours.

The first 22 roads (see the Attached Table 6) served in 2013, which belong to the improvement of county or township roads under the subproject B, were identified in the preparatory stage of the project. Other roads under subproject A and subproject B will be selected from the relevant road planning scope in the 12th five-year plan of Guiyang during the project implementation period.

1.2 Environmental assessment (EA)

Environmental assessment of this project should accord with relevant EA policies, rules and technical guideline of China and the World Bank. In view of little potential environmental impact decided by the construction nature of this project, the World Bank (WB) proposes that the form of **Environmental Code of Practices (ECOPs)** is taken for the EA report of this project, which makes environmental protection request for typical constructions included in the investment activities with different forms (such as road improvement, upgrading, construction of maintenance base and overweight control station). Environmental code of practice should be fully combined

with design and contractor must comply with it in construction. For those extended and large-upgraded roads, project owner should act in accordance with the procedure specified in the code to prepare specific EA and environmental management plan.

The 22 roads identified in the preparatory stage of the project have a small construction scale and an unobvious environmental impact. According to the above WB proposal, it is not needed to prepare special EA and environment management plan for these roads for WB examination and approval.

General procedure prepared for EA report is as follows:

(1) Preparatory stage of subproject

Mainly including subproject screening, preparation of EA documents, public consultation and information announcement.

① Environment screening of subproject

Environmental assessment organization should assist the Project Office to review subproject, definite EA grade, report form, applicable rules and WB environmental safeguard policy, assessment scope and degree, examination requirements, and so on. Environmental assessment organization should assist the Project Office to fill in the environment screening form (the Attached Table 1) for each subproject, which will be signed and confirmed by the person in charge of the Project Office. Each subproject screening form should be filed properly for review of WB and department concerned.

Note: According to WB environmental assessment policy, this project is categorized in Class B. If a proposed subproject is identified in the screening to have heavier environmental impact and involve higher sensitive area, it maybe categorized in Class A environmental assessment project. Thus, its subproject cannot be included in this project.

② Preparation of EA documents

After screening, if it is confirmed that environmental impact of a subproject is small, this ECOPs can be applied directly. For those extended and large-upgraded roads, project owner should prepare specific EA documents, i.e. an environmental impact assessment (EA) report and an environmental management plan, or only prepare an environmental management plan. Before the subprojects are practiced, the Project Office should submit the environment screening form and other relevant documents of the subprojects in this class to the World Bank, at the same time, should make a suggestion for the form, scope, degree and applicable policy of EA report. The World Bank will make examination and give advice.

③ Public consultation

(a) The Project Office is responsible for carrying out information announcement and public consultation; while environmental assessment organization is responsible for offering technical support.

(b) Public consultation is aimed at hearing stakeholders' suggestions on environmental impact of the project. The impacted parties or individuals will determine their important environment issues. Any important suggestion in public consultation will be included in EA documents.

(c) Public consultation should be conducted once at least. EA documents of the project, including this environment code of practices as well as the EA documents of

specific subproject (if any), should be announced in full text and guaranteed to be obtained by the public. Ways of effective consultation will include questionnaire, interview, meeting, etc. Announcement and consultation course, analysis and results should be included in EA documents.

④ Examination and approval of EA documents

This ECOPs must be examined and approved by WB and departments concerned in the project appraisal stage. EA and other relevant documents (e.g. water and soil conservation plan) related to the specific subproject should be also approved by WB, environmental protection authority and other administrative departments before project implementation.

Note: This ECOPs and environmental management plan (if any) should be brought into road design. The road design of subproject should refer to this ECOPs; design institute and the environmental administrators of the Project Office should hold coordination meeting of environmental design at regular intervals.

(2) Practice stage

This ECOPs and the environmental management plan (if any) of subproject must be included in civil work bidding documents and construction contract, and must be implemented during the period of construction.

① Requirement for bidding documents

In project bidding, the Project Office is responsible for ensuring that ECOPs and the environmental management plan (if any) are fully included in the bidding documents and the contract. Satisfying these conditions is necessary for bidder to win the bidding. In addition, the Project Office will ensure terms and conditions of subproject construction contract conforming to Chinese relevant rules.

② Monitoring

The Project Office will ensure effective setup, personnel available, practice arrangement and relevant environmental protection systems, and will supervise effective implementation of the construction code of environmental protection and the environmental management plan of subproject.

③ Report

On schedule, the Project Office should semiannually submit semi-annual implementation report of environmental management to WB. The report should cover environment screening form of subproject, practice of environmental protection, etc.

General procedure of EA preparation is shown in Diagram 1.2-1.

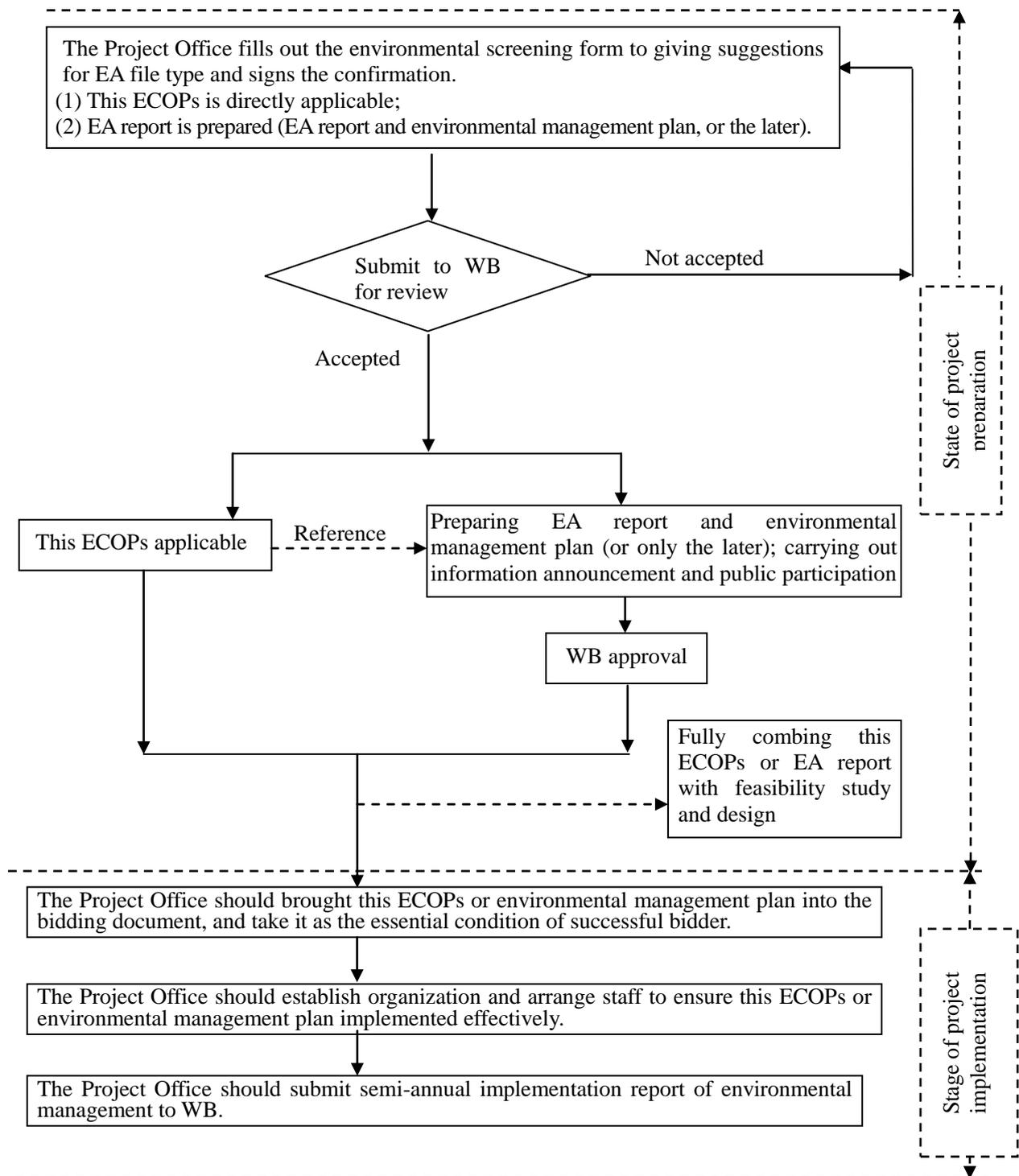


Diagram 1.2-1 General procedure of EA report preparation

1.3 Purpose, criterion and scope of drawing up environmental code of practices

1.3.1 Purpose of drawing up environmental code of practices

Purpose of drawing up ECOPs: defining relevant departments' responsibilities and obligations in environmental protection; serving as the action guide of project's environmental management; instructing contractor to prepare and implement various

measures to alleviate adverse environmental impact during the period of construction; instructing all project owners to take environmental protection measures specified in the contract after the project is completed and put into operation. In this code, a standard operation procedure is set up, which aims at adverse environmental impact in the course of construction of road transport project. A set of detailed and operable environmental measures is drawn up, which is feasible in technology and sustainable in finance, so as to eliminate or reduce project's adverse impact on environment and society to an acceptable level. Specific objectives include:

(1) Defining the environmental management obligations of contractor and operator

Environmental assessment organization and relevant design institute should make detailed site verification to the environmental protection objective in the project area; at the same time, according to the environmental characteristics and project features of the project area, draw up practical environmental protection measures and bring the measures into the engineering design, as the contract responsibilities of contractor and operator.

(2) Serving as the operation guide of environmental management

Relevant environmental protection measures in construction period and operation period provided in ECOPs can ensure the effective implementation of environmental control and impact alleviation. In construction period and operation period, this ECOPs will be provided to construction consulting organization, environmental supervision company and other units concerned, so as to definite the responsibilities of relevant functional departments and administrative organizations, and to introduce the channel and manner of exchange among the departments.

(3) This ECOPs should be fully combined with project's engineering design and provide design guidance.

1.3.2 Principle of drawing up environmental code of practices

(1) Principle of scientificity, objectivity and fairness: ECOPs must be scientific, objective and fair. Possible impact on various environmental elements and their ecosystem, resulted from the implementation of this code, should be comprehensively taken into account, to provide decision-making with scientific basis.

(2) Principle of integrity: Taking integrity into account, ECOPs should be connected with the policies, schemes, plans and relevant project related to the code.

(3) Principle of public participation: In the course of ECOPs implementation, public participation should be encouraged and supported, fully taking the interests and proposals of all social circles into account.

(4) Principle of consistency: ECOPs should keep pace with construction level and degree.

(5) Principle of operability: Simple, practical and feasible methods should be selected as far as possible; ECOPs should be operable.

1.3.3 Applicable scope of environmental code of practices

Environmental assessment of World Bank safeguard policy (OP4.01) is applicable for this project. According to the requirement of environment screening and classification of this policy, through the environment screening of project type,

location, sensitivity and scale as well as the characteristics and degree of potential environmental impact, this project is categorized in Class B. In order to safeguard constructors and the personnel in the sensitive area, and to prevent the interference of construction period to the sensitive area and surroundings, it is needed to draw up environmental code of practices (ECOPs). This report is related to rural road project ECOPs, applicable to new construction and reconstruction projects of rural road and counterpart infrastructure. These projects will produce a certain impact on environment during construction period and operation period. Although the impact is slight and the measures are mature, it is still required to draw up ECOPs to provide relevant environmental management mechanism, control and alleviation measures to minimize the impact.

1.4 Relevant laws, rules and security policies

Relevant laws, rules and security policies are listed in the Table 1.4-1.

Table 1.4-1 Relevant laws, rules and security policies

SN	Relevant laws, rules and security policies	Implementation date and document No.
(1)	Environmental protection law of the People's Republic of China	26/12/1989
(2)	Law of the People's Republic of China on environmental impact assessment	01/09/2003
(3)	Law of the People's Republic of China on prevention and control of atmosphere pollution	01/09/2000
(4)	Law of the People's Republic of China on prevention and control of water pollution	28/02/2008
(5)	Law of the People's Republic of China on prevention and control of noise pollution	29/10/1996
(6)	Law of the People's Republic of China on water and soil conservation	01/03/2011
(7)	Law of the People's Republic of China on land management	29/08/1998
(8)	Forest law of the People's Republic of China	Modified in 1998
(9)	Law of the People's Republic of China on cultural relics protection	29/12/2007
(10)	Law of the People's Republic of China on the protection of wildlife	08/11/1988
(11)	Regulations of the People's Republic of China on the protection of wild plants	01/01/1997
(12)	Regulations on the administration of environmental protection of construction projects	29/11/1998
(13)	Classification and management list of environmental impact assessment of construction projects	01/10/2008
(14)	Management regulations on environmental protection acceptance of "three-simultaneity" supervision, inspection and completion of construction projects, the Ministry of Environmental Protection (trial)	17/12/2009
(15)	Measures on environmental protection acceptance and management of construction project completion	01/02/2002
(16)	Management measures on environmental protection of transport construction projects	Degree No.5, 2003
(17)	Code for design of environmental protection of roads	JTG B04-2010
(18)	Provisions on water and soil conservation of road construction projects	[2001]No.12, MWR, MOC
(19)	Policy for prevention and control technology of ground traffic noise pollution	HF [2010] No.7
(20)	Notice on launching environmental supervision of traffic projects	JHF [2004] No.314

(21)	Code for design of road drainage	JTJ018-97
(22)	Technical standard for highway engineering	JTGB01-2003
(23)	Management regulations on environmental protection acceptance of “three-simultaneity” supervision, inspection and completion of construction projects, the Environmental Protection Department of Guizhou Province (trial)	04/09/2011
(24)	Regulations of Guizhou Province on graded examination and approval of environmental impact assessment documents of construction projects	Revised, 2012
(25)	Code of Guizhou Province for environmental protection management of construction projects	
(26)	Regulations of Guizhou Province on environmental protection	June 2009
(27)	Operation manual of the World Bank --- environmental assessment	OP/BP4.01
(28)	Operation manual of the World Bank --- natural habitat	OP/BP 4.04
(29)	Operation manual of the World Bank --- material culture resources	OP/BP 4.11

1.5 Experience summary of rural road subproject of “Guiyang transport project”

The rural road subproject under the “Guiyang transport project” financed by the World Bank loan is being implemented, which can offer reference for this Guiyang rural road project. In this section, the requirements for environmental management of construction site and project operation are summarized, mainly including construction camp, access road, borrow area, spoil ground, asphalt mixing station, slope treatment, traffic safety, road maintenance and management, etc. Now, they are described respectively as follows:

1.5.1 Experience summary of construction camp

Based on site survey, the project belongs to rural road and along the road there are a number of civilian houses, which are rented for the living campsite of the implemented Guiyang transport project that is financed by the World Bank loan. Operation campsite is a new land, which will be earthed up or afforested after the construction is finished. The selection and outline of operation campsite and living campsite are shown in Fig. 1.5-1.

Fig. 1.5-1 Campsite selection and requirement of rural road project

Campsite category	Site photos	Successful experiences	Problems	Experience summary and requirements
Living campsite		Local civilian houses are rented for the project to avoid a new land occupation, which conforms to the site selection requirement of construction and living campsite; the campsite depends on the existing sewage treatment facilities (pit toilet), living and heating energy comes from electricity, thus reducing the impact on water and air environment.	Because located in rural area, garbage collecting device is not perfect; moreover it is a bad hand at campsite management, resulted in littering about, no household garbage collecting point or waste bin.	Combining with project features, this project chooses local civilian houses as the campsite, relies on the existing sewage treatment facilities and living energy to reduce the impact of new campsite on air, water and land. Special waste bin or garbage collecting point is set up to gather the household garbage produced by builders.
				
Operation campsite		Generally, operation campsite is located in the road section with bridge, mainly used to pile up building materials and to fabricate precast bridge parts. Based on site survey and in view of Guizhou's terrain, that is, flat ground in the project area is cultivated land, it is unavoidable to occupy the cultivated land when selecting operation campsite; however, basic farmland or fertile farmland will not be occupied. After the construction, the land will be cultivated in time, so the environmental impact on land is not considerable.	Sedimentation basin for industrial waste water and pit toilet are not available in the campsite; some of industrial waste water and domestic sewage are drained disorderly.	Barren slope and hill shall be selected for campsite as far as possible. If it is unavoidable to occupy the cultivated land, the surface soil should be removed and piled up separately, which will be used for secondary ploughing when construction is finished. Sedimentation basin for industrial waste water and pit toilet are built in campsite. The precipitated industrial waste water can be used in operation, and the domestic sewage treated in pit toilet can be used for irrigation.
				

1.5.2 Experience summary of quarry and spoil ground construction

Based on site survey, the project belongs to rural road, involving road repair or reconstruction and expansion in the main. For the demand of dressed stone and spoil is not in large, so special quarry and spoil ground are not arranged. The demanded dressed stone is mined nearby or outsourced, and allocated and transported comprehensively along the road. The site selection and outline of quarry and spoil ground are shown in Fig. 1.5-2.

Fig. 1.5-2 Selection and requirement of quarry and spoil ground of rural road project

Campsite category	Site photos	Successful experiences	Problems	Experience summary and requirements				
Quarry		<p>Quarry is selected along the road or outsourced, not impacting basic farmland and forest land. Bush and herbaceous vegetation is on the earth's surface, which can reduce not only the transport cost, but also the construction of shortcut required by dressed stone transportation, at the same time, can reduce the adverse impact on environment, such as dust, noise and land occupation, resulted from long-distance transportation of dressed stone.</p>	<p>Surface soil is not stripped and piled up; excavation surface of dressed stone with service expiration is not reforested in time.</p>	<p>Combining with the project features, quarry is selected in barren slope and hill along the road, or outsourced. Surface soil of the ground should be stripped and piled up, and excavation surface of dressed stone with service expiration should be reforested in time.</p>				
					Spoil ground		<p>Site selection of project spoil ground keeps away from occupation of basic farmland and forest land. Piling spoil in natural low-lying land can prevent water and soil loss effectively, moreover, the land can be fully used after it is filled and leveled.</p>	<p>The spoil ground that has been filled with spoil is not reforested or replanted in time. Some of spoil ground are arranged in valley, but there are no retaining wall and rainwater ditches, or spoil is piled too high, which is easy to result in geological disasters, e.g. water and soil loss, landslide and mud-rock flow. Once spoil is washed out, the farmer's land at the lower reaches of spoil ground would be submersed.</p>
Spoil ground		<p>Site selection of project spoil ground keeps away from occupation of basic farmland and forest land. Piling spoil in natural low-lying land can prevent water and soil loss effectively, moreover, the land can be fully used after it is filled and leveled.</p>	<p>The spoil ground that has been filled with spoil is not reforested or replanted in time. Some of spoil ground are arranged in valley, but there are no retaining wall and rainwater ditches, or spoil is piled too high, which is easy to result in geological disasters, e.g. water and soil loss, landslide and mud-rock flow. Once spoil is washed out, the farmer's land at the lower reaches of spoil ground would be submersed.</p>	<p>Depression or valley should be selected as project spoil ground, not occupying basic farmland, fertile land or forest land. The spoil ground that has been filled with spoil should be reforested or replanted in time. Retaining wall and rainwater ditches should be arranged for spoil ground to avoid water and soil loss, landslide and mud-rock flow.</p>				
								
		None						

1.5.3 Experience summary of slope protection

Based on site survey, because of poor slope protection measures, the geological disaster, such as slope collapse and landslide, is widespread. See Fig. 1.5-3.

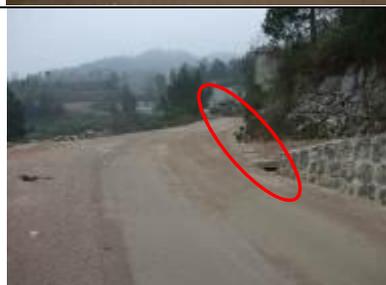
Fig. 1.5-3 Slope protection and requirement of rural road project

Site photos	Problems	Experience summary and requirements
	<p>Because retaining wall and upper rainwater side ditch are not arranged and there is no planting measures, the slope is easy to be washed out and unstable in rainy season, resulted in landslide.</p>	<p>Slope retaining wall should be built up and rainwater side ditch should be arranged at the top of slope. The slope with retaining wall should be hardened or planted to avoid incompact soil washed out by rainwater and resulted in landslide and collapse.</p>
	<p>Although road slope retaining wall is arranged, the height is not enough, in addition, there is no rainwater side ditch at the top of slope. In this case, sandy soil is easy to be washed out by rainwater, resulted in landslide.</p>	
	<p>Although retaining wall is arranged for the upper slope, the height is not enough, in addition, there is no rainwater side ditch at the top of slope. In this case, incompact soil is easy to be washed out by rainwater, resulted in landslide.</p>	
	<p>Although retaining wall and drainage ditch are arranged for the lower slope, there is no any retaining measures or planting measures taken at the inner side of slope, which is extremely easy to result in landslide in rainy season.</p>	
	<p>Although retaining wall and drainage ditch are arranged for the lower slope, there is no any retaining measures or planting measures taken at the inner side of slope, which is extremely easy to result in landslide in rainy season.</p>	
	<p>Although retaining wall and drainage ditch are arranged for the lower slope, there is no any retaining measures or planting measures taken at the inner side of slope, which is extremely easy to result in landslide in rainy season.</p>	

1.5.4 Experience summary of crossroad and road drainage ditch

Based on site survey, drainage of the roadside ditch of the implemented rural road subproject is difficult, which results in the surface gathered water. See Fig. 1.5-4.

Fig. 1.5-4 Situation and requirement of crossroad and road drainage ditch of rural road project

Road surface	Cause and result	Experience summary and requirements
	<p>Because of no drainage ditch at crossroad and between road side and resident houses, the rainwater at both sides of road and the pavement runoff are difficult to be drained in rainy season, resulted in surface gathered water, muddy pavement and disorder flow of domestic sewage.</p>	<p>Drainage ditch and cover plate are arranged at crossroad and between road side and resident houses, to ensure unobstructed drainage of the rainwater at both sides of road and the pavement runoff in rainy season, to avoid surface gathered water, muddy pavement and disorder flow of domestic sewage.</p>
		
		
		

1.5.5 Experience summary of rural road maintenance

Rural roads have a lower classification, and are easy to be destroyed under natural or man-made impact. Rural road construction is one of livelihood projects or people-benefit projects. So after the project is completed, the project administration should strengthen management and propaganda as well as operation maintenance, to make the project really play a role of driving the economic development along the road. Based on site survey, because out of maintenance and the influence of natural or man-made factors, road surface damage and blocked side ditch have appeared in some operational road sections of the implemented rural road project, moreover, it is serious that local residents stack their building materials (sand, stone) disorderly. See Fig. 1.5-5.

Fig. 1.5-5 Maintenance status and requirement of crossroad and road passing village of rural road project

Road surface	Causes	Experience summary and requirements
	<p>Residents stack their building materials (sand, stone) on the road.</p>	
	<p>Road surface damage resulted from heavy vehicle and rain immersion.</p>	
	<p>Road surface damage resulted from heavy vehicle and rain immersion.</p>	<p>Strengthen management, propaganda and maintenance to keep clean road surface and unblocked side ditch.</p>
	<p>Road surface damage resulted from heavy vehicle and rain immersion.</p>	
	<p>Side ditch is blocked because out management and maintenance.</p>	
		

1.6 Structure of the report

This environmental code of practices (ECOPs) is divided into three parts, i.e. preface, text and appendixes, totaling 21 chapters.

The preface covers project background, EA procedure, ECOPs objective, criterion and scope, as well as applicable laws, rules and security policies, with the purpose of making readers learn about ECOPs composition background and relevant information.

Main contents of the text include the general requirement of environmental management control of rural road construction and the specific requirements of construction progress. The characteristics, impact on environment, and measures to alleviate environmental impact of all divisional works are described in accordance with different subprojects. When project construction is involved in the environmental impact of a specific work, please refer to the environmental code of practices for the specific work.

Appendixes mainly include attached maps and attached tables. The former covers geographic position map, drainage map and sensitive object distribution map, with the purpose of making readers have an overall knowledge about Guiyang's geographic position in Guizhou, China, as well as drainage system and sensitive area distribution. The later covers environment screening form, summary sheet of environmental supervision of project, checklist of environmental protection review in construction period, rectification notice of environmental protection issued by environment supervisor to contractor, checklist of environmental protection before acceptance and so on, with the purpose of supervising and reviewing the environmental behavior of all works in the course of project construction; meanwhile, correcting the unreasonable environmental behavior.

This code is drawn up in accordance with the impact of road project on environment, suitable for design institute to prepare the environment chapter of feasibility study report and design report, for general contractor in construction site management and environmental supervision, and for project owner and authority in site supervision and management.

The structure of this ECOPs is shown in Diagram 1.6-1.

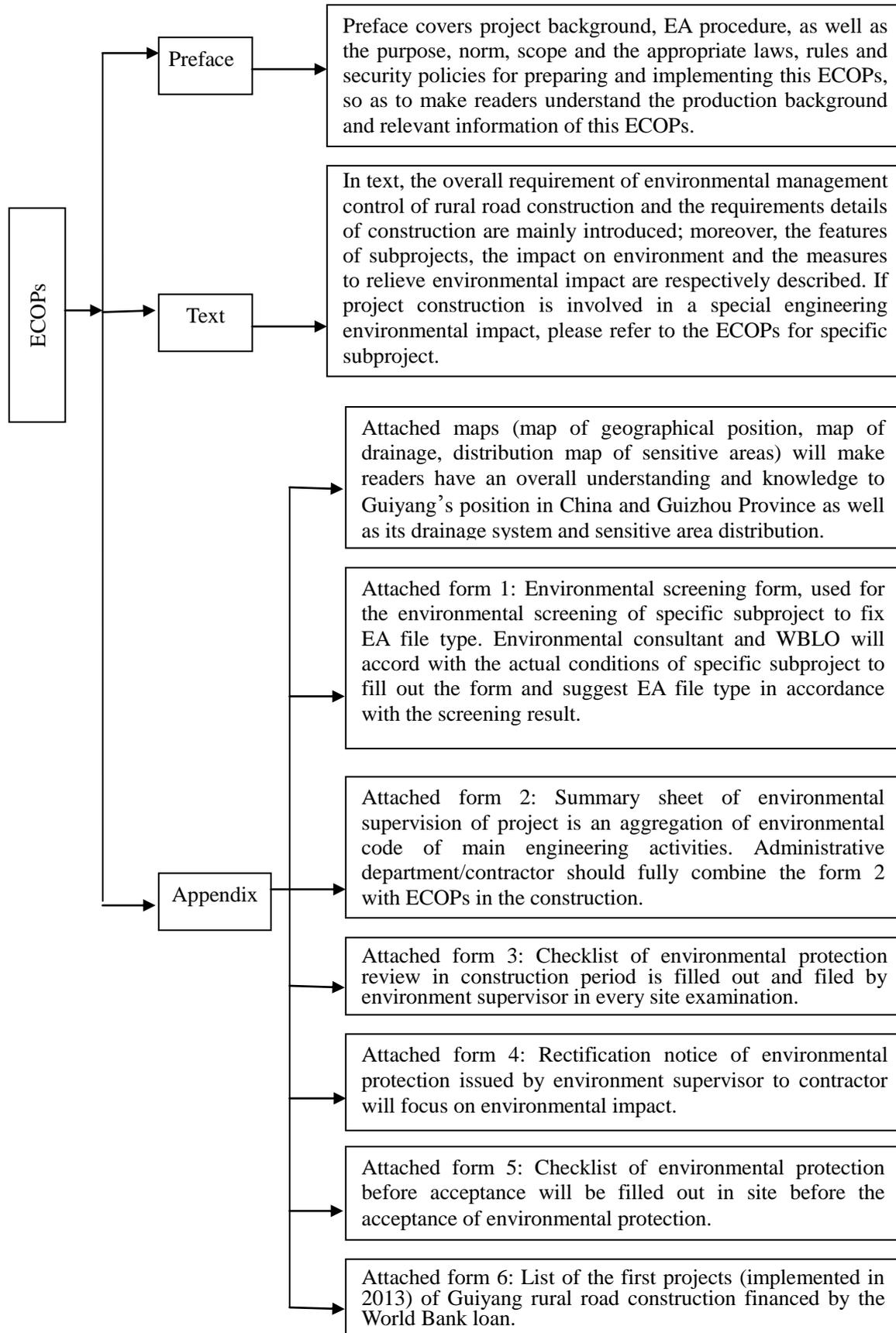


Diagram 1.6-1 Report structure of this ECOPs

2 Outline of Basic Information of Guiyang City

2.1 Natural environment

2.1.1 Geographic position

Guiyang, the capital of Guizhou Province, is one of the key cities in the southwest of China, also is a significant transportation junction, industrial base, and commercial, trading and tourism center. Guiyang is located at 106°07'-107°17' E and 26°11'-26°55' N, bordering Weng'an County, Longli County, Huishui County and Changshun County in the southeast, Pingba County and Zhijin County in the west, Qianxi County, Jinsha County and Zunyi County in the north, with total land area of 8034 km², accounting for 4.56% of the provincial area. The area of administrative districts of the city is 230 km², of which Yunyan District is 67.5 km², Nanming District is 89.68 km², Huaxi District is 1020.73 km², Wudang District is 964.9 km², Baiyun District is 272 km², and Guanshanhu District is 307 km². Total area of "one city and three counties" (i.e. Qingzhen City, Kaiyang County, Xifeng County and Xiuwen County) is 5625.5 km², of which Qingzhen City is 1492 km², Xiuwen County is 1071 km², Xifeng County is 1036.5 km² and Kaiyang is 2026 km².

Guiyang's geographic position in Guizhou, China is shown in Attached Map 1.

2.1.2 Topography

Guiyang is located in the middle part of plateau hills of central Guizhou, a watershed between the Yangtze River and the Pearl River, with the topography of higher in the southwest and lower in the northeast. Denuded hills are alternate with basin, valley and depression. Relative height difference is 100-200m. The peak is at Miaowoding of Shuitian Town, with the elevation of 1659m; the lowest is at the outlet of Nanming River, with the elevation of 880m. Stratified landform is obvious, mainly including Guiyang-Zhongcaosi syncline basin, Baiyun-Huaxi-Qingyan composed multistage platform and karst depression. Peak cluster, dishing depression, funnel, underground stream and karst cave are developed. Flat grounds are distributed in Huaxi, Mengguan, Wudang, Jinhua and Zhuchang. Nanming River flows through the downtown from the southwest to the northeast, with the drainage area accounting for 70% of the total urban area. The landform belongs to hill-plain basin, dominated by mountains and hills, of which mountain area is 4218 km², hill area is 2842 km² and plain area is 912 km². In addition, gorge area accounts for 1.2% of the total.

2.1.3 Climate and weather

Guiyang falls into Ferrell circulation, controlled by westerly zone and belonging to subtropical humid mild climate. Annual average temperature is 15.3°C, annual extreme maximum temperature is 35.1°C and annual extreme minimum temperature is -7.3°C; annual average relative humidity is 78%; annual average precipitation is 1129.5 mm; annual average thunder climate is 49.1 days; annual average overcast climate is 235.1 days; annual average sunshine duration is 1148.3 hours; annual average snowfall is only 11.3 days. Predominant wind direction of all year round is northeaster, souther in summer and northeaster in winter, with average wind speed of 2.2m/s.

2.1.4 Hydrology

2.1.4.1 Surface water

(1) Main rivers

Guiyang is located at the watershed between the Yangtze River system and the Pearl River system, bounded by Tongmuling of Huaxi District. The rivers to the south of Tongmuling belong to the Pearl River system, with drainage area of 415 km², accounting for 5.2% of Guiyang's land area; the rivers to the north of Tongmuling belong to the Yangtze River system, with drainage area of 7631.67 km², accounting for 94.8% of Guiyang's land area. Main rivers flowing through Guiyang include Wujiang River, Qingshuijiang River, Nanming River, Maotiao River, Yuliang River and so on, which are separately described as follows:

① Wujiang River

Wujiang's tributaries present feather-like distribution with higher density of river network. The river length is about 17 km/100 km². The drainage area of the left bank is more than that of the right bank. There are 16 tributaries with each drainage area above 1000 km². Besides Liuchong River of the north source, the tributaries with each drainage area above 2000 km² include Maotiao River, Qingshuijiang River, Shiqian River, Zhaishui River and Yujiang River at the right bank as well as Yeji River, Hongdu River, Furongjiang River and Daxi River at the left bank. The partition of Wujiang main stream reaches is shown in Table 2.1-1.

Table 2.1-1 Partition of Wujiang main stream reaches

Reaches	From ... to	Catchment area (km ²)		Length (km)	Water head (m)	Gradient (‰)
		Interval	Accumulation			
North source	From Liuchong River source to Huawuji	110	273.4	273.4	1293.5	4.73
Upstream	From Sancha River source to Huawuji	7264	18138	325.6	1298.5	4.29
Middle stream	From Huawuji to Sinan	33132	51270	368.8	503.7	1.37
Downstream	From Sinan to Hekou	36650	87920	342.6	221.3	0.65
Whole river	From Sancha River source to Hekou	87920	87920	1037	2123.3	2.05

② Qingshuijiang River

Qingshuijiang is a main stream at the upper reaches of Yuanjiang in Hunan Province. It originates from Qinggangpo at the south foot of Mt. Doupeng in Guiding County, Guizhou Province, and flows in Jinping County, flowing through Duyun, Majiang, Kaili and Taijiang counties (cities), including 12 towns/townships and 32 villages, with the drainage area of 1532 km². The flowing reaches is 81.9 km long, of which 13.1 km is as the boundary river between Jianhe County and Taijiang County. Riverbed is 50m-200m wide. Maximum and minimum flow rates are 14693m³/s and 47m³/s respectively with the average value of 158.22m³/s. Water head is 123m, that is, inlet head is 471m and outlet head is 348m. Qingshuijiang has 52 streams in the county, of which 29 streams travel down from the north bank and 23 streams from the south bank.

③ Nanming River

Nanming River is the left source of Qingshuijiang River --- a tributary of Wujiang River. As the longest river in Guiyang, it flows through the west part, the middle part and the northeast part of Guiyang, from southwest to northeast. The river has two sources. The main source is Lengshuichong in Linka of Pingba County, which flows into Guiyang from the northeast of Pingba, named Malu River; another source is Cigutang in Zhongba farm of Qingzhen City, which flows into Guiyang from the southeast, named Cigushui. These two sources meet at the northeast of Huajie, Shibao

Town, Huaxi District, and then flow to the east, flow through Banbianshan and Dazhai, and at last reach to Huaxi Jifan Bridge, named Huaxi River, which first turns to the north, flows through Zhongcaosi, where it takes in Chenliang River and Madi River, then brings Xiaoche River into it at the northeast of Wuyanqiao, turns to the east and flows through Zhaikoutan, and at last reaches to the south of Guiyang downtown, named Nanming River. The river flows round the south of the downtown, takes in Shixi River and Guancheng River at Cinanmen and Liudongqiao respectively, then turns to the northeast and flows out of Tongjiqiao from Shuikousi, renamed Jiaodu River. The river flows to the northeast at first, flows through Dayuzhai to Gaozhaitian Daliangkou and takes in Xintian riverlet, flows through Hongjiqiao to Luowan and takes in Longjing riverlet, then turns to the southeast to Wudang and takes in Longdong River. On the flow way, it successively takes in Ganba River, a riverlet, Baishui River and Xima River at Dingpa, Puduzhai, Xiaba and Laping respectively. In Songjiadu, it flows out of the city boundary and into Longli and Kaiyang counties. At last, it joins with Dushui River, which comes from Guiding County and flows through Longli County, at Liangchahe --- the junction of Longli, Kaiyang and Fuquan counties, where it is named Qingshuijiang River. After taking in Xini River in Kaiyang County, Qingshuijiang River flows into Wujiang River at Lianghekou of the county.

From the source to the outlet, Nanming River is 150 km long, with the water head of 462m and the average gradient of 3‰. The gradient from Huaxi to Guiyang downtown is the flattest, only 1.8‰ against the length of 23.4m and the water head of 42m; while the gradient from Zhuanjiaolongtang to the outlet is the steepest, up to 4.7‰ against the length of 13.5 km and the water head of 63m. The catchment area that is controlled by Guiyang Hydrometric Station is 757 km². Annual average runoff is 491.8×10⁶m³ with the flow rate of 13.3m³/s; the runoff volume in the driest year is only 230.8×10⁶m³; the runoff volume for general dry year is 335×10⁶m³ with the flow rate of 10.6m³/s.

(a) Xiaoche River

Xiaoche River is one of larger tributary of Nanming River, having three sources, i.e. north source, west source and south source. The west source comes out of Majingxiang of Jinhua Town, Wudang District, flowing to the east through Shangbanya, Xiabanya and Baiyanzhai, and reaching Hangjiaqiao, about 21.6 km long; the north source (Caijiaguan River) comes out of Hunshui Longtan of Babao, flowing to the south through Huishuitian, Gaoposhao, Jinguan and Caijiaguan, reaching Hangjiaqiao, about 20.16 km; the south source (Youyudong River) comes out of Dongping Longtan of Maiping Township, flowing to the northeast through Datongzhai and Youyudong, reaching Hangjiaqiao, about 20 km long. The above three sources meet in Hangjiaqiao to form Xiaoche River, which flows 7 km to the east and joins Nanming River at Wuyanqiao. The total length of the river, from the main source (south source) to the outlet, is about 28 km.

(b) Chenliang River

Chenliang River originates from Chenliang Town, Huaxi District, flowing from the south to the north through Chenliang, Xiaomachang, Gaobang and Sunjiayuan, reaching Sanjiangkou, where it joins Nanming River, 21.9 km long and 5-7m wide. Elevation of riverbed is 1072.3-1073.7m. Because of unobvious topographic relief and little gradient, the water flows gently. Water level elevation of flood of one in hundred years is 1076m.

(c) Shixi River

Shixi River originates from Bangshang of Qianling Township and joins Nanming River near Yizhongqiao of Guiyang downtown, with the total length of 16.2 km, the catchment area of 42.0 km², the annual average flow rate of 0.74 m³/s and the annual average runoff is 23.4×10⁶m³.

(d) Yuliang River

Yuliang River originates from Pojiao of Gujiao Town, Longli County, flowing through Xiaobi Township of Huaxi District, Longdongbao area of Nanming District, Yongle Township and Dongfeng Town of Wudang District, at last joining Nanming River, from its right bank, at Jiuyanqiao of Mairang Village, Dongfeng Town. The river is 40.8 km long, including 34.8 km within the borders, with average gradient of 5.9‰ and catchment area of 374.1km² (including 214.3 km² within the borders). The annual average natural flow, which joins Nanming River, is 6.5m³/s; the drainage area of the right bank is larger than that of the left bank. It is a larger primary tributary of Nanming River.

(e) Yudong River (also known as New River)

Two riverlets at the upper reaches are taken in this river, one of which comes from Shisungou of Yongle Township and another from Maochang Township of Longli County. The two riverlets collect the underground water from Yudong and join Yuliang River at Toubao, and then flow into Nanming River. Yudong River is perennial, about 30 km long and 20m wide.

④ Maotiao River

Maotiao River flows through the southwest boundary of Xiuwen County and joins Wujiang River at Sanchahe of Liuguang Township. The river length within the borders is 49.65 km, with drainage area of 3195 km², annual average flow rate of 55.9 m³/s and annual runoff of 1763×10⁶m³. It originates from Dabaiyan of Chashan Village, Shi'an Township. The source is known as Huaqiao River, which flows through Chong'en Township, Changba Township and Saping Township, and join Maotiao River at the junction of Zhongzhai Township and Wuli Township. Its drainage area is 149.4km², river length is 20 km, annual average flow rate is 2.2m³/s and runoff is 69×10⁶m³.

(a) Xiuwen River

As a primary tributary of Maotiao River, Xiuwen River is located in the middle of Xiuwen County. It originates from the northeastern Mengchong of Dongqing Village, Jiuchang Town, flows through Shi'an, Majiaqiao, Zhouguan and Chengguan, joins Maotiao River at the southwestern outlet and at last flows into Wujiang River. Its length is 37 km and drainage area is 228.2 km².

(b) Maijia River

Maijia River is the largest in Baiyun District, originating from the northern Xiuwen County's Shibanshao and the west foot of Mt. Zhouwu. It flows, from the north to the south, through Shatian reservoir, Bianshan and Jinjia, turns at Mahcangying to the west, then flows through Guoyuan, Maijia, Mayan and Zhuchang, at last into Maotiao River, with the total length of 26.15 km, drainage area of 150.2km² and annual average flow rate of 2.70m³/s.

(c) Tiaodun River (also known as Anliu River)

As a primary tributary of Maotiao River --- the primary tributary of Wujiang River, Tiaodun River originates from Laocaishan of Jiujia Township, Pingba County and flows into the city boundary at Xiaoluohai of Pingbao Village. Then it flows through Gaole, Xiguan, Gangou, Liwo, Caishui, Yongle, Wangzhuang, Anliu and Muke villages, underflows into a cave in Anliu. It is exposed about 300m in Xiangshuihe and again underflows into Yangpi Cave in Yangqiao Village, at last forms a 30m waterfall and empty into Maotiao River. The total river length is 66.7 km, with the drainage area of 299.2km², average flow rate of 5.08m³/s and dry season flow rate of 1.01 m³/s.

(d) Ganhe River

Ganhe River belongs to a primary tributary of underflow, originating from Houshan of Zhongzhai, at the southwest foot of Mt. Pagoda. It flows through Wengtong Tianba, Toudaohe, Yanlong, Fengxiangba, Pingzhai, Yongle Tianba, Xiniutun and Hujiashai, underflows into a cave, then is exposed in Dacao, at last empty into the underflow. The total river length is 30.0 km, with the drainage area of 73.0 km² and average flow rate of 1.31m³/s.

⑤ Qingshui River

Qingshui River originates from Baining of Machang Town, Pingba County, Guizhou Province and the source elevation is 1310m. It empties into Wujiang River at Qingshuikou, the northeast of Kaiyang County with the confluence elevation of 510m. The total length of main stream is 219 km, with total water head of 800m, average gradient of 3.65‰ and 3.32 riverway bending coefficient. Drainage system is developed. There are 22 primary tributaries, of which 10 tributaries have the drainage area of above 100 km² respectively; Yuliang River, Toubao River and Dumu River have the drainage area of above 300 km² respectively.

(a) Yuliang River

Yuliang River is a secondary tributary of Wujiang River, located in the southeast of Xiuwen County. It originates from Longjinggou of Sanyuan Village, Zhazuo Town, flows through Zhazuo Town from the south to the north and then turns to the northeast (also known as Zhazuo River from the source to Sanli Bridge, and known as Taoyuan River at the lower reaches of Sanli Bridge). At Sanli Bridge, Gema River is joined from the north. After confluence, it is named Yuliang River. The river turns to the east, flows through Yujingba and into the reservoir of Xiangbafang Hydropower Station. And then, passing through Sandaoxiang and Taoyuan Sanzhai, it flows into Kaiyang County at Dongtang of Xiaomu Village. It joins Qingshui River in Kaiyang County and at last empties into Wujiang River. The source elevation of Yuliang River is 1350m, with annual average flow rate of 3.6m³/s, annual average runoff of 114×10⁶m³ and the drainage area within the borders of 375.91 km².

(b) Gema River

Gema River, located in the east of Xiuwen County, originates from Yanjingchong of Lushan Village, Jiuchang Town. It flows through Qingshui and Qingrang townships, and joins Taoyuan River near the Sanli Bridge of Zhazuo Town. It is mainly used for irrigation, with the drainage area of 64 km², river length of 11.8 km, annual average flow rate of 1.17m³/s, annual average runoff of 37×10⁶m³ and dry season flow (in January 2009) of 0.18 m³/s.

(c) Guangdong River

Guangdong River originates from Xifeng County. As a boundary river between Xiuwen County and Kaiyang County, it flows into Kaiyang County at first, and then into Xiuwen County at Dalinpo of Liutun Township. At the river dike of Liutun Township, it flows underground and out of Xiuwen County, and joins Yuliang River in Kaiyang County. Before underflow, the drainage area is 119.4km² and the length within Xiuwen borders is 3.8 km, with annual average flow rate of 1.01m³/s and runoff of 37×10⁶m³.

(d) Lengshui River

Lengshui River originates from Poshang and flows through Chengguan and Fengsan towns of Kaiyang County, with the total length of 12.7 km, drainage area of 39.81km² and annual average flow rate of 0.47m³/s. Lengshui River joins Macha River at Lengshuihe (place name) nearby. After 5 km of confluence, the river joins Qingshui River at Fengxiangao, at last it emptied into Wujiang River.

⑥ Yangshui River

Yangshui River originates from Laofangzi of Yongwen Township, Kaiyang County. From the south to the north, it flows through Kaiyang Phosphate Mine, Jinzhong and Hongshuibai and joins Gucha River at Menqianba. After 500m of confluence, it empties into Wujiang River. The main reach of Yangshui River is 49.9 km, river width is 10-50m and drainage area is 158.0 km². There is no any important water conservation or hydropower facility. According to the calculation made by Dongtou Hydrometric Station, referring to Qingshui River with similar drainage, the average flow rate in wet year, normal year and dry year is 3.47m³/s, 2.79m³/s and 2.18m³/s respectively. The driest month in dry year is March with average monthly flow rate of only 0.80m³/s.

(2) Lakes and reservoirs

① Hongfeng Lake, Baihua Lake

Hongfeng Lake is located at 106°19′-106°28′ E and 26°26′-26°35′ N, with drainage area of 1596 km². At normal water level, i.e. elevation of 1240m, the lake has a water surface area of 57.2 km², total storage capacity of 601×10⁶m³, length of 16 km, average width of 4 km, shoreline of 143 km, max. depth of 45m and average depth of 10.52m; at dead water level, i.e. elevation of 1227.5m, the corresponding storage capacity is 159×10⁶m³. The total effective storage capacity of Hongfeng Lake is 442×10⁶m³ and the installed capacity of dam power station is 20,000 kW.

Baihua Lake is at the lower reaches of Hongfeng Lake, located at 106°27′-106°34′ E and 26°35′-26°42′ N. The catchment area between Hongfeng Lake dam and Baihua Lake dam is 299 km². At full water level, i.e. elevation of 1195m, the lake has a water surface area of 14.5 km², total storage capacity of 191×10⁶m³, max. backwater line of 21 km; at dead water level, i.e. elevation of 1188m, the corresponding storage capacity is 108×10⁶m³. The total effective storage capacity of Baihua Lake is 83×10⁶m³.

At present, the above two lakes are Guiyang's drinking water source. The hydrological characteristics of the two lakes (reservoirs) are shown in Table 2.1-2.

Table 2.1-2 Main hydrological characteristic parameters of the two lakes

Main characteristic parameters	Hongfeng Lake	Baihua Lake
1. Date of completion	May 1960	1966
2. Height of dam	52.5m	48.7m
3. Installed capacity	20,000 kW	22,000 kW
4. Drainage area	1596km ²	1895 km ²
5. Water surface area	57.2 km ²	14.5 km ²
6. Length of lake	16 km	18 km
7. Average width of lake	4 km	0.8km
8. Length of shoreline	143km	89 km
9. Storage capacity	601×10 ⁶ m ³	191×10 ⁶ m ³
10. Effective storage capacity	442×10 ⁶ m ³	83×10 ⁶ m ³
11. Max. depth	45m	45m
12. Average depth	10.52m	12.55m
13. Recharge coefficient of lake	27.9	125.9
	4-13: The parameters at full water level, i.e. elevation of 1240m; recharge coefficient K= drainage area + water surface area	4-13: The parameters at full water level, i.e. elevation of 1195m; recharge coefficient K= drainage area + water surface area
14. Surface area at dead water level	At elevation of 1227.5m, surface area: 17.8 km ²	At elevation of 1188m, surface area: 19.65 km ²
15. Storage capacity at dead water level	At elevation of 1227.5m, storage capacity: 159×10 ⁶ m ³	At elevation of 1188m, storage capacity: 108×10 ⁶ m ³
16. Reservoir inflow in wet year	(1971, P=20%), 1198.95×10 ⁶ m ³	(1971, P=20%), 1343.43×10 ⁶ m ³
17. Reservoir inflow in dry year	(1989, P=95%), 501.38×10 ⁶ m ³	(1989, P=95%), 693.79×10 ⁶ m ³
18. Annual average reservoir inflow	(1961-1990), 918.64×10 ⁶ m ³	(1966-1990), 1094.3×10 ⁶ m ³
19. Reservoir outflow in dry year	(1989, P=95%), 513.47×10 ⁶ m ³	(1989, P=95%), 644.91×10 ⁶ m ³

②Aha reservoir

Aha reservoir is located on Guiyang Xiaochu River --- the tributary of Nanming River, 8 km away from the downtown. The catchment area at the upper reaches of the dam site is 190 km². The drainage basin includes five inflow tributaries, i.e. Youyu River, Baiyan River, Caichong River, Jinzhong River (Shahe River) and Lannigou River, all of which belong to Nanming tributaries of Wujiang river system, Yangtze River basin. Of them, Xiaochu River (its main upstream is named Changzuoyu River, also known as Youyu River) is a primary tributary, and others are classified to secondary tributaries. The reservoir is located in Jinzhu area, belonging to the type of fracture cleuch --- intermountain river and in a syncline structure belt. Reservoir area: Maoba to the north, Lannigou to the south, Xuechang to the west, Dadongkou to the east. Water surface is slightly like a northeastern chicken claw.

Aha reservoir was completed in June 1960 and appointed as the source of drinking water in 1982. At present, its water supply capacity has been up to 250,000 m³/d, of which Nanjiao Water Works can supply 200,000 m³/d, while Hebin Water Works 50,000 m³/d. Since many times of extension and heightening, the current check flood level is 1116.13m and total storage capacity is 86.58×10⁶m³. At normal storage level of 1110m, the corresponding storage capacity is 54.2×10⁶m³ and water surface area is 4.5 km². At dead water level of 1090m, the water surface area is 0.8 km² and dead storage capacity is 2.75×10⁶m³. As a medium-sized reservoir focusing on urban

water supply and flood control, it will retain the water coming from Xiaoche River --- the tributary of Nanming River in flood season, thus to assist urban flood control. At the same time, it is one of the main sources of Guiyang urban water supply.

At present, the reservoir is Guiyang's drinking water source.

③Huaxi reservoir

Huaxi reservoir is located at the upper reaches of Nanming River, which originates from Lengshuichong in Linka of Pingba County. From the west to the east, the river in Huaxi reach flows through Songbaishan reservoir, Huaxi reservoir and Huaxi Town, then turns to the north and flows 5 km to the intake of Zhongcao Water Works. The geographical position is 106°38'40.5" E and 26°26'07.33" N.

Huaxi reservoir was constructed from July 1958, the dam was completed in July 1959, water was stored in June 1960, and power was generated in June 1962. The catchment area of upstream Songbaishan reservoir is 139km². It is a medium-sized reservoir with annual average flow rate of 5.3m³/s, normal storage level of 1137.9m and storage capacity of 20×10⁶m³, focusing on water supply and giving consideration to power generation. In 2002, the reservoir was expanded and heightened. After that, the total storage capacity is increased to 31.4×10⁶m³, normal storage level is up to 1140.0m, the elevation of check flood level is controlled to 11.45×10⁶m³, utilizable storage capacity is 28.4×10⁶m³ and flood-control storage capacity is increased from 0 to 11.4×10⁶m³. Huaxi reservoir has become a hydraulic complex, which focuses on flood control and integrates urban water supply, water for environment and power generation into a whole, to produce comprehensive benefit.

Huaxi Water Works, with the design scale of 50,000 t/d, was completed and put into operation in 1978, mainly supplying water for Huaxi urban area. It is located in Jilin Village of Huaxi District, and intake source is Huaxi River, which is from the lower reaches of Huaxi reservoir dam to the entrance of Huaxi Park. There dense buildings and large population make it become a lively area.

At present, the reservoir is Guiyang's drinking water source.

④Songbaishan reservoir

Songbaishan reservoir is located at the middle and lower reaches of Malu River --- the main source of Huaxi River, with the catchment area of 139 km² at the upper reaches of the dam site. The main stream comes from Huolongshan spring group, located in Kuchakan of Hujiqiao, Longshan, on the left side of middle part of the reservoir. It originates from Baintian of Machang Town, Pingba County and it is also the source of Nanming River. From Baintian, it flows through Fenglibao, Kaizhang and Zimujiang, there the main stream is narrowed gradually; at Baiyanjiao, it goes underground. Then it is exposed in Huolongshan. In Yang'ai Farm and neighboring area, surface water goes underground many times, and also exposed in Huolongshan. At the site of downstream 5.5 km of Baintian, Kaizhang reservoir was built in 1959, with the storage capacity of 3.5×10⁶m³ and the catchment area of 12 km². From the lower reaches of Kaizhang reservoir to Zhongzhai, there is a stream joined from Xujiaying. The catchment area at the upper reaches of Huolongshan springs is about 55 km², with higher flow rate in dry season. The major tributary is Linka River, originating from Dalongjing of Minidapo, which is also the first tributary of Nanming River. From the source Dalongjing, it flows through Kulishan and Shizhuang to Sancha River, and is known as Kailun River at the lower reaches of Sancha River and known as Linka River after confluence of Kailun River and Lengshuichong. Linka

River flows into the reservoir at Xinpanjing Xiaozhai, with the catchment area of 45 km².

At present, the reservoir is Guiyang's drinking water source.

⑥Wujiangdu reservoir

Wujiangdu reservoir is located on the main stream of Wujiang River and the dam site is in Wujiang Town of Zunyi County. It is a large-sized reservoir, focusing on power generation and flood control, and giving consideration to shipping. The project was constructed from 1970 and completed in 1983. The reservoir has a normal storage level of 760m and storage capacity of $2140 \times 10^6 \text{m}^3$. The catchment area at the upper reaches of the dam site is 27790 km², of which the catchment area at the upper reaches of Yachihe Hydrometric Station is 18187 km². Total installed capacity is up to 1250 MW and annual average generating capacity is $4140 \times 10^6 \text{kW}\cdot\text{h}$. It is the first hydropower station with the installed capacity above a million-scale in Wujiang drainage basin.

⑦ Dongfeng reservoir

Dongfeng reservoir is located in the reach of Yachi River --- the main stream of Wujiang River, by which a II-step hydropower station is formed. The installed capacity of the station is 510 MW, total storage capacity is $1016 \times 10^6 \text{m}^3$, regulation storage capacity is $491 \times 10^6 \text{m}^3$, catchment area at the upper reaches of the dam site is 18161 km², and normal storage level is 970m.

⑧Suofengying reservoir

Suofengying reservoir is located in the reach of Liuguang River --- the main stream of Wujiang River. As a III-step hydropower station in Wujian main stream, it installed capacity is 600 MW, normal storage level is 837m, storage capacity is $168 \times 10^6 \text{m}^3$, and the catchment area at the upper reached of the dam site is 21862 km².

Guiyang's water system composed of main surface water (rivers, reservoirs) is shown in the Attached Map 2.

2.1.4.2 Underground water

(1) Type of underground water

Karstic water is the main component of Guiyang underground water and clasolite fissure water takes the second place. Pore water is very poor. According to aquifer lithology, combination feature and formation cause of water-bearing space, the underground water of the survey area can be categorized to three types, that is, carbonatite karstic water, bedrock fissure water and loose-rock pore water.

①Carbonatite karstic water

It is a major underground water type characterized by widespread distribution, thick aquifer and rich water yield. For its complex structure, it can be further categorized to two subclasses in accordance with stratum combination feature, that is, pure carbonatite karstic water (carbonatite stratum > 70%) and carbonatite mixed with clasolite karstic water.

②Bedrock fissure water

Distribution area is 546 km², accounting for 22.65% of the region area. Water-bearing stratum is composed of sandshale, mudstone and coal-bearing series.

Underground water occurs in structural fracture and weathering fracture. The thickness of water-bearing stratum is varied and obviously influenced by terrain and geological structure.

③ Loose-rock pore water

Distribution area is about 70 km², accounting for 2.91% of the region area, and outcrops in the alluvial or proluvial eluvial-slope wash at the bottom of basin valley and large karst depression. Water-bearing stratum is distributed discontinuously and buried depth of underground water is 0.5m-3m.

(2) Underground water recharge --- runoff --- discharge

① Conditions of recharge, runoff and discharge of loose-rock pore water: Pore water mainly comes from atmospheric precipitation, recharged by a little bedrock aquifer and river water. Pore aquifer is mainly distributed in gentle basin and valley, where hydraulic slope is gently, so underground water runoff is very slower. Plane leakage flow is the main discharge form. Because pore water is buried shallowly and moreover farm crops are widespread, ground evaporation and plant transpiration are also the important discharge.

② Conditions of recharge, runoff and discharge of bedrock fissure water: Bedrock fissure water mainly comes from atmospheric precipitation. The recharge is closely related to the landform, fissure development and cutting. Clasolite weathering fissure is developed, but not deep and with poor continuity. So fissure water has a short runoff channel, and it is discharged from the earth surface in the form of small spring, forming intermountain stream. More springs, lower flow rate and bigger dynamic change can be found in severe slope place; while less springs but higher flow rate and stable change appear in gentle area. There are many housing estates and domestic wells in clasolite area, so people and livestock drinking is an important consumption channel of fissure water.

③ Conditions of recharge, runoff and discharge of karstic water: Karstic underground water mainly comes from atmospheric precipitation, which penetrates into ground through karstic fusture, doline, ponor, puddle, underground stream scuttle. Other recharge sources of karstic underground water include river water, reservoir seepage and farmland water seepage. Because karstic underground water is controlled by geological structure landform and hydrological network, runoff conditions are complex. The watershed between Yangtze River system and Pearl River system traverses the south part of the survey area. Northern side of the watershed belongs to Wujiang drainage basin, accounting for 82.6% of the survey area and including 25 rivers. South side of the watershed belongs to Mengjiang drainage basin, including 8 rivers. On the whole, underground watershed of the survey area is as the same as that of surface watershed. The primary watershed controls the general trend of runoff and discharge of underground water; while the secondary watershed controls the runoff conditions of underground water in a small drainage basin, which results in a very complex pattern of runoff movement of karstic underground water. The geological structure and stratigraphy constitute multiple hydrogeological structures, which controls the local movement rule of underground water. The intermediate layered hydrogeological structure is widely distributed, and the movement along stratum trend becomes an important form of karstic water runoff. When aquifer is cut transversely by river or fault, underground water will outcrop, forming an outlet of large spring or underground stream.

2.1.5 Animals and plants

According to generation nature, Guiyang's vegetation can be classified to two categories: natural vegetation and artificial vegetation. Natural vegetation covers coniferous forest, broad-leaved forest, bushwood or grass cluster. Coniferous forest mainly includes masson pine, cedarwood, keteleeria; broad-leaved forest mainly includes cyclobalanopsis glauca, photinia davidsoniae, cinnamomum glanduliferum, carpinus turczaninowii, geman oak, betula luminifera, sweetgum; bushwood or grass cluster mainly includes itea ilicifolia, cotinus coggygria, pyracantha, smallfruit rose root, quercus tabri, seguinii, distylium racemosum, linden viburnum, pteridium aquilinum, dogstail, heteropogon contortus, themeda japonica, arthraxon hispidus, etc. Artificial vegetation mainly include Chinese fir forest, masson pine forest, Chinese white pine forest, tea-oil tree, tea grove, fruit tree, rice field vegetation, corn-wheat-rape dryland vegetation, vegetable crop, etc.

According to general zoological classification system, Guiyang's animal can be classified to two categories: invertebrate and vertebrate. Invertebrate mainly includes amoeba, polyp, planaria, philodina, pheretima, vivipara, caridina, etc. Of the vertebrate, birds, fishes and small beasts are in the main. Fishes mainly include crucian carp, grass carp, black carp, spotted silver carp, silver carp, loach, rice field eel, etc. Amphibians mainly include giant salamander and rana limnocharis. Reptiles mainly include tortoise, trionyx sinensis, gekko japonicus, takydromus septentrionalis, adder, rhabdophis tigrina, trimeresurus stejnegeri, etc. Birds mainly include mandarin duck, golden pheasant, streptopelia orientalis, grey crane, cuckoo, small skylark meat, sparrow, etc. Mammals mainly include great roundleaf bat, squirrel, harvest mouse, etc. In recent years, frequent interference from urban construction, road/railway construction, deforestation and human activities has harmed animal's living environment and made Guiyang's large animals reduced rapidly.

2.1.6 Sensitive area

2.1.6.1 Scenic spots

(1) Hongfenghu (Hongfeng Lake) scenic spot

Hongfenghu scenic spot is located to the west of Qingzhen city proper, stretching across Qingzhen City and Pingba County, 28 km away from Guiyang, with the area of 200 km², of which water area is up to 57.2 km². As one of the largest artificial lake in Guizhou plateau, it was approved by the State Council as the national key scenic spot in 1988 and was rated by the National Tourism Administration as the national AAAA tourist area in 2001.

According to scenic spot demarcation, that is, taking scenery resource distribution as the basis, starting from benefiting scenery resources and meeting landscape requirement and applying the method that combines ridge line with administrative division, the area of Hongfenghu scenic spot is delimited to 200 km² (including water area of 57.2 km²). It stretches across Qingzhen City and Pingba County and covers 4 towns, 8 districts, 29 villages and 3 farms (all or partial land). Planned boundary line: from northern Laowangchong, Huangjiawan and Tuanpo of Qingzhen City to southern Zhengjiawan, Qingyutang, Baobaoshang, Huajiaoguan and Guankouzhai on Pingba line; from western Sandaogou and Luoqiaqiao of Qingzhen City and Mawutun of Pingba County to eastern Ganheba, Shizishan, Lumaotang and Tongmuzhai of Qingzhen City.

This scenic spot is characterized by plateau karst lake scene, karst landform and

karst vegetation, and merged with full-bodied folk custom. It is a comprehensive plateau lake-type national scenic spot with multi-functions, such as touring and sightseeing, leisure and summer resort, culture and entertainment, popular science education, water sports, meeting reception, and so on.

Its curved lake shoreline is changeable; islands, peninsulas and harbors are scattered all over the lake, producing a plentiful and changeable space. According to the above characteristics, comprehensive feature and actual situation, the scenic spot is divided into 11 scenic zones --- 6 in the north lake and 5 in the south lake. See Table 2.1-3.

Table 2.1-3 Introduction to the scenic zones of Hongfenghu scenic spot

No.	Scenic zone	Introduction
1	Dichengguan scenic zone	It is the main entrance of Hongfenghu scenic spot, including the scenes of Dichengguan, tortoise island, snake island, mandarin duck island, sun island, Xuyuan, Hailuopo and Enyuan, characterized by scattered small islands and broad lake surface, and focusing on natural landscape, with the area of 2.1 km ² .
2	Dongmiaochong Ethnic Village scenic zone	It includes three parts, i.e. Tong village, Miao village and Buyi village, reflecting Guizhou's folk custom and architectural culture, focusing on folk custom, characterized by ethnic culture and taking folk performance as the main contents, with the area of 1.2 km ² .
3	Xinglong scenic zone	It includes water sports base and holiday entertainment center, taking water sports and holiday entertainment as the main contents, with the area of 1.8 km ² .
4	Guanjingshan popular science zone	It includes Hongfeng power station, Guanjingshan and Jinmengyuan, focusing on popular science education, culture and entertainment, with the area of 2.3 km ² .
5	Baiyan scenic zone	It is named by Baiyan village in the scenic spot, focusing on rural scenery and characterized by its quiet and kind atmosphere, with the area of 6.1 km ² .
6	Wanggaopo scenic zone	It focuses on natural landscape and is characterized by wide sphere of vision, with the area of 4.2 km ² .
7	Jiangjunwan scenic zone	It is characterized by original natural landscape --- "cave in island and lake in cave", with the area of 2.5 km ² .
8	Tianxing islands scenic zone	It reflects natural landscape of rock part, characterized by karst bushwood vegetation, suitable for going camping and outing, with the area of 5.4 km ² .
9	Ludishao scenic zone	It focuses on rural scenery and history/human landscape, with the area of 2.4 km ² .
10	Huayudong scenic zone	It focuses on picturesque peaks and rocks, with the area of 1.9 km ² .
11	Heitu scenic zone	It focuses on local folk performance and natural lake scene, with the area of 0.9 km ² .

(2) Baihuahu (Baihua Lake) scenic spot

This is a provincial scenic spot, located in the northwest of Guiyang and 22 km away from Guiyang. It is an artificial lake, formed in 1960 when constructing Baihua Hydropower Station --- the secondary hydropower station on Maotiao River. The scenic spot has an area of 83 km², of which water area is 14.5 km². Baihuahu is characterized by karst landform and natural landscape. There are more than 110 islands with different areas scattered on the lake; 23 main natural landscapes, e.g. looking pine forest far into the distance, comparing beauty of peaks, green peaks and

islands, double monkeys guarding garden, double gorges in Baihua, and island paradise; moreover many human landscapes, such as Guanin Cave in Mt. Maoli, Hongwu temple in Mt. Moon, Gupanying in Chafan Village, old castle in Zhuchang, Huilong temple in Huaqiao, etc.

(3) Huaxi scenic spot

This is a provincial scenic spot with the total area of 350.5 km², composed of 7 scenic zones, that is, ten-mile river beach, Tianhetan scenery, famous historical and cultural Qingyan, Qiantao-Mengguan zone, Gaopo zone, Yanlou-Maling zone.

(4) Anliuhe (undercurrent stream) scenic spot

The scenic spot is located in Anliu Township of Qingzhen City, Guizhou Province, 65 km away from Guiyang, with the planning area of 50 km². Its name comes from an undercurrent stream, which flows through Anliu Township and into underground cave. Fully developed karst landform is its scenery source. Many charming scenes are available in it, for example, unique Dawan karst cave, Yangpidong waterfall, hot spring, underground river, sky hole, scuttle, blind valley, face upward sky, echo water and flow cloud, plunging waterfall, singing swallow in the ninth heaven, skyscraper cave, gorge, and so on, as well as full-bodied Miao's folk custom zone. According to the assessment of scenic spot sources made by experts, 70% of its sources have been up to the provincial standard and 30% up to the national standard. This scenic spot was approved by Guizhou Provincial People's Government in 2003.

(5) Xiangzhigou scenic spot

In February 2000, it was approved by Guizhou Provincial People's Government as a provincial scenic spot. The spot is located in Xinbao Buyi Township at the northeast of Guiyang, with total area of 50.8 km², 42 km away from the city proper. There the elevation is 960-1563m, annual precipitation is above 1200 mm and annual average temperature is 15°C, with abundant rainfall and pleasant climate, without severe cold in winter and intense heat in summer.

Xiangzhigou has beautiful natural scenery and biological diversity, where Buyi folk custom is simple and full-bodied, traditional paper workshops are scattered all over, caravan bells are sweet-sounding, and Buyi's pinup pictures are shown ingeniously. There are 8 scenes in the spot, i.e. Longjingwan, Guodiqing, Majiaochong, Xiangzhigou, Baishuihe, Hongzigou, Huluchong and pinery fishing area, which integrates mountain, river, forest, bamboo, suspended spring, plunging waterfall, rare peak and fairy stone into a whole.

(6) Yangming scenic spot

Taking Yangming cave as the center, Xiuwen sceneries cover 4 zones, i.e. Liuguanghe (Liuguang River) gorge, Maotiao River, Yanyingshan reservoir and Zhazuo forest farm, of which Yangming scenic spot, with the area of 161 km², is world-renowned for famous philosopher and educator Wang Yangming, who lived in the Ming dynasty, once resided in Longchangyi of Xiuwen County and established Yangming heart-mind theory after realized the truth. Liuguanghe is the boundary river of Xiuwen, Qianxi and Jinsha counties at the upper reaches of Wujiang River. From Baimatan to the downstream county boundary --- Huangjin Village, the valley is 35 km long, including 7 gorges and 40 scenes, such as Baima gorge, Houchou gorge, Feilong gorge, Buyi Shangri-la, silver fine rain and fighting goshawk. Maotiao River is a tributary in the south bank of Wujiang, 181 km long. The main scenes include

Maotiaoshi (a stone like a jumping cat), Gongjishan (a mount like a cock) and Houershan (a mount like a monkey). Yanyingshan reservoir is to the north of county town, 13 km away. Reservoir dam is arched, built by laying square stones, with 124 stone steps. It was completed in 1971 and won the national award of scientific and technological achievement.

(7) Xiangsihe (Xiangsi River) scenic spot

Xiangsihe provincial scenic spot is located in Shuitian Town and Xianba Township of Wudang District, 26 km away to the northeast of Guiyang, Guizhou Province, with the area of 68 km². It borders Xiangzhigou scenic spot to the north, Yandi Miao Village to the east, Ma-Bai highway to the south and Gui-Kai highway to the west. Within the scenic spot, there are 52 sceneries, including 33 natural scenes and 19 human scenes, and covering the types of rock peak, gorge, river bend, lake, waterfall, spring, trees, bamboo forest, ancient temple, ancient bridge, ancient courier rout, as well as Buyi and Miao villages with local features. With deep valley and dense forest, trees spread all over the scenic zone; the vegetation coverage is up to 76% while the forest coverage up to 41%. The area of masson pine forest and Chinese amand pine forest in Fenghuanshan forest farm, Hulushan forest farm and Guodiqing forest farm is over 67 km², there are also a number of bamboo forests. Yandi Miao Village can be approached by two natural viaducts; Kabao Miao Village is located in mountains and keeps full-bodied folk custom and original style; Wangbi Buyi Village is simple but elegant with rich folk custom; all of the historic site of Laping Xuanfusi seat, historic buildings in the late of Ming dynasty and early of Qing dynasty, and business street are conserved very well.

(8) Xifeng scenic spot

Xifeng scenic spot is located in Xifeng County with the total area of 35.543 km², including 6 scenic zones, i.e. Hot spring, Mt. Tiantai, Mt. Nanshan, Xuantian cave, Mt. Tuanyuan and Mt. Xiwang, of which Hot spring and Mt. Tiantai are located in Wenquan (hot spring) Town. The former, with scenic area of 1.27 km², is characterized by tour for hot spring and relaxation on holiday; the later, with scenic area of 1.529 km², is characterized by its original secondary forest --- Tiantai jungle, which is conserved very well in the middle of Guizhou. In the scenic zone, forest is dense and natural plants are abundant. It focused on the ecological protection of forest and the utilization of good ecological environment to properly develop ecotourism. Mt. Nanshan scenic zone is located in Yongjing Town, with the area of 5.456 km², covering forest farm headquarters and nursery garden. Artificial pore masson pine forest is the main forest vegetation, at the same time grassland scenery in forest is obtained. According to the forest landscape characteristics, forest recreation is taken as the main direction; moreover the ecological protection of forest is promoted vigorously. Xuantian cave scenic zone is located in Yongjing Town, with the area of 7.25 km², covering Xuantian cave and Pingtianba. Pore masson pine forest is the main forest landscape, and considerable grassland landscape is got in the forest. Moreover, Xuantian cave is a patriotic education base for General Yang Hucheng was locked up here. Combining with the scenery and forest features, patriotic education is taken as the main direction; at the same time entertainment and forest exploration are developed properly. Mt. Tuanyuan scenic zone is located in Yongjing Town, closing to Xifeng county seat, bordering Gui-Zun highway to the east, Yami Village to the south, Dizhaihe to the west and Xi-Jiu highway to the north, with the area of 12.708 km². Forest recreation is its development direction. Mt. Xiwang scenic zone is located in

Xishan Town, bordering Xiaolywo to the east, Shiluguan to the west, a road to the south and Erhuoyan to the north, with the area of 7.33 km². Here geographic landscape, human landscape and biological landscape are concentrated; forest vegetation is dense. This scenic zone takes forest sightseeing and Buddhist cultural tour as the direction.

(9) Kaiyang scenic spot

It includes Nanjiang gorge scenic spot and Zijiang gorge scenic spot. Nanjiang River flows through Nanjiang gorge, which belongs to Wujiang drainage basin with the total gorge length of about 40 km. Now the developed section, from the western Longguangqiao to the eastern Houzitian, is 18.5m long and 218m water head, with the area of 40 km². Most of the sceneries are concentrated on Nanjiang River valley and the zone, which the tributary passes through (accounting for 55% of the main scenes). The valley integrates gorge, green mountain and river, magical cave, dangerous rock, deep pool, rapid stream, plunging waterfall, mountain spring, dense forest, as well as the newly constructed rope bridge and viaduct into a whole, with charming and changeable landscape. In addition, the largest national calcified waterfalls are conserved in the valley.

Zijiang gorge scenic spot is characterized by its plunging waterfall. Unique karst landform is magnificent; picturesque peaks and rocks have a great variety of fantasies. Here river reach forms a geofracture, from which impetuous river, gathered in a 1.9m wide narrow fracture, pours down. In central part of the scenic spot, vegetation coverage is above 90%. Within the scenic spot, suspended spring and plunging waterfall are spectacular. Along the river, beautiful scenery comes into view. Drift across geofracture, scientific investigation, sightseeing and ecoenvironment education can be developed here.

2.1.6.2 Forest park

(1) Changpoling national forest park

According to the “Overall planning of Guiyang Changpoling national forest park”, the park is located at 106°38'-106°40' E and 26°38'-26°40' N, bordering Yunyan District to the southeast and Guanshanhu District to the southwest, 2.8 km wide from the east to the west and 4 km long from the south to the north, with the total area of 10.75 km². Predecessor of the park is Changpoling forest farm, Duxi forest farm and parts of collective forest land of Heishitou Village and Yulengshui Village, Dula Township.

In the park, the native vegetation type belongs to mid-subtropical evergreen and deciduous broad-leaved mixed forest; but it has been destroyed. The existing forest vegetation includes the coniferous forest with masson pine and Chinese white pine as the main, the broad-leaved forest with poplar and locust tree as the main, the mixed broadleaf-conifer forest with masson pine, Chinese white pine, locust tree and catalpa as the main, and the mixed conifer forest with masson pine and Chinese white pine as the main, with the forest coverage of 66.1%. At present, there are 107 species and 249 genera of vascular plant species in the park, including some national and Guizhou's key protective plants, such as tulip tree, ginkgo and yacca. There are 59 species of wild animal, including 30 species of birds, 12 species of beasts, 10 species of reptiles and 7 species of amphibians.

(2) Qianling Park

Qianling Park is a national AAAA tourist area, located in the north west of Guiyang city proper, connecting Zaoshan Road to the south, Bageyan Road to the east, Shibe Road to the northeast, Guandaoyan and Xiaoguan reservoir to the north, Changpoling forest farm, Qichongling, Sanqiao and Shengquan to the west, 1.5km away from the city proper and with the area of 426 km². Mt. Qianling is a part of middle Qianzhong mountain plateau, with the elevation of 1100-1396m, topographic relief and not changeable relative height difference (200m or so), containing Baixiangling, Bajiaoyan, Daluoling, Xiangwangshan, Qichongling, Tanshan, Zhangboshan, of which Daluoling (1396m elevation) is the first peak in the park and in the northwest of Guiyang city proper. Because of complex geological structure, more strata are outcropped within small scope, including Maokou group of lower series, Wujiaping group and Changxing group of upper series, Permian system; Daye group and Anshun group of lower series, Guiyang group of middle series, Sanqiao group and Erqiao group of upper series, Triassic system; Ziliujing group of lower series, Jurassic system.

(3) Nanjiao Park

Nanjiao Park is located in the southwest of Guiyang city proper, connecting Xiaochehe (Xiaoche River) nursery garden to the west, reaching the northern Xiaochehe, and connecting with Taiciqiao through Cheshui Road to the northeast, 1.5 km away from Taiciqiao with convenient traffic. The park was constructed from 1966, with the same status as the central Hebin Park, the southeastern Forest Park and the downtown Qianling Park. They jointly constitute Guiyang's park system at city level. As an early developed karst cave in Guizhou, Nanjiao Park has a rugged and varied topography, mainly composed of Bailongdong scenic spot, outside scenic spot and Xiaochehe scenic spot.

(4) Hebin Park

Hebin Park is located in the southwest of Guiyang city proper with very convenient traffic. In the park, nanmu garden, as well as bamboo room, corridor, pavilion and fence are the good places for tourists' tea drinking, chess playing, fishing, swimming and relaxation.

2.1.6.3 Water conservation area

Water conservation areas within the boundary mainly include Hongfenghu water conservation area, Baihuahu water conservation area, Huaxi reservoir water conservation area, Songbaishan reservoir water conservation area and Aha reservoir water conservation area. Outline of all water conservation areas is shown in the Section 2.1.4 of this report.

Distribution of main sensitive spots in Guiyang (scenic spots, forest parks, water conservation areas and folk custom places) is shown in the Attached Map 3.

2.2 Social environment

2.2.1 Population development status of the project area

Status of population size, structure, quality and distribution is the basic background of social and economic development for a region. According to the "Social impact assessment report on the infrastructure construction projects of urban and rural overall development in Guiyang City" drawn up by the social impact assessment group of Wuhan University, Guiyang's population status presents the following features:

(1) Considering from population size: In 2010 Guiyang's permanent resident population was 4,325,000, increased by 606,000 in ten years compared with 3,718,000 in 2000, with annual average increase of 1.52%. The average population per household is 2.93, decreased by 0.31 compared with 3.24 of the fifth population census in 2000. It can be seen that the household size presents a reduction trend.

(2) Considering from the sex structure of population: Of Guiyang's permanent resident population, male population is 2,226,700, accounting for 51.49% and female population is 2,097,800, accounting for 48.51%. Total sex ratio of population (taking female as 100 to see male proportion to female) is decreased to 106.14 from 110.84 of the fifth population census in 2000. Considering from age structure, of Guiyang's permanent resident population, the 0-14 aged population is 742,700, accounting 17.17%; the 15-64 aged population is 3,239,500, accounting for 74.91%; the 65 or above aged population is 342,300, accounting for 7.92%. Compared with the fifth population census in 2000, the 0-14 aged population proportion is decreased by 5.77%, the 15-64 aged population proportion is increased by 3.83% and the 65 or above aged population proportion is increased by 1.94%. It can be seen that aged tendency of population appears.

(3) Considering from population quality: Of Guiyang's permanent resident population, the population with university (above junior college) degree is 660,000, that with senior high school (including technical secondary school) degree is 598,000, that with junior high school degree is 1,430,000, that with primary school degree is 1,161,700, and illiterate population (15 or above aged) is 167,700 with the illiterate rate of 3.88%, of which rural illiterate or semiliterate population is about 80,000, accounting for 6% of the total rural population, the rural population with junior high school degree is about 500,000, accounting for 38% of the total rural population. About 80% of the 320,000 poor people are illiteracy or semiliteracy, or only have primary school degree.

(4) Considering from population distribution: Of Guiyang's permanent resident population, urban population is 2,946,300, accounting for 68.13%; rural population is 1,378,200, accounting for 31.87%. Compared with those of the fifth population census in 2000, urban population is increased by 671,600 and rural population is decreased by 65,500. The proportion of urban population is increased by 6.96%.

2.2.2 Economic development status of the project area

Guiyang is located in the western China. In the past, because of inferior geographical location, little land resources and short development history, its economic development level lags behind the eastern coastal regions relatively, which is reflected by Guiyang's small economic aggregate, weak economic strength, lower per capita GDP and income, backward infrastructure, lower industrial level, and inferior innovation capacity and competitiveness. The current economic development status of the project area can be summarized as follows.

(1) Guiyang has a weak economic foundation and the development is relatively backward, but the development potential is sufficient. At present, it is in a pursuant development stage and has become one of the regions with the fastest growth in China.

According to the statistics for the year 2011, the gross regional GDP and social fixed asset investment of Guiyang were up to RMB 138.8 billion and 160 billion respectively. And both rankings in the provincial capitals were raised by one place

respectively, compared with those in 2006. Gross output value of the industrial enterprises above specified size was up to RMB 143.66 billion. The growth of added value came to the top among the western provincial capitals, increased by 2.8 times or 14.2% annual average growth compared with those before ten years. Guiyang will become the “locomotive” to drive social and economic development of the province and the “engine” to appear in the economic zone of the middle Guizhou.

(2) Guiyang is accelerating industrialization course. Under the strategic guidance of booming the city by developing industry, industry and service are developed rapidly.

In 2009, Guiyang started the implementation of the strategy of booming the city by developing industry. CPC Guiyang committee and the municipal government drew up the “Suggestion on some policies to promote industrial economy” to unswervingly implement new industrialization, achieve great speed acceleration and benefit growth, and promote Guiyang’s industrial economy. Guiyang industrialization has stepped in a rapid development stage. At the same time of rapid industrial growth, Guiyang’s service trade realizes the growth in the same pace. The added value of service is increased by 3.3 times with annual average growth of 15.6%, compared with that before ten years; its GDP proportion is increased from 45.3% to 53.0%. And the proportion of added value of modern service in the whole service trade is above 30%.

(3) Now, Guiyang is being in rapid urbanization development stage, in which urban scale is expanded and urban population size and proportion are grown rapidly.

In the past ten years, Guiyang energetically implemented the strategy urbanization drive. Taking transportation system structure as the link and taking “old town diversion” and “new town construction” as the carrier, Guiyang’s urban function is perfected, urban space is expanded and urbanization level is raised continuously. Now, the construction land area is extended to 230 km², and the urbanization rate is increased from 62.0% in 2002 to 69.2% in 2011.

(4) Guiyang is still lack of rural infrastructure, but the conditions have been improved greatly.

According to the data of the 2nd agricultural survey, at the end of 2006, railway stations were built in 22.08% towns/townships, and second-class road passed through 37.66% towns/townships. Post office, savings bank, park, comprehensive market and special farm products market are obtained in 61.04%, 87.01%, 10.39%, 77.92 and 23.38% of the towns/townships respectively. Centralized water supply is carried out in 96.55% towns, domestic sewage is treated in 31.03% towns, and waste is disposed in 41.38% towns. Of Guiyang, road, electric power, telephone and TV program are connected with 97.94%, 99.49%, 96.91% and 98.20% of villages respectively. Drinking water of 35.68% villages is purified, garbage is collected for treatment in 21.36% villages, methane-generating pit is constructed in 95.88% villages, and general store or supermarket with the area of above 50m² is available in 17.84% villages.

2.2.3 Rural social development status of the project area

As the capital of Guizhou Province, Guiyang’s social and economic development level is higher relatively. But in some rural area under the jurisdiction of Guiyang, social development level is backward, especially some poor rural areas with inconvenient transportation. Because of information blockage, residents’ ideology is relatively backward and conservative. They are lack of modern market economy

concept and competition sense. Considerable people have a lower educational level. All of the above restrict local social development. Current rural social development status in Guiyang can be summarized as follows.

(1) Guiyang is still in a society with obvious urban-rural dual structure, the state of imbalance between urban and rural area is not yet changed.

Guiyang's urbanization rate in 2011 was up to 69.2%, but urban-rural dual structure still exist and urban-rural gap is more prominent. According to the statistic, per capita disposable income of Guiyang urban residents in 2012 was RMB 21796 yuan and that of rural residents was RMB 8488 yuan, with the income ratio of urban and rural residents is 2.57:1. It can be seen that the development imbalance between urban and rural area still exist. Rural labor forces, especially young laborers go to cities and towns in succession to be engaged in industry or trade. Most of the residents in rural area are mainly women, children and elderly people.

(2) In Guiyang rural area, living environment is beautiful, climate is pleasant and dwelling conditions are improved greatly, however the infrastructure, e.g. road, is still backward.

In Guiyang rural area, climate is pleasant, scenery is picturesque and environment is beautiful. For the past few years, along with the increase of farmers' income, they constructed or reconstructed a lot of housings and their dwelling conditions are improved greatly. According to the statistics, at the end of 2006, 96.59% of the rural households had their own house with average dwelling area of 124.9m²; 79.91% of the households made use of pipe water and 79.33% of the household took coal as the cooking energy. Per hundred households had 79.2 sets of color TV, 30.7 sets of telephones, 53.9 sets of mobile, 1.4 sets of computer, 17.1 sets of motorcycle and 3.7 sets of vehicle. Moreover, farmer family's private property was increased obviously. But there is still lack of infrastructure, such as road transport. The problems of lower road network density, access rate and technical level exist in rural area. The hardening ratio of access road is about 70% and that of main road in villages is about 50%. Because of lack of road maintenance, the roads that pass through poverty-stricken villages is in poor conditions. It is required to expend a lot of finances and labors.

(3) The rural area under the jurisdiction of Guiyang is distributed with large number of poverty-stricken population.

According to the poverty line, that is, per capita annual pure income of RMB 2,300 yuan, adjusted by the state in 2011, now Guiyang's poverty-stricken population is still 323,200, accounting for 16.8% of the total rural population, which is mainly concentrated in Xiuwen, Kaiyang, Xifeng, Qingzhen, Wudang and Huaxi districts (cities, counties), of which the rural poverty-stricken population in Xiuwen, Kaiyang, Xifeng and Qingzhen districts (cities, counties) is above 50,000 respectively, with a vast size.

Guiyang's poverty incidence is also higher. According to the statistics, there are 77 rural towns (townships) in Guiyang, of which 18 belong to poverty-stricken towns (townships), accounting for 23.38% of the total. There are 1166 administrative villages in Guiyang, of which 449 belong to poverty-stricken villages, accounting for 38.50% of the total. The districts (cities, counties) in the order of poverty incidence are listed as follow: Xifeng County (poverty-stricken population is 51,200, accounting for 25.4% of the total county population), Xiuwen County (poverty-stricken population is 56,200, accounting for 21.4% of the total county population), Huaxi

District (poverty-stricken population is 46,800, accounting for 20.8% of the total district population), Kaiyang County (poverty-stricken population is 67,700, accounting for 20.0% of the total county population).

The distribution of Guiyang rural poverty-stricken population is shown in Table 2.2-1.

Table 2.2-1 Distribution of Guiyang rural poverty-stricken population

Area	Rural poverty-stricken population (1×10^4)	Rural poverty incidence (%)
Guiyang Municipality	32.32	16.8
Nanming District	0.06	1.0
Yunyan District	0.06	0.7
Huaxi District	4.68	20.8
Wudang District	2.03	8.8
Baiyun District	0.57	7.9
Xiaohe District	0.28	9.9
Kaiyang County	6.77	20.1
Xifeng County	5.12	25.4
Xiuwen County	5.62	21.4
Qingzhen City	7.13	17.1

(4) Many rural areas in Guiyang belong to multi-ethnic areas; all ethnic groups can treat each other as equals and live in harmony, without ethnic conflicts.

Guiyang is a multi-ethnic area, Han population accounts for the most, Buyi population takes the second place and Miao population ranks the third. Guiyang's ethnic minorities include Dong, Yi, Bai, Dai, Zhuang, Miao, Hui, Lisu, Lahu, Wa, Naxi, Yao, Zang, Jingpo, Bulang, Buyi, Tujia, Achang, Hani, Xibo, Pumi, Mongol, Nu, Jinuo, De'ang, Shui, Man and Dulong. According to the data of the 6th population census, Guiyang's Han population is 3,603,000, accounting for 83.3%; the population of all ethnic minorities is 722,000, accounting for 16.68%.

Guiyang's ethnic minorities have their own customs, which are reflected on clothing, diet, inhabitancy, marriage, etiquette and funeral. Their festivals are distinctive, such as "Siyueba festival" of the Miao people, "Sanyuesan festival", "Liuyueliu festival" and "Tiaochang" of the Buyi people. These ethnic groups use the same characters and they intermarry each other widespread.

3 Implementation Management of Environmental Code of Practices

3.1 Organization structuring and main responsibilities

According to the relevant policies of the World Bank loan and the requirement of practical work, in order to implement this environmental code of practices (ECOPs), special management organization will be set up for this project, which is in charge of environmental management and environmental supervision of the project. The organization is structured by The Project Office, the subproject offices of all relevant counties and cities, the appointed design institute, the environmental assessment organization, the external monitoring organization for environmental management (see Appendix 1. Outline of appointing external monitoring organization for environmental management), and supervision department, which constitute an organization frame for internal environmental management. Organization structuring and main responsibilities of all organizations are shown in Diagram. 3.1-1 and Table 3.1-1.

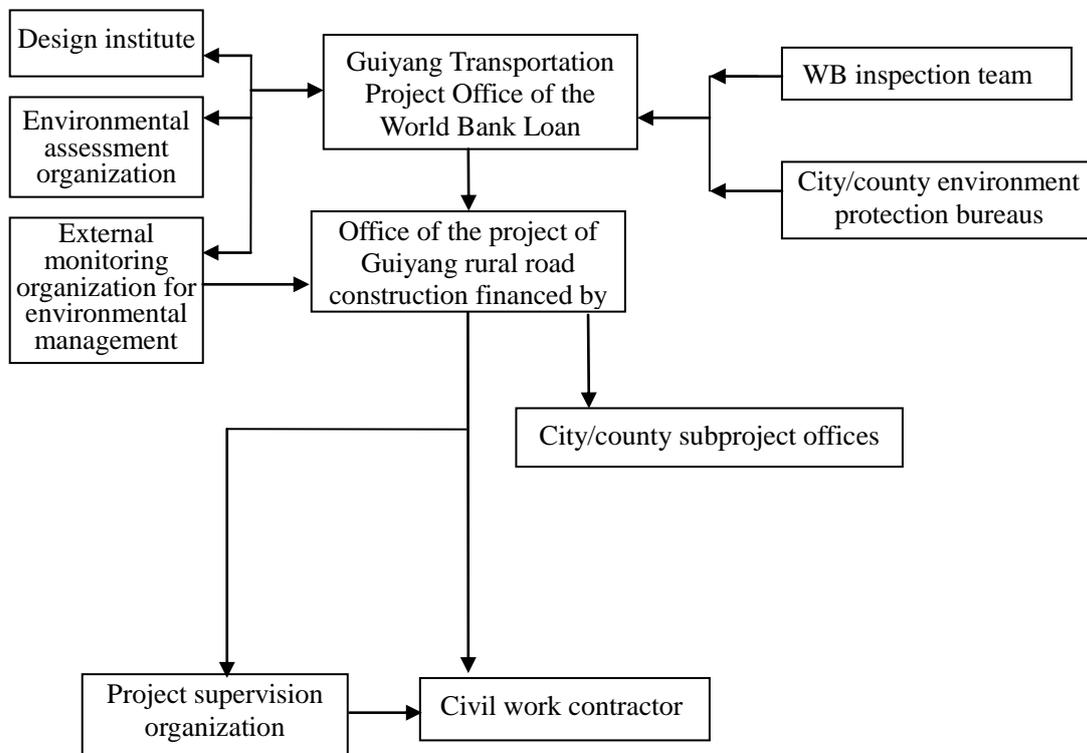


Diagram 3.1-1 Chart of environmental management system

Table 3.1-1 Organization structuring and main responsibilities of environmental management system

Name of organization	Task of organization	Main responsibilities
The Project Office	In charge of overall coordination and management for the project	① Project planning, design and environment protection to make the project meet domestic and WB procedure requirement; ② coordination, supervision, overall tracking report, and solution of key environment issues; ③ appointing environmental assessment organization and external monitoring organization for environmental management.
Office of the project of Guiyang rural road construction financed by the World Bank loan	In charge of implementation and management of all subprojects	① A series of environmental protection and management in the project design and preparation stage; ② ensuring environmental protection fund; ③ contact with The Project Office to coordinate environmental management affairs; ④ appointing environmental administrative staff, implementing their ECOPs and tracking report, timely coordinating contractor and supervisor to take environmental management action; receiving and disposing environment complaint.
City/county subproject offices	In charge of coordination of all subprojects	Coordinating land acquisition and resettlement of all subprojects.
City/county environment protection bureaus	In charge of approving and replying environmental assessment of construction projects, in government capacity of administrative supervision and management	Approving and replying environmental assessment of construction projects, in government capacity of administrative supervision and management.
Contractor	In charge of implementing relevant environmental protection measures specified in ECOPs, in implementation capacity	Verifying construction site and ECOPs/EIA report before operation; implementing ECOPs, ensuring no environmental degradation under the project construction.
Environmental supervision	Environmental supervision is one of the functions of project supervision, in charge of site supervision, examination and participation in disposal of pollutant discharge and ecological damage event during the project construction in accordance with relevant laws	① Conducting site environment examination every week; filling the checklist of environmental examination during construction period and keeping it on file; ② presenting remediation plan and supervising the implementation for those behaviors not meeting the requirements specified in ECOPs.
Environmental assessment consultancy	In charge of independent EIA for subprojects, providing technical support for the environmental protection of project design, and drawing up ECOPs	Drawing up ECOPs and preparing domestic EA documents.
Design consultancy	In charge of the preparation of feasibility study, preliminary design, construction drawing design and bidding documents	① Ensuring minimum impact of the technical plan on environment; ② bringing all environmental protection measures in feasibility study, preliminary design and EIA of the project into design plan and budget, and into the technical specifications of the bidding documents.
External monitoring organization for environmental management	In charge of assisting The Project Office to prepare EIA report and supervising the implementation of environmental protection during project implementation period	① Submitting WB and environmental administration with an annual mid-term monitoring report; ② submitting WB and the owner with an annual monitoring report; ③ submitting a comprehensive environmental management post-assessment report after half a year when all environmental management works are finished.

3.2 Settings and main responsibilities of environmental administrative staff

The environmental management system of this project includes the internal organizations, the appointed consultancies and the external organizations. In order to better perform the main responsibilities of environmental management organizations, it is suggested that all of the organizations should be in accordance with the

requirements of Table 3.2-1 to appoint relevant environmental administrative staff.

Table 3.2-1 Settings of environmental administrative staff

Environmental management organization	Personnel settings	Main responsibilities	Qualification
The Project Office	Project director	① Reviewing and coordinating the project office director in charge of environmental management; ② arranging the investigation of WB environment experts; reporting and implementing WB's environmental management requirements to WB; ③ summarizing environmental management report and submitting it to WB for approval; coordinating with other departments concerned to solve key environmental issues; ④ inspecting site environment one time at least a year; filling the checklist of environmental examination during construction period and keeping it on file.	Environmental administrative staff must have professional knowledge about environment and management.
	The appointed external independent monitoring organization for environmental management	① Offering technical assistance and training; ② assisting the preparation of plan for recovering the damaged ecoenvironment caused during the construction period; ③ according to ECOPs requirements to monitor and survey environmental management; ④ assessing the living conditions of the affected population to confirm whether they are recovered sufficiently; ⑤ preparing and submitting external monitoring and assessment report to the project management office and WB.	
Office of the project of Guiyang rural road construction financed by the World Bank loan	Project director	① Inspecting site environment one time at least a month; filling the checklist of environmental examination during construction period (Attached form 3) and keeping it on file; ② organizing and implementing environmental management training; ③ supervising implementation of the environmental protection measures specified in ECOPs; ④ Collecting, recording and reporting the complaint in project construction and operation; solving public complaint.	
City/county subproject offices	Project director	Coordinating relevant matters during the implementation of all subprojects; cooperating Office of the project of Guiyang rural road construction financed by the World Bank loan to deal with environmental protection.	
Organization with Class-A qualification certificate for EIA of construction projects	Person in charge of project	① Investigating all subprojects on the spot and assessing the environment; ② preparing ECOPs.	
Contractor	Person in charge of environmental management	① Ensuring contractor to implement the environmental measures specified in ECOPs; ② reporting the environmental emergency, which occurs in the construction, to the person of local project organization and in charge of environmental management; drawing up all environmental protection measures for the construction; ③ facing environmental protection supervision and inspection made by project supervisor, WB and environmental protection departments at all levels; ④ setting up feedback mechanism; accomplishing rectification within 3 working days after receiving the notice (or within 10 working days if the rectification requires the coordination of management organization); ⑤ filling out the construction site checklist with project supervisor before the construction, and reporting it to local project organization; ⑥ reporting project progress to the supervisor every week.	
Environmental supervision	Environment supervisor, concurrent project supervisor	① Inspecting site environment every week; filling the checklist of environmental examination during construction period and keeping it on file; ② raising rectification plan and supervising the implementation for the behaviors not meeting ECOPs requirements.	

3.3 Construction preparation and environmental supervision

This ECOPs (as well as environmental management plan possibly prepared in the future) should be brought into bidding documents and civil works construction contract, which should be fully considered by contractor when tender offer. After accession to site, contractor should investigate the construction site, verify and identify whether the site conditions are compatible with this ECOPs (or environmental management plan). For any sensitive environmental issue newly found, contractor should set forth relevant control and relief measures, and the construction will be continued only after approved by environmental supervision company and the Project Office.

During the period of project construction, the task of environmental supervision is to inspect the environmental protection and measures whether meet the requirements specified in ECOPs (For these measures, contractor and environment supervisor can refer to Chapters 4-19 and Attached Table 2: summary sheet of environmental supervision of project of this ECOPs).

Environment supervisor should inspect construction site day to day, fill the checklist of environmental examination during construction period (Attached Table 3) and keep it on file. If in the construction activities, contractor's behavior violates this ECOPs or environmental management plan, environment supervisor should issue the Rectification notice of environmental protection (see Attached Table 4) to the contractor and supervise the contractor to take corresponding rectification measures. Moreover, environment supervisor should semiannually submit a semi-annual summary report of environmental supervision to the environment director of the Project Office.

Before construction is coming to an end, environment supervisor should carry out environmental protection acceptance, fill out the checklist of pre-environmental protection acceptance (see Attached Table 5), keep it in file, and submit it to the Project Office.

Working process of environmental supervision during construction is shown in Diagram 3.3-1.

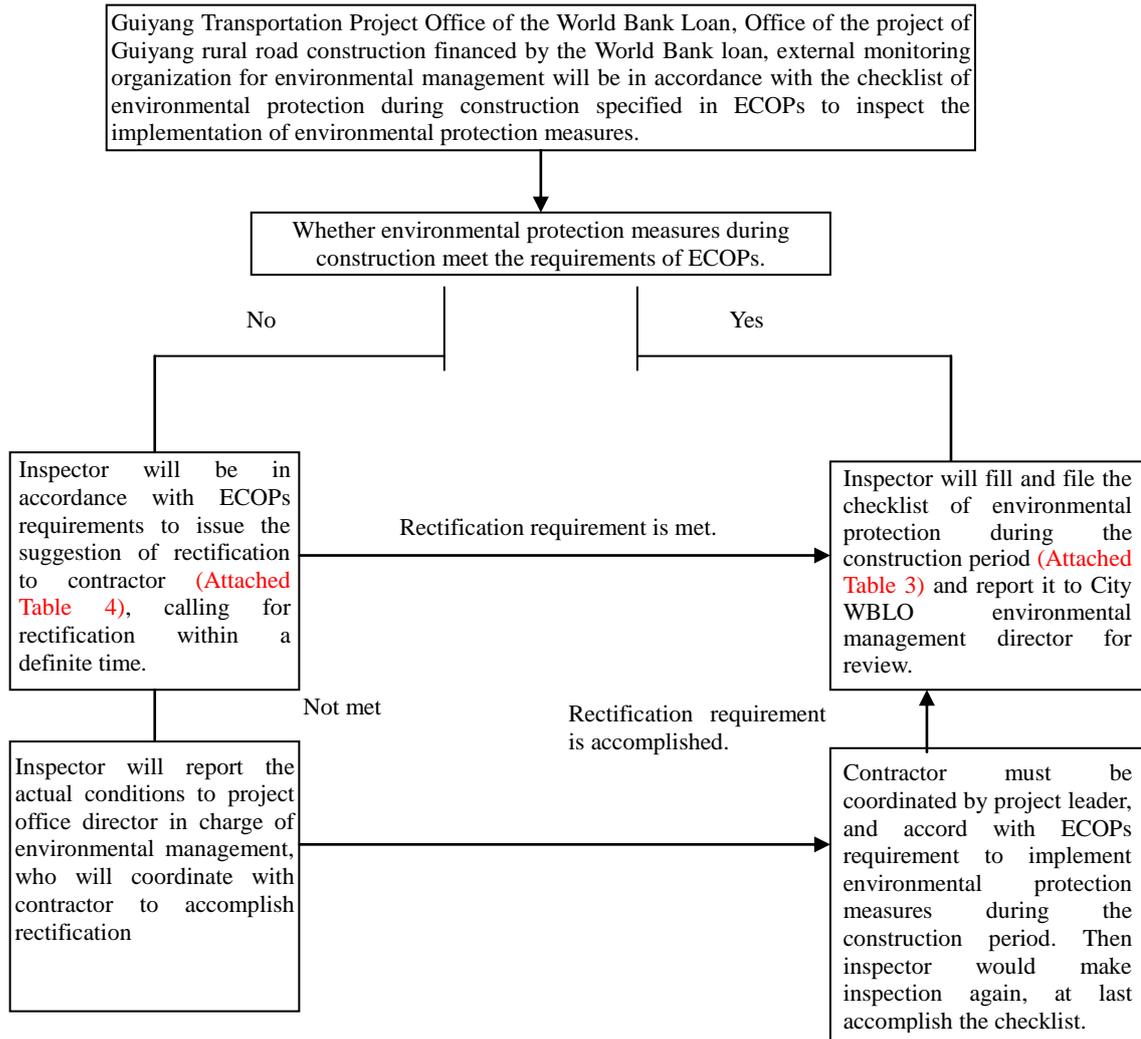


Diagram 3.3-1 Working process of environmental supervision

3.4 Document management and report

During ECOPs implementation period, all of The Project Office, Office of the project of Guiyang rural road construction financed by the World Bank loan, external monitoring organization for environmental management, environmental assessment organization, project supervisor and contractor should manage and report relevant documents. See Table 3.4-1.

Table 3.4-1 Requirement for document management of all organizations

Name of organization	Document management
The Project Office	① Drawing up ECOPs and supervising its implementation; preparing domestic EA documents; placing on file; ② recording the report made by Office of the project of Guiyang rural road construction financed by the World Bank loan one time a half year; submitting a semi-annual environmental monitoring report to WB; placing on file; ③ Coordinating with other relevant department to solve key environmental issues, recording specific measures, placing on file.
Office of the project of Guiyang rural road construction financed by the World Bank loan	① Preparing rules and regulations of environmental management for subproject implementation; placing on file; ② Preparing the plan of environmental management training; placing on file; ③ Organizing special study or related investigation; managing seminar and investigation documents; placing on file; ④ Collecting, recording and filing the complaint in project construction and operation; ⑤ Quarterly recording and filing the report made by project supervisor; submitting report (statement) to The Project Office; ⑥ Signing for site checklist submitted by contractor and project supervisor; verifying sensitive environmental issues; placing on file; ⑦ Managing and filing the submitted rectification notice.
External monitoring organization for environmental management	① Submitting an interim monitoring report to WB and environmental management organization every half year; placing on file; ② Submitting an annual monitoring report to WB and owner every year; placing on file; ③ Submitting a comprehensive environmental management post-assessment report after half a year when all environmental management works are finished; placing on file.
Contractor	① Weekly recording construction details; placing on file; reporting to project supervisor; ② Accomplishing construction site checklist with project supervisor before the construction; placing on file; reporting to Office of the project of Guiyang rural road construction financed by the World Bank loan; ③ In case of emergency, recording construction details, placing on file; reporting to project supervisor; ④ Accomplishing rectification within 3 working days after receiving the notice (or within 10 working days if the rectification requires the coordination of management organization); placing on file.
Environment supervisor	① Weekly recording the report made by contractor, placing on file; reporting to Office of the project of Guiyang rural road construction financed by the World Bank loan; ② Accomplishing construction site checklist with contractor before the construction; placing on file; reporting to Office of the project of Guiyang rural road construction financed by the World Bank loan; ③ In case of emergency, recording the detail plan of contractor; placing on file; reporting to local project organization; ④ Setting forth rectification solution for the relevant environmental protection issues faced by contractor in construction and tracking the implementation, including issuing rectification notice and rectification checklist, as well as the filed check documents.
Organization with Class-A qualification certificate for EIA of construction projects	① Preparing ECOPs and domestic EA documents; filing the first draft, the draft for examination, and the draft examined.

4 Environmental Code of Practices for Site Construction

4.1 Environment code of practices for site environment

Site mainly includes construction camp, concrete mixing station, asphalt mixing station, and so on. According to the different functions, construction camp can be divided into living campsite, operation campsite and living/operation campsite. The living campsite is used for constructors' board and lodging; operation campsite is mainly used for placing building materials, concrete mixing, fabrication of precast bridge parts, etc.; living/operation campsite integrates living and operation as a whole, suitable for contractors' board and lodging, building materials placing and fabrication of precast bridge parts. Asphalt mixing station is mainly used for mixing asphalt required by pavement laying.

(1) Requirements of site selection

The requirements of site selection are shown in the Table 4.1-1.

Table 4.1-1 Requirements of site selection

Not selected	Selected
<ul style="list-style-type: none"> • Main sensitive places, such as residence and school, and the land within 200m from upwind • Basic farmland • House site • Forest land • The land within 200m from river course • The land within upstream 1000m or downstream 500m from the intake of drinking water source so as to avoid water conservation area, as well as sensitive environmental area, such as scenic spot and forest park • Depression or paddy field • The land well covered by vegetation • Dangerous collapse and landslide area • Susceptible area of debris flow • The land for special use 	<ul style="list-style-type: none"> • Renting local civilian houses • The land within the scope of permanent use for road • Uncultivated land • Abandoned land • Land parcel with a higher terrain • Other poor land

(2) Analysis of site impact on environment

Site impact on environment mainly includes noise of construction machinery, drainage of industrial wastewater and domestic sewage, construction dust, cooking oil fume, construction waste and household garbage. See Table 4.1-2

Table 4.1-2 Site impact on environment

Site category	Environmental elements	Impact on environment
Operation campsite	Water	Impact of industrial wastewater on water environment
	Air	Impact of construction flying dust on ambient air
	Sound	Impact of construction machinery on sound environment
	Solid waste	Impact of construction waste on environment
Living campsite	Water	Impact of domestic sewage produced from constructors' board and lodging on water environment
	Air	Impact of constructors' residential heating and cooking oil fume on ambient air
	Sound	Impact of constructors' shouting on sound environment
	Solid waste	Impact of domestic garbage on environment
	Society	Impact of constructors' access on local social environment
Asphalt mixing station	Air	Impact of asphalt fume on ambient air
	Sound	Impact of mixer noise on sound environment

(3) Environmental code of practices for site

According to the requirement of site selection and combining with the actual conditions of the project, site selection should abide by the following requirements:

① The project should rent the civilian houses along the line as far as possible; arrange the collecting station and or container to gather domestic garbage; electric energy or other clean energies can be used for residence and heating.

② Constructors should abide by local village regulations and non-governmental agreements, accord with civilized construction and deal well with local residents.

③ Pit toilet and sedimentation basin should be arranged in operation campsite. After precipitated, the industrial waste water can be recycled in operation, not discharged to outside. The domestic sewage (from constructors' toileting) treated in pit toilet can be used for agricultural irrigation. Construction waste in the camps should be recycled as far as possible, or transported to the appointed place at regular intervals, prohibiting littered everywhere.

④ Barren slope, brushwood land and poor land have a prior selection to operation campsite. Cultivated land is prohibited to be occupied. If it is inevitable to occupy cultivated land, the occupation of basic farmland is prohibited. Before construction, it is required to strip the cultivated surface soil and temporarily stack it in a flat ground, retaining with packed earth, arranging temporary drainage ditch and desilting measures, and covered with dust screen. After the construction is finished, the soil can be used as cover earth for second ploughing or green planting.

⑤ Special concrete mixing station and asphalt mixing station are not set up for this project; all of concrete and asphalt will be purchased from outside.

4.2 Environmental code of practices for site construction

(1) Provisions of construction time

① Construction time: day shift: 6:00-22:00; night shift: 22:00-6:00; suspended: 12:00-14:00. The access time of construction vehicle must accord with local government's requirements.

② Night construction is restricted. If unavoidable, the surrounding residents

should be informed by public announcement. At the same time relevant formalities must be handled and it is needed to take measures to reduce the impact on the surrounding residents.

(2) Management of building materials

Building materials for this project mainly include sand, stone, cement, etc. If the management is improper in transportation, storage and application, these materials will impact environment with varying degree. So it is required to take corresponding environmental protection measures to minimize the impact.

The measures to be taken for the building materials in transportation, storage and application are as follows:

① Vehicle should be low-noisy and transportation of day shift must be strictly executed, strengthening management and reducing night transport times in abnormal working conditions.

② Speed of transport vehicle must be restricted. When passing through environmental protection objects (e.g. hospital, residential area, school), vehicle must be driven slowly with lower speed.

③ Vehicular access sign should be available; driver should control his/her automobile in a civilized way to ensure safe transportation.

④ Powdery materials, such as cement and lime, should be canned or bagged, prohibiting bulk transportation. The truck, with which aggregate and other construction materials are transported, must be equipped with anti-falling device, covered by felt, and not fully loaded to prevent the materials blown off. Transport route and time should be planned to reduce the impact on sensitive environmental area as far as possible.

⑤ The stacking place of powdery materials should be selected at 300m far from the downwind sensitive environmental area. It is needed to reduce stack volume and consume it in time; in addition, take wind-proof and rain-proof measures, build up fence if necessary, sprinkle water at regular time to prevent flying dust, and is covered by felt in severe weather.

⑥ Construction truck must be inspected at regular intervals and the damaged truck bed should be repaired in time to avoid the building materials or construction waste fallen from the truck when the truck is driven.

⑦ Surface of access road should be hardened or treated by sprinkling water, so as to control the impact of rolling compaction of motor vehicle wheels and reduce flying dust pollution.

⑧ During construction period, it is required to strengthen the management of powdery (or granular) materials transport and use, and to sprinkle and clean the working surface, on which reentrainment of dust is easy to occur.

(3) Management of construction equipments

Construction equipments mainly include loading machine, road roller, excavator, blender, vibrator, tamper, and so on. During construction period, these equipments will generate noise, tailgas and possible leakage, which maybe impact the environment of project area. In order to minimize the harmful influence, it is planned to take

following management measures:

① Construction equipments should be placed in the specified construction area, not allowed to be arbitrarily parked outside the construction site to occupy other land and destroy vegetation and soil.

② It is better to use low-noise equipment.

③ Muffler will be installed in the noise source of equipment, that is, in the proper position of various exhaust or unloading devices, e.g. air inlet/outlet; in addition, damping foundation or damping support can be used.

④ Fuel oil machinery and vehicle must be in normal conditions, ensuring waste gas emission up to the standard.

⑤ Equipment should be properly used, maintained and repaired to prevent it from leakage and impact surface water environment and soil environment of the project area.

5 Environmental Code of Practices for Site Cleaning

5.1 Contents of site cleaning

Site cleaning include vegetation, surface soil, old roadbed, side ditch, pavement concrete, concrete structure, garbage, waste residue and other barriers pointed out by supervisor. And the scope covers the surface of all area of construction site to be cleaned, such as permanent or temporary work area, stock ground, storage area, waste disposal area, etc.

5.2 Environmental code of practices for site cleaning

(1) Vegetation cleaning of construction site surface of main works must be extended to the max. excavation sideline shown in the construction drawing, or 5m at least from the outside of building foundation sideline.

(2) In case of vegetation cleaning of main works, the scope of tree stump excavation must be extended to the max. excavation sideline shown in the construction drawing, or filling line shown in the construction drawing, or 3m at least from the outside of building foundation.

(3) It is required to pay attention to the natural vegetation protection around the cleaning area. For the damage of forest resource around the cleaning area as well as the harmful impact on environment protection resulted from improper construction, the contract should bear the compensation.

(4) Within the scope of site cleaning, the sawn lumber or the materials with business value obtained by contractor should belong to employer. Contractor should be in accordance with supervisor's direction to transport them to an appointed place.

(5) All unworthy combustibles should be burned down by fire as quickly as possible, during which, contractor should take necessary fireproofing measures and should be responsible for combustion results.

(6) All of debris removals, which cannot be fully burn out or will impact environment severely, must be buried in the area that is specified by supervisor. It is not allowed to obstruct natural drainage or pollute rivers.

(7) The cultural relics and historical sites found in site cleaning should be treated in accordance with the regulations of Chapter 17 of this ECOPs.

(8) Surface soil cleaning should be in accordance with the excavation depth specified by supervisor. The excavated organic soil must be transported to a specified stack area, preventing the soil washed out. The stacked organic soil can be used for environmental protection of the project. According to the contract requirements and employer's overall environmental planning, organic soil should be used properly.

(9) Waste and organic residue within roadbed scope, as well as humus, grass sod, tree stump and crop root on the original soil pit surface (100-300 mm deep) should be cleared away and put them together in the place specified by supervisor or stack them in spoil ground. After site cleaning, the pits within roadbed scope should be backfilled and compacted entirely, making the density up to the specified standard.

(10) When explosion or other operation is needed for the removed structure or barrier, it must be finished before new work to avoid the possible damage of new structure. In order to avoid unnecessary loss, all utilizable materials should be stacked properly in the specified place. All potholes should be backfilled and compacted,

making the density up to the specified standard.

(11) Demolishment of side ditch, culvert, pavement and other barriers is made only after properly arranging normal transportation and drainage. As for the underground part of original structures, both excavation depth and scope should accord with supervisor's requirements.

6 Environmental Code of Practices for Access road

6.1 Site selection requirements of access road

If access road is required, site selection should follow the principle shown in Table 6.1-1.

Table 6.1-1 Site selection requirements of access road

Not selected	Selected
<ul style="list-style-type: none"> • Basic farmland or other farmland, paddy field and industrial crop field • Sensitive areas, such as water conservation area, scenic spot, forest park, etc. • House site • Forest land • The land within 200m from river course • Depression or paddy land • The land well covered by vegetation • Dangerous collapse and landslide area • Susceptible area of debris flow • The land for special use 	<ul style="list-style-type: none"> • Road at county/town/village levels • Uncultivated land • Abandoned land • Other poor land

6.2 Environmental impact analysis on access road

Environmental impact resulted from access road are mainly reflected:

- (1) Road dust pollution generated from vehicle driving and equipment operation;
- (2) Noise pollution generated from vehicle driving;
- (3) Destruction of ground vegetation and accompanying water and soil loss, generated from temporary land occupation.

6.3 Environmental code of practices for access road

(1) The existing roads at county/town/village levels can be used as access road as far as possible; at the same time, the roads at town/village levels should be reconstructed.

(2) If new access road is required, high-fill and deep-cut should be avoided as far as possible, so as to reduce water and soil loss and ecological damage. New access road should be hardened. Recycled load-bearing brick (construction member) can be used for the pavement for heavy truck; while recycled water-seepage brick can be used for general pavement.

(3) Before new shortcut is constructed, it is required to strip the surface soil and temporarily stack it in a flat ground, retaining with packed earth, arranging temporary drainage ditch and desilting measures, and covered with dust screen. After the construction is finished, the soil can be used for ecological restoration of the shortcut.

(4) Access road can be combined with construction campsite shortcut to reduce the quantity of shortcut.

(5) Access road should be maintained and cleaned at fixed time every day; dust-generating road section should be sprinkled to suppress dust.

(6) The impact of noise on environment will be relieved by controlling vehicle speed, no horn and no transportation from 12:00 to 14:00 in the day and from 22:00 to 6:00 at night.

(7) Before construction is finished, the ecological status of new access road should be recovered at least as before.

(8) The occupied or destructive local road will be transformed or maintained, and the pavement will be recovered and greening after construction. At the same time, it is required to pay local government a certain compensations to safeguard the legitimate interests of local government and residents.

7 Environmental Code of Practices for Quarry and Borrow Area

7.1 Site selection requirements of quarry and borrow area

Generally, construction stock ground includes quarry and borrow area. Site selection of quarry and borrow area should follow the principle shown in Table 7.1-1.

Table 7.1-1 Site selection requirements of quarry and borrow area

Not selected	Selected
<ul style="list-style-type: none"> • Basic farmland or other farmland, paddy field and industrial crop field • House site • Forest land • The land within 200m from river course • The land within sensitive areas, such as scenic spot, water conservation area, forest park, etc. • Depression or paddy land • The land well covered by vegetation • Dangerous collapse and landslide area • Susceptible area of debris flow • The land for special use 	<ul style="list-style-type: none"> • Uncultivated land • Abandoned land • Other poor land

7.2 Analysis of quarry and borrow area on environment

(1) Destruction of vegetation; acceleration of water and soil loss

Vegetation diversity of slope is higher than that of flat, including bushwood, grass cluster and dry crop. After excavation, surface vegetation disappears. With the addition of certain gradient (height difference), soil erosion modulus of local scope will be increased. In this case, if quarry and borrow area are not regreened in time, water and soil will be lost easily.

(2) Impact on landscape

Quarry and borrow area will destroy vegetation and change original terrain, landform and natural landscape.

(3) Impact of quarrying and borrowing machinery noise on sound environment.

(4) Impact of quarry and borrow area dust on ambient air.

(5) Water and soil loss resulted from quarry and borrow area excavation, if stockpiling is improper.

7.3 Environmental code of practices for quarry and borrow area

According to the site selection requirements and the impact on environment, quarry and borrow area should abide by the following requirements:

(1) Nearby quarrying is made and the spoil of the project itself is fully used; local and legal existing quarry and borrow pit should be used as far as possible to relief the impact of quarrying and borrowing on ecological environment.

(2) In case of quarrying, it is required to build rain side ditch to avoid water and soil loss, land slide and debris flow resulted from quarrying in rain season.

(3) Deep excavation should be avoided in construction, trying to achieve a balance between excavation and filling. Borrowing can be from the spoil of other construction project in this project area through coordination, avoiding independent borrow area, which can fundamentally eliminate the impact of borrow area on

environment.

(4) Concentrated quarrying and borrowing will be adopted for the project to reduce quarry and borrow area.

(5) It is needed to pay attention to water sprinkling and dust suppression in quarrying and borrowing operation, so as to reduce the dust pollution resulted from earth excavation.

(6) In order to prevent water and soil loss, cutoff ditch and drainage ditch should be arranged in quarry and borrow area, which can avoid the lost sediment directly flowing into surface water along with the runoff in the drainage ditch, resulted in lower water quality.

(7) In the operation of excavation, the topsoil should be retained for land rehabilitation. The topsoil will be temporarily stacked on a flat ground, retaining with packed earth, arranging temporary drainage ditch and desilting measures, and covered with dust screen. After the construction is finished, the soil can be used for ecological restoration of the borrow area.

(8) The principle of simple and easy conservation will be followed, and the greening can combine tree, bush with grass, thus to form plant community landscape, recover natural ecology of quarry and borrow area, and reduce water and soil loss.

(9) Working hours must be controlled strictly. If there is any sensitive object, such as housing estate, within noise effect scope, quarrying and borrowing operation should be prohibited from 12:00 to 14:00 in the day and from 22:00 to 6:00 at night.

8 Environmental Code of Practices for Spoil/Waste Residue Ground

8.1 Site selection requirements of spoil/waste residue ground

Site selection of spoil/waste residue ground should follow the principle shown in Table 8.1-1.

Table 8.1-1 Site selection requirements of spoil/waste residue ground

Not selected	Selected
<ul style="list-style-type: none"> • Basic farmland or other farmland, paddy field and industrial crop field • House site • Forest land • The land within 200m from river course • The land within sensitive areas, such as scenic spot, water conservation area, forest park, etc. • Depression or paddy land • The land well covered by vegetation • Dangerous collapse and landslide area • Susceptible area of debris flow • The land for special use 	<ul style="list-style-type: none"> • Uncultivated land • Abandoned land • Other poor land • Col or depression

8.2 Analysis on environmental impact factors of spoil/waste residue ground

In the course of road construction, a certain amount of waste residue may be produced, mainly including surplus earth-rock, waste road materials, waste rock and sludge from site cleaning, etc. Improper disposal will bring about the following environmental impacts:

(1) Waste residue ground surface will be exposed, which will result in severer dust pollution, if not any measures.

(2) Water and soil will lost, if no retaining or waterproof work in waste residue ground.

(3) Ground vegetation will be destroyed, which will bring adverse impact into ecological environment.

8.3 Environmental code of practices for spoil/waste residue ground

(1) As the first consideration, the surplus earth-rock should be used in local area, or used for other bidding section of this project, or turned back to borrow area for vegetation recovery, avoiding independent borrow area, which can fundamentally eliminate the impact of borrow area on environment.

(2) In case of unavailability, it is required to investigate whether there is a specified place in the locality to accept the construction waste. If yes, the waste should be transported to the specified place after going through the formalities as specifi

(3) Waste residue ground should be compacted layer by layer, which can effectively suppress the dust produced.

(4) The mode of water sprinkling and dust suppression can reduce the dust pollution resulted from earth surface explosion.

(5) In order to prevent water and soil loss, cutoff ditch and drainage ditch should be arranged waste residue ground, which can avoid the lost sediment directly flowing into surface water along with the runoff in the drainage ditch, resulted in lower water

quality, during construction period and operation period.

(6) Before waste residue ground is put into use, the surface soil should be excavated out and used for land rehabilitation. The surface soil should temporarily stacked in a flat ground, retaining with packed earth, arranging temporary drainage ditch and desilting measures, and covered with dust screen. After the construction is finished, the soil can be used for ecological restoration of the waste residue ground.

(7) The principle of simple and easy conservation will be followed, and the greening can combine tree, bush with grass, thus to form plant community landscape, recover natural ecology of spoil/waste residue ground, and reduce water and soil loss.

(8) Prohibit disorderly spoil stacking and discarding.

9 Environmental Code of Practices for Slope Stability and Earth Squaring/Filling

9.1 Analysis on common damages appearing on road slope and formation cause

9.1.1 Type of damages appearing on road slope

Damages often appear on mountainous rural road slope because of lower construction level, shortage of fund, rough design and lower constructional and technical standards, which severely influences normal use of road. The damages on rural road slope are mainly reflected in following aspects.

(1) Stripping

The rock on road slope is easy to be weathered, so rock stripping appears easily in the use of road.

(2) Rockfall

Because of incomplete construction, the rock with loose blocky structure or fragmentary structure remains on the slope. With the time passing and external force influence, the rock is easy to fall on the pavement and consequently bring about risk.

(3) Collapse

If slope rock mass is too precipitous, the top fracture maybe occurs and results in slope collapse.

(4) Crumpling

If slope excavation is too precipitous, the tension fissure maybe occurs and extends to side hill gradually, resulted in crumpling.

(5) Surface slide fall

If weak soil mass or fractured hard rock are distributed on the slope surface, it maybe occurs that surface fractured soil mass slides and falls down along local weak surface under the effect of air weathering and water erosion. The collapsed stone and earth fall on road and severely influence the normal use of road.

(6) Weathered stripping

The rock-soil slope surface with easy weathering will be severely weathered under external force impacts, such as rainwater and sunlight, after it is excavated. And a loose layer with certain thickness will be formed after the slope is weathered. Under the effect of gravity and rainwater, the loose layer will slide down along the slope, resulted in weathered stripping.

(7) Shallow-layer slide of slope surface

If weak rock-soil mass or fractured hard rock are distributed on the shallow layer of slope, it maybe occurs that the shallow-layer rock and soil slide down integrally with horizontal displacement in the main, along certain weak surface or belt, under the effect of natural force and gravity. Shallow-layer slide will result in large damage to the pavement.

9.1.2 Influence factors of slope stability

(1) Rock mass structure

Structure surface of slope is one of the key factors of influencing the stability of

rocky slope, which will reduce the overall strength, heighten the deformation performance, hydromechanical property and other time, as well as strengthen the non-uniformity, anisotropy and non-continuity of rock mass. Generally, unstable rock mass produces shear slippage, tension crack and dislocation along an interface of one structure surface or multiple structure surface combination, which will cause the instability of slope rock mass.

(2) Influence of weathering and erosion

Weathering can change rock properties, generating adverse deformation property, and lower the strength. Erosion effect mainly comes from water. Water can widen the fracture of rock mass and accelerate rock weathering, resulted in unstable rock mass.

(3) Influence of mechanical factors

Many mechanical factors can damage rocky slope of road, such as shaking force, geological structure force, self-gravity of rock mass, as well as the stress from the effect of physical chemistry and geochemistry in the rock mass. During road construction, explosion (shaking) is the most general, most severe and most frequent basic factor to impact rocky slope stability, especially for step slope.

(4) Influence of atmospheric temperature

Atmospheric temperature is one of the key causes to make rock mass physical weathering. Shock cooling or heating will intensify the weathering of slope rock mass, result in natural slope-cutting or natural stripping, at last change slope appearance and gradient.

(5) Influence of time factor and asymptotic damage

With the time passing, slope experiences asymptotic damage in wriggle and flow course, so final slope design should meet the requirement of both short-term stability and long-term stability, which is very important.

9.2 Type of slope protection

Road slope is divided into upper slope and lower slope. At present, there are three types of slope protection, i.e. plant protection, engineering protection and comprehensive protection (see Diagram 9.2-1).

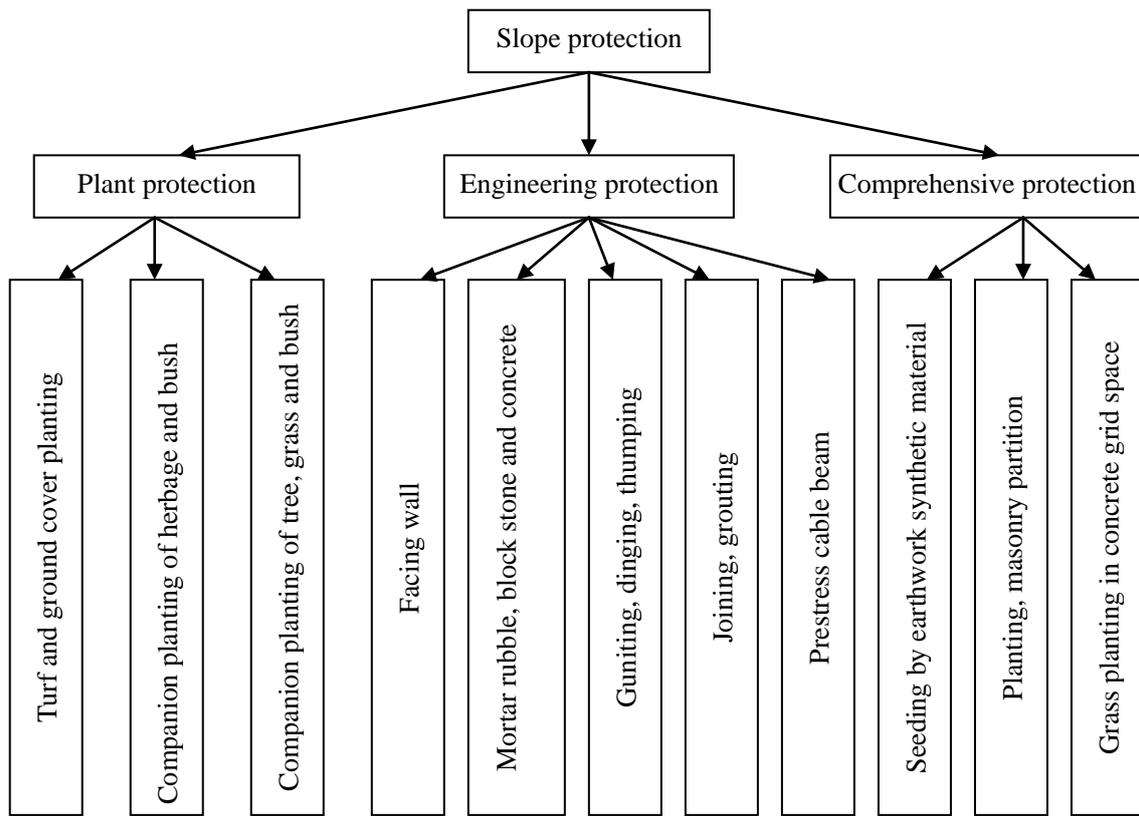


Diagram 9.2-1 Type of road slope protection

(1) Plant protection

By use of the coverage of vegetation and the strengthening of plant root system to the slope, plant protection prevents roadbed slope from atmospheric precipitation and surface runoff washing. The coverage of vegetation has a great relief function to surface runoff and water washing. Adopting plant protection, increasing vegetation area and reducing surface runoff can reduce water and soil loss of the slope fundamentally; moreover, can purify air, protect ecological balance, beautify the environment and ensure traffic safety, with well economic benefit, social benefit and ecological benefit. Therefore, the plant protection measures should be taken in the first place for all of soil slope suitable for planting. The effect of plant protection measures is shown in Fig. 9.2-2.



Fig. 9.2-2 Realistic view of plant protection of slope

(2) Engineering protection

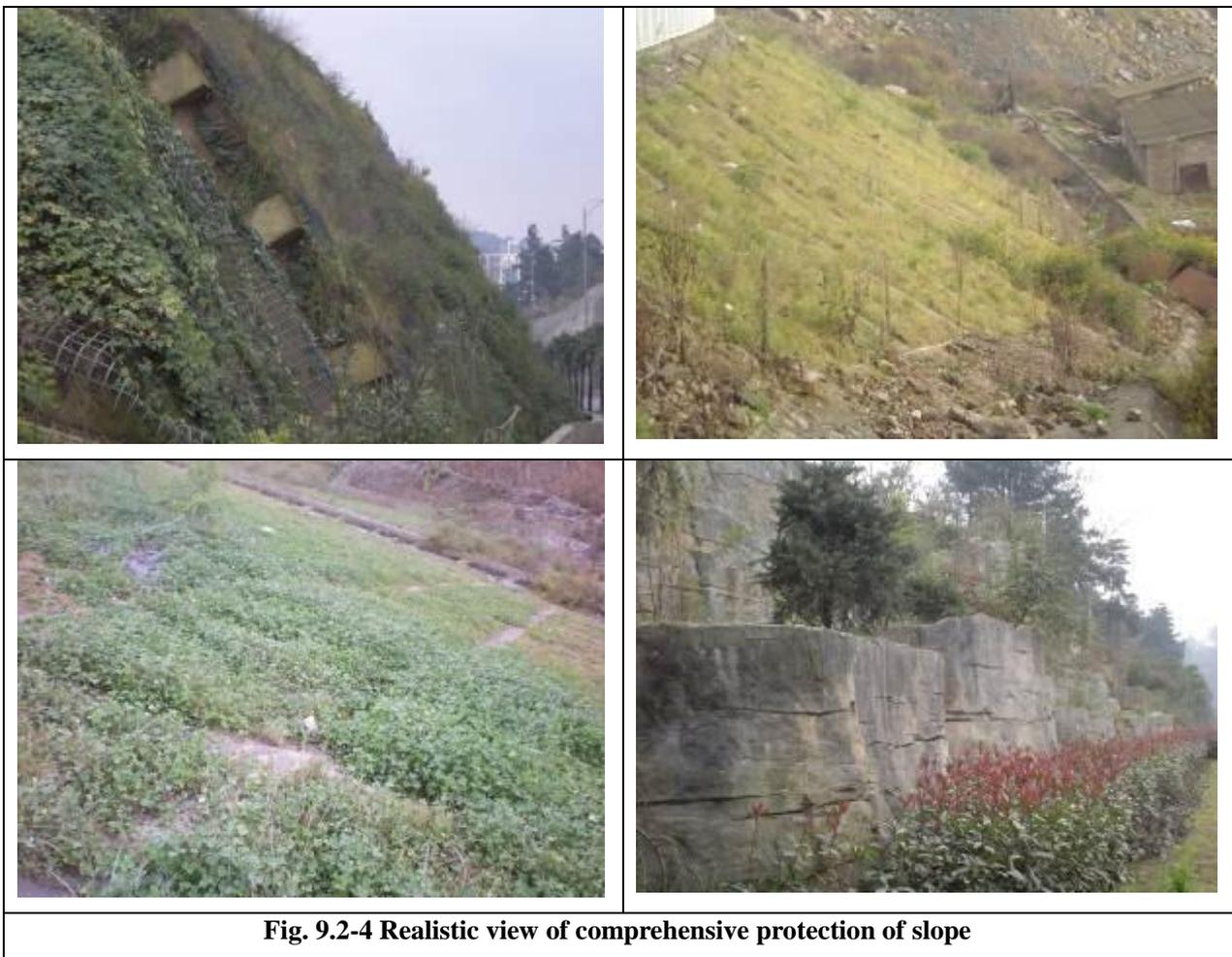
Plant protection is the first protection measure for slope. Engineering protection measure, that is, arranging manmade protective structure, is only useful for rock cutting slope and gravelly soil excavation slope, where the soil is not suitable for plant growth, weathering is severe and joint is development. Although single engineering protection can solve the problems of water and soil loss as well as slope stability, it brings about the inharmonious roadside slope and landscape. For the cutting action of road, the change of landscape structure is reflected not only in local living environment and plant community destruction, but also in overall landscape destruction, making natural landscape broken down. The effect of engineering protection is shown in Fig. 9.2-3.



Fig. 9.2-3 Realistic view of engineering protection of slope

(3) Comprehensive protection

Most of road slopes are protected comprehensively by combining vegetation with masonry. Comprehensive protection has many methods, such as grass planting in concrete grid space, as well as protected by diamond or rectangular grid, hexagonal hollow brick, laminated arch, etc. Of them, the slope protection by laminated arch is characterized by large section size, stable structure, satisfactory landscape effect, benefit of draining slope surface water, suitable for soil slope with high filling deep excavation. The aim of grass planting in concrete grid space is to prevent grove resulted from rain-eroded or severe weathered soil. It can be used for the soil not suitable for plant growing and the place required for greening. Its disadvantage lies in not bearing earth pressure and higher cost compared with plant protection. The comprehensive protection is shown in Fig. 9.2-4.



9.3 Environmental code of practices for slope protection

In slope protection, the common method include dinging, thumping, mortar guniting, concrete guniting, joining, grouting, facing wall, mortar rubble and planting protection.

(1) Dinging protection

In road construction, it means to pave a weather-resistant layer on the surface of

easily weathered and soft rock cutting slope so as to isolate the atmosphere and prevent weathering. Common dinging materials include lime compound mortar and cement mortar, with the thickness of 3-7 cm. Also, an asphalt protective layer can be covered on the slope surface.

(2) Thumping protection

In road construction, dinging protection can be carried out for the soil slope that is easily washed out or the rocky slope that is easily weathered and stripped. The method is as the same as that of dinging protection. The difference between the two protections is that thumping surface is thicker than dinging surface and its strength is higher.

(3) Mortar guniting and concrete guniting

The protection of mortar guniting and concrete guniting can be used for the rocky slope surface with easy weathering, developed joint fissure and cataclastic structure, with the effect of sealing slope rock fissure and joint, preventing surface water from entering into the slope, preventing the rock weathered continuously, strengthening slope stability and preventing the slope from rock falling and collapse.

(4) Joining and grouting

The rocky cutting slope, which is harder and difficult to be weathered, and the slope with more joints and fissures, can be joined and grouted with cement.

(5) Dry-laid rubble protection

By utilizing local resource, dry-laid rubble protection can be used for the filling or excavating roadbed slope that is earthy, soft, easy weathering and severely destructed. In masonry protection, the first selection is dry-laid rubble structure, which not only reduces investment, but also adapts more deformed slope, preventing surface soil layer from washing out and relieving floater's impact. In addition, cushion (or reversed filter) composed of macadam or gravel can be arranged under the dry-laid rubble layer. The cushion is also replaced by geotextile.

(6) Mortar rubble protection

Generally, mortar rubble protection is suitable for the soil slope that is easily eroded by water, the soft rocky slope that is severely stripped, the rocky slope that is intensely weathered or crushed, and the loose slope that has thicker slide rock layer.

(7) Planting protection of road slope

In order to prevent slope damage, thicker vegetation can be planted on the slope in the later stage of construction to stabilize the mountain mass. Considering from the function of slope protection, the first requirement of planting protection is to reinforce and stabilize the slope, green and improve road environment. The plants, which will be used for planting protection of slope, must have the following characteristics: developed root system, good effect of soil fixation and slope protection, extensive coverage, higher density, long green period, perennial, trample resistance, suitable for extensive management, easy transplant and reproduction (natural reproduction at best), easy management, having a stronger ability of antipollution and air purification.

10 Environmental Code of Practices for Drainage System

10.1 The importance of drainage system to rural road

As the technical standard of rural road is low, without favorable drainage system, the road will be soaked in water. This may cause problems, ranging from upheaval, subsidence and potholes of roadbed and raveling and chuckhole of pavement to destroy of roadbed, threat to pavement and traffic interruption at worse. So the traffic capacity will be affected. However, if the rural road has favorable drainage system, then the stable, solid and dense roadbed, smooth pavement, suitable road hump, traffic safety and comfort, long service life of rural road and high social efficacy can be ensured.

10.2 Types of drainage system of rural road

According to the relevant provisions of “Design Specifications of Highway Drainage” (JTJ018-97) and “Technical Standard of Highway Engineering” (JTGB01-2003), the drainage of rural road is divided into roadway surface drainage, subsurface drainage, transverse drainage and drainage of road section passing through the town.

10.3 Environmental code of practices for drainage system

10.3.1 Roadway surface drainage scheme

(1) Pavement surface drainage

① Cross slope

To give full play to the design function of the road, reasonable road humps on the road surface must be designed to rule out surface gathered water. This may contribute to the reduction of water accumulation. Therefore, the gradient slightly higher than the lowest road hump should be implemented in the road section where possible. The specific methods are as follows: a. for the mountain road, if ditches along both sides of the road are unavailable, then road humps should be applied to let the road surface lean to one side, so the water on the traffic lane can be drained to the side ditches; b. when the road is restricted by the designated lowest road hump on the ramp, the relatively suitable way is to make the road hump no less than 50% of the longitudinal gradient. This is very important to ensure that the surface gathered water flows to the road shoulder.

② Longitudinal slope

The longitudinal slope plays a role in letting the rainwater gathered on the road surface drain without strain, and can be applied to the internal drainage of the surface layer. The longitudinal gradient to 0.3% is suitable for the purpose of drainage.

(2) Slope surface drainage

① Intercepting ditch of natural slope surface

When the surface runoff flowing from the natural cutting or bank slope to the roadway is larger, a ditch should be applied to intercept the surface water. For the roads in a township or county, there should be at least one roughly-paralleled intercepting ditch on the slope with long confluence as required. The intercepting ditch should be in accordance with the surrounding terrain and parallel with the contour line. The intercepting ditch should be about 5m from the cutting slope or 2m from the bank slope toe, but the former may be no less than 2m if the soil property is

favorable and the cutting slope is not high.

② Side ditch of side slope surface and drainage ditch

The side ditch of side slope surface is applied at the slope toe to contain the water from the road surface and slope surface. The sections of side ditch are usually trapezoid, U shape, triangle and canal shape.

The drainage ditch, also known as outlet drain, is mainly used to drain the water beyond the side ditch, intercepting ditch, borrow pit or roadbed to the depression or natural river beyond the bridge and culvert and roadbed. The cross section of the drainage ditch is generally trapezoid. The width and depth of the ditch should be no less than 0.5m. The longitudinal gradient of the drainage ditch is usually 0.3% to 0.8%, no larger than 3% and no less than 0.12%; the drainage ditch should be shorter rather than longer, usually within 500m.

③ Vertical drainage ditch (suspended ditch)

On the slope surface of high-fill embankment and deep cutting, vertical drainage ditch (suspended ditch) is needed when the water is drained down from the slope crest or slope surface in a vertical and concentrated way. The suspended ditch is usually paved with mortar rubbles, with rectangular and trapezoidal cross section composed of concrete members. The energy dissipation measures (such as drop well and baffle bank) should be created at the exit of the drainage facility to prevent the rapid flow from scouring the side ditch of the roadbed.

④ Hydraulic drop and chute

For the low-grade mountain road, in the sections where the rain is heavier and the gradient of side slope is larger, the water flowing from the slope surface is liable to scour the vegetation on the surface. Even if protective measures are applied to the slope surface, sometimes the side slope is inevitably washed out, which may result in collapse and water and soil loss, and even has a greater impact on the surrounding ecological environment. The chute, a kind of steep artificial gutter channel, is usually in the entrance and exit sections of steep hillside and culvert not allowed for washout geologically. The purpose is to dissipate the energy of water flow intensively and slow down the flow after the drainage through the steep slope. At the stage of design of chute, the measure like increasing the roughness of the bottom of channel may be considered for energy dissipation and slowdown of flow, or single-stage and multi-stage hydraulic drop may be adopted to dissipate energy.

10.3.2 Roadway underdrainage scheme

Main sources of ground water: retained water penetrating from the ground and not reaching the under layer; frequent phreatic water under the ground; fissure water flowing along the fissure of rock stratum; still interbedded fissure water in the broken sedimentary rock.

The underdrainage facility of roadbed is mainly to collect water flows by way of seepage and to drain from the roadbed nearby. For roads in a township or county, blind drain and underdrain are usually used. For the emergence of new materials, geotextile may be used to drain the ground water from economic considerations.

① Blind drain

When the roadbed confronts some spring (spring welling up) and detour is unavailable, people may ditch between the mouth of the spring and water outlet and

construct blind drain or concealed conduit to let the spring flow out of the fill slope toe or to drain it through digging a square side ditch. The blind drain is about 20cm high and 20-30cm wide. As for well depth, the depth of fill on the top of cover plate should be ≥ 50 cm, and the longitudinal gradient at the bottom of trench is suggested to be $\geq 1\%$.

② Underdrain

To make the ground water collected in the ditch through penetration and drain the water to the designated place through channel at the bottom of trench. The underdrain plays the roles in dewatering the surface soil, increasing the slope stability, cutting off the ground water for diversion, lowering ground water and preventing the fine soil underground from being washed away. The rock-fill underdrain (blind drain) is frequently applied, whose longitudinal gradient is 5% and the groove width depends on the ditch depth. If the ditch depth is 2m, the width should be 0.6-0.8m; but if the ditch depth is 3-4m, the width should be ≥ 1 m. The gravel packing used for draining and water penetration in the ditch should be filtered and washed.

③ Horizontal drain pipe (hole)

The horizontal drain pipe may be inserted into the water-bearing layer to release the hydrostatic pressure in the slope and increase the slope stability. Generally, a perforated plastic drainpipe with a diameter of 50mm is drilled into the slope with a gradient of 10%-15%. The circular aperture of the perforated drainpipe is 10mm and the longitudinal spacing is 75mm. They should be arranged evenly in three lines around the pipe. The plastic drainpipe without holes should be applied to the area 1-10m from the water outlet, and the gap between the drill holes and drain holes should be blocked up with clay within the area at least 60cm from the water outlet.

④ Blind ditch

Horizontal and longitudinal blind ditches may be built inside the roadbed to avoid cutoff of ground water flow due to building of roadbed which may cause difference of ground water level of side slope at both sides of the route, and to remain the seepage fields in the roadbed unchanged. At the time of setting up longitudinal blind ditch, inverted filter may be applied to one side of the upstream face and water-resisting layer may be applied to the other side; while the water-resisting layer is needed at both sides of the horizontal blind ditch to let the ground water flow through the route without affecting the roadbed stability.

10.3.3 Transverse drainage

Using drainage facilities such as side ditch and intercepting ditch to cut off the water flowing from the slope to and on the roadbed sectionally, in other words, letting the surface water on the upper side of the roadway (or roadbed) flow across the roadbed to the natural cleugh, wasteland, borrow pit or swale on the lower side of the roadway. If the water diversion is obstructed, the slope toe of roadbed will be washed out and the pavement will be destroyed. So the construction of transverse drainage – culvert is necessary. The factors such as depth of fill on the top of the culvert, design flow, foundation status, vehicle load, existing waterway in the upstream and downstream regions, highway classification and terrain should be taken into consideration at the time of selecting and designing the culvert.

10.3.4 Drainage of road section passing through the town

Reasonable drainage measure for the road section of the town will not only minimize the damage of the rainwater to roadbed and pavement, prolong their service life, but also can improve the traffic capacity greatly. According to the data, the main subgrade drainage facilities of the existing rural roads include earthy side ditch, rectangular and trapezoid mortar side ditch. The decentralized drainage through road hump and cross slope is applied to surface drainage. There are many drainage methods for the road section passing through the town, but those frequently used are side ditch with cover plates, side ditch with parapet, etc.

① The method of side ditch with cover plates

The method is to cover the side ditches at both sides of the road passing through the town with plates for fear of blockage of side ditches and for pedestrians' convenience. For surface drainage, drain opening may be applied to intensive drainage as needed, or making slotted holes on the cover plates for drainage. The top of the cover plate with slotted holes is usually flush with the pavement, so the rainwater can flow to the cover plates along the road hump and then flow into the side ditch through the slotted holes on the cover plates. The cover plates without slotted holes are usually set up combining with kerb. There is a drain opening every other 20m at the side of kerb, and the surface water flows into the side ditch along the drain opening. The mortar rubbles and brick structure are usually applied to side ditch. This method is suitable for the road section passing through the town with small traffic volume or small transverse interference.

② The method of side ditch with parapet

The method of side ditch with parapet combines side ditch for drainage and parapet for isolation. Openings on the parapet and cover plates on the side ditch are needed accordingly at a certain distance, so pedestrians could walk through. This is one of the effective measures for the arterial highway passing through the town with large traffic volume. The mortar rubbles, bricks and mortar surface are usually applied to brickwork like parapet and side ditch. The sign “«” is painted on the side of the parapet in red and white color to show driving direction. In addition to parapet, hedge or metal barrier can also be applied for isolation. As the side ditch is not covered with plates, the maintenance should be strengthened and the sundries and garbage in the side ditch should be cleared away timely, so as to ensure the drainage unblocked.

10.3.5 Cleaning, maintenance and inspection of drainage

Whether the roadbed drainage system can work normally directly affects the stability of roadbed. Therefore, the strengthening of daily maintenance of the drainage facilities is a key point to ensure the stability of roadbed.

Before the corn snow, especially before the flood season and in the rainy season, the drainage facilities such as side ditch, intercepting ditch and blind ditch must be dredged to keep the water flowing smoothly and prevent the rainwater from destroying the embankment intensively. Extensive inspection should be implemented after the rainstorm. Timely repair and reinforcement are needed in case of washout or damage; and timely dredging is necessary in case of blockage.

As for earthy side ditch, regular design section should be ensured to meet the requirement of drainage, and attention must be paid to the setting of outfall and unobstructed drainage. The longitudinal gradient of 0.5% at the bottom of trench should be ensured, and no less than 0.3% for the road section in flat area with

drainage difficulty. The crops can not be grown in the side ditch, not to mention using the side ditch as a channel for irrigation.

11 Environmental Code of Practices for Bridge Construction

11.1 Features and damage causes of rural road bridge

11.1.1 Features of rural road bridge

(1) The medium and small span is taken as the principal: nearly half of the rural road bridges have a small span of 5m-10m, and 10% of the bridges with a span over 20m.

(2) The concrete is the main material. There are a lot of stone bridges in the area rich in building stones. There are a few brick arch and wooden bridges in some areas.

(3) The types of bridges mainly include beam bridge, slab bridge and arch bridge, but most are beam bridges.

(4) The mixed traffic dominates the traffic condition, and the load distribution is relatively chaotic.

(5) Most bridges are located in near residential district, and are obviously influenced by human.

11.1.2 Damage investigation and cause analysis of rural road bridge

(1) The factor of design

① Lower design. The traffic types in rural areas are numerous and complicated. However, there is no specialized design specifications or guide for rural bridge so far. The design is done mainly through drawing on the experience of road or urban bridge, and a considerable part of the bridges are built by local residents by experience. The bridges built under the circumstances are hard to match the actual load requirements.

② Unreasonable structure. The selection of bridge design scheme depends on many factors such as local hydrogeological condition, construction technology and method, economic indicators and operating requirements. Unreasonable choice of structure or layout, like type of bridge structure, form of component construction, bridge section form, partition of bridge span and arrangement of pier height, will lead to various defects during the service period of the bridge.

③ Miscalculation. The miscalculation in bridge design may make the bridge congenitally deficient.

④ Imperfect construction drawing. For bridges with a medium and small span, only the overall structural design is emphasized and the refined design of some local structures is neglected. For instance, the thickness of web is insufficient; the constructional reinforcements are not enough, and the ability of the structure to resist various factors rather than the load is weakened; the loading capacity of some parts is not enough; the influences of secondary stress like drying shrinkage and temperature stress are poorly conceived; the thickness of the protective layer of structure is relatively thin, resulting in poor structural durability and premature problems.

⑤ Imperfect design theory. At present, there is no suitable design and construction standard for rural road bridge. As a result, there is no basis for direct reference when doing the conceptual design of bridge, so the design is done through borrowing ideas from the road or urban bridge with the same span, but some concrete issues can not be directly manifested.

(2) Factor of construction quality

The construction is a process to implement the design. Whether the design is correct and perfect will be tested in the construction. Meanwhile, the strength and weakness of construction quality will affect the overall performance of the bridge. In the construction of bridge, although the design is correct, but if the construction method is unsuitable and the construction quality is not strictly controlled, the carrying capacity of bridge will be weakened in case of some unpredictable disasters such as flood and earthquake in the construction process. Naturally the desired objectives of design can not be achieved. And the carrying capacity of bridge in the future is not strong enough due to the construction. The failure of the quality of materials such as concrete, reinforcing bars and gravel used in the construction to meet the code requirements is the internal cause resulting in various quality defects of the structure. The construction of bridge is with multiple types of work and procedures. In addition, it is a site construction, so each constructor often needs to undertake different types of work. A little negligence will lead to mistakes and structural defects.

(3) The problem of maintenance

① There is no sufficient and stable maintenance machinery and technicians. The local transport agency is responsible for the maintenance of rural road, but there is not enough funds to purchase maintenance machinery due to financial difficulties. Consequently, the maintenance level and mechanization level are low. What's worse, the maintenance workers are transferred from each township every year, so the quantity of professional workers can not meet the requirements of rural road maintenance. As the maintenance workers are underpaid and not fully funded, there is not a stable maintenance team, resulting in ubiquity of pavement damage, subsidence of roadbed, etc. of rural road. Meanwhile, the service level of rural road is affected.

② There is a lack of management of overloaded vehicles. The management of bridge should not only include management of bridge structure, but also the management of various loads on the bridge. The design standard of rural road bridge is already low, and the influence of overloaded vehicles is unavoidable in the service period. The overload may lead to fatigue, on the other hand, as the internal damage of bridge caused by overload is irrecoverable, the working condition of the bridge in normal load effect will change, and the safety and durability of the bridge will be threatened.

③ The lack or incompleteness of relevant technical data of bridge will not support the maintenance and management. Each bridge should have complete archival data, so as to make program decisions at the time of repair.

④ Without technical standard of maintenance suitable to rural road bridge, the maintenance has no principle to follow, and the strength of maintenance technology is weak.

11.2 Analysis of impact of bridge construction on the environment

(1) Surface destruction, water and soil loss. The ground will be excavated inevitably in the bridge construction, and the surface and ground vegetation will also be destructed, resulting in exposed soil and rock, and water and soil loss easily. Without further prevention and control, the soil will be washed away into the river.

(2) Air pollution. A lot of dust may be generated from the fields stacked with lime or gravel, or used for mixing of concrete. And the building materials may also generate dust in the transportation process. Without protective measures, the dust will

have a certain influence on the ambient air.

(3) Water pollution. At present, the mechanical work method of bored pile is usually applied to the construction of bridge substructure - pier. In the early stage of construction, the river bottom around the working site will be partly disturbed due to cofferdam and nidification, and the suspended matter like silt in some water will increase. In addition, the drilling of pier will generate some boring muds which will choke the downstream channel, degrade the water quality and cause pollution within a certain period and certain scope when discharged at will. In the construction of bridge superstructure, some construction wastes and dust will fall into the river inevitably to affect the water quality. The oily sewage running out, springing out, dripping or leaking out in the process of repair and maintenance of construction machinery or operation process, and the production and sanitary sewage from the bridge construction camps, as well as the wash water of concrete mixing equipment will flow into the river to affect the water quality.

(4) Noise pollution. The construction machinery noise, especially the bridge piling, will have a greater influence on the acoustic environment.

(5) Solid waste. The boring muds, soil, sand, gravel and other waste materials as well as the huddle of household garbage will affect the environment.

11.3 Environmental code of practices for bridge construction

11.3.1 Environmental code of practices at the design stage

(1) Combined with actual conditions of rural road bridge, the experimental study may be conducted combining the relevant projects through investigation and analysis of corrosion, abutment, expansion joint and bridge deck pavement, and then to bring forward the design method to prevent the damage, in an attempt to solve the problems of concrete bridge thoroughly.

(2) The ideas of safety and smoothness should be persisted in the process of design, including safety in construction, materials, geology, site selection, design, quality, function and use, etc.

(3) The rural development situation should be fully considered to design the load and bridge deck width. The moderately advanced principle may be used to improve the traffic capacity and operating requirements of bridge.

(4) The mountain condition, landform, riverbed as well as pattern and features of flows in ditches and channels should be fully considered when selecting bridge location, the transfer rule between the approach bank of roadbed and mechanical behavior characteristics and the potential risk of unfavorable geology should also be considered.

(5) The bridge type should be confirmed scientifically, and the type of bridge structure which is with mature technology, widely used and easy to maintain should be prioritized.

11.3.2 Environmental code of practices at the construction stage

(1) Management measures

① Supervision company of environmental protection. The employer should initiatively cooperate with the administrative department of environmental protection in establishing an environmental protection management office which is responsible

for the inspection and supervision of environmental protection measures and the implementation of the employer at the construction stage.

② Monitoring of the environmental protection during the construction. The administrative department of environmental protection will conduct real-time monitoring of the deforestation, land occupation, water and soil loss, noise pollution, air pollution, water pollution and landscape devastation during the construction, and will timely instruct the employer to rectify and reform in case of exceeding standard or any behavior adverse to environmental protection.

③ Giving full play to the supervisory role of the supervising engineer. The supervising engineer should check whether the environmental engineering design is implemented, whether the quality meets the requirements and whether the environmental engineering funds fall into place; and should cooperate with the functional department of environmental protection in detecting and supervising the environmental protection during the construction.

(2) Measures for reducing water and soil loss

① According to the actual excavation-and-fill soil texture, reasonably setting the gradient of side slope and temporary drainage system at the excavation-and-fill construction site of earth and stone, and timely dredging the rainwater to relieve the washout of rainwater to the excavation-and-fill soil slope. The fill slope should be timely tamped and slope greening is needed. The place for borrowing or spoiling should be confirmed reasonably, the aggregate site should be exploited reasonably, and the dressed stones, discarded soils and waste residues should be sorted and disposed.

② When selecting place to stack earth and stone, the redundant earth and stone should be laid on the slop surface on the spot. If the earth and stone have to be taken out, they should be carted to a designated place without nature conservation value. The discarded soils should not destroy or bury the ground flora.

(3) Measures for preventing air pollution

① The wastes on the construction site should be cleared timely. Appropriate watering is needed to reduce the flying dust. Littering at will should be prohibited. The coke button, brick rubble or concrete may be paved on the surface of the temporary access road to reduce the flying dust, meanwhile, the road surface destroyed by construction should be repaired at all times to prevent floating dust.

② Regularly watering the construction site to shorten the time of flowing dust pollution, reduce the pollution scope and minimize the dust emission.

③ The constructors suffer most from the environmental and air pollution in the process of construction, so the employer should take preventive and labor protection measures for the constructors emphatically, for instance, shortening working hours and providing dust mask, etc.

(4) Measures for preventing water pollution

① The sedimentation basin is necessary at the site where the concrete and mortar are mixed. The waste water discharged into the sedimentation basin will be recovered after twice sedimentation for dust suppression. The untreated muddy water can not be discharged into the river and sewage conduit directly.

② The silt and top soil should be cleared away from the roadbed, and then

recycled back to the road or shipped to the designated place for stockpiling; the discarded stone and soil should be shipped to a reasonable place, and should not be stacked at random or stagnate the river channel; as for cofferdam of bridge, the cofferdam soil should be cleared away and shipped out after the completion of construction, for fear of blocking the river channel.

③ The simple and effective oil separator is needed for the sewage from the temporary canteen at the construction site. The sewage generated will flow through the oil separator through the sewer pipe. At ordinary times, people should strengthen management and dispose the oil regularly to prevent pollution.

④ The construction of pile foundation works should be conducted in the dry season rather than flood season.

(5) Measures for preventing noise pollution

① The employer must use the construction equipment and transport vehicles up to the relevant national standards, and should try to use the construction machinery and technology with low noise. The vibration attenuation engine base should be installed on the fixed mechanical equipment that vibrates excessively, and the blimp should be applied to the fixed strong noise source (such as generator car). Meanwhile, the maintenance of various construction equipments should be strengthened for well function, so as to reduce the noise source fundamentally.

② The loud construction machinery should stop working at night (22:00-06:00). For the construction site where continuous construction and operation are necessary, the employer must get in touch with the local environmental protection department in time according to the specific situation to apply for the Night Construction Permit in accordance with the regulations, and should publish notice to acquire support from the masses up to the hilt. If there are groups of residents within 50m around the site, then the transportation of building materials on the service road at night should be prohibited.

③ The processing and manufacture of finished products or semi-finished products, which will generate strong noise, should be finished in the factory or workshop, so as to reduce the noise generated from field processing and manufacture.

④ The management of construction site should be strengthened, especially the noise from man-made beating and shouting should be eliminated to prevent the residents from being disturbed.

⑤ In order to ensure the constructors' health, the employer should reasonably arrange workers to take turns to operate the construction machinery with intense radiation and strong noise, so as to reduce their time to contact noise. For the constructors close to the intense radiation and strong noise source, their working hours should be shortened appropriately apart from the labor protection measures such as bring earplugs or wearing a helmet.

⑥ The development unit should instruct the employer to announce the complaints hotline, and the employer should timely get in touch with the local environmental protection department after receiving a report, with the aim of settling various environmental disputes without delay.

11.3.3 Environmental code of practices for bridge maintenance

(1) Defining subject of liability, and strengthening the responsibility of the

supervising authority

The management system of “unified leadership and level-to-level administration” is applied to the maintenance management of road bridge. Based on the principles of “consistent powers or authority of office, and clear responsibility”, dividing according to the supervising unit and maintenance unit to define the administrative leaders in charge of maintenance management of bridge and specific technicians, and to determine their job duties reasonably. The details are below:

① The Transportation Bureau of the county/district/city is the supervising unit of all bridges and maintenance unit of bridges over the county roads and major country roads under its jurisdiction. The bureau is responsible for raising funds for bridge maintenance, supervising the maintenance management of bridges over the country roads and village roads of the road maintenance management stations of the townships (towns), and providing technical guidance; checking the assessment of technical conditions of type IV and V bridges according to the regulations, and drawing up the technical proposals and countermeasures for the major and medium building and reconstruction works of dangerous bridges.

② The road maintenance management stations of the townships (towns) are the maintenance units of the bridges over the country roads and village roads under their jurisdictions. They are responsible for the daily minor repair, disasters resisting and emergency rescue of the bridges over the country roads and village roads under their jurisdictions, organizing frequent and regular inspections of the bridges, timely reporting the conditions of damages of bridges due to natural disasters or other factors, filing an application for special examination of bridges as needed, establishing the double-post responsibility system of “administrative person in charge and technical person in charge” and then making a bulletin board on the bridges identified as dangerous bridges.

③ The maintenance unit shall shoulder the major responsibility for a safety accident of bridge, if the maintenance unit neglects the maintenance management of road bridge, fails to grasp the technical conditions of the bridge accurately according to the relevant regulations, or does not take the relevant measures in time.

(2) Strengthening the inspection of bridge, and assuring safety through timely maintenance management

① The frequent inspection refers to daily walkaround inspection of technical conditions of the facilities of the bridge deck, superstructure, substructure and accessorial structure through visual inspection with simple tools. The inspection cycle should be once a month at least, but the inspection frequency should be increased in the flood season.

② The regular inspection includes follow-up and comprehensive inspection of technical conditions of the major structure and accessorial structure of the bridge, and rating of technical conditions of the bridge mainly through visual inspection with inspection by instruments. The inspection cycle should be at least once every three years, and once a year for the bridge with special construction.

③ The special inspection refers to appraisal of technical conditions of the bridge under specific conditions, in order to find out the causes of problems, degree of damage, carrying capacity or anti-disaster ability of the bridge mainly through inspection by instruments. A scientific and explicit judgment of defects, causes of problems, carrying capacity or anti-disaster ability of the bridge should be made

through the method of detection or testing, and combining theoretical analysis. And the targeted maintenance and disposal measures and suggestions should be proposed according to the testing results.

According to the inspection results, the minor repair and maintenance of the bridges whose technical conditions belong to type I and II should be strengthened to prevent obvious problems. The medium repair of the bridges whose technical conditions belong to type III should be conducted in time to prevent the problems from becoming more serious and affecting the bridge safety. As for the bridges whose technical conditions belong to type IV and V, the relevant safety management regulations should be made according to the special inspection results and technical argument and analysis of the bridge; the type and quantity of warning signs, and management measures should be made clear; and then the major repair or reconstruction should be arranged.

(3) Intensifying supervision to remove potential risks

① As the supervising unit of road bridges, the Transportation Bureau of the county/district/city should supervise and inspect the maintenance management of the road bridges under its jurisdiction according to the relevant laws and regulations. The road maintenance management stations of the townships (towns) should consciously accept the supervision and inspection conducted by the Transportation Bureau of the County according to law, and shall not prevaricate or refuse for any reason.

② When conducting supervision and inspection of the maintenance management of road bridges, the Transportation Bureau of the county/district/city should put the implementation of maintenance plan and management of maintenance engineering into practice in the bridge maintenance management site; should take necessary technical detection means to evaluate the bridge conditions and remove the risks in time; should instruct the unit concerned to correct the problems found; and should give feedback to the unit concerned after the completion of supervision and inspection.

12 Environmental Code of Practices for Pipe Culvert

12.1 Classification and applicable conditions of pipe culvert

(1) The culvert is divided into stone culvert, concrete culvert, reinforced concrete culvert, steel corrugated culvert, etc. according to building materials.

(2) The culvert is divided into pipe culvert, slab culvert, arch culvert, box culvert, etc. according to the structural pattern.

(3) The culvert is divided into open culvert and buried culvert according to the depth of fill. It is called open culvert when the depth of fill on the top of the culvert is less than 0.5m, and buried culvert when greater than or equal to 0.5m.

(4) The culvert is divided into three types according to the hydraulic properties, namely inlet unsubmerged culvert, inlet submerged culvert and outlet submerged culvert.

The reinforced concrete culvert has better adaptability to the roadbed and mechanical performance, with simple structure. Generally, single span is applied, but no more than three bores at most. The reinforced concrete culvert is suitable for the small-span buried culvert with enough depth of fill in the area lacking building stones; the reinforced concrete slab culvert is suitable for the area without building stones and open culvert or buried culvert with large discharge area; the arch culvert is suitable for crossing trench or high-fill embankment; the reinforced concrete box culvert is suitable for soft soil roadbed; the stone slab culvert is suitable for small culvert rich in building stones and with small discharge area; the inverted siphon pipe culvert is suitable for irrigation canal when the cutting excavation height can not meet the requirement of clearance of aqueduct, and not suitable for flood discharge channel; and the steel corrugated culvert is suitable for the roadbed with low bearing capacity of foundation soil or with obvious settlement and deformation.

12.2 Analysis of impact of pipe culvert construction on the environment

(1) The unreasonable culvert design and unsatisfactory discharge capacity may result in flooding of road, damage of pavement and roadbed, etc.

(2) The noise from construction machinery, dust, waste water, earth and stone, ground excavation, etc. may affect the environment.

(3) The ineffective or neglectful culvert maintenance may result in blocking and loss of discharge capacity of culvert, moreover, destroy of roadbed, flooding of road, damage of pavement due to long-term immersion in water, etc.

12.3 Environmental code of practices for pipe culvert

12.3.1 Environmental code of practices for pipe culvert at the design stage

(1) Principles of culvert layout

① Combining the route drainage system according to the conditions of terrain, geology and hydrology along the line, the culvert should be laid out economically and reasonably for the irrigation and drainage of farmland.

② The culvert should be laid out in the spanned drainage groove, channel for irrigation and drainage of farmland, swale or mud flat where the route of plain terrain passes through a long distance, the region near the mountain or region where the surface runoff along the streams will gather during the downpour, and where needed

for drainage of side ditch. When the topographic condition permits, the culvert may be laid out through combining the ditches after the technical and economic comparison.

③ The location and direction of culvert should be consistent with the water flow direction. The improper layout of culvert should be avoided to prevent banked-up headwater level from flooding the farmland, village and roadbed, as well as to prevent large flow rate of downstream from washing out the ditch, bank and roadbed.

④ The requirements of construction, maintenance and repair should be comprehensively considered in laying out the culverts, so as to reduce the costs of construction and maintenance.

⑤ The layout density of culvert along the line should be confirmed according to the natural conditions such as terrain, landform, hydrology, irrigation and drainage of farmland. But the space between the culverts should not be less than 50m for the convenience of construction and compaction of roadbed.

⑥ There should be one culver for each ditch in the mountainous terrain. In the regions with heavy or intensive rainfall and sparse slope vegetation, the streams can not be combined for a culvert. However, if the catchment area is small, the two streams are located very close to each another, and the requirement of linking is met, they can be combined for a culvert after the economic and technical comparison, but the protection engineering is necessary.

⑦ The layout of culvert should be consistent with the water flow direction to the greatest extent, the imposed direct cross for shortening the length of culvert is inadvisable. When the flow rate is high, or the transverse gradient of both sides of the narrow and deep brook is big, and the water flow direction of the brook is not perpendicular to the route, oblique crossing is suitable for the culverts, but the inclination should not exceed 45° .

⑧ A culvert should be laid out at the outlet of the intercepting ditch in order to avoid the water flowing along the side ditch too long and washing out the pavement.

⑨ A culvert should be laid out near the curve when the corner of the route is greater than 90° , the curve radius is small, the longitudinal gradient before the curve is greater than 4%, the slope length is within 200m and there is no other culvert.

⑩ A culvert should be laid out near the grade change point when the route transits from abrupt slope section ($\geq 5\%$) to gentle slope section ($\leq 3\%$), and there is no other culvert within 200m.

⑪ The water flow direction of the upstream tunnel opening should be considered when laying out a culvert along the stream, and the downstream tunnel opening should not endanger the farmland, villages and towns.

(2) Technical specifications of culvert design

① The designed flood frequency, vehicle load and designed safety level of the roads and culverts at different levels should meet the relevant requirements, see Table 12.2-1 for details.

Table 12.2-1 Designed flood frequency, vehicle load and designed safety level of culvert

Road classification	Express way	First-class road	Second-class road	Third-class road	Fourth-class road
Designed flood frequency	1/100	1/100	1/50	1/25	Not stipulated
Vehicle load level	Road – level I	Road – level I	Road – level II	Road – level II	Road – level II
Designed safety level	Level III				

② The newly-built culvert should be inlet unsubmerged culvert; and the outlet submerged culvert or inlet submerged culvert may be applied when accumulated water before them is allowed.

③ The aperture of culvert should be confirmed through hydraulic checking calculation according to the designed flood frequency, section morphology of riverbed, geology and reinforcement form of gully bed at the entrance and exit.

④ The newly-built culverts should apply the standard spans like 0.75m, 1.0m, 1.25m, 2.0m, 2.5m, 3.0m, 4.0m and 5.0m, among which, the aperture of 0.75m is only suitable for the irrigation canals of the site without deposit. The span of the culvert for draining off floodwaters should be no less than 1.0m.

⑤ The inner diameter or clear height of culvert should be no less than 0.75m; when the length of culvert is greater than 15m and less than 30m, the inner diameter or clear height should be no less than 1.0m; when the length of culvert is greater than 30m and less than 60m, the inner diameter or clear height should be no less than 1.25m; when the length of culvert is greater than 60m, the inner diameter or clear height should be no less than 1.5m;

⑥ The small-bore pipe culvert and inverted siphon pipe culvert are not suitable for the frost region. But if needed for irrigation and drainage of farmland, the water accumulated in the pipe must be drained off before the frost period, and the entrance and exit at both ends should be sealed.

⑦ The clearance from the top in the inlet unsubmerged culvert to the highest water surface should meet the requirements specified in Table 12.2-2. The depth of water before the culvert should be less than or equal to 1.15 times of the clear height of the culvert. The influence of accumulated water before the culvert on the design flow may be neglected.

Table 12.2-2 Headroom of inlet unsubmerged culvert

Type of culvert	Pipe culvert	Arch culvert	Rectangular culvert
Clear height of culvert entrance h_d (m)			
≤ 3	$\geq h_d/4$	$\geq h_d/4$	$\geq h_d/6$
> 3	≥ 0.75	≥ 0.75	≥ 0.5

⑧ As for checking calculation of the aperture of inlet unsubmerged culvert, the flow rate and depth of water in the culvert as well as the banked-up water level before the culvert may be calculated after the aperture is drafted according to the section morphology of the brook.

⑨ The location of culvert should meet the requirement of linear layout. If not restricted by linear layout, the culvert should be laid out on the stream (ditch) cross section with favorable terrain, good geological conditions, high bearing capacity of foundation soil and stable riverbed.

⑩ There should be headwalls at the entrance and exit of culvert. The headwall and barrel should be separated by a fissure which will be filled with impervious materials.

⑪ The gully bed, roadbed slope and cone fill within a certain scope from the culvert barrel to the entrance and exit should be paved and reinforced. The type of pavement at the entrance and exit should be confirmed according to the type of ditch. If there is no obvious cannellure, the isosceles trapezoid should be applied to the entrance surface, with a paving angle of 20°; the paving materials should be confirmed according to the peak flow rate on the paved layer, and there must be a cut-off wall at the end of pavement.

When the gully bed is covered with rocks or boulders which will not be washed away by floods, the riverbed will not need to be paved.

For the brook with abrupt longitudinal slope and high flow rate, the chute, hydraulic drop and other corresponding energy dissipation measures are necessary. The cut-off wall is needed at the bottom outside the headwall, and also needed at the end of the paved gully bed.

⑫ The foundation of culvert with base should be designed to be integral or non-integral according to the structure of culvert, geological conditions and ground treatment conditions.

⑬ As for the pipe culvert and other culverts with closed section, if the foundation is up to the specifications in table 12.2-3, the properties of soil are average and the amount of sedimentation is small, the culvert without base may be applied. But there should be a base at the entrance and exit of the culvert, and the seepage-proofing function should be considered to avoid differential settlement among the pipe joints and leakage at the joints.

Table 12.2-3 Treatment of bottom of pipe joints of culvert without foundation

Name of basal soil	Form	Thickness of cushion layer or tamping layer (m)
Rock	Concrete cushion	----
	Sand cushion	No less than 0.4m
Gravelly soil and cobbly soil	Filling the interstice with sand and then tamping	No less than 0.4m
Grit, rough sand, medium sand and fine sand	Tamping the surface layer	No less than 0.4m

⑭ There should be headwall and wing wall at the entrance and exit of the culvert, the type and size should ensure the corresponding discharge capacity of the culvert and stability of the embankment at the culvert.

⑮ With regard to culvert foundation, the post-construction settlement should be calculated. The post-construction settlement amount of the culvert should not be greater than 100mm, if not, the foundation treatment is needed.

12.3.2 Environmental code of practices during the construction period

(1) General provisions

① To evaluate through regarding each culvert as a subdivisional work. The construction quality of each part and procedure must be strictly controlled in the process of construction.

② The requirement of filling on the culvert should be the same as the roadbed.

③ For the channel whose span or overall length is up to the standards of culvert, the quality may be evaluated referring to the standards in this chapter.

④ For the culvert with chute, the quality of culvert and chute may be evaluated respectively, and then an average will be taken.

⑤ The quality evaluation of the precast concrete units (such as pipe joint and cover plate), pile foundation of culvert and reinforcement of box culvert should be conducted according to the relevant standards.

⑥ The construction time should be strictly controlled. If there are residents living at the construction site, construction from 12:00 to 14:00 in the day and from 22:00 to 6:00 at night should be prohibited.

⑦ Watering at the construction site is needed to prevent flowing dust pollution.

⑧ A sedimentation basin should be built at the construction site, and the industrial wastewater should be recycled after the sedimentation, instead of being drained off.

⑨ The earth and stone generated should be removed as filling materials, and the redundant parts should be shipped to the designed place for stacking. Dumping and leaving about should be prohibited.

⑩ The surface soils dug up should be stockpiled with a bumper plate, and should be backfilled after the construction, and then the revegetation is necessary.

(2) Code for practice of pipe culvert

① The bought-in reinforced concrete circular tubes, whose quality must meet the design requirements specified by the construction specifications, may be installed after the site acceptance. The precast pipe joints may be installed after being evaluated to be qualified according to the relevant standards.

② The slit width of pipe joint and choke materials should strictly meet the requirements of design and specifications.

③ The bearing capacity of foundation soil must meet the design requirements.

(3) Slab culvert and box culvert

① Only the precast cover plates which have been assessed to be qualified may be installed. The concrete quality of box culvert must meet the design requirements specified by the specifications.

② The settlement joint, waterproof layer and back filling behind abutment should be constructed according to the construction specifications and design requirements.

③ The culvert abutment's bearing capacity of foundation soil must meet the design requirements.

④ When used as channel, its clearance must meet the design requirements.

(3) Arch culvert

① The masonry or pouring of arch ring should meet the code requirements.

② Only when the arch ring is up to the intensity required by the design, the shelf may be taken down and the soil may be backfilled. In case of fissure of the arch ring, it must be dealt with after the reason is found out

③ The settlement joint, waterproof layer and back filling behind abutment should be constructed according to the construction specifications and design requirements.

④ The culvert abutment's bearing capacity of foundation soil must meet the design requirements.

(4) Inverted siphon

① The waterproofing work should be applied to the pipe joints and seams of entrance and exit to avoid leakage. The water filling test should be conducted before the filling.

② The quality of pipe joints must meet the construction specifications and design requirements. Only the precast pipe joints which have been assessed to be qualified according to the requirements in section 6.13 may be installed.

③ The bearing capacity of foundation soil must meet the design requirements.

(5) Bridge and culvert to which the jack-in method is applied

① The foundation bottom should be solid with enough bearing capacity.

② The construction with water should be prohibited.

③ The abutment wall of working pit must be perpendicular to the axis of the bridge and culvert, and should have enough strength to bear the jacking force.

④ The waterproofing work should be applied to the seams according to the design requirements.

12.3.3 Environmental code of practices for maintenance management of pipe culvert

(1) In case of any damage, deformation, or subsidence of the paving layers at the bottom and entrance of the culvert, they should be repaired in time. And the groove upstream and downstream should be renovated to ensure smooth gradient of the water flow.

(2) In case of fissure at the juncture of the entrance to culvert and water fall or torrent slope at the water outlet, it may be filled with dry oakum soaked with bitumen. So it can be closely integrated with the entrance to culvert.

(3) The inverted siphon which is apt to rupture or leak should be particularly checked. In case of any wet spots, it should not be used anymore and should be repaired after removing the earth. For instance, to replace the softened earth fill of roadbed and ruptured pipe joints. In a word, the joints should be tightly stuffed

(4) When the sealing materials at the joints of pipe culvert and at the seams of hinge points of quadri-hinge culvert pipe come off, instead of daubing the crack with mortar, the dry oakum soaked with bitumen should be used to fill solidly.

(5) If somewhere on the top of the brick arch culvert leaks, the excavation and filling are needed. The high-grade cement mortar should be used for filling, and then

the plaster waterproof layer or oil felt waterproof layer of 10-15m should be paved. The whole construction process should be serious and careful to prevent leaking again.

13 Environmental Code of Practices for Maintenance Station and Overloading Control Station

13.1 Requirements of site selection of maintenance station and overloading control station

The site selection of maintenance station and overloading control station should follow the principles shown in Table 13.1-1.

Table 13.1-1 Site selection of maintenance station and overloading control station

The following should not be selected	The following should be selected
<ul style="list-style-type: none"> • Basic farmland or other farmland, paddy field and cash crop farmland • Sensitive areas such as water conservation district, scenic spot and forest park. • Land with large vegetational cover rate • Dangerous area of collapse and landslide • Susceptible area of debris flow • Land for special use 	<ul style="list-style-type: none"> • Construction land • Wasteland • Derelict land • Other inferior land

13.2 Analysis of impact of maintenance station and overloading control station on the environment

13.2.1 Environmental impact analysis during the construction period

- (1) The impact of construction dust on the ambient air;
- (2) The impact of discharge of industrial wastewater and sanitary sewage on the water environment;
- (3) The impact of noise from construction machinery on the acoustic environment;
- (4) The impact of earthwork engineering, construction waste and household garbage on the environment;
- (5) The impact of land occupation and destroy of ground vegetation on the ecological environment.

13.2.2 Environmental impact analysis during the operation period

- (1) The impact of domestic lampblack made the staff of the maintenance station and overloading control station on the ambient air;
- (2) The impact of sanitary sewage discharged by the staff of the maintenance station and overloading control station on the water environment;
- (3) The impact of household garbage dumped by the staff of the maintenance station and overloading control station on the environment.

13.3 Environmental code of practices for maintenance station and overloading control station

13.3.1 Environmental code of practices during the construction period

- (1) Measures for preventing air pollution during the construction
 - ① The closed construction method should be applied to the construction site, i.e., separating the construction site from the surrounding environment. Guardrail may be built around the construction site to avoid the impact of construction dust and flying

ash on the surrounding environment.

② The transport vehicles should be freighted with building materials or muck according to the authorized loading capacity. The loaded materials that may cause flying dust should be covered in the transportation process to prevent flying and spattering.

③ The wheels of vehicles driving away from the construction site must be cleaned to avoid the mud of the construction site from being brought into the urban road environment.

④ The civilized construction should be adhered to. There should be a special site to stack building materials, which should be covered by tarpaulin in the process of stacking to avoid dust of building materials.

⑤ The specially-assigned persons should clean the roads and inspect the civilized construction every day. The roads around the construction site should be kept clean, if any building materials or mud scatter or the vehicles with mud affect the cleanliness of road surface, the employer is responsible for organizing people to clean.

⑥ The clean energy should be applied to the constructors' cooking and heating as far as possible, so as to reduce the smoke dust caused by fire coal and the impact of SO₂ on the air environment. But the pollutants discharged have a smaller impact on the air environment because of the short construction period.

(2) Measures for preventing water environment pollution during the construction

① The industrial wastewater generated during the construction period flows into the sedimentation basin through the collecting gutter, the supernatant liquor of wastewater after the sedimentation should be used to wash vehicles, prevent dust at the construction site, and water the temporary mound, etc.

② The construction team should make the most of the public facilities like public toilet near the construction site, and should build a pit toilet if there is not any public facility. The sanitary sewage generated will flow to the pit toilet and then shipped out by the hired farmers for farm irrigation. The pit toilet will be earthed up and buried after the completion of construction.

(3) Measures for preventing noise pollution during the construction

① The employer should work out the construction organization design before entering the site; specify the adopted unit type, noise level and operation specifications; define the measures and facilities for preventing noise, and then submit to the environmental supervision department for examination and filing.

② Planning reasonably to reduce equipment noise and man-made noise.

③ The construction time should be arranged reasonably. The facilities with strong noise should not be used at the same time, and the level of local noise should not be too high. The "Environmental Noise Emission Standards of Construction Site" should be strictly enforced. The equipment with strong noise should not be used from 22:00 at night to the early morning and from 12:00 to 14:00 in the day. If the engineering construction must be conducted at night, the employer should get the approval of the local environmental protection bureau before the construction, and should notice the residents nearby.

④ Measures for preventing other noise

For the mechanical equipment with relatively fixed position, the operation should be finished in the work shed as far as possible. But if the operation can not be finished in the work shed, sonic barrier equipment may be installed at the sensitive side.

(4) Measures for preventing solid waste pollution

The surface soils during the construction should be piled up properly and be covered with felt, so as to avoid rain wash and flying dust caused by strong wind. The soils, which will be used for afforestation after the completion of construction, should not be cluttered up and left about.

The earth and stone and construction waste generated during the construction should be shipped to the designated construction waste treatment site in the locality, and the household garbage should be cleared in time and then shipped to the designated municipal solid waste landfill for concentrated disposal.

(5) Measures for preventing ecological environment pollution during the construction

① The principle of optimal land utilization should be adhered to during the project construction, and less land should be occupied. The earth and stone works should be excavated for filling, meanwhile, high filling and deep excavation should be avoided. The goals of less borrowed earth, less spoil and less occupation of land should be achieved. The excavation and filling of earth and stone should achieve a balance, and the temporary ground should be minimized.

② The influence of abandoned earth and stone mainly lies in the temporary stock dump. The facilities for protection, flood prevention and drainage of the stock dump should be prepared before the construction, and the temporary drainage facility should be combined with the permanent drainage facility as far as possible. The measures for preventing water and soil loss should be taken, like building an acceptable retaining wall around the construction site. The principles of cutting and covering, compacting and filling, no loose soil, no dumping of soil should be adhered to, so as to reduce water and soil loss during the construction and prevent rainwash and water pollution. For the road section digged deeply, the slope protection works should be conducted in time, such as slope protection works by vegetation and slope protection works by cement mortar. In addition, there should be strict construction management system; construction in rainy season should be avoided; the abandoned soils (stones or residues) for leveling the ground should be piled up reasonably; the shed for preparing materials must be built in the charging area for the stockpiling of earth and stone materials; and the impact of water and soil loss on the environment should be minimized. The civilized construction should be carried out throughout the project construction, and the “balance between excavating and filling” should be ensured as far as possible to minimize the impact of water and soil loss.

③ After the completion of construction, the vacant land should be reclaimed and afforested in time to preserve the ecological environment and vegetation.

13.3.2 Environmental code of practices during the operation period

(1) The sanitary sewage from the overloading control station and maintenance station with complete municipal facilities should be discharged into the municipal pipe. If unavailable, a pit toilet should be built to collect and treat the sanitary sewage which will be shipped out for irrigation.

(2) The clean energy (like liquefied gas or electricity) should be used, and the

smoke exhaust ventilator should be installed in the canteen.

(3) The household garbage should be timely shipped to the designated rubbish dump in the locality for disposal.

14 Environmental Code of Practices for Preventing Water and Soil Loss

The principles of “combining erosion and torrent control works with main work of road; laying equal stress on the main work and ancillary works as well as temporary works; putting prevention first; treating comprehensively; treating both symptoms and root causes; integrating prevention and treatment” should be carried out when preventing water and soil loss of road construction project. Meanwhile, the soil and water conservation facilities should be arranged reasonably according to the local conditions with an emphasis on actual effect; the soil and water conservation during the construction should be highlighted; the afforestation and reclamation of the borrow area and spoil ground should be emphasized; and the spoil ground should be baffled before the spoiling.

14.1 Soil and water conservation measures and construction arrangement

(1) Arrangement of controlling measures

The water and soil loss which may result from project construction mainly occur in roadbed area and spoil ground. As the construction time of the roadbed construction area is the longest, the slope treatment and layout of drainage works should be the emphases on prevention; and the prevention measures of the spoil ground should focus on temporary obstructing, drainage facility and vegetation recovery.

(2) Arrangement of construction progress

The water and soil loss which may result from project construction mainly occur in the project construction period. As the water erosion predominate the types of erosion, the prevention should focus on the drainage of rainwater. As the main work is designed with impeccable rainwater system, some rainwater system should be put into practice in advance through connecting the natural channels and existing drainage facility, for the purpose of giving a full play to the function of water and soil conservation.

14.2 Prevention area of the main works

The water and soil loss which may result from project construction mainly occur in the period from roadbed filling to the completion of pavement construction. A lot of soils and stones will be transported in the process of roadbed filling, and the loose soils may slip off easily; after the construction period, as the pavement is compacted by rolling, and the flow rate becomes larger, the road runoff will wash the roadbed slope. The gully erosion is the main type of soil erosion, accompanied by extensive surface erosion and rain splash erosion. Consequently, the emphases on preventing water and soil loss in this area include drainage of both sides of the roadbed, slope protection and temporary protective measures during the construction.

(1) Construction requirements:

① The side ditch of roadbed should be prior to the roadbed filling, so as to reduce the influence of roadbed filling on both sides;

② The slope protection should be conducted in time after the roadbed forms;

③ The drainage ditch and desilting basin should be dredged regularly in the rainy season, and the silt soils should be paved on the filling slope and then compacted;

④ If an irrigation channel is occupied by the roadbed, it should be rechannelled and dredged as soon as possible to avoid the influence on the normal agricultural

production.

(2) Protective measures:

① Stripping and protection of surface soil

Principles of piling up surface soil: The surface soils can not be piled up at the places where the surface runoffs meet; where the construction may be affected or the road is unobstructed; where the vacant land is with high elevation, in order to reduce the work amount of protective measures. The surface soils piled up for a short time refer to those stripped from the farmland before the roadbed filling, and will be used for slope greening in the later period. The surface soils should be piled up temporarily within the scope of land acquisition at both sides of the roadbed. In order to prevent the soils from slipping off, the woven earth bags should be applied around the mound for retaining.

② Water retaining ridge at the road shoulder and temporary chute

When the roadbed forms after the filling, the ridge should be built at the road shoulder and chute should be built on the side slope. Then the road runoff will be led to the chute to avoid washing the side slope. The ridge may be built with the redundant soils of the road shoulder during the roadbed filling, with a width of 0.2m and a height of 0.1m. The chute should be built every other 100m with a dishing section, and with a width of 0.3m and a depth of 0.15m. The mortar should be used to protect the surface in the range 1m from the entrance, with a thickness of 0.05m and a gradient of 2%. As for the surface protection of chute, mortar (3cm), color bar or woven bag may be used. The investigation shows that the mortar top has the characteristics of simple construction, lasting protection, effortless removal, etc.; although the color bar costs less, it is difficult to stick to the ditch, and needs maintenance due to the unstable protecting effect; it's difficult to use the woven earth bag to protect the surface, and the woven bag is easy to be weathered and then loses the function of water proofing.

③ Desilting measure

A desilting basin should be built at the exit of drain ditch of the roadbed.

14.3 Prevention area of concrete mixing station

(1) Construction requirements

① The concrete mixing station should be built according to the principles of “less stationing and concentrated construction”, the temporary occupation of land should be minimized;

② The land with higher elevation should be chosen to build concrete mixing station, in order to avoid the scour of water outside;

③ The ground of concrete mixing station should be hardened with cement;

④ The necessary measures for prevention and suppression of dust should be applied to the concrete mixing station, for instance, the dust keeper should be applied to the cement container, etc.;

⑤ The concrete mixing station should be regularly watered to suppress dust on sunny days (dry days);

⑥ The desilting basin should be dredged in time, and the silt soils can not be piled up around the desilting basin at will.

(2) Protective measures:

The prevention emphasis of the concrete mixing station is the surface water in the area. Because of the frequent passing vehicles and need of stockpiling, the area is suggested to be wholly hardened with cement. The area is piled up with lots of gravel and the surface water contains more mud and sand on rainy days, besides, the waste water, which contains more cement after cleaning the cement tanker and mixing equipment, will pollute the water if discharged directly. Therefore, a desilting basin should be built at each concrete mixing station, and the surface water in the area will be utilized comprehensively after the sedimentation in the desilting basin.

The land will be reclaimed at a later stage of the engineering. The main tasks are to remove the construction facilities, to clear the building materials such as pebbles and sand spilled in the process of concrete mixing, and to afforest or reclaim the land where the project is located for recovery as far as possible.

14.4 Prevention area of access road

The access road of this project refers to the channel used for transportation of building materials and spoil (residue). In case a new access road needs to be built, the waste land or dry land should be chosen preferentially. Meanwhile, the range of access road should be narrowed as much as possible, so as to minimize the damage of temporary land occupation to vegetation and soil

(1) Construction requirements

① The existing road should be chosen as the access road, and should be widened and hardened with the invested funds after the consultation with the local department for a win-win result;

② The heavy excavation and land along the river should be avoided when building a new service road;

③ Watering is regularly needed for dust suppression on sunny days and windy days.

(2) Design of protective measures:

The drainage ditches should be built at both sides of the access road, and the trapezoidal cross-section of type II should be selected.

14.5 Prevention area of temporary spoil (residue) ground

(1) The site selection of spoil ground should be emphasized; when the spoil (residue) ground destroys the existing ground vegetation or changes the original gradient and causes bare slope, afforestation and reclamation are needed.

The swale, waste ravine, waste land or other field which is rich in reserves and with low elevation, and is not apt to be scoured by water flow should be selected as the temporary spoil (residue) ground, which should not be built on the basic farmland, forest land or other fields that may result in geological disasters or roadbed problems.

The temporary spoil (residue) ground should not be built in the debris flow gully, or above the sliding mass, etc.

(2) The temporary spoil (residue) ground should be afforested, reclaimed or utilized comprehensively in time after the soils are abandoned. The renovation requirements are as follows:

The surface soils should be put together for stockpiling before the abandonment, and then be utilized after all soils are abandoned; the spoil ground after the renovation or reclamation will be reasonably utilized according to the land quality, irrigation conditions, climatic characteristics, production function and planning conditions.

(3) The barrier of residues and slope protection works of the spoil ground should be reasonably confirmed according to the location, nature and estimated height of abandoned soils, etc. A residue dam should be built when the abandoned soils are piled up in the trench.

(4) The drainage system of spoil ground should be set up after the overall consideration of terrain, geology and hydrologic conditions of the borrow area, and of facilities such as canal and farmland irrigation, so as to avoid the water flow scouring the soil mass or changing the conditions of surface runoff, as well as to avoid the scouring of farmland and sloping field. The spoil ground located in the ravine or sloping field must have impeccable drainage facility; when there is a confluence around the spoil ground, the water flow may be channeled and discharged through the measures of interception and drainage.

In addition, when recovering the vegetation of the prevention area of main work, prevention area of access road, prevention area of concrete mixing station and temporary spoil (residue) ground after the completion of the project, the native species rather than alien species should be adopted.

15 Management of Social Interference

The social interference during the project construction refers to the impact on the production and life of the residents nearby. The impact is mainly from the connectivity of water conservancy, connectivity of branch line, construction noise, dust, construction waste and household garbage, etc.

15.1 Connectivity of water conservancy system

The project is rural road, along which a large number of water conservancy facilities such as farmland irrigation canal are distributed. Therefore, during the project construction, the connectivity of water conservancy facilities such as farmland irrigation canal along the road must be fully considered to ensure that it will not be affected by the project construction, and the following measures should be taken.

(1) For the road section where the project and the farmland irrigation canal intersect, the buried closed conduit or slab culvert should be applied to ensure the connectivity of the farmland irrigation canal, shown in Fig. 15.1-1.



(2) For the road section where the farmland irrigation canal parallels the road, the farmland irrigation canal should be hardened. The roadbed can be protected in this way; on the other hand, the water for farmland irrigation will not leak due to the project construction.

(3) After the completion of construction, the employer should repair the rural roads and canals damaged during the construction, or compensate the local government appropriately to protect the legitimate interests of the local government and residents.

15.2 Connectivity of branch line

This project is rural road for the convenience of traveling of the masses nearby and cargo transportation. Therefore, the connection between the main line and branch line connecting the village should be seriously considered into the design. When the technical standard is met, the smooth and safe connection between the branch line and main line should be ensured.

15.3 Environmental code of practices for noise influence

The noise sources will have different effects on the acoustic environment quality of the project area at different stages of the construction period, so the management should be strengthened and corresponding environmental prevention measures should be taken to minimize the effects.

(1) The advanced and reliable low noise equipment should be selected.

(2) The construction should start from 6:00 in the morning to 22:00 in the evening, and should be prohibited from 12:00 at noon to 14:00 in the afternoon during the noon break period. Meanwhile, construction at night should be restricted. If the continuous construction at night is really necessary, a certificate should be issued by the administrative department of construction after the approval of administrative department of environmental protection, and the residents nearby should be notified.

(3) The construction period should be arranged reasonably. The large machineries with strong noise can not be operated in the same time at the same construction site. The construction progress should be accelerated against time, and the time of noise effect should be shortened to minimize the impact of construction noise on the operating personnel.

(4) The basic shock absorption or shock mount should be applied to the mechanical equipment with strong noise through wrapping up the damping material.

(5) The noise from vehicle transport may have a certain influence on the acoustic environment along the road. Therefore, the employer should strengthen the constructors' awareness of environmental protection; know the local folk customs and living habits in time; arrange the transport time reasonably; consciously take measures to limit the speed and prohibit the use of horn of the construction machinery in the environmentally sensitive section like residential area; and then the results of preventing and mitigating the noise effect can be achieved.

(6) The mechanical equipment with strong noise should be placed on one side of the construction site far away from the residential area. A barrier with noise reduction function should be built at the construction site less than 5m from the dwelling house or school.

(7) The employer should reasonably arrange the constructors to shorten the workers' time to operate the machinery with strong noise. The constructors may be provided with earmuffs to mitigate the effect.

(8) All mechanical equipment should be maintained and repaired regularly and effectively to achieve the aims of maintaining good condition, reducing noise and extending the service life.

(9) The requirements of management of construction intensity, operators of machinery and vehicles, operation specifications, etc. should be strict.

15.4 Flying dust management measures

(1) The access road should be paved with macadam and watered regularly to reduce the flying dust.

(2) The granular materials piled up at the construction site should be sealed or covered; and the surface of material pile should be watered according to the material property to suppress the dust actively.

(3) The fence-type barrier should be applied when the road construction passes the environmental sensitive spot (area).

(4) The construction wastes should be removed with closed container handling vehicle, and throwing about in the air should be strictly prohibited. The construction wastes should be stored by categories and then cleared and disposed in time according to the relevant regulations on systematic management of municipal wastes, and appropriate watering is necessary before the garbage removal.

(5) The management of transport vehicles should be strengthened, and the vehicles which will generate flying dust during transport should be covered with tarpaulins.

(6) The measure of suppressing dust through water spray should be taken to dismantle the engineering construction; and the muck should be removed within 3 days from the date of completion of dismantling construction according to the relevant regulations on management of dismantlement work.

(7) The measures such as baffle plate or watering should be taken to keep out and suppress the flying dust at the construction field.

(8) The earths of the construction site should be piled up concentratedly and covered; the vehicles should not be overloaded in order to avoid vibration and scattering in transit.

(9) The measure to ensure the cleanness of vehicles should be applied to the entrance and exit of the construction site. The dirt adhering to the surface of the vehicles should be cleared before the vehicles leave the construction site.

(10) The areas for the storage of materials and large templates at the construction site must be flat and solid.

(11) The construction site should be watered and cleaned in time.

(12) The predominant wind direction and surrounding environmental protection goals should be taken into consideration to position the storage yard of granular materials or other main dust sources at the downwind direction 300m from the surrounding environmental protection goals.

(13) The incineration of all kinds of wastes should be strictly prohibited.

15.5 Solid waste management measures

(1) The construction wastes should be comprehensively utilized combined with the simultaneous small civil construction project and road works; the rest of the wastes should be concentratedly piled up at the designated storage yard of the construction site, and then removed timely to the refuse landfill of the project site for disposal according to the construction progress.

(2) The construction wastes should be removed with closed container handling

vehicle, and throwing about in the air should be strictly prohibited. The construction wastes should be stored by categories and then cleared and disposed in time according to the relevant regulations on systematic management of wastes.

(3) The construction wastes should be appropriately watered before the removal.

(4) The household garbage should be collected in the garbage cans or garbage bags at the construction site, and then removed uniformly to the refuse landfill of the project site for disposal.

(5) The mellow soils among the abandoned soils should be used for the reclamation and afforestation of the wasteland at the project site, and the remainder may be used as roadbed filling and padding at both sides of the channel in the neighborhood.

(6) The poisonous and harmful substances can not be burned at the construction site, and should be disposed according to the relevant regulations.

15.6 Organizational planning of construction transportation

The reasonable construction scheme should be worked out during the project construction period, and half-range construction scheme is applicable. A warning sign should be set up at the construction section, and two traffic wardens should be arranged to disperse the traffic so as to minimize the adverse impact of road construction on the traffic capacity along the road. Meanwhile, the impact of all-over road construction on the transportation should be avoided. If the construction of a whole road section needs to be conducted, a temporary passage should be built before the construction.

16 Environmental Code of Practices for Sewage Treatment

16.1 Types of sewage from construction and operation of road

The wastewater generated during the construction and operation of road mainly includes industrial wastewater (such as wastewater in foundation pit, and wastewater after flushing the machineries, vehicles, building materials and concrete mixing equipment), sanitary sewage, waste road runoff, etc.

16.2 Environmental code of practices for sewage treatment

(1) The construction of foundation engineering of bridge pile should be carried out in the dry season instead of flood season as far as possible.

(2) The contract for a construction project should specify the clause about the prevention of spilling or leakage of road-building materials (such as bitumen, oil materials and chemicals). The storage yard should not be set up at the road section near the river, in order to prevent the road-building materials from being washed into the river along with the rainwater, and to avoid pollution of surface water.

(3) The storage yard of harmful construction materials such as oil materials and chemicals should be fenced and covered with tarpaulin to avoid the pollution caused by rain wash.

(4) The boring residue of pile foundation and construction wastes can not be discharged into the surface water; the construction site near the river should have necessary drainage ditch for the dredging of construction wastewater, and the soil slope of drainage ditch should be tamped in time.

(5) The construction wastewater should be recycled after the treatment by the sedimentation basin.

(6) The advanced equipment and machinery should be used to effectively reduce the amount of running, springing, dripping and leaking as well as times of mechanical maintenance, and thus to reduce the quantity of oily sewage. In the process of running, springing, dripping and leaking which are unavoidable, the solid oil absorption materials (such as cotton yarn, saw dust and oil-absorbing sheet) should be used to absorb the waste oil into solid matter to avoid excessive oily sewage. The greasy dirt leaked into the soils should be timely collected with scraping apparatus and sealed up, and then shipped to a competent site for centralized processing.

(7) The maintenance of machinery, equipment and transport vehicle should be centralized at the maintenance point of each road section as much as possible, for the convenience of collection of oily sewage; if the maintenance can not be conducted at the same time, as the quantity of oily sewage is normally not greater than 0.5m³/d, all the oily sewage can be absorbed by and mixed with solid oil absorption materials, and then sealed up and shipped out.

(8) The horizontal sedimentation tank should be built at the construction site and mechanical maintenance site to collect the oily sewage. After the simple treatment like acid-base neutralization, sedimentation, oil isolation and residue removal, the concentration of oils and other pollutants will lower. The sedimentation tank should be buried with earth after the completion of construction.

(9) After being packed and sealed up, the waste oil absorption materials collected should be shipped out together with other dangerous solid wastes of the construction site to a certified site nearby for disposal.

(10) The construction site should be far away from the section where the rivers are concentratedly distributed. The modified septic tank should be set up near the construction site to separately collect the fecal sewage and catering washing-up sewage. The excrement should be used to fertilize the soil, while the catering washing-up sewage, after being treated in the oil separation tank, should be disposed with the fecal sewage in the septic tank, and then used to irrigate the farmland after meeting the water quality standard of farmland irrigation. The septic tank should be regularly dredged by the commissioned villagers nearby, and buried with earth after the completion of construction. The residential area along the road should be used to build construction camp as far as possible, and sewage prevention measures should be taken to prevent the sanitary sewage flowing into the water body.

(11) The centralized and unified management should be applied to the dining and washing of the constructors, like centralized dining and washing, to reduce the quantity of sanitary sewage. The use of detergent in the washing process should be limited to reduce the content of detergent in the sewage.

(12) During the construction, the retaining wall and drainage facility should be set up around the water well along the road to prevent the waste residues and sewage from entering the well. Meanwhile, the temporary storage yard of waste residues or construction materials should not be set up within 50m around the water well, in order to avoid the adverse impact of waste residues and construction materials on the water quality of the well.

During the operation, the drainage ditch and crash barrier should be set up at the road section where there is a well, so as to prevent the initial rainwater on the road surface and accidental sewage from flowing into the drinking water and affecting the water quality.

(13) Befouled runoff on the road surface (bridge floor)

The runoff on the road surface (bridge floor) is formed mainly by water accumulated on the road surface and bridge crossing the river when it rains. According to the analog data, in the road runoff, the average value of pH is about 7.4, the mean concentration of SS is about 100mg/L, of BOD5 is about 5.0 and of petroleum is about 11.25mg/L. The drainage of surface rainwater runoff will have a certain adverse impact on the water quality of surface water body, but the impact is only limited to the initial rainfall (about 20 minutes generally). As the rainfall increases, the concentration of water will lower, and the impact on the surface water body will be mitigated naturally. In general, the road runoff only has a small effect on the surface water body.

16.3 Emergency management system and emergency measures suggested

In order to protect the water environment along the road, great importance should be attached to the risk of carriage of dangerous goods at the proposed river-crossing road section and sensitive road section with a well. Therefore, the governments at all levels along the road should bring the emergency rescue of risk of carriage at the aforementioned road sections into the emergency plan of accident of road transportation of dangerous chemicals. The emergency plan should include organizational structure, responsibilities and system, emergency work procedures, principles of management, etc. The cantonal leaders in charge of road transport bureau, public security bureau and environmental protection bureau should jointly establish the coordination group of dangerous chemicals transportation accident, which is

responsible for organizing and coordinating the rescue and handling of dangerous goods transportation accident. The responsibilities mainly include researching on and formulating the safety precautions and policies of road transportation of dangerous chemicals in the districts; filing the operators, vehicles and staff of road transportation of dangerous chemicals under the jurisdiction; regularly carrying out safety inspection on the operators of road transportation of dangerous chemicals; regularly holding a meeting among the coordination and leading group members to report the conditions of accidents of road transportation of dangerous chemicals; regularly organizing the responsible persons, drivers, supercargos, loading and unloading staff of road transportation of chemicals for professional training and exercising the contingency plan; actively implementing multiform propaganda to strengthen the masses' and employed persons' awareness of safety production; counting up and reporting the accidents of road transportation of dangerous chemicals. The emergency work procedures and principles of management include:

(1) Once an accident happens, the discoverer should report to the local coordination group of dangerous chemicals transportation accident through the contact number of maintenance people on the roadside sign or other communication mode.

(2) After receiving the accident report, the local coordination group should immediately notify the neighboring fire department which will send fire engine and firefighters to the place for rescue.

(3) If the dangerous goods are solid, they may be cleaned, and the accident should be recorded and filed.

(4) But if the dangerous goods are gaseous and toxic, they should be disposed by firefighters with gas masks. If the escape of dangerous goods is unavoidable, the environmental protection bureau and public security department should be informed promptly; the people within the pollution scope along the road should be evacuated when necessary to avoid poisoning, injuries and deaths.

(5) If the dangerous goods are liquid and have flowed into the public water body, the environmental protection bureau should immediately send some environmental protection experts and supervisors to the scene for monitoring analysis after receiving the notice, and should timely cooperate with the relevant departments in salvaging the containers of dangerous goods falling into the water body.

(6) The crash barrier should be designed designedly and then installed at both sides of the river-crossing bridge to avoid the impact of accident of dangerous chemicals transportation vehicle on the water quality of river.

17 Environmental Code of Practices for Physical Cultural Relics

In case cultural relics and historic sports are discovered or suspected during the construction, the employer should immediately preserve the scene according to the requirements of “Cultural Relics Protection Law of the People’s Republic of China” coming into effect on December 29, 2007, should report to the local cultural relics bureau, and should resume the construction after they are dealt with by the cultural relics bureau. See Diagram 17.1-1 for the reporting procedure of cultural relics.

In case cultural relics and historic sports are discovered or suspected during the construction, Chance-find procedures must be followed.

(1) The employer should terminate construction at the site where the cultural relics are found and strengthen the protection of the scene;

(2) The contractor should timely report to the police department and competent department of cultural relics for identification and disposal;

(3) The employer should delimit the scope of protection immediately once they are defined as cultural relics;

(4) The employer should rescue and excavate the cultural relics due to the urgency of construction period or danger of natural destroys indeed;

(5) The rescue and excavation of cultural relics should be conducted by professionals with special equipment, the contractor should not excavate without authorization;

(6) Once it is determined to be great discovery of cultural relics, whether the project should be constructed in another place should be demonstrated.

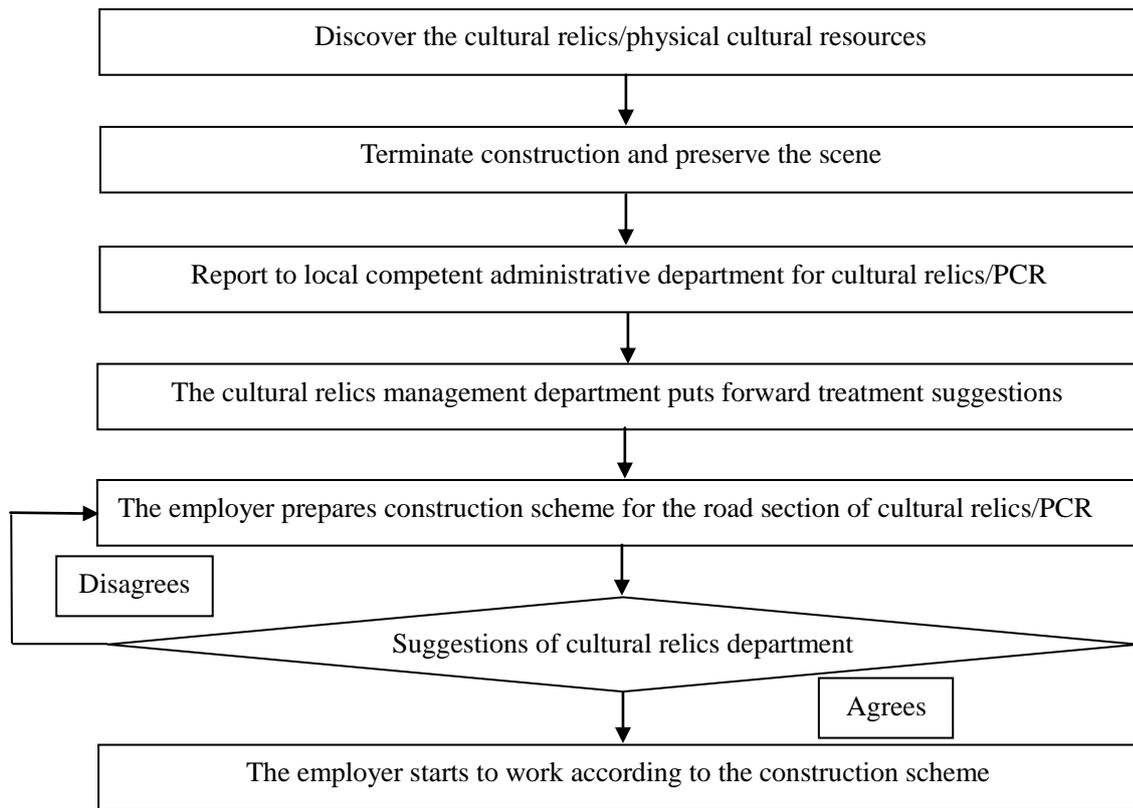


Diagram 17.1-1 Processing procedure of cultural relics discovered during the construction

18 Environmental Code of Practices for Safety and Health

18.1 Analysis of construction safety and health

The employer and regulatory organization are responsible for taking all reasonable measures to protect the personal safety of the workers and security of the buildings nearby, and to protect them from the accidental damage from construction. The enterprise should employ a contractor that has the ability to manage the occupational health of employees and safety matters, and should also require the contractor to perform its risk management rules through a standard purchase agreement. The construction safety and health of this project include design and operation of general facility, communication and training, personal risk and supervision.

18.2 Measures for construction safety and health

The employer has the responsibility to follow all national and local safety requirements and to take other measures which can avoid accidents, in order to assure the constructors' safety and health.

(1) The integrity of all buildings within the construction site should be assured; the temporary buildings should be structurally safe and reliable enough to resist the hit of heavy weather of the region, and should have adequate light to isolate partial flying dust and noise.

(2) The employer should make sure that it can give satisfactory first aid treatment. The construction site should be equipped with necessary first-aid tools; there should be written emergency procedures in the remote area, so the patients can be transferred to the suitable medical establishment.

(3) The occupational health and safety training should be conducted for all new constructors; and the basic working rules, physical protection rules and the way to protect other workers from injuries should be introduced to them.

(4) The danger areas (such as switching room and compressor room), device, materials, safety measures and emergency exit should be equipped with correct signboards.

(5) If the workers' hands and arms vibrate due to the use of manual tools or electric tools, or their whole bodies vibrate when standing or sitting on the vibratory surface, the vibration should be controlled through equipment selection, installation of anti-vibration pad or damping device, and limit of exposure time.

(6) The danger of nipping should be eliminated when designing machine to make sure that the projecting part of machinery will not do harm to human body under normal operational circumstances.

(7) Warning boards should be placed on all galvanical electric actuators and electric wires; all wires, cables, manual and electric tools should be checked to avoid frayed and exposed wires, and the allowable maximum working voltage of manual tools should be confirmed according to the suggestions of the manufacturer; double insulation and earth connection should be applied to all electrical equipment used in humid (or likely humid) environment.

(8) All operators participating in or assisting the welding should be provided with eye protection equipment (like welding goggles and/or mask).

(9) The protective barrier should be installed at the edge of fragile and dangerous area (one rod in the middle and baffle plate around), meanwhile, the constructors should use the fall prevention device (including safety belt and distance limit lanyard).

(10) The employer should determine and offer the suitable personal protection equipment to the constructors to adequately protect the workers, other workers and occasional visitors, and should avoid the inconvenience to the users.

(11) The employer should establish the procedure and system of reporting and recording occupational accident, damage and dangerous situation.

(12) The health education for constructors should be implemented; for instance, implementing the strategy of information communication, strengthening face-to-face consultation, solving the systematic problems affecting individual behaviors, encouraging the individuals to take protective measures, avoid passing on the damage to others through using condoms. In addition, the constructors should be encouraged to use anophelifuge, clothes, mosquito net and other things to prevent the spread of damages caused by mosquito bites.

18.3 Road Traffic Safety Signs and Facilities

18.3.1 The necessity of traffic safety signs and facilities

The traffic safety signs and facilities may enable the drivers to foresee the road conditions ahead and conditions of sensitive spots like village and school, and to focus their attention and lower their speed to effectively avoid the happening of traffic accidents or minimize the extent of damage from traffic accidents. Therefore, the traffic safety signs and facilities are necessary.

18.3.2 Environmental code of practices for traffic safety signs and facilities

(1) The guardrail or railing should be applied to the road section with a river, lake, swamp, cliff, or gorge aside, and to the road section or bridge which may cause serious traffic accidents. The night reflecting marking should be applied to the guardrail and railing.

(2) A warning board should be set up at the road section where there is a pond with a depth greater than 3m, embankment or shallow ridge with an altitude difference greater than 4m, and at the roadside 10m from a bridge.

(3) A reflective convex mirror should be set up at the road section with disadvantageous sighting distance resulting from sharp turn or structure of the mountain.

(4) The speed hump or deceleration strip should be built at the road section before a town, village or school to impel the drivers to lower their speed and assure the safety of pedestrians in the town or village. According to the limited speed of the town or village to be passed through, the corresponding signs of speed limit, avoiding pedestrians, watching for children, etc. may be set up before the speed humps or deceleration strips.

(5) A warning sign of school or limiting speed should be set up near a school at the side of the road, and traffic lights may be used for control at the passageway for students, speed hump or stone-paved road when necessary.

19 Environmental Code of Practices for Hazardous Waste and Chemical Waste

19.1 Measures for managing hazardous waste and chemical waste

The project construction involves storage and transportation of partial hazardous wastes and chemical wastes which will have a great impact on the environment if not disposed properly. The management measures of hazardous waste and chemical waste are below:

- (1) The chemicals should be stored properly and labeled;
- (2) The storage of dangerous goods should meet the requirements of regulations on storage type and data specified in the Storage Certificate;
- (3) The greasy dirt should be collected by a special container during the maintenance of mechanical equipment;
- (4) The tools and materials such as antifouling box/sand/saw dust should be prepared to absorb the leaked chemicals.

19.2 Risk prevention measures and emergency plan

19.2.1 Risk prevention measures

(1) To set up the emergency network, establish the emergency accident leading group, and assign the emergency commander.

The project organization unit should take the lead in establishing the emergency network with the relevant departments such as environmental protection bureau, public security bureau, fire brigade, environmental monitor station and water conservancy department. For the emergency management of dangerous goods transportation accidents, the accident management group consisting of people from the relevant departments which are capable of handling accidents should be established.

(2) To lay down strict management rules and regulations on transportation of oils and chemicals through investigation, and strengthen the management and prevention of unexpected environmental pollution accident on the road.

(3) To strengthen the management of dangerous chemicals transportation and work out the emergency plan of traffic accident of dangerous goods; the dangerous goods transportation should be registered and filed by the public security department and transport agency; on-the-job training for the relevant managers and employees should be conducted and employment with certificates should be ensured to avoid a leakage accident.

(4) In the course of transportation of dangerous goods, the driver must concentrate and pay attention to the road signs, and should value traffic safety especially when passing by a residential area and river, and should not stop off at will.

(5) The collision avoidance sign, speed limit sign for dangerous goods vehicles and warning board should be set up at both sides of the bridge; the alarm telephone should be indicated; and the drivers should be prompted to drive with care.

19.2.2 Emergency plan of risk

The employer should work out the detailed emergency plan, unify the emergency action, and specify the responsibilities of person in charge of emergency and the

relevant departments, so as to make sure that the accident will be controlled within the shortest time and to mitigate the damage to the environment. The emergency plan of this project should be integrated with the regional emergency plan, so the rescue effort can be made at full speed when a dangerous chemicals accident happens, and the damage and loss caused by accident may be reduced. The emergency rescue headquarters of dangerous chemicals accident should be established to uniformly organize and direct the rescue operation of an accident within the jurisdiction. The main contents of the emergency plan include:

- (1) Contact way of alarm and communication;
- (2) Hierarchical response procedure;
- (3) Environmental monitoring, emergency processing, rescue and control measures;
- (4) Organizational planning of personnel evacuation;
- (5) Recovery measures.

The accident recovery mainly refers to the recovery of soil and water polluted. The polluted topsoil should be scraped off the seriously polluted soil and then sent to the hazardous waste center for disposal. The affirmative measure of purification should be applied to the polluted water, for instance, skimming the surface pollutants. The skimmed pollutants should be sent to the sewage treatment plant for disposal or burned away.

- (6) Emergency training plan.

20 Environmental Code of Practices for Public Consultation

The public participation is a kind of two-way communication between the construction party and the public. After the normal mechanism that the public participates in supervision and management of the environment is established, the public of the area affected by the project can timely know the information about environmental issues, and will have the opportunity to express their opinions through a normal channel. The project will be scientized and democratized in the decision-making process. This is very important for decision making and smooth implementation of the construction scheme.

20.1 The purpose of public participation

(1) To let the public know the purpose, scale and location of project construction through participation, the pollution of surrounding environment during the project construction and operation, as well as the prevention measures proposed; to let the public express their opinions so as to obtain their understanding, support and cooperation.

(2) Seeking for the local permanent residents' firsthand experience and Intuitive feelings of their living environment may assist the analysis of current situation, quality and level of environmental elements of the region, so as to reflect the objectivity of environmental assessment and protect the vital interests of the public.

20.2 General requirements of public participation

The general requirements of public participation include disclosing environmental information and seeking for opinions of the public. The employer or the commissioned environmental impact assessment organization or competent administrative department for environmental protection should disclose the information about environmental impact assessment to the public by the means known to the public according to the provisions of the relevant laws and regulations. They may bulletin the information through a forum, announcement at the construction site and questionnaires, etc. known to the public. After the relevant information is disclosed, the public may submit their written opinions to the employer or the commissioned environmental impact assessment organization through letters, faxes, e-mails or other ways required by the relevant public notice. The employer or the commissioned environmental impact assessment organization should archive the sources of feedback for future reference.

As for the principles, the information should be released in due time and in the forms accessible to the affected individuals, groups and organizations.

20.3 Organizational forms and findings of public participation

20.3.1 Organizational forms of public participation

(1) Announcement

The employer or the person chiefly in charge of the commissioned environmental impact assessment organization may disclose the construction project overview to the public society in the form of announcement in the township, town or village in which the project is located, including the basic information, scale, contents, quantities, land occupation, main factors and consequences of environmental impact, prevention measures and desired effect related to the construction project. The contact number and address should be disclosed for feedback. Fig. 20.3-1 shows some photos about

information announcement taken in the project townships, towns and villages.



Xinbao Township, Wudang District



Pingba Village, Yangchang Town, Wudang District



Xinglong Village, Wenquan Town, Xifeng County



Wenquan Town, Xifeng County



Dagu Village, Qingzhen City



Liwo Township, Qingzhen City



Gaoping Village, Kaiyang County



Huali Town, Kaiyang County



Yanshanhong Town, Baiyun District



Dula Township, Baiyun District



Baigu Village, Huaxi District



Shuitang Village, Huaxi District

Fig. 20.3-1 Some photos taken in the information publicizing places in the project townships, towns and villages

(2) Forum

① Overview of the forums

According to the relevant requirements, the employer and environmental impact assessment unit held some forums participated in by the public in the road transport bureaus of the districts/counties in which the projects are located from July 17, 2013 to July 23, 2013. The participants mainly include cadres of the townships/villages and villagerss' representatives involved in the projects, as well as persons chiefly in charge of the road transport bureaus of the districts/counties, etc. Fig. 20.3-2 shows the forum sites in the districts, counties and cities.



Forum site in Xifeng County



Forum site in Kaiyang County



Forum site in Wudang District



Forum site in Baiyun District



Forum site in Huaxi District



Forum site in Qingzhen City

Fig. 20.3-2 Forum sites in the project districts, counties and cities

② Topics of the forums

According to the features of the projects, the forums included the following topics (see Table 20.3-1 for details).

Table 20.3-1 Topics of the forums

Topics	Comments or suggestions	Remarks
(1) General opinions about project restoration and renovation		
(2) Embodiment of positive significances of project construction		
(3) Suggestions or comments on project construction		
① Connectivity between the road and farmland irrigation canal		
② Drainage of side ditch (especially the road section passing by a village)		
③ Security issues (especially the road section passing by a village or school)		
④ Environmental protection measures during the construction and operation		
⑤ Selection of construction camp, asphalt mixing station, borrow area and spoil ground		
⑥ Slope protection		
⑦ Road maintenance		
⑧ Connectivity of branch line		

(3) Distribution of public participation questionnaires

According to the features and distribution of projects, the public participation questionnaires were distributed to the township/town governments, village committees and villagers' representatives involved in the projects. See Table 20.3-2 (for individuals) and Table 20.3-3 (for groups) for the detailed contents of survey.

**Table 20.3-2 The project of Guiyang rural road construction financed by the World Bank loan
Table for seeking public opinions (for individuals)**

Name: _____ Sex: _____ Age: _____ Degree of education: _____ Occupation: _____ Place of residence: _____
<p>Project overview: the project that the World Bank funds Guiyang rural road is in the project library of Guiyang rural road development plan formed during the Twelfth Five-year Plan. The project includes four components below:</p> <p>(1) Subproject A: upgrading and reconstruction of roads at county and township levels, including two aspects: ① upgrading a county-level road from the fourth class to the second class ; ② upgrading the low-grade roads at county and township levels to the fourth class;</p> <p>(2) Subproject B: reconstruction of roads at county and township levels: reconstructing the roads at county and township levels with poor conditions.</p> <p>(3) Subproject C: establishment of rural road maintenance station. Building 2 rural road maintenance stations and providing maintenance equipment; building 5 overloading control stations and providing weighing and test equipment.</p> <p>(4) Subproject D: technical assistance: including ① improvement, application and popularization of rural road maintenance system; ② socio-economic impact from rural road development; ③ investment and financing management of rural road; ④ training programs for the capability of Guiyang rural road management departments.</p> <p>The project covers six districts, three counties and one city under the jurisdiction of Guiyang City. Its construction establishes a development platform for implementing the strategy of “economic zone in middle Guizhou”, and lays a good foundation for shortening the gap between urban and rural places, raising the level of rural economy, building a new socialist countryside and promoting the social economic sustainable development.</p> <p>The project that the World Bank funds Guiyang rural road is made up of Guiyang county-region rural</p>

road network, and will complete in 5 years:

(1) 2013 (the first batch of project): reconstruction of roads at county and township levels with a length of 255.7km; two maintenance stations and four overloading detecting stations; with a total investment of about RMB 410 million yuan. **See the attached figures for the involved projects of each district.**

(2) 2014 (the second batch of project): upgrading a county-level road with a length of about 20km from the fourth class to the second class, with a total investment of about RMB 480 million yuan.

(3) 2015 (the third batch of project): reconstruction of roads at county and township levels with a length of 224.2km; upgrading the low-grade roads at county and township levels with a length of 130.8km to the fourth class; with a total investment of about RMB 517 million yuan.

(4) 2016 (the fourth batch of project): upgrading the low-grade roads at county and township levels with a length of 139.4km to the fourth class; one overloading detecting station; with a total investment of about RMB 328 million yuan.

(5) 2017 (the fifth batch of project): reconstruction of roads at county and township levels with a length of 170.6km, with a total investment of about RMB 198 million yuan.

The implementation plan of technical assistance: To complete the implementation from the year 2013 to the year 2017, with a total investment of RMB 12.42 million yuan.

1. Your view on the project construction:	For <input type="checkbox"/>	Against <input type="checkbox"/>	Indifferent <input type="checkbox"/>			
2. What will the project construction bring to your life and income?	Positive effect <input type="checkbox"/>	Adverse effect <input type="checkbox"/>	No effect <input type="checkbox"/>			
3. What do you think of the environmental quality where you are living now?	Good <input type="checkbox"/>	General <input type="checkbox"/>	Poor <input type="checkbox"/>			
4. The main environmental problems where the project is located at present:	Air pollution <input type="checkbox"/>	Water pollution <input type="checkbox"/>	Noise pollution <input type="checkbox"/>	Ecological damage <input type="checkbox"/>		
5. The environmental problems you care about most during the project construction:	Geological disaster <input type="checkbox"/>	Ecological damage <input type="checkbox"/>	Landscape damage <input type="checkbox"/>	Water pollution <input type="checkbox"/>	Air pollution <input type="checkbox"/>	Noise <input type="checkbox"/>
6. Which will seriously affect the environment during the operation after the completion of construction?	Noise <input type="checkbox"/>	Tail gas <input type="checkbox"/>	Water pollution <input type="checkbox"/>	Dust <input type="checkbox"/>		
7. Some farmland will be occupied and houses pulled down due to the road construction. Which do you think is the best compensation way?	Monetary compensation <input type="checkbox"/>	Relocation <input type="checkbox"/>	Other <input type="checkbox"/> (please specify)			
8. Do you think the project construction will contribute to the local economic development?	Yes <input type="checkbox"/>	Not obvious <input type="checkbox"/>	No <input type="checkbox"/>			
9. Can you accept the environmental impact caused by the project construction?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not care <input type="checkbox"/>			
10. Do you bow to the land acquisition, demolition and relocation?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Conditional acceptance <input type="checkbox"/>			
11. Which way do you think will mitigate the impact?	Road greening <input type="checkbox"/>	Sound barrier <input type="checkbox"/>	Being far away from the centralized residential area <input type="checkbox"/>	Other <input type="checkbox"/>		

Other comments: (including the questions unmentioned above or unmentioned options for the designed questions above)

Please tick in if you agree.

Table 20.3-3 the project of Guiyang rural road construction financed by the World Bank loan
Table for seeking public opinions (for groups)

Name of organization: _____	Contact information: _____
<p>Project overview: the project that the World Bank funds Guiyang rural road is in the project library of Guiyang rural road development plan formed during the Twelfth Five-year Plan. The project includes four components below:</p> <p>(1) Subproject A: upgrading and reconstruction of roads at county and township levels, including two aspects: ① upgrading a county-level road from the fourth class to the second class ; ② upgrading the low-grade roads at county and township levels to the fourth class;</p> <p>(2) Subproject B: reconstruction of roads at county and township levels: reconstructing the roads at county and township levels with poor conditions.</p> <p>(3) Subproject C: establishment of rural road maintenance station. Building 2 rural road maintenance stations and providing maintenance equipment; building 5 overloading control stations and providing weighing and test equipment.</p> <p>(4) Subproject D: technical assistance: including ① improvement, application and popularization of rural road maintenance system; ② socio-economic impact from rural road development; ③ investment and financing management of rural road; ④ training programs for the capability of Guiyang rural road management departments.</p> <p>The project covers six districts, three counties and one city under the jurisdiction of Guiyang City. Its construction establishes a development platform for implementing the strategy of “economic zone in middle Guizhou”, and lays a good foundation for shortening the gap between urban and rural places, raising the level of rural economy, building a new socialist countryside and promoting the social economic sustainable development.</p> <p>The project that the World Bank funds Guiyang rural road is made up of Guiyang county-region rural road network, and will complete in 5 years:</p> <p>(1) 2013 (the first batch of project): reconstruction of roads at county and township levels with a length of 255.7km; two maintenance stations and four overloading detecting stations; with a total investment of about RMB 410 million yuan. See the attached tables for the involved projects of each district.</p> <p>(2) 2014 (the second batch of project): upgrading a county-level road with a length of about 20km from the fourth class to the second class, with a total investment of about RMB 480 million yuan.</p> <p>(3) 2015 (the third batch of project): reconstruction of roads at county and township levels with a length of 224.2km; upgrading the low-grade roads at county and township levels with a length of 130.8km to the fourth class; with a total investment of about RMB 517 million yuan.</p> <p>(4) 2016 (the fourth batch of project): upgrading the low-grade roads at county and township levels with a length of 139.4km to the fourth class; one overloading detecting station; with a total investment of about RMB 328 million yuan.</p> <p>(5) 2017 (the fifth batch of project): reconstruction of roads at county and township levels with a length of 170.6km, with a total investment of about RMB 198 million yuan.</p> <p>The implementation plan of technical assistance: To complete the implementation from the year 2013 to the year 2017, with a total investment of RMB 12.42 million yuan.</p>	
1. Your view on the project construction: For <input type="checkbox"/> Against <input type="checkbox"/> Indifferent <input type="checkbox"/>	
2. What will the project construction bring to the economic development of the local area and the department? Positive effect <input type="checkbox"/> Adverse effect <input type="checkbox"/> No effect <input type="checkbox"/>	
3. What do you think of the environmental quality of each project along the road? Good <input type="checkbox"/> General <input type="checkbox"/> Poor <input type="checkbox"/>	
4. The main environmental problems where the project is located at present: Air pollution <input type="checkbox"/> Water pollution <input type="checkbox"/> Noise pollution <input type="checkbox"/> Ecological damage <input type="checkbox"/>	
5. The environmental problems you care about most during the project construction: Noise <input type="checkbox"/> Geological disaster <input type="checkbox"/> Ecological damage <input type="checkbox"/> Landscape damage <input type="checkbox"/> Water pollution <input type="checkbox"/> Air pollution <input type="checkbox"/>	
6. Which will seriously affect the environment during the operation after the completion of construction? Noise <input type="checkbox"/> Tail gas <input type="checkbox"/> Water pollution <input type="checkbox"/> Dust <input type="checkbox"/>	
7. Is the project construction conducive to the improvement of local residents' living quality? Yes <input type="checkbox"/> No <input type="checkbox"/> Uncertain <input type="checkbox"/>	
8. What will the project construction bring to the development of tourist business?	

Positive effect <input type="checkbox"/>	Adverse effect <input type="checkbox"/>	No effect <input type="checkbox"/>
9. What will the project construction bring to the ecological environment and agricultural resources along the road?		
Big impact <input type="checkbox"/>	Little impact <input type="checkbox"/>	No impact <input type="checkbox"/>
Other comments: (including the questions unmentioned above or unmentioned options for the designed questions above)		

Please tick in if you agree.

(4) Announcement of full text

After this ECOPs was compiled, the full text was announced in the project township/town government websites (government portal website of Wudang District: <http://www.gzwd.gov.cn/>; government affairs network of Qingzhen Transport Bureau: <http://guide.conac.cn/www/243542148/40624302/index.html>; government affairs network of Highway Management Office of Huaxi District: <http://贵阳市花溪区公路管理所.公益.cn/>; network of Transport Bureau of People’s Government of Xifeng County: <http://www.xifeng.gov.cn/>; government affairs network of Transport Bureau of Baiyun District: <http://guide.conac.cn/www/243542146/40717032/index.html>; government affairs network of Transport Bureau of Kaiyang County: <http://guide.conac.cn/www/243542149/40532457/index.html>). See Fig. 20.3-3 for the announcement site and the screen shots on Internet.



Full text announcing site in Wenquan Town, Xifeng County



Screen shots of full text announced on the website in Xifeng County



Full text announcing site in Yongwen Town, Kaiyang County



Screen shots of full text announced on the website in Kaiyang County



Full text announcing site in Pianpo Township, Wudang District



Screen shots of full text announced on the website in Wudang District

	
<p>Full text announcing site in Shawen Town, Baiyun District</p>	<p>Screen shots of full text announced on the website in Baiyun District</p>
	
<p>Full text announcing site in Liwo Township, Qingzhen City</p>	<p>Screen shots of full text announced on the website in Qingzhen City</p>
	
<p>Full text announcing site in Yanlou Township, Huaxi District</p>	<p>Screen shots of full text announced on the website in Huaxi District</p>

Fig. 20.3-3 Screen shots and photos of ECOPs full text of Guiyang rural road construction project financed by the World Bank loan

20.3.2 Findings

(1) Announcement

The site survey and visit reflect that all the masses along the road strongly support the project construction and hope that the construction will start as soon as possible.

In the 10 days after the announcement was posted, the employer and environmental impact assessment unit did not receive a call or letter objecting to the project construction.

(2) Results of the forums

All participants voiced their opinions in the forums, and offered some constructive suggestions on the project construction. See Table 20.3-4 for all the summarized questions and suggestions of the forums.

Table 20.3-4 Topics of the forums

Topics	Comments or suggestions	Remarks
(1) General opinions about project restoration and renovation	All support the project construction	
(2) Embodiment of positive significances of project construction	① After the completion of project construction, the travel conditions of the local residents will be improved immediately, and it will be convenient for them to see a doctor, go to school and shop; ② After the completion of project construction, the potential risk from the original bumpy road will be removed, and the rural environment (flying dust on sunny days and muddy road on rainy days) will be greatly improved; ③ After the completion of project construction, the conditions of carriage of local agricultural products will be immediately improved, the local agricultural products can be sold in time and the farmers' income will be increased; ④ After the completion of project construction, the road network and driving conditions in the rural area will be improved to create conditions for the development of local non-agricultural industries such as transportation and tourism and to offer new source of income for local residents.	
(3) Suggestions or opinions on project construction		
① Connectivity between the road and farmland irrigation canal	① If a farmland irrigation canal along the road will be affected by the construction in the farmland irrigation season, the farmland irrigation canal should be built in advance to avoid the impact of project construction; ② A water channel should be designed for the road section where the farmland irrigation canal intersects the road; ③ The farmland irrigation canal damaged during the construction should be repaired after the completion of construction.	
② Drainage of side ditch (especially the road section passing by a village)	① The responsibilities of dredging and maintaining the side ditch should be assigned to specific persons, and the side ditch should be regularly inspected; ② The side ditch of the road passing by a village should be equipped with cover plate.	
③ Security issues (especially the road section passing by a village and school)	① Warning signs should be placed before a village and school to remind the drivers and conductors; ② The speed limit signs should be established; ③ Speed bumps, zebra stripes, etc. should be built at the road section passing by a village and school.	
④ Environmental protection measures during the construction and operation	① Suppressing the dust through watering during the construction; ② Prohibiting the road transportation from 22:00-6:00 at night during the construction; ③ Strengthening the management and education of constructors, observing the village regulations and non-governmental agreements of the	

	villages along the road, and prohibiting the disturbance to the residents, casual destruction or destroy of crops and property; ④ The remaining soils and stones can not be piled up on the roadside and should be removed to the designated spoil ground in time, in order to prevent the soils and stones from destroying the downstream plowland or farmland in case of rain wash; ⑤ Prohibiting whistling when the vehicles pass by a village during the operation.	
⑤ Selection of construction camp, asphalt mixing station, borrow area and spoil ground	① The villagers' houses along the road should be rented as construction camps; ② The plant-mixing method should be applied to the asphalt mixing stations (if any); ③ The local existing borrow area and spoil ground should be used as far as possible.	
⑥ Slope protection	① The way of protecting slope with plants should be applied to the upper soil slope with low gradient and altitude; ② The comprehensive slope protection should be applied to the lower slope and vertical slope; ③ In addition to slope protection, the collective drainage ditch should be built on the edge and at the foot of the side slope for the convenience of slope drainage.	
⑦ Road maintenance	① The bulletin board including the contents such as name of maintenance unit, person in charge of maintenance, name of the road, start-stop stake mark of the road and supervision hotline should be established to accept the supervision of the local people; ② The overrun and overload should be inspected strictly; ③ The maintenance and dredging of roadside ditch should be strengthened in the flood season to prevent the flood from destroying the road; ④ The drainage design for the low-lying road section should be made to avoid damage of road surface due to long-term immersion.	
⑧ Connectivity of branch line	① The interface of road passing through a village should be reserved.	

(3) Results of questionnaire survey

① Respondents

The respondents mainly involve the villagers along the road, township/town governments and village committees where the project is located. 300 public participation questionnaires were distributed to the individuals, including 60 questionnaires in Xifeng County, 120 questionnaires in Kaiyang County, 120 questionnaires in Huaxi District, 100 questionnaires in Wudang District, 60 questionnaires in Qingzhen City and 100 questionnaires in Baiyun District; and 90 public participation questionnaires were distributed to the groups, including 10 questionnaires in Xifeng County, 20 questionnaires in Kaiyang County, 20 questionnaires in Huaxi District, 15 questionnaires in Wudang District, 15 questionnaires in Qingzhen City and 10 questionnaires in Baiyun District.

② Findings

See Table 20.3-5 for the findings among the individuals and table 20.3-6 for the findings among the groups.

Table 20.3-5 Statistical results of public opinions about environmental impact assessment (for individuals)

Questions		Number of people	Ratio (%)
1. Your view on the project construction:	For	300	100
	Against	0	0
	Indifferent	0	0
2. What will the project construction bring to your life and income?	Positive effect	300	100
	Adverse effect	0	0
	No effect	0	0
3. What do you think of the environmental quality where you are living now?	Good	98	33
	General	156	52
	Poor	46	15
4. The main environmental problems where the project is located at present:	Air pollution	218	73
	Water pollution	20	7
	Ecological damage	18	6
	Noise pollution	130	43
5. The environmental problems you care about most during the project construction:	Noise	173	58
	Geological disaster	3	1
	Ecological damage	78	26
	Landscape damage	80	27
	Water pollution	42	14
	Air pollution	178	59
6. Which will seriously affect the environment during the operation after the completion of construction?	Noise	165	55
	Tail gas	10	3
	Water pollution	0	0
	Dust	210	70
7. Some farmland will be occupied and houses pulled down due to the road construction. Which do you think is the best compensation way?	Monetary compensation	180	60
	Relocation	120	40
	Other	13	4
8. Do you think the project construction will contribute to the local economic development?	Yes	300	100
	Not obvious	0	0
	No	0	0
9. Can you accept the environmental impact caused by the project construction?	Yes	213	71
	No	0	0
	Not care	87	29
10. Do you bow to the land acquisition, demolition and relocation?	Yes	80	27
	No	0	0
	Conditional acceptance	220	73
11. Which way do you think will mitigate the impact?	Road greening	270	90
	Sound barrier	0	0
	Being far away from the centralized residential area	10	3
	Other	20	7
Other suggestions and comments are summarized below: 1. Implementing the construction of each project as soon as possible; 2. Strengthening the management and maintenance of side ditch and loading limit especially; 3. Afforesting the roadside with plants; 4. Applying guardrails to the dangerous areas, and warning signs and speed bumps to the intersections in the villages densely distributed; 5. Working out the slope protection design.			

Table 20.3-6 Statistical results of public opinions about environmental impact assessment (for groups)

Questions		Number of people	Ratio (%)
1. Your view on the project construction:	For	150	100
	Against	0	0
	Indifferent	0	0
2. What will the project construction bring to the economic development of the local area and the department?	Positive effect	150	100
	Adverse effect	0	0
	No effect	0	0
3. What do you think of the environmental quality of each project along the road?	Good	50	33
	General	100	67
	Poor	0	0
4. The main environmental problems where the project is located at present:	Air pollution	70	47
	Water pollution	20	13
	Ecological damage	10	7
	Noise pollution	90	60
5. The environmental problems you care about most during the project construction:	Noise	100	67
	Geological disaster	3	2
	Ecological damage	78	52
	Landscape damage	80	53
	Water pollution	42	28
6. Which will seriously affect the environment during the operation after the completion of construction?	Air pollution	120	80
	Noise	130	87
	Tail gas	10	7
	Water pollution	0	0
7. Is the project construction conducive to the improvement of local residents' living quality?	Dust	120	80
	Yes	150	100
	No	0	0
8. What will the project construction bring to the development of tourist business?	Uncertain	0	0
	Positive effect	150	100
	Adverse effect	0	0
9. The impact of project construction on the ecological environment and agricultural resources along the road is:	No effect	0	0
	Acceptable	150	100
	Unacceptable	0	0
Other suggestions and comments are summarized below:	Indifferent	0	0
	1. Implementing the construction of each project as soon as possible.		

The statistical results in table 20.3-2 and 20.3-3 indicate that the project construction is strongly supported by individuals and groups. And they hope that the construction of each project will start as soon as possible; the side slope and drainage ditch, etc. will be designed; the maintenance and management of road may be strengthened; and the economic benefit, social benefit and environmental benefit will be really realized.

(4) Result of announcement of full text

During the announcement of full text, the employer and environmental assessment department did not receive any call or letter objecting to the project construction.

21 Training and Capacity Building

For the smooth and effective implementation of the project, the trainings of environmental protection knowledge and skills for all employees, especially the constructors, must be carried out. Main training materials include this ECOPs and environmental management plan (if any), as well as national and local laws and rules of environmental protection, water conservation, cultural relics preservation, health and folk customs preservation. In principle, before every new subproject comes into operation, the Project Office should organize contractor and supervision company to carry out a training. During the period of subproject implementation, the Project Office can accord with the requirement to train the contractor and supervision company. Also, the contractor and supervision company should carry out internal environmental protection training at regular intervals. The training and education of environmental protection should include the following contents:

(1) Before the project construction starts, the Project Office should organize training class to train civil works contractor and supervision company.

(2) Before the construction starts, the civil works contractor should educate, train and evaluate the operating personnel of the construction site. During the period of construction, the training should be carried out at regular intervals in accordance with actual requirement (e.g. to new constructors).

(3) The civil works contractor should annually implement the training of risk emergency plan for the employees and organize the practice.

(4) The civil works contractor should semiannually carry out the occupational health training and physical examination for the people who are exposed to toxic and harmful environment, and should direct the operating personnel to correctly use the occupational damage prevention equipment and personal labor protection articles.

(5) The Project Office should regularly organize or ask for contractor and supervision company to invite local epidemic prevention department to launch epidemic, venereal and Aids prevention education in the constructors.

See Table 21.1-1 for the detailed training plan.

Table 21.1-1 Training plan of environmental protection technicians

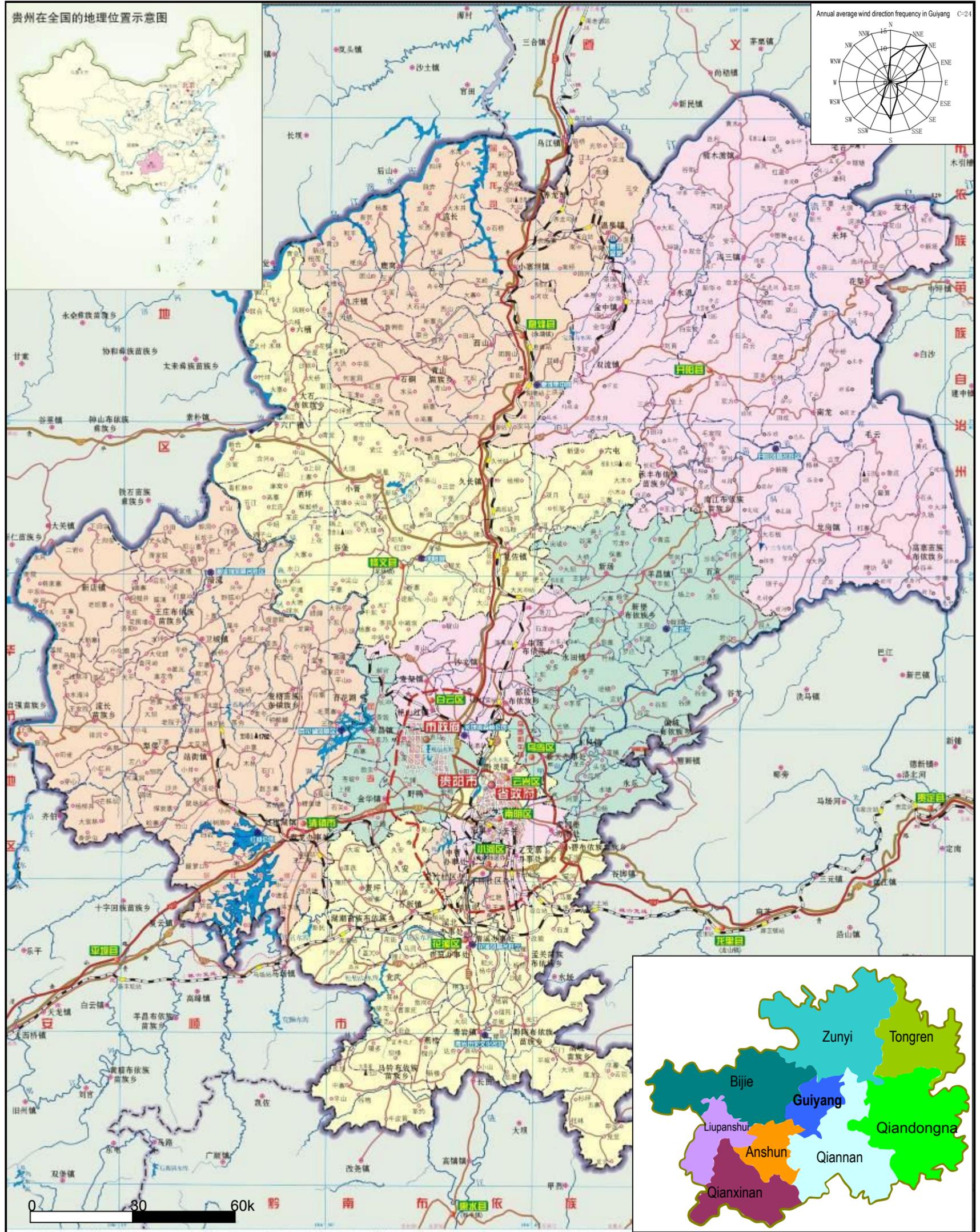
Objects	Training contents	Way	Number of people	Time (day)
Environmental workers	Basic theories and monitoring methods of environment, compilation of monitoring report and on-the-job training	Domestic training	2 persons for each construction section	2
Environmental engineers and environmental management personnel of the building party	Environmental laws and regulations, construction planning, and environmental monitoring standards and specifications	Domestic training	1-2 persons for each construction section 2-4 persons of the building party	2
	Monitoring of ambient air and control technology; noise monitoring and control technology	Domestic training	6	2
Senior managers of environment and environmental engineers	Advanced environment and traffic management experiences and noise controlling methods from abroad	Domestic training	4	1
Total				7

Attached Maps:

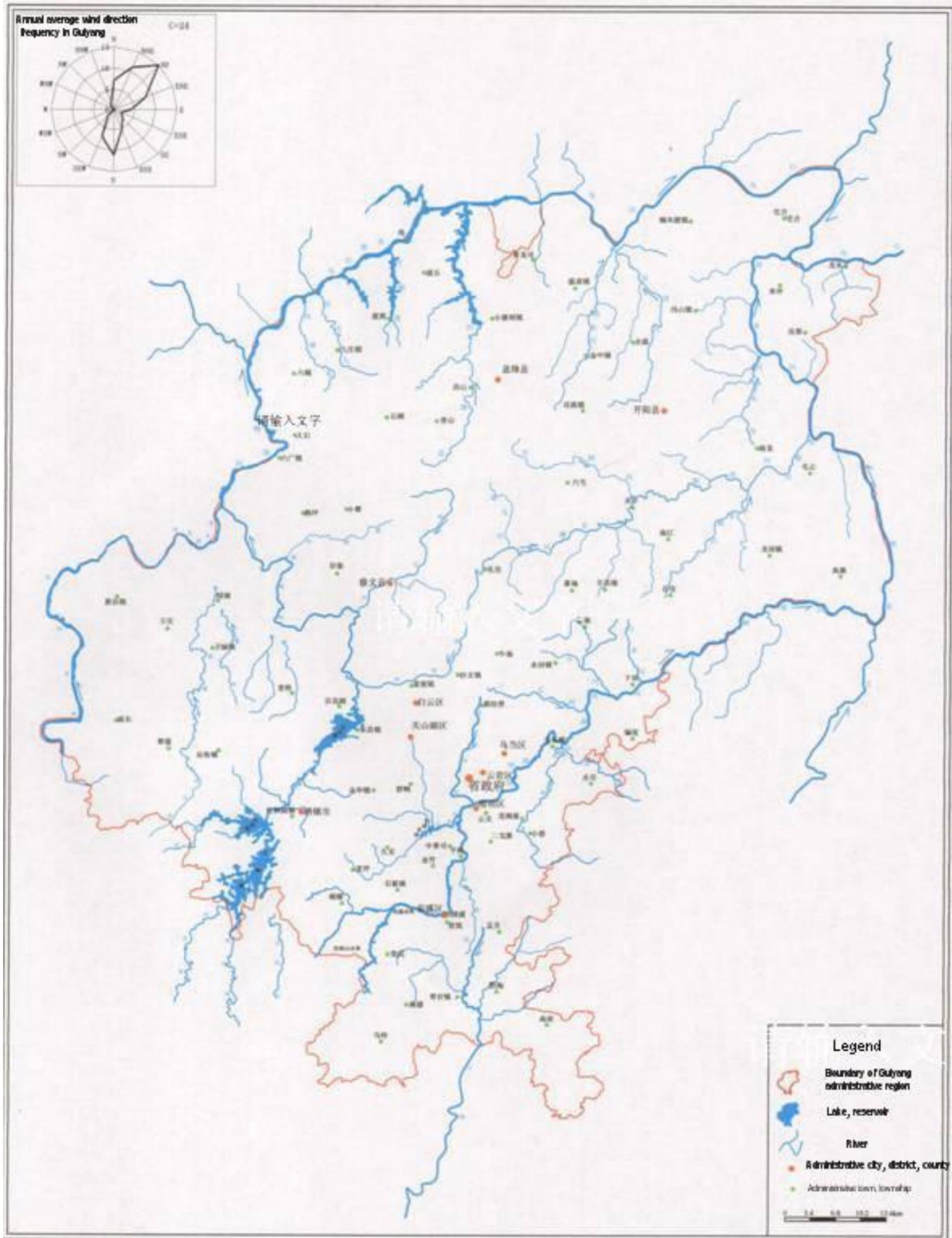
Attached map 1: Map of Guiyang's geographical position in Guizhou, China

Attached map 2: Map of main surface drainages (river and reservoir) in Guiyang

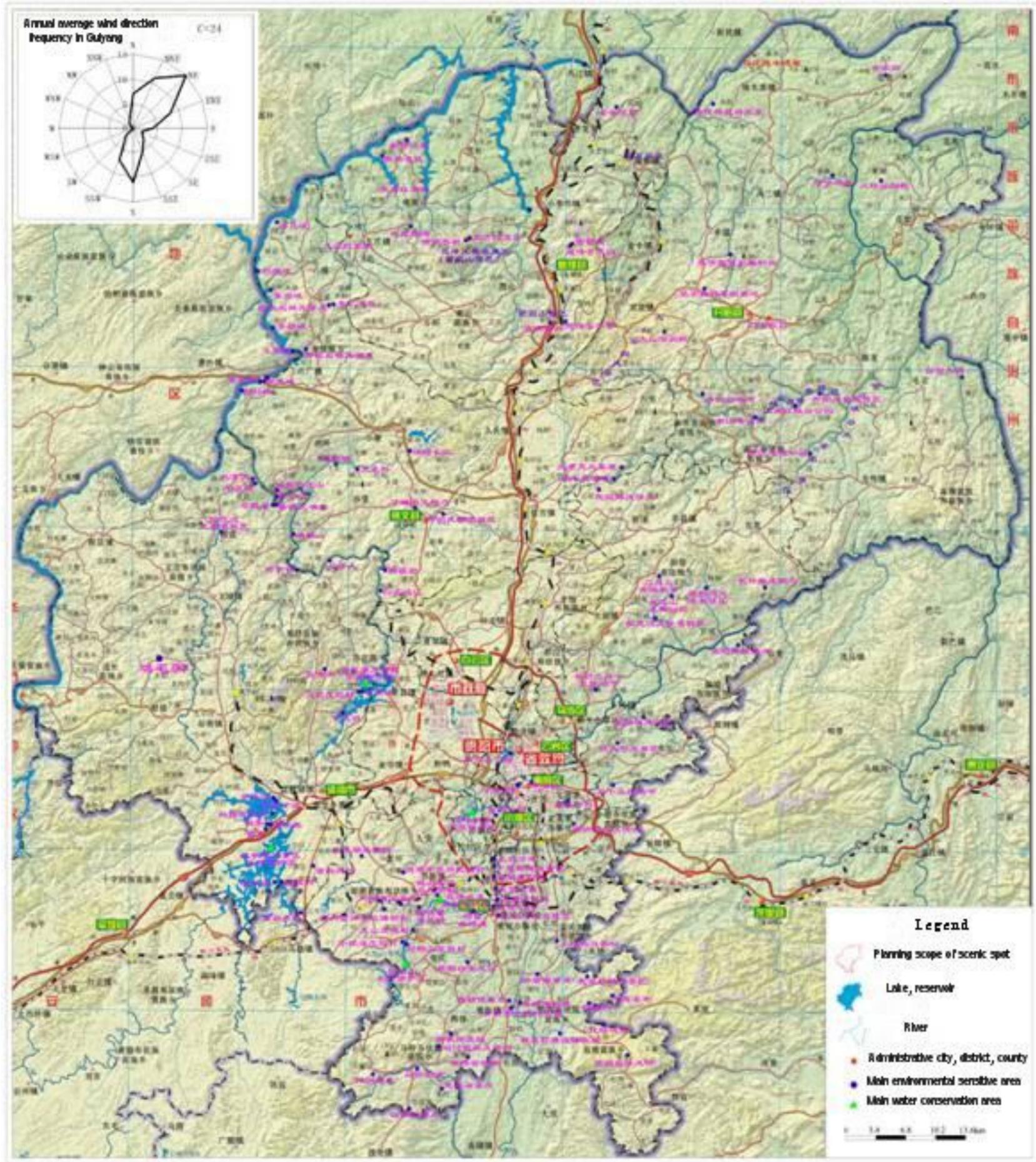
Attached map 3: Distribution map of main sensitive areas (scenic spot, forest park, water conservation district, folk customs spot, etc.) in Guiyang



Attached map 1: Map of Guiyang's geographical position in Guizhou, China



Attached map 2: Map of main surface drainages (river and reservoir) in Guiyang



Attached map 3: Distribution map of main sensitive areas (scenic spot, forest park, water conservation district, folk customs spot, etc.) in Guiyang

Appendixes:

A. Abbreviations & Technical Terms

1. The World Bank (WB)

A specialized agency under the United Nations, an international financial institution responsible for long-term loans

2. World Bank Safeguard Policy

In order to properly consider the social and environmental impact brought by the projects funded by the World Bank, including analysis of possible impact and mitigation measures of negative impact

3. Environmental Assessment (EA)

Giving value assessment, judgment and to propose solution for environment system condition

4. Environmental Impact Assessment (EIA)

The method and system for implementing analysis, prediction and assessment on the environmental impact of programs and construction projects that might incur after they are carried out, proposing countermeasures and matures for preventing or mitigating adverse environmental impacts and making follow-up monitoring

5. Environmental Code of Practices (ECOPs)

Refers to the countermeasures, measures, methods and system for preventing or mitigating adverse environmental impacts of programs and construction projects that might incur after they are carried out

6. Roadway Surface Drainage

Refers to the surface drainage within the road land range, including pavement surface drainage, central dividing strip drainage, slope drainage, and drainage of water within the road that flow from adjacent roads or cross ways

7. Pavement Surface Drainage

Refers to the drainage of surface water within the pavement and shoulder

8. Slope Drainage

Refers to the drainage of surface water within the embankment slope, cut slope and natural slope tending to the road

9. Underdrains

Refers to the drainage ditch under the ground or set in roadbed, which is made of drain-pipe or drain-hole, water permeability backfill pellets and filtration fabrics or inverted filter formed to block or reduce the groundwater level

10. Culvert

A small structure built to ensure overland flow can crosses beneath a road

11. Pipe Culvert

A culvert with pipe-shape body

12. Arch Culvert

A culvert with arch top

13. Box Culvert

A culvert with reinforced concrete body, box-type section and arch top

14. Slab Culvert

A culvert with reinforced concrete slab, slate, etc. body

15. Outlet Submerged Culvert

A culvert with both inlet and outlet submerged in water, filled with water in the whole body and the top of body withstanding head pressure

16. Inlet Submerged Culvert

A culvert with inlet submerged in water, only partial body withstanding head pressure

17. Inlet Unsubmerged Culvert

A culvert with the flow under non-pressure

18. Inverted Siphon Culvert

A culvert with water pressure on both sides of the roadbed through the shape of inverted siphon.

19. Back Water

The phenomenon that the upstream water level arising caused by compression of water flow or jacking of tidal water level, main stream water level

20. Sediment

The phenomenon that the silt carried by water deposited due to slow flow

B. Attached Tables

Attached Table 1. Environmental screening form

Attached Table 2. Summary sheet of environmental supervision of project

Attached Table 3. Checklist of environmental protection review in construction period

Attached Table 4. Rectification notice of environmental protection issued by environment supervisor to contractor

Attached Table 5. Checklist of environmental protection before acceptance

Attached Table 6. List of the first projects

C. Appendix

Appendix 1. Outline of appointing external monitoring organization for environmental management

Attached Table 1: Environmental screening form

This form is used to assess potential environmental and social risks and impacts arising from engaging in specific engineering activities in specific workplace. The results can determine the type of environmental assessment, guide preliminary design of the project and is conducive to the guidance of the type and scope of environmental assessment, also can be as a tool for an environmental consultant to guide environmental assessment.

Name of subproject		No.			
Location of subproject		Filling date			
Checker		Signature of project leader			
No.	Screening criteria	Yes	No	Description	Remark/ proposed action
Geographic position					
1	In or adjacent to nature reserves (existing or planned), scenic areas, forest parks, protection areas of drinking water source or areas of high ecological value?				
2	Having vulnerable or endangered species (aquatic or terrestrial) in the area?				
3	Having natural habitats / ancient and rare trees in the area?				
4	If there is a natural habitat, is it unique and rare in the scale?				
5	Having wetlands, saturated soil zone (permanent or temporary), or pond marks (cracks, high-clay soil, dead plants, water marks) in the project area?				
6	Has the project area degraded (low water, poor soil)?				
7	An abrupt slope?				
8	People living in the project or near the project?				
9	Some land used for other purposes (pasture, farm) in the project area?				
10	Having roads in the project area?				
11	To be threatened by natural disasters (floods, earthquakes, high winds)?				
12	Having any economic activities around the project (businessmen, sellers)?				
13	Having any known archaeological, historical or other cultural heritage in the project area?				
Impact on nature					
14	A large excavation planned? Needing a lot of stones (quarry and borrow area)?				
15	Will the project add solid waste or mechanical waste (waste oil, etc.)?				
Impact on water resource					
16	Will the level of underground water be changed for changes in flow, surface laying or extraction of more and more underground water?				
17	Affecting the quality of underground water?				
18	Affecting the quality (discharged with the form of sediments, wastewater, rain water or solid waste, etc.) of surface water (lakes, rivers, brooks, irrigation canals)?				
19	Affecting the quality of nearby water (lakes, rivers, brooks)?				
20	Having sources of drinking water near the project area to be protected?				

Attached Table 1: Environmental screening form (continued)

Name of subproject		No.			
Location of subproject		Filling date			
Checker		Signature of project leader			
No.	Screening criteria	Yes	No	Description	Remark / proposed action
Impact on ecology					
21	Affecting natural habitats or areas of high ecological value?				
22	Affecting the natural attributes of adjacent or nearby sites?				
23	Affecting wildlife, natural vegetation and ancient trees?				
Impact on drainage					
24	Affecting the existing drainage way by the rainwater drainage system?				
25	Bringing stagnant water which is dangerous to public health?				
26	Will the sediment caused by water and soil loss affect the nearby water bodies?				
27	Affecting the surface drainage system of quarries and borrow areas?				
28	Affecting the permeability way?				
Impact on social economy					
29	Involving human settlements?				
30	Affecting the indigenous peoples?				
31	Affecting local residents to use natural resources?				
32	Affecting land utilization, plant type?				
33	Schools around the project?				
34	Be harmful to human health?				
35	Affecting the nearby residents in construction period? Any safety issue in construction period?				
36	Affecting cultural resource?				
37	Affecting nearby property?				

Attached Table 2: Summary sheet of environmental supervision of project

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
Design stage				
1	Water loss & soil erosion	Designing reasonable construction process and scientific construction method, selecting material and the location of stock ground and spoil ground properly so as to prevent water loss and soil erosion.	Design institute Assessment organization	Office of the project of Guiyang rural road construction financed by the World Bank loan and project supervision company
2	Greening	Designing for greening around buildings.		
3	Farm protection	Compensating for the requisition land according to relevant regulations and the fund should be issued to each household.		
4	Air pollution	The stock ground and mixing station should be located at a distance of more than 200m away from the sensitive point.		
5	Slope protection	Selecting reasonable slope protection methods according to project features and requirement of slope protection.		
Construction stage				
1	land resource and land vegetation	<p>(1) Arranging construction site properly, minimizing the scope of construction activities and reducing the extent of damage to vegetation;</p> <p>(2) The necessary construction materials, such as stone, sand, cement, etc., should be purchased according to consumption so as to reduce land coverage and damage to vegetation; After the project is completed, clean and greening the construction site, try best to recover the damaged vegetation;</p> <p>(3) According to check results of construction site, protective fence should be built for the trees in the construction site before construction;</p> <p>(4) All signs except identification label cannot be pasted to the trees and any construction materials and mechanical equipments cannot be placed around the protected area of trees;</p> <p>(5) To construct drainage ditches in the construction site and to built flood discharge channel for the surface runoff channel which has been damaged by the project, so as to discharge flood in rainy season and to avoid erosion to project;</p> <p>(6) Under the premise of high construction quality, the employers should try their best to shorten the time for temporary land occupation, to control construction time of earthworks, to cut and fill slopes stably and to reduce the impact on the place outside the scope of construction.</p> <p>(7) The topsoil of construction camp, dressed stone ground and borrow area should be stripped and stockpiled, which will be used for late rehabilitation and greening.</p>	Contractor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management
2	Water and soil loss	<p>1. Roadbed</p> <p>(1) topsoil stripping and protection;</p> <p>(2) water retaining dam of road shoulder and temporary chute;</p> <p>(3) sediment precipitation measures: building sedimentation basin at the outlet of roadbed drainage ditch</p> <p>2. Concrete mixing plant</p> <p>(1) The whole site should be hardened with cement;</p> <p>(2) Each concrete mixing station should be with a sand basin and the surface water can be used comprehensively through sand basin;</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
		<p>(3) In the late phases of project, the main tasks of land remediation are to dismantle construction facilities, to clear the building materials, such as stone, sand, etc., throwing during the concrete mixing process, and to greening or reclaim the land where the project is located and to restore the former appearance as far as possible.</p> <p>3. Access road Try to select existing road as access road; For new construction, wasteland should be chosen, and it is prohibited to occupy forest land, farmland. Drainage ditches should be built on the sides of access road to prevent water loss and soil erosion.</p> <p>4. Temporary spoil (residue) ground (1) Pay attention to selection of the spoil (residue) ground; when the spoil (residue) ground destroys the original vegetation or change the original slope gradient and bare slope is formed, afforestation or reclamation are needed. (2) After the spoil is disposed, the spoil ground should be covered with greenery, used for farmland or for other purposes. (3) The spoil holding structure and slope protection project of the spoil ground shall be built properly according to the location, nature and height of spoil. If the spoil is stacked in channel, the spoil holding dam should be built. (4) The drainage system in spoil ground should be set up according to topography, geological and hydrological conditions of borrow area, as well as channels and irrigation facilities, so as to avoid washing to farmland and slope caused by washing of soil or the change of surface runoff conditions. If the flow can converge around the spoil ground, the flow can be discharged through the measures of cutoff and drainage;</p> <p>In addition, after the project is completed, native species rather than alien species should be planted in the control areas of main works, access road, concrete mixing station and temporary spoil (residue) ground.</p>		

Attached Table 2: Summary sheet of environmental supervision of project (continued)

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
3	Surface water pollution	<p>(1) The vehicle cleaning wastewater, materials washing wastewater, concrete curing wastewater and sand and gravel washing wastewater should be collected through deposited in temporary sedimentation basin after mixing dilution. The temporary sedimentation basin must be built with the size of holding wastewater for over 12 hours. The wastewater after treatment shall be used to wash construction site, building materials, sand and gravel and cure concrete.</p> <p>(2) A dry latrine should be built in the construction site. The feces should be removed regularly as fertilizer according to actual living conditions in rural area.</p> <p>(3) Strengthen construction management, strictly control the construction machines' running, discharge, dripping and leakage, take measures of drainage system and water conservation for temporary soil store area so as to protect water environment from water loss and soil erosion of spoil stocking.</p> <p>(4) All employers must implement the various measures to treat production wastewater and sewage to ensure that all wastewater are treated and disposed well.</p> <p>(5) The construction workers' environmental protection education should be strengthened and their environmental awareness should be improved. Construction workers cannot abandon wastes and wastewater at will.</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management
4	Construction noise	<p>(1) Selecting advanced and reliable equipments with low noise;</p> <p>(2) The construction time is from 6:00 am to 22:00 pm, of which, construction is prohibited from 12:00 to 14:00. Construction is also prohibited at night. If the project must be contentiously constructed at night, a certification should be issued by an administration office of construction and approved by an administration office of environmental protection. The nearby residents should be informed.</p> <p>1. Construction period should be arranged properly so as to avoid several large high-noise machines operating at the same time and in the same construction site. The construction should be completed as quickly as possible to shorten the time of noise impact and the employer should make every effort to reduce the noise impact on construction workers.</p> <p>(4) For the high-noise machines, basic shock-absorbing should be taken or damping materials should be dressed.</p> <p>(5) The noise of vehicle transportation may has some impact on sensitive points, therefore, the employer should improve the environmental awareness of the construction workers, know the local custom and living habits in time, arrange transportation time properly, take measures, such as speed-limit, no-honking, etc., on the noise of construction machines in the environmental sensitive places so as to prevent and reduce the noise impact.</p> <p>(6) The high-noise mechanical equipments should be placed at the side of construction site away from residential areas. The barrier with noise-reduction function should be built around the construction site</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
		<p>which is located at the distance of less than 5m.</p> <p>(7) The employer should arrange construction workers properly, shorten their time of operating high-noise machines and provide earmuffs to construction workers to reduce the noise impact on them.</p> <p>(8) All mechanical equipments should be in good state by regular maintenance and repair so as to achieve the purposes of noise-reduction and long service time.</p> <p>(9) It should be strictly control the intensity of construction, mechanical and vehicle operators, operating procedures.</p>		
5	Air pollution	<p>(1) The construction road should be built with gravel surface and be watered regularly to reduce dust;</p> <p>(2) The materials in fine particles piled up in the construction site should be kept sealed or covered, and watered the pile surface according to the materials nature to reduce dust production effectively.</p> <p>(3) When constructing canal, the environmental sensitive points (areas) should be enclosed in barricade;</p> <p>(4) The construction waste should be removed by a closed container and cannot be throw in the air. The construction waste should be stocked in different classes based on relevant municipal waste classification regulations and cleaned and removed in time after watering moderately.</p> <p>(5) To strengthen the management of transportation vehicles, the vehicles transported with dust-production should be covered with tarpaulin.</p> <p>(6) The demolition project should be constructed in the condition of watering to reduce dust. All muck should be removed within 3 days from the date of completion of the demolition. The employer should comply with relevant regulations on demolition project management.</p> <p>(7) The measure of enclosing shelter or watering should be taken in the dust emission area of the construction site to reduce dust.</p> <p>(8) In construction site, the earthwork should be stacked in a place and covered. The vehicles should not be overfilled to prevent scattering during transportation.</p> <p>(9) A measure of cleaning vehicles should be taken at the entrance of construction site. All soils adhered to vehicles should be removed before get out the entrance.</p> <p>(10) The place used to stock materials and large formwork in the construction site should be flat and solid.</p> <p>(11)The construction site should be watered and cleaned in time.</p> <p>(12) Considering the prevailing wind and the surrounding environmental protection objectives, the material of main dust production such as dispersed materials with fine particles should be kept in a down wind area and over 300m away from surrounding environmental protection objectives.</p> <p>(13) Various types of waste cannot be burnt.</p> <p>(14) The fuel construction machinery and vehicles must be used under normal conditions and the waste gas should be discharged after reaching the emission standard.</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management

Attached Table 2: Summary sheet of environmental supervision of project (continued)

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
6	Construction safety and health	<p>The employer is responsible for compliance with all national and local safety requirements to avoid accidents and other measures to protect the safety and health of construction workers.</p> <p>(1) The employer should ensure the integrity of all buildings within the construction site; temporary buildings should be structurally safe and reliable, can withstand the bad weather appropriately, and should be with adequate light, can isolate partial dust and noise.</p> <p>(2) The contractor should ensure that the first-aid treatment requirement can be met. In the construction site, appropriate first-aid equipment should be equipped; in remote locations, there should have written emergency procedures, so the patient can be transferred to an appropriate medical institution.</p> <p>(3) All new construction workers should be trained with occupational health and safety, and introduced with basic working rules, personal protection rules and methods that can prevent injuries to other workers.</p> <p>(4) Correct signboards shall be hung in all dangerous areas (distribution room, compressor room, etc.), equipments, materials, safety measures, emergency exits, etc..</p> <p>(5) The conditions that workers' hands and arms shake due to using hand tools, electric tools, or the whole body shakes due to standing or sitting on a shaking surface shall be controlled by the methods of selecting proper equipments, installing shock pad or equipments, limiting exposure time.</p> <p>(6) Clamping hazards should be eliminated when designing a machine to ensure that the part out of the machine under normal operation is not harmful to persons.</p> <p>(7) Place warning signs on all energized electrical devices and wires; check all wires, cables, hand electric tools to confirm whether they are damaged or bared and confirm the allowable maximum operating voltage of the hand electric tools according to the suggestion of manufactures; double insulating or giving ground processing all electric equipments used in wet (may be wet) environment.</p> <p>(8) Provide appropriate eye protection appliances for all welding operators and assistants (such as welding goggle and/or mask).</p> <p>(9) Protective railings should be installed on the edge of the dangerous areas (should with a middle pole and toe-board); meanwhile, construction workers should adopt falling prevention device (including seat belts and distance limit line).</p> <p>(10) The employer confirms and provides appropriate personal protection equipment to construction workers to sufficiently protect construction workers, other workers, occasional visitors, and cannot bring unnecessary troubles for the users.</p> <p>(11) The employer should establish the procedure and system to report and record occupational accidents and damages, dangerous situations and accidents.</p> <p>(12) Provide health education for construction workers, such as implementing information communication strategies, strengthening face-to-face consulting work;</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management

No.	Management content	Mitigation measures	Implementing agency	Supervision agency
		in addition, encourage using anophelifuge, clothes, mosquito nets to block mosquito and avoid damage spread.		
7	Hazardous waste and chemical waste	<p>(1) The chemicals should be kept appropriately and with a sign.</p> <p>(2)The dangerous articles should be stored with the requirement of the certificate of storage on storage type and date.</p> <p>(3) When the mechanical equipments are maintained, the greasy dirt should be collected in special containers.</p> <p>(4) The materials and tools for emergency accidents such as oil spill kits, sand, saw dust for absorbing the leaked chemicals should be prepared.</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management
8	Others	<p>(1) The requisition land should be compensated according to relevant requirement. The funds cannot be retained for other purposes to protect the vital interests of affected people.</p> <p>(2) All workers should be examined regularly to prevent epidemics.</p> <p>(3) Construction must be stopped when cultural relics is found and report the situation to the local department of cultural relics. Construction cannot be continued before the department of cultural relics completes appraisal work and takes necessary protective measures.</p> <p>(4) In construction site, there should be safety supervisors, obvious warning signs and night lights with sign. Pedestrians and livestock are prohibited to enter the construction site.</p>	Constructor	Office of the project of Guiyang rural road construction financed by the World Bank loan, project supervision company, external monitoring organization for environmental management

Attached Table 3: Checklist of environmental protection review in construction period

Check elements	Implemented or not?		N/A	Remark
	Yes	No		Problems and illegal conditions founded, measures for rectification and prevention proposed
1. Air pollution control				
1.1 Reduced dust in the construction site by watering?				
1.2 Covered or watered the stacking area for power materials to reduce dust?				
1.3 Covered or watered the vehicles transported powder?				
1.4 Watered the demolition project to reduce dust.				
1.5 Allocated and transported the building waste with enclosed container				
1.6 Enclosed the environmental sensitive points (areas) in barricade when the road is constructing;				
1.7 Piled up earthwork in construction and taken coverage measures?				
1.8 Cleaned the solid adhered to the vehicles before get out of the construction site?				
1.9 Does the place used to stock materials and large formwork in the construction site is flat and solid?				
1.10 Kept the material of main dust production such as dispersed materials with fine particles in a down wind area and over 300m away from surrounding environmental protection objectives, for considering the prevailing wind and the surrounding environmental protection objectives?				
1.11 Hardened, paved with sand or watered the roads with more dust?				
1.12 Limited speed on access road? With speed-limit signs?				
1.13 Used construction machinery with oil and vehicles under normal condition? Eliminated black smoke at runtime?				
1.14 Burnt various waste?				
1.15 Others (please specify)				
.....				
2. Water pollution control				
2.1 Used and maintained the wastewater system (eg. Temporary sedimentation basin) in construction site normally?				
2.2 Treated and used wastewater of construction effectively?				
2.3 Discharged the wastewater of construction to rainwater channel?				
2.4 Set up sedimentation basin to collect wastewater of construction (such as earth-bank ditch or U-shape slot)?				
2.5 Removed sediment of U-shape slot?				

Attached Table 3: Checklist of environmental protection review in construction period (continued)

Check elements	Implemented or not?		N/A	Remark
	Yes	No		Problems and illegal conditions founded, measures for rectification and prevention proposed
2.6 Removed sediment of temporary sedimentation basin?				
2.7 Cleaned vehicles and equipments before get out of the construction site?				
2.8 How about the maintenance situation of washing facilities? Taken measures to prevent overflow of sediment?				
2.9 Precipitated the soil and sand of facility washing area and removed regularly?				
2.10 Kept the public roads, entrances, temporary walls in clean conditions without muddy water?				
2.11 Treated the sewage properly?				
2.12 Removed feces in dry latrine in time?				
2.13 Prohibited to pile up construction materials such as pitch, oil plants, chemicals, etc. in the place near water?				
2.14 Constructed bridges and culverts in dry season and minimized construction time to reduce impact for water body?				
2.15 Others (please specify)				
.....				
3. Noise control				
3.1 Held valid construction noise permit in noise-limit period?				
3.2 Pasted the construction noise permit on the entrance and exit of the construction site?				
3.3 The idle equipments in the construction site are turned off or under throttled state?				
3.4 Taken effective noise reduction measures (vibration attenuation, sound attenuation, noise barriers)?				
3.5 Selected low-noise equipments?				
3.6 Arranged the construction time reasonably?				
3.7 Set up the high-noise mechanical equipments at the side of construction site away from residential areas?				
3.8 Effectively maintained and repaired all mechanical equipments regularly?				
3.9 Strictly control the intensity of construction, mechanical and vehicle operators, operating procedures?				
3.10 Others (please specify)				
.....				
4. Solid waste management				
4.1 Is the construction site clean and tidy?				

Attached Table 3: Checklist of environmental protection review in construction period (continued)

Check elements	Implemented or not?		N/A	Remark
	Yes	No		Problems and illegal conditions founded, measures for rectification and prevention proposed
4.2 Comprehensively used some building waste combined with small civil engineering and public roads?				
4.3 Piled up the remaining building waste at the stipulated place in the construction site and removed to solid waste landfill where the project is located for disposal?				
4.4 Used spoil including some mellow soil to reclaim the wasteland to forest where the project is located? Used remaining earthwork to fill embankment and both sides of channels of nearby public roads?				
4.5 Moderately watered before cleaned and transported building waste?				
4.6 Collected garbage in bags and then removed to solid waste landfill where the project is located for disposal?				
4.7 Burnt poisonous and harmful substance in construction site?				
4.8 Cleaned the soil polluted by oil immediately?				
4.9 Treated waste of asbestos by registered professionals?				
4.10 Others (please specify)				
5. Hazardous waste and chemical waste				
5.1 Kept the chemical in a safety place and with a sign?				
5.2 Does the storage of dangerous articles meet the requirement of the certificate of storage on storage type and date?				
5.3 Collected the greasy dirt in a special container during the maintenance period of mechanical equipment?				
5.4 Prepared tools for emergency accidents such as oil spill kits, sand, saw dust for absorbing leaked chemicals				
5.5 Others (please specify)				
.....				
6. Protection of animals, plants and cultural relics				
6.1 Minimized the impact for land plants? Was plants protected?				
6.2 Found rare animals?				
6.3 Found cultural relics in construction period? If find, protection measures was taken?				
6.4 Others (please specify)				

Attached Table 3: Checklist of environmental protection review in construction period (continued)

Check elements	Implemented or not?		N/A	Remark
	Yes	No		Problems and illegal conditions founded, measures for rectification and prevention proposed
7. Resource protection				
7.1 Prevented the conditions of water pipe break and waste?				
7.2 Turned off diesel- powered equipment when it is not in use to reduce fuel consumption?				
7.3 Taken energy conservation measures?				
7.4 Used metal or other substitute products to reduce wooden consumption?				
7.5 Is the materials under good storage conditions to prevent degrade or waste of materials?				
7.6 Others (please specify)				
.....				
8. Conservation of water and soil				
8.1 Taken topsoil stripping and protection before the construction of roadbed?				
8.2 Set up water retaining dam of road shoulder and temporary chute?				
8.3 Built sedimentation basin at the outlet of roadbed drainage ditch?				
8.4 Hardened The whole site of concrete mixing station with cement?				
8.5 Built a sedimentation basin to each concrete mixing station?				
8.6 Taken measures of barrier, slope protection and drainage around temporary spoil (residue) ground?				
8.7 Taken plant measures (greening by native species)?				
8.8 Repaired the bared slope in time to shorten the bare time?				
8.9 Others (please specify)				
.....				
9. Construction safety and emergency measures				
9.1 Protected all buildings in the construction site in integrity?				
9.2 Equipped with appropriate emergency tools in the construction site?				
9.3 Hung correct signboards in dangerous areas, equipments, materials, safety measures, emergency exits?				
9.4 Provided proper personal protective tools for construction workers by the employer?				
9.5 Established procedures and system to report and record the occupational accidents and damages, dangerous situation and accidents?				
9.6 Provided health education to construction workers?				

Attached Table 3: Checklist of environmental protection review in construction period (continued)

Check elements	Implemented or not?		N/A	Remark
	Yes	No		Problems and illegal conditions founded, measures for rectification and prevention proposed
9.7 Reported accidents or incidents? Proposed and recorded suggestion for rectification and prevention when checked?				
9.8 others (please specify)				
.....				
Construction state checked: _____ Checking date: _____ Checking time: _____ Weather condition: _____ Signature of field checker: _____ Signature of environment supervisor principal: _____ Note: ① The blank of remark can be filled with the information of the problems observed, note for the unqualified conditions, suggestion for rectification and preventing. ② When the measure is found to be unqualified or needs to rectify in the field check, the environment supervisor should issue “Rectification notice of environmental protection” immediately and write the number in the blank of remark. The detailed information for rectification activities of contractor should be noted in a separate sheet. ③ This form is general checklist of environmental protection review in construction period of second projects of Project of Guiyang Rural Road Construction Financed by the World Bank Loan. For the detailed subproject and detailed environmental problems, this form can be adjusted properly according to the local environmental condition and construction content. Appropriate measures for environmental protection shall be taken.				

Attached Table 4. Rectification notice of environmental protection issued by environment supervisor to contractor

Name of project		Name of construction site	
Contract No. And subproject location		Current construction phase	
Problems found in field check:			
Reasons analyzed by contractor and improvement measures proposed:			
Improvement opinions put forward by environmental units (if necessary):			
Environment supervisor: _____		Date: _____	
Limit date of improvement: must be finished within ___ days.		Acceptor: _____ Date: _____	
Conclusion of review:			
Reviewed by: _____		Date: _____	

Attached Table 5: Checklist of environmental protection before acceptance

Name of project		Weather on check day:		
Name of construction site:		Environmental inspector:		
Current construction phase:		Contract No. & location of project		
Check date of environmental protection:		Specific time		
Check items	Implemented or not?		N/A	Remark Problems and illegal conditions founded, measures for rectification and prevention proposed
	Yes	No		
1. Have all building wastes in the construction site been taken to the landfill of solid waste where the project is located?				
2. Have the measures for protection objects of sound environment been taken along the road?				
3. Does the sound environment of the protection objects of sound environment along the road meet the relevant standards?				
4. Have ecological recovery measures been taken for the temporary spoil (residue) ground?				
5. Have the road and traffic conditions of rural roads as construction roads been improved?				
6. Has the hardened concrete mixing station been demolished?				
7. Have the measures of land reclamation, second plowing or afforesting been taken for the land occupied by temporary concrete mixing station?				
8. Have the temporary sedimentation basin and grit chamber been demolished?				
9. Have the measures of land reclamation, second plowing or afforesting been taken for the land occupied by sedimentation basin and grit chamber?				
10. Have the temporary water retaining dam of road shoulder, temporary chute and drainage ditch been demolished and corresponding measures for ecological restoration been taken?				
11. Has the stripped and stocked top mellow soil been used for ecological restoration?				
12. Have trees been planted on both sides of roads?				
13. Are the types of roadside trees suitable for the area?				
14. Has the roadbed slop been afforested?				
15. Is the road drainage system perfect?				
16. Is there visual pollution along the road?				
17. Have the relevant training and education been provided in the cities and counties?				
18. Are the local residents satisfied with the road engineering?				
<p>Notes for filling: This form is a general checklist of environmental protection review in construction period. If necessary, it can be adjusted according to specific subproject, local environmental condition and relevant measures for environmental protection.</p> <p>* Any "not implemented" record may indicate there are illegal conditions or conditions to be improved. And the environment supervisor should issue "Rectification notice of environmental protection" immediately and write the number in the blank of remark. The detailed information for rectification activities of contractor should be noted in a separate sheet.</p>				
Signature of field inspector:		Date:		
Signature of environmental supervision director:		Date:		

Attached Table 6: List of the first projects (implemented in 2013) of Guiyang rural road construction financed by the World Bank loan

No.	Name of route	District / county located	Score of construction	Level of road	Nature of construction
1	Yongwen - Jinzhong	Kaiyang County	11.7	IV	Reconstruction
2	Gangzhai - Maoyun	Kaiyang County	15.8	IV	Reconstruction
3	Yongwen - Wenquan	Kaiyang County	16.7	IV	Reconstruction
4	Sanwangmiao - Miping	Kaiyang County	7.6	IV	Reconstruction
5	Xiaba - Maoping	Kaiyang County	7.3	IV	Reconstruction
6	Weicheng - Maige	Qingzhen City	22.8	IV	Reconstruction
7	Liwo - Maocao	Qingzhen City	18.5	IV	Reconstruction
8	Yangchang - Xiaba	Wudang District	14.1	IV	Reconstruction
9	Xinchang - Niuchang	Wudang District	3.9	IV	Reconstruction
10	Xinpu - Xiangzhigou	Wudang District	7.5	IV	Reconstruction
11	Toupu - Pianpo	Wudang District	15	IV	Reconstruction
12	Shuitian - Caijiazhai	Wudang District	4	IV	Reconstruction
13	Pianpo - Xiaohekou	Wudang District	1.7	IV	Reconstruction
14	Longtan - Fenghuangshao	Baiyun District	5.8	IV	Reconstruction
15	Erfenchang - Dulaying	Baiyun District	5.9	IV	Reconstruction
16	Longdongbao--Maochang	Naming District	16.6	IV	Reconstruction
17	Qingyan - Pingfa	Huaxi District	13.9	IV	Reconstruction
18	Longchang - Chalukou	Huaxi District	12	IV	Reconstruction
19	Maojing - Kaiba	Huaxi District	9.2	IV	Reconstruction
20	Qingyan - Maojing	Huaxi District	2.6	IV	Reconstruction
21	Xifeng - Xiaozaiba	Xifeng City	10	IV	Reconstruction
22	Tiantai - Xinglong	Xifeng City	9.8	IV	Reconstruction
	Total		232.4		

Appendix 1:

Outline of appointing external monitoring organization for environmental management

In accordance with relevant requirement of WB, the project office will choose external monitoring organization with environmental management experience to monitor and assess the implementation of environmental management and restoration during the implementing procedure of environmental management, so as to ensure the environmental management is carried out with the ECOPs.

1. Purpose of external monitoring

External monitoring and assessment will be practiced by an qualified institution independent of project office and environmental assessment institution, aims to monitor and assessment the restoration of social disruption, sewage treatment, cultural relic protection, safety and health, air pollution, water loss and soil erosion, noise monitoring and to propose assessment options and recommendations. Through external monitoring and assessment, the implementation results of environmental protection work will be guaranteed by the way of taking systematic measures to identify problems and taking remedial measures and following up in time.

2. In order to successfully complete the external independent monitoring of this project, the project office will appoint an experienced professional organization to practice the external monitoring of the project. In selecting participants of the external monitoring, the main factors to be considered are as follows:

(1) Participated in a similar work, has rich experience in social survey, understands the requirements of ECOPs of WB, masters relevant policies and regulations on environmental management issued by the state and local government.

(2) Can make social investigation independently, with good communication ability and quality, with hard working spirit.

3. According to the preliminary arrangements for the project, an independent organization with experience will be appointed to practice external monitoring and assessment. The works of independent monitoring organization are:

(1) offering technical assistance and training;

(2) assisting the preparation of (recovery) plan for the ecological environment destroyed during the construction period;

(3) monitoring and investing the environment management according to the requirements of ECOPs;

(4) assessing the living conditions of affected people to determine whether they are recovered sufficiently; and

(5) preparing and submitting external monitoring and assessment reports to the project management office and WB.

4. Report system of external monitoring

Based on observation and investigation, the external monitoring organization writes report of external monitoring and reports to WB and the project office independently. The external monitoring organization should report to WB and the project office with the following time:

(1) submitting an interim monitoring report about the environmental management

condition of the year to WB and the organization of environmental management implementation before June 30 every year.

(2) submitting an annual monitoring report to WB and the owner before December 31 every year.