Shi-Man Expressway Rural Road Upgrading Project

Jiangjunhe Hanjiang River Bridge

Environment Impact Assessment and Environment Management Plan

Hubei Provincial Communications Department

Mar. 2004 Wuhan China
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Chapter 1 Introduction

1.1 Project Background

The proposed Jiangjunhe Hanjiang River Bridge (the Project) is one of the rural road upgrading components in the Shiyan to Manchuanguan (Shiman) expressway. The HPCD includes this component in the Shiman project with the consideration of the maximizing the benefits of the expressway to the local areas as well as the priority roads in the Shiyan's 2003-2005 road network plan. The rural road upgrading in the Shiman project will be implemented in phases. Hanjiang River Bridge (this project) is one project of the first phase.

The proposed Hanjiang Bridge is located within Shiyan Area, northwest of Hubei Province. This area is bordered by Qinling Mountain and Daba Mountain, with Hanjiang River through the area dividing it into south and north parts which are locally called “Jiangnan” or south of the water and “Jiangbei” or north of the water, respectively. The lack of transportation infrastructure has been a critical constraint to the economic development of this region. Until now, all of the counties under the jurisdiction of Shiyan City have been listed as national-level poverty areas. Hanjiang River is 252 km long within Shiyan City, but only 3 bridges across the water body two of which are on the 240 km water body upstream of Danjiangkou dam. One is within Chengguan Town of Yun County, which is 100 km down stream of the proposed Project. The other is a suspended bridge 30 m upstream of the proposed bridge. This suspended bridge was constructed by the army as a stop-gap bridge which is formed by iron suspended and wooden plates. The suspended bridge is too weak to sustain large vehicles. However this suspended bridge is the only one in the west region of Shiyan over Hanjiang River. Worse, it also connects the important road G316 and YunYang Road in Jiangnan and Jiangbei, respectively. Due to safety considerations, the suspended bridge was repaired and strengthened in 2002, extending its service life by another 2.5 years. It is estimated this bridge will become obsolete by 2004. At that time, there will be only one bridge on Hanjiang River within Shiyan to connect the Jiangnan and Jiangbei areas. The people should take up to 300 km detour to access this bridge. It is apparent that a new bridge is urgently needed, but should be close to the existing suspended bridge, to link the Jiangnan and Jiangbei. Hubei Provincial Communication Department (HPDC) has included this proposed bridge into its road network development planning. Map 1 shows the location of the proposed bridge.

With considerations of poverty alleviation in rural area, HPCD has applied for a loan from the World Bank to partially finance the rural road upgrading works. Hubei Provincial Transportation Planning and Design Institute was contracted to carry out the feasibility study for the proposed works in Nov. 2002, which was completed in Aug. 2003. The Preliminary Design Document has been finished in Nov. 2003 by HBCPDI.

1.2 Progress of EA
Directives (OD). They are:

- Environmental Assessment (OP/BP/GP4.01);
- Forestry (OP/GP4.36);
- Natural Habitats (OP/BP4.04);
- Safety of Dams (OP/BP4.37);
- Pest Management (OP4.09);
- Involuntary Resettlement (OP4.12);
- Indigenous People (OD4.20);
- Cultural Property (OP4.11);
- Projects in Disputed Areas (OP/BP/GP7.60); and
- Projects on International Waterways (OP/BP/GP7.50).

Among these safeguards policies, Environmental Assessment (OP 4.01) is the primary requirements and thus the focus of this report. In addition, policies on Involuntary Resettlement (OP4.12), Indigenous People (OD4.20), Forest (OP4.36), and Cultural Property (OP4.11) are also applied in the EA at least in the screening stage or full process if triggered.

Since no project components will involve international waterways, dam construction or disputed areas as defined in OP7.60, natural habitats and pest management, policies related to these subjects are not applied in the EA. In addition, the World Bank Financed Project Office of HPCD has contracted another institute to carry out the social assessment, and a resettlement team has been established and will be responsible for the Resettlement Action Plan, with the major findings and conclusions to be included in this EA. Therefore the following policies are applied in this EA:

- Environmental Assessment (OP/BP/GP4.01);
- Forestry (OP/GP4.36);
- Involuntary Resettlement (OP4.12);
- Indigenous People (OD4.20); and
- Cultural Property (OP4.11).

1.4.2 National Legal Frame for EA

- Environmental Protection Law of PRC of December 26, 1989;
- Land Management Law of PRC of August 29, 1998;
- Water and Soil Conservation Law of PRC of June 29, 1991;
- Water Pollution Prevention Law of PRC of May 15, 1996;
- Noise Pollution Prevention Law of PRC of October 29, 1996;
- Air Pollution Prevention Law of PRC of April 29, 2000;
- Solid Waste Pollution Prevention Law of PRC of October 30, 1995;
- Rules of Environmental Protection Management for Construction Projects, issued by the State Council of PRC;
- Measures Concerning with the Environmental Protection and Management for Transportation Construction Projects, issued by MOC;
- Rules of Environmental Protection Management for Traffic Construction Project, Hubei
EPB, Oct. 1993;
- Notice to Strengthen the Environmental Impact Assessment and Management of Construction Projects Financed by Loan from International Financial Organizations, jointly issued by SEPA, the State Planning Commission, the Ministry of Finance and the People's Bank of China;
- Rules for Water Pollution Control of Hanjiang River Basin in Hubei Province, issued by the Standing Committee of the People's Congress of Hubei Province, Nov. 27, 1999;
- Preliminary Design Report for Hanjiang Bridge on Jiangjun River under the Rural Road Upgrading Component of Shiyan-Manchuangguan Expressway Project, prepared by Hubei Provincial Transportation Planning and Design Institute, Nov. 2003 and

1.5 Scope of the EA

The EA coverage for this project is presented in the following Table 1-5-1.

<table>
<thead>
<tr>
<th>Items</th>
<th>EA Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic/cultural environment</td>
<td>Areas within 200 m from the road, and those to be directly impacted by the project.</td>
</tr>
<tr>
<td>Biological environment</td>
<td>Areas within 300 m from the road. Borrow and deposit area and land for temporary occupation</td>
</tr>
<tr>
<td>Acoustic environment</td>
<td>Areas within 200 m from the road's central line.</td>
</tr>
<tr>
<td>Ambient air environment</td>
<td>Areas within 200 m from the road's central line.</td>
</tr>
<tr>
<td>Water environment</td>
<td>Within 1000 m upper stream and 5000 m downstream from bridge.</td>
</tr>
</tbody>
</table>

1.6 EA Factors

Based on the previous experience of EA for road constructions, the environmental factors to be covered in the assessment for this Project are as follows:
- Acoustic environment: L\text{Aeq}
- Ambient air: NO\textsubscript{2}, PM\textsubscript{10}
- Water environment: SS, permanganate index, oil
- Eco-environment: land occupation, vegetation loss, and soil erosion
- Social environment: Social economy, living quality, and infrastructure

1.7 Contents of EA

As an extra-bridge project crossing the Hanjiang river, the most important environmental impact is on surface water environment (including accident risk analysis) in construction phase and operation phase. Furthermore, the project will cause some other environmental impact on eco-environment, acoustic environment, ambient air and social environment. This report places its focus on the surface water environment assessment.
Map 1  Location of Proposed Road in Poverty Area of Hubei Province
In March 2003, Shanghai Ship and Shipping Research Institute (SSSRI) was retained by the HPCD to undertake Environmental Assessment (EA) for this project. An EA team was formed immediately and conducted two rounds of preliminary site investigation along the proposed project alignment, initial data collection and the various forms of consultation with the affected public, organizations and local governments during March-April 2003. An environmental baseline monitoring program was then initiated to cover the project area. On the basis of the site investigation, information collection and analysis and baseline monitoring, potential impacts of the project were identified, screened, and assessed. Relevant environmental mitigation measures, corresponding costs, and environmental management plan were then proposed following additional public consultation and disclosure of project information to the public. Draft EA document is prepared in May 2003. As there are some change in the feasibility study for the proposed works, so a revised draft EA document is prepared in Sept. 2003. In October, 2003, a World Bank mission conducted an appraisal of the project. According to the Aide Memoir and comments received during the appraisal, the EA team revised this environmental impact assessment report and environmental management plan. In March 2004, a World Bank mission officially appraised the Shiman expressway project including the rural road components. Following comments received from the appraisal, the EA team revised the environmental impact assessment report and environmental management plan. In late March 2004.

1.3 Purpose of EA

The EA predicts various environmental and socio-economic impacts of the Project, and analyzes the impacts quantitatively or qualitatively through investigation or monitoring of the physical, biological, and socio-economic environment, and through public consultation along the project area. More specifically, the purposes of the EA are:

- To improve the decision-making process by introducing environmental criteria and assessment to design engineers and decision makers and to ensure the Project is environmentally sound and sustainable;
- To ensure adverse environmental impacts be identified and evaluated in the earlier stage of the Project development so as to develop appropriate measures including alternative alignments and designs to avoid, mitigate, reduce or otherwise minimize the adverse impacts to acceptable levels;
- To develop measures of compensation for the impacts which could not be avoided or mitigated; and;
- To provide a basis for Project executing agency and relevant government agencies to develop and implement plans for environmental management and monitoring.

1.4 Basis of Assessment

1.4.1 World Bank Requirements

The World Bank requirements include primarily the Bank’s ten safeguards policies, including Operational Policies (OP), Best Procedure (BP), Good Practice (GP) and Operational
1.8 Environment Protection Targets

Based on detailed and thorough site reconnaissance and the information collected from relevant local agencies, the EA team has determined that within the project area there is no natural reserve, significant scenic and cultural sites. The major environment protection targets and sensitive settings within the area are the water body where the proposed bridge will cross and the village adjacent to the bridge - Jiangjunhe Village. Following sections present the details on these targets.

1.8.1 Surface Water Environment

The proposed Project will cross Hanjiang River, the significant water source for the national South-North Water Diversion Project. The major water environment protection target is therefore the Hanjiang River, which is presented in Table 1-8-1 and photograph in the right.

<table>
<thead>
<tr>
<th>Name</th>
<th>Applicable standard</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanjiang River</td>
<td>Class II standard</td>
<td>This proposed bridge is located in a valley. There is no embankment long the river. G316 road and Yunyang Road is to the south and north of the river respectively. The max. width of the river is 410 m and the narrowest is 150 m.</td>
<td>According to the site survey, no intakes for drinking water are found within 50 km down or up stream of the bridge. The nearest intake of Yun County Water Supply Plant is 70 km downstream.</td>
</tr>
</tbody>
</table>

1.8.2 Acoustic Environment and Ambient Air

As the Project will pass through a rolling mountain area where the roadside villages are scarce. There is only one village adjacent to the proposed bridge. Therefore there is only one protection target or sensitive receptor identified for acoustic environment and ambient air, which is presented in Table 1-8-2 and shown in the right photograph.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Min. Distance to road center</th>
<th>Scale</th>
<th>No. of first row hh/resident</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiangjunhe Village</td>
<td>South of the bridge</td>
<td>5-20 m from both sides of the road</td>
<td>About 50 households, 200 people</td>
<td>9 households</td>
<td>This village is scattered around the river mouth of Jiangjun River—a tributary of Hanjiang River. There will be a few house demolition.</td>
</tr>
</tbody>
</table>
1.8.3 Ecological and Social Environment

The access roads leading to G316 road and Yunyang Road will be constructed by cutting the hill, therefore a small extent of ecological impact will result. Based on the site survey and investigation during this EA, the major ecological and social protection targets are summarized in Table 1-8-3.

<table>
<thead>
<tr>
<th>Environmental factors</th>
<th>Protection objects</th>
<th>Location</th>
<th>Environmental characteristics</th>
<th>Impacting activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-environment</td>
<td>Soil reservation (deep digging)</td>
<td>Along the road</td>
<td>As the project is located in hillside, hills will be disturbed.</td>
<td>Deep digging cutting,</td>
</tr>
<tr>
<td></td>
<td>Plants and wild animal</td>
<td>Along the road</td>
<td>Part of the roadside hills are covered by sparse plants. No wild animals under protection are found</td>
<td>Construction activity</td>
</tr>
<tr>
<td></td>
<td>Fish in Hanjiang River</td>
<td>Near the proposed Hanjiang bridge</td>
<td>Carp is dominated in the fish species in Hanjiang River. All of the fish are edible without need to protect.</td>
<td>Bridge construction</td>
</tr>
</tbody>
</table>

1.8.4 Social Environment

This proposed road project is welcomed by the local people because it will bring significant social and environmental benefits. However some adverse social impacts may also be produced by the project. Based on the site survey and investigation during this EA, the major social protection targets are summarized in Table 1-8-4.

<table>
<thead>
<tr>
<th>Environmental factors</th>
<th>Protection objects</th>
<th>Location</th>
<th>Environmental characteristics</th>
<th>Impacting activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social environment</td>
<td>Land acquisition</td>
<td>Near the south access road</td>
<td>This proposed project will occupy 18.25 mu land, which will affect Jiangjunhe Village, near the south access road to the bridge. About 1527.86 m² buildings, 12 households will be demolished.</td>
<td>Construction of access road</td>
</tr>
<tr>
<td></td>
<td>Traffic safety</td>
<td>Along the road</td>
<td>The proposed bridge will connect the G316 road and Yunyang Road. The current traffic would be affected by the construction activity on the two roads.</td>
<td>Bridge construction</td>
</tr>
<tr>
<td></td>
<td>Human health</td>
<td>Along the road</td>
<td>Construction camp and human settlement center</td>
<td>Daily life</td>
</tr>
</tbody>
</table>
1.9 Applicable Standard for EA

According to the Technical Guideline for EA and EA Specifications for Road Project (pilot edition), the following standards are applied for the EA.

1.9.1 Surface Water

The surface water quality in the Hanjiang is evaluated by Class II of Environmental Quality Standard for Surface Water (GB3838-2002), and Class I of the Water Standards for Agricultural Irrigation (GB 5084-92) is applied to assess SS, details are presented in Table 1-9-1; Class I of the Integrated Wastewater discharge Standard (GB8978-1996) is applied for wastewater discharge, detailed standards are presented in Table 1-9-2.

<table>
<thead>
<tr>
<th>Item</th>
<th>Environmental Quality Standard for Surface Water (GB3838-2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD≤</td>
<td>15</td>
</tr>
<tr>
<td>Permanganate index≤</td>
<td>4</td>
</tr>
<tr>
<td>Oil≤</td>
<td>0.05</td>
</tr>
<tr>
<td>SS≤</td>
<td>150</td>
</tr>
</tbody>
</table>

Note: the data is from the Environmental Quality Standard for Surface Water (GB3838-2002)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>COD cr</th>
<th>Oil</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>100</td>
<td>10</td>
<td>70</td>
</tr>
</tbody>
</table>

Note: the data is from the Integrated Wastewater discharge Standard (GB8978-1996)

1.9.2 Acoustic Environment

Noise Limits for Construction Site (GB12523-90) are applied in the assessment for noise impacts in construction phase. For Jiangjunhe Village, Class IV of Standard of Environmental Noise of Urban Area (GB3096-93) is applied for assessment of noise impact in operation phase.

<table>
<thead>
<tr>
<th>Construction stage</th>
<th>Major source of noise</th>
<th>Noise limit Daytime</th>
<th>Noise limit Nighttime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth &amp; stone work</td>
<td>Bulldozer, excavator, loader, etc.</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>Piling</td>
<td>Pile driver, etc.</td>
<td>85</td>
<td>Forbidden</td>
</tr>
<tr>
<td>Structuring</td>
<td>Concrete mixer, etc.</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>Finishing</td>
<td>Crane, elevator</td>
<td>65</td>
<td>55</td>
</tr>
</tbody>
</table>

Note: the data is from the Noise Limits for Construction Site (GB12523-90)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Daytime</th>
<th>Nighttime</th>
<th>Applicable zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>70</td>
<td>55</td>
<td>Both sides of trunk roads</td>
</tr>
</tbody>
</table>

Note: the data is from the Standard of Environmental Noise of Urban Area (GB3096-93)
1.9.3 Ambient Air

The ambient air quality is evaluated against Class II in the *Ambient Air Quality Standard (GB3095-1996)*, listed in Table 1-9-5.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Measure time</th>
<th>NOx</th>
<th>NO2</th>
<th>PM_{10}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily average</td>
<td>0.1</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Hourly average</td>
<td>0.15</td>
<td>0.24</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: the data is from the *Ambient Air Quality Standard (GB3095-1996)*.

1.9.4 Eco-environment

*EA Specifications for Road Project (interim edition)* has been applied to assess soil corrosion conditions of the project area, the indicators for classification are presented in Table 1-9-6 below.

<table>
<thead>
<tr>
<th>Class</th>
<th>Corrosion ratio (t/km².year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Weak corrosion (with apparent trace)</td>
<td>1000</td>
</tr>
<tr>
<td>II minor corrosion</td>
<td>1000–2500</td>
</tr>
<tr>
<td>III moderate corrosion</td>
<td>2500–5000</td>
</tr>
<tr>
<td>IV strong corrosion</td>
<td>5000–8000</td>
</tr>
<tr>
<td>V Significant corrosion</td>
<td>8000–15000</td>
</tr>
<tr>
<td>VI Severe corrosion</td>
<td>&gt;15000</td>
</tr>
</tbody>
</table>

Note: the data is from the *EA Technical Guidelines for Road Projects (Interim edition)*

1.10 Methodology for EA

The EA applies as its principle for the methodology of focusing on key (sensitive) sites, cover selected sections and reflecting the entire project area.

Site investigation and collected data analysis are the primary methods for the assessment of social and economic impacts, as well as ecosystem impacts assessment. Analogy analysis method is applied for assessing acoustic environment and ambient air impacts. Analogy analysis method is also applied for assessing soil corrosion and water environment.
Chapter 2 Overview of the Project

2.1 Geographical Location

The proposed bridge is located within Shiyan City, northwest of Hubei Province. The project area is an inter-provincial joint area of Hubei, Henan and Shaanxi provinces. It is bordered by Xiangfan city of Hubei Province to the east, Ankang Region of Shaanxi Province to the west, Shennongjia Region and Chongqing City to the south and by Shangluo Region of Shaanxi Province and Nanyang City of Henan Province to the north. The proposed bridge will cross Hanjiang River, upstream of Jiangjun River. The proposed bridge will be 50 m downstream of the existing suspended bridge (this proposed bridge will replace the suspended bridge once built). The proposed bridge will connect with Yunyang Road to the north, with G316 road to the south. The bridge is located 110°59'E and 32°33'N. Map 2 shows its geological location.

2.2 Current Conditions of the Suspended Bridge

The existing suspended bridge was designed and constructed by No. 7434 Plant of People’s Liberation Army (PLA) in July 1990. The span of the bridge is 342 m, and the width is 4.1+2X0.75 m. The bridge is for military purpose and not registered in the Hubei Road system. However it is an important element in the provincial road network. The designed load of the bridge is Class 15 trucks and Class 18 trailers. The bridge has 14 main cables and 36 beams, with an one-way lane for motorized vehicle and two for pedestrians. In March 2002, HPDC contracted a special institute to inspect the bridge since the service life was about to be over. By investigation, the institute found major safety flaws in the bridge, and recommended an overhaul. At the end of 2002, the Transportation Bureau of Yunxi County repaired and strengthened the bridge but the service life of the bridge could only been extended for another 2.5 years. Currently, the speed and load limit is strictly controlled, with the maximum speed of 10 km/h, maximum load of 150 KN and one way traffic. During rush hours, the waiting vehicles on both ends are lined up causing congestion. Although the bridge can merely meet the current need as traffic flow is relatively low, it won't be able to meet the rapidly growing traffic in this part of the provincial transportation network in the near future. The need for a new bridge to replace the suspended bridge is urgent. The photos show the suspended bridge. Currently, the transportation Bureau of Yunxi County has set up a management and toll station with 38 staff. The No. 2 Traffic Police Station of Yunxi County has also set up a management at the bridge ends to check load of vehicle and dangerous materials.
Map2  The Location of Proposed Rural Road
2.3 Function of the Proposed Road

Shiyan City relies on the multiple modes of transportation, including road and railway which are dominant, and water navigation, with rather complete transportation network in Shiyan. Xiang-Yu Railway is the major railway crossing the city while the water carriage service is largely concentrated on Hanjiang River and Du River. The road network in the form of a "three horizontal and three vertical line" road grid has been established including trunk roads, national and provincial roads, and rural roads connecting counties and villages. Map 2 shows the position of the project as well as the regional network. The first "horizontal line" refers to the Danyun Road, Yunman Road and Shanghu Road, which connect the Xiangfan City, the Jiangbei area of Danjiangkou City, Jiangbei area of Yun County and Yun County before entering into Shaanxi Province. The second "horizontal line" refers to the new G316 road, which connects Xiangfan City, Jiangnan area of Danjiangkou City, Shiyan City and the Jiangnan area of Yun County, before entering Baihe County of Shanxi Province. The third "horizontal line" refers to the S305 road, which connects Xiangfan City, Fan County, Zhuanshan County and Zhuxi County, before entering Shanxi Province. The first "vertical line" refers to the road line connecting Yunxi County, Baihe County, Zhushan County, Zhuxi County and Chongqing City. The second "vertical line" refers to the road line connecting Yuxi-Yangwei road, the Hanjiang Suspended Bridge, Baoxia-Zhushan road, Zhushan-Xiangba road and Chongqing Road. The third "vertical line" refers to the G209 road, which pass through Jiangbei of Yun County, the Hanjiang Bridge in Yun County, Shiyan City and Fang County before entering the Shennongjia area.

Although this suspended bridge is not a conventional road bridge, it plays a pivotal role in the provincial transportation network in Shiyan City. It provides a short-cut route for the western counties of Shiyan City to cross Hanjiang River. However, as described above this bridge will be closed by the end of 2004 when its service life ends and safety concerns. At that time there will be only one bridge over Hanjiang River within Shiyan City. As a result, the vertical road line in the west region of Shiyan will be disconnected at the river. Therefore the proposed bridge to replace the suspended bridge will be a significant element to ensure the function and intactness of the regional transportation network.

2.4 Magnitude of the Proposed Work

The total span of the proposed Hanjiang Bridge is 350 m. When including the access road, the total length of the access road will be 696 m.

According the preliminary design, the proposed bridge will join G316 (at Yun county side) and Yunyang road (at Yunxi county side) at the same grade. As Yunyang road elevation is higher than G316 by about 10 m, it is planned to build a 636 m long and 8.5 m wide approaching road at the Yun county side to connect G316. The connection road starts at the Jiangjunhe river bank and ends at about 200 m from the existing bridge on G316 with an alignment roughly perpendicular to the bridge. On the Yunxi county side, the bridge will connect directly to Yunyang road with a connection road of about 60 m long and 12 m wide.
The major work quantity is shown in Table 2-4-1 below, and the locations of the bridge and access roads are illustrated in Map 3.

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Span</td>
<td>m</td>
<td>350</td>
</tr>
<tr>
<td>2</td>
<td>Total length</td>
<td>m</td>
<td>696</td>
</tr>
<tr>
<td>3</td>
<td>Area of road surface</td>
<td>Km²</td>
<td>4.77</td>
</tr>
<tr>
<td>4</td>
<td>Footprint</td>
<td>mu</td>
<td>18.25</td>
</tr>
<tr>
<td>5</td>
<td>Houses to be demolished</td>
<td>M²</td>
<td>1527.86</td>
</tr>
<tr>
<td>6</td>
<td>Earth work of Yun county/ Yunxi county side</td>
<td>Km²</td>
<td>1.608</td>
</tr>
<tr>
<td>7</td>
<td>Drain system</td>
<td>Km²</td>
<td></td>
</tr>
</tbody>
</table>

### 2.5 Major Technical Specifications

Based on the function and the existing capacity of the connecting road, the proposed bridge will be constructed as Class II Standard for road bridge. The major technical specifications of the proposed bridge are presented in Table 2-5-1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Class of road</td>
<td>Class</td>
<td>II</td>
</tr>
<tr>
<td>2</td>
<td>Designed vehicle travel speed</td>
<td>Km/h</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Net width of bridge</td>
<td>m</td>
<td>9.0+2×1.5</td>
</tr>
<tr>
<td>4</td>
<td>Designed vehicle load</td>
<td>ton</td>
<td>vehicle-20, trailer-100</td>
</tr>
<tr>
<td>5</td>
<td>Return of Flood</td>
<td></td>
<td>1/100</td>
</tr>
<tr>
<td>6</td>
<td>Max. Longitudinal slope</td>
<td>%</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Max. Longitudinal slope of access road</td>
<td>%</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Vertical slope of bridge surface</td>
<td>%</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>Water level for navigation</td>
<td>M</td>
<td>186.48</td>
</tr>
<tr>
<td>10</td>
<td>Net height for navigation 4.5</td>
<td>M</td>
<td>8.0</td>
</tr>
<tr>
<td>11</td>
<td>Net width for navigation</td>
<td>M</td>
<td>50</td>
</tr>
</tbody>
</table>

### 2.6 Traffic Volume Projection

Based on the natural and induced annual growth, the traffic volume projections for 2007, 2010 and 2020 are presented in Table 2-6-1. According to a site investigation, a small number of local residents at both sides of the river have regular needs to cross the river. It is expected that when this project is in operation, the pedestrian traffic on the bridge will be less than 300 person-times per day. For this traffic volume, the current design of 1.5 m pedestrian lanes on both sides of the bridge shall be sufficient and can satisfy the cross-river needs by the local residents.
Map 3: The Align 
Locations of Sensitive Spots

Legend

⭐ Sensitive Spots
⊙ Noise Monitoring Spots
◌ Air Monitoring Spots
◌ Water Monitoring Spots
--- Proposed Project
--- Rope Bridge of Hanjiang River
--- Yunxi—Yangwei Road
--- G316 Road
--- Xiang-Yu Railway
Table 2-6-1 Projected Traffic Volume

<table>
<thead>
<tr>
<th>Item</th>
<th>2007</th>
<th>2010</th>
<th>2028</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic volume</td>
<td>1292</td>
<td>1562</td>
<td>3019</td>
</tr>
</tbody>
</table>

2.7 Borrowing and Deposit Balance

The project is located at the foot of a mountain where it connects with Yunyang road and G316. As such, the earth work is limited. On the Yun county side, there will be some excavation for road base which will generate 25,800 m³ excessive earth requiring disposal. At the same time, on the Yunxi county side, there will be a demand of 26,600 m³ filling materials. It has been planned to ship the excessive earth materials from Yun county to Yunxi county side by barge. With this plan, earth materials are expected be mostly balanced and thus there will be no need for dedicated excessive soil disposal site in this project.

2.8 Sources and Transportation of Construction Materials

As the project is located in a mountainous region, most of the construction materials could be supplied locally. Except No.45 cement, which need to be shipped in from outside, sand, stone, gravel, and steel can be found from Shiyan city. There are multiple suppliers with the city for each of these materials which can totally satisfy the project needs.

The construction materials are to be shipped in to the construction site via local roads from both ends of bridge sites, i.e., Yunyang road and G316, respectively. Both roads are well connected with the regional road network with good transportation conditions.

It is very convenient to ship the excessive earth materials from Yun county to Yunxi county side by barge.

2.9 Bridge auxiliary facilities

According to project design, a toll station will be set up at the bridge for toll collection, maintenance and administration of the bridge during the operation. As the existing toll station for the Hanjiang river suspension bridge is close to the proposed new bridge (see Map 3 for exact location) and the suspension bridge will be phased out following the new bridge operation, this toll station will be moved to use for the new bridge and the existing staff at the current toll station will also be retained for the new bridge operation.

At present, No.2 Team of Yunxin Traffic Police Brigade runs an inspection station at the west side of the suspension bridge for over-loading and hazardous materials inspection. This inspection station is located about 60 m from the proposed bridge (see Map 3) and will continue its operation for the new bridge.
2.10 Cost Estimate and Financing Plan

The total capital cost is estimated about RMB 38.00 million. Part of the cost will be funded by a World Bank loan, with the balance to be covered by Central, Hubei Provincial and local governments.

2.11 Implementation Plan

The Project construction is scheduled to commence in the Jul. of 2004 and complete in December 2006 with a total construction period of 2.5 years.

2.12 Analysis of Alternatives

The design team has proposed alternatives on the location and structural type of the proposed bridge. Following is the brief discussion and comparison about the alternatives.

Alternative on bridge location

Four alternative sites for the bridge have been proposed and they are:

- Alternative 1: 500 m from the river mouth of Jiangjun River, 100 m downstream of the existing suspended bridge, 442 m span;
- Alternative 2: 840 m from the river mouth of Jiangjun River, 200 m upstream of the existing suspended bridge, 390 m span.
- Alternative 3: 600 m from the river mouth of Jiangjun River, the location of the existing suspended bridge, 370 m span;
- Alternative 4: 550 m from the river mouth of Jiangjun River, 50 m upstream of the existing suspended bridge, 350 m span.

In comparison, the geological conditions at all those four locations are suitable for bridge construction. But Alternative 1 is rather long of the bridge. Alternative 2 needs to make a 90 m long and 30 m high hill cut, to connect with Yunyang Road, resulting in a high potential of soil erosion and interruption to the current traffic. In addition, under Alternative 2, a large amount of house demolition would be needed and the alignment is 70 m away from the Xiangyu railway. Alternative 3 needs to pull down the suspended bridge and the current traffic need to be connected by ferry service. Alternative 3 will bring a rather serious impact on the current traffic and people's daily life. In contrast, Alternative 4 is on an open and flat area without any need for hill cutting and is the shortest among these alternatives. Therefore, Alternative 4 is recommended as it has the least environmental impacts.

Alternative on structural type of bridge

There are three types of bridge selected for comparison and they are:
- Alternative 1: the arrangement of span is 60+3×100+60, a pre-stress reinforced concrete bridge
- Alternative 2: the arrangement of span is 61+110+110+61, a pre-stress reinforced continuous ridge frame concrete bridge
- Alternative 3: the arrangement of span is 3×40+50+80+50+3×40, a pre-stress reinforced concrete bridge;

In comparison, with regard to technical and cost considerations, the design team recommends the Alternative 2. With environmental considerations, the EA team reckons that the three types of bridge all meet the requirement for flood discharge and navigation requirements therefore with similar magnitude of environment impacts. Therefore the consequential assessment will be focused on the recommended alternative.

2.13 Potential Impact by Raised Dam Hanjiang River on the proposed project

As the head water source for the national South-North Water Diversion Project, Danjiangkou Reservoir's dam will be raised by 13 m under the second-phase Water Conservancy Work. This work will begin at the end of 2003 and complete by 2008. At that time, the water level at the normal storage will be 170 m. Furthermore, the local government has planed to built a water power plant (Gushan water power plant) in Hanjiang River 8 km downstream of proposed bridge. According to technical information, after the dam work and power plant be finished, the flooded area will extend to the Lijiapeng of Yunxi County, 0.5 km downstream of the proposed bridge. And the water level will be 181 m.

The design team has already taken into full account of the potential impact by the raised dam of Danjiangkou Reservoir and Gushan water power plant. Based on elevation calculation for the Yunyang Road and G316 Road to the both sides of the proposed road, the current elevations are higher than the raised water level. The Jianjunhe Hanjiang river bridge is designed for the 100 year flood. As Hanjiang river is a planned Class IV navigation water way, it requires 8 m clearance. The design bridge height is higher than 194.48 m, meeting the navigation clearance requirements as well as the 100 year flood elevation. Based on the above analysis, the water level rises due to the Hanjiang river dam downstream and Gushan hydro power stations will not affect the project. Furthermore, as the bridge is designed for the 100 year floods, the impact from flood is minimal.
Chapter 3 Baseline Environment

3.1 Natural Environment

Topographical Characteristics
The proposed bridge will be located in an erosive or alluvial area. The river course of Hanjiang River at this section is straight and flat. At the side to Yunxi County, there are cliffs and bare rocks while at the side to the Yun County, the alluvial layer forms flat topography. Photo below shows the typical topographical characteristics at the bridge location.

Climate
The area climate is characterized with north semi-tropical monsoon with distinct seasons. The summer is wet and hot, the winter is harsh and dry, while the spring and autumn are mild. The average temperature is 11°C~17°C, and annual average rainfall is 696-900 mm, with 73% of which occurs in the summer season. The prevailing wind direction is from the southeast.

Seismic Activity
The seismic activity in the project is scaled VI degree, which is relatively mild and not very active.

Hydrology
Hanjiang River where the proposed project will cross is the biggest tributary of Yangtze River, which arises from south Qinling Mountain of Shaanxi Province, and flows through Shaanxi and Hubei Province from west to east, before joining the Yangtze River at Longwangmiao at Hankou of Wuhan City. The total length of mainstream Hanjiang River is 1577 km with a total catchment of 159,000 km2, about 8.8% of the total of Yangtze River.

The area hydrology is characterized by the historical average flow of 23.1 billion m³ and average flow rate of 732 m³/s. The maximum water level is 184.54 m and the minimum level is 171.82 m. The average level is 173.37 m.
North to Hanjiang River is Qinling Mountains, and south is Wudang Mountains. There are no embankments on both sides of the river. The maximum width of the river surface is 410 m, and minimum, 150 m.

The navigation channel in the area is controlled by the narrow water surface at the bridge site and navigation service only can be sustained in the high flow season. According to the river navigation planning, the navigation scale at present is Class VI on this section with 90% pass rate and the future navigation scale will be improved to Class IV on this section.

3.2 Social Environment

The proposed project is located at the joint area of Yunxi County and Yun County, both of which are under the jurisdiction of Shiyan City. By this proposed project, Yangwei Town in Yunxi County will be connected with Huijiaying Town in Yun County. Shiyan City, Yun County and Yunxi County are clearly the direct impacted area.

Shiyan City is in the northwest of Hubei Province, bordered by Xiangfan City to the east, by Ankang Region of Shaanxi Province to the west, by Shennongjia and Chongqing City to the south, and by Nanyang Region of Henan Province and Shangluo Region of Shaanxi Province to the north. Under its jurisdiction, there are 5 counties, 1 county-level city and two urban districts. The area of the city is 23,700 km², 12.7% of the provincial total. Except the urban area of Shiyan which is well developed on automobile industry, all counties which are centered on agricultural production fall into the national-level poverty standards. Geographically impeded by Qin-Ba Mountains, economic development is very slow due to poor transportation conditions.

Yunxi County is at the northwest of Shiyan City, bordered by Qinling Mountains to the north and by Hanjiang River to the south. It is a national-level poverty county. The land area of the county is 3509.6 km², 97.3% of which is dominated by hills and mountain range, leaving only 287 km² cultivated land, equivalent to 0.86 mu/capita. Till 2002, the total population of the county was 502,000, with 418,300 of them as agricultural production. The annual net income per capita of agricultural population is RMB1,401.

Yun County is situated at the middle part of Shiyan City. It is the joint area of Hubei Province, Shaanxi Province and Henan Province. It is the national-level poverty county. The total area of the county is 3863 km², equivalent to 5,794,550 mu. The mountain, cultivated land, water surface, road and village accounts for the total area of 81.2%, 10.3%, 4% and 4.4% respectively. There is a total of 596,833.5 mu of cultivated land, equivalent to about 1 mu per capita. Under the jurisdiction of the county, there are 12 towns and 14 town-level villages. Till the end of 2001, the total population of the county was 591,000, with 470,500 agricultural residents, accounting for 79.6% of the total. It is therefore obvious that the economy of the county is centered on agricultural production.
3.3 Eco-environment

Vegetation Cover
The vegetation species are abundant in the project area. Massion pine trees are dominated in the area. The forest coverage rate is 45.65% in the whole Shiyan city, 35.87% in Yun county and 28.98% in Yunxi County, respectively, below the city-wide average.

On the side of Yunxi County, the rivebank is characterized with steep cliffs and well covered with underbrush and grass. On the side of Yun County, the riverbank is characterized with flat alluvial plain which is cultivated by local people. Within the project area, no virgin forest is found.

Wild Animals
This project area has been significantly developed with a long history of human activities. The existing Yunyang Road and G316 Road were built many years ago. A large number of residents have been attracted to the roadside area, resulting in a severe damage of the ecosystem necessary to support large wild animals. According to information from forest authorities of both Yun county and Yunxi county who have the jurisdiction on wildlife protection, only small mammals, such as deer, hog badger, and fox as well as birds are spotted in the mountainous areas, distant from the Project site.

Acquatic life
According to the collected information from relevant local authorities, the aquatic life in Hanjiang river are main fishes. The fish species are carps and other commonly found species with no protected or otherwise endangered species.

Status of Soil Erosion
According to the Soil Conservation Planning for Hubei Province, the Project area is designated as a key area for soil erosion monitoring. Severe soil erosion, primarily non-point erosion, often occurs in this region. According to the local forestry department, the soil erosion degree at the site of the proposed bridge is medium, with the erosion mode being 3000t/km².a.

3.4 Natural Resource

Tourism Resource
According to a site survey during this EA, no significant scenery is found within the directly impacted project area.

Mineral Resources
According to a site survey during this EA, no significant mineral source is observed at the site of the proposed bridge.

Cultural Property
According to the confirmation from the local cultural bureau and EA team site investigation and observations, no above ground cultural property is found within the project site and no record of underground archaeological finds are in the inventory lists of local cultural authorities for the area.

3.5 Baseline of Environment Quality

In order to understand the baseline environmental status in the project area, the EA team has collected information from relevant government agencies and carried out an environmental monitoring program for noise, water and air quality. Map 3 presents the locations of the monitoring points covered in the EA.

3.5.1 Acoustic Environment Status and Assessment

According to the site investigation, the EA team reckons that the current acoustic quality at the project site is mainly impacted by the traffic noise of the current suspended bridge and the impact is rather light because of the low traffic flow in general. However, areas near the access road to the bridge are affected by the traffic on Yunyang Road and G316 Road.

Since there is only one sensitive receptor within the project area, Jiangjunhe village, the Environment Monitoring center of Yunxi County has been contracted to monitor the noise level on the village. The monitoring program lasted for one day, and one measurement was taken at day and night each. Monitoring points have been placed at the location 1 m in front of the sensitive receptors facing the proposed road. Table 3-5-1 presents the monitoring results.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of receptor</th>
<th>Reference of pile</th>
<th>Baseline (dB)</th>
<th>Standard excess (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daytime</td>
<td>Nighttime</td>
</tr>
<tr>
<td>1</td>
<td>Jiangjunhe Village</td>
<td>K0+950</td>
<td>61</td>
<td>51</td>
</tr>
</tbody>
</table>

Source: Environment Monitoring Center of Yunxi County

It can be seen that, the noise level in daytime and night time is 61 and 51 dB respectively, slightly exceeding Class II standard, but meet Class III standards. The noise level is expected to rise when the project is completed since more traffic flow will be attracted to the area.

3.5.2 Surface Water Environment and Assessment

3.5.2.1 Drinking Water Intakes in Project Area

Hanjiang River is the starting point and source for the national South to North Water Diversion Project. During the site investigation of this EA, the EA team paid an attention to the potential impact to the water quality of the downstream water from the project site and
area 50 km downstream from the project site have been investigated for any water intakes. The site investigation showed that there is no water intake within the surveyed area except a discarded intake for a copper mine which had been closed. Further downstream, the intake for Chenguan Town Water Supply Plant of Yun county is 70 km downstream of the project site, and domestic water intakes for Danjiangkou City and Hanjiang Group Industry are 200 km downstream of the site. It is reckoned that these intakes would not be affected by the project.

3.5.2.2 Water Environment Status and Assessment

In order to understand the baseline status of surface water quality, the EA team has visited local EPBs. Historical monitoring records confirmed that the surface water quality in Hanjiang River can basically meet Class II standards.

In addition, the Environment Monitoring Center of Yunxi County has been contracted by the EA team to carry out a water quality monitoring program and the monitoring location was on the proposed bridge site. The monitoring program lasted for 2 days. The results are shown in Table 3-5-2 below.

<table>
<thead>
<tr>
<th>Water quality parameter (mg/l)</th>
<th>Cross section</th>
<th>Item</th>
<th>Date</th>
<th>Hypermanganate index</th>
<th>SS</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Monitored result</td>
<td>9 April 2003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>1.43</td>
<td>37</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle</td>
<td>1.40</td>
<td>35</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>1.45</td>
<td>35</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 April 2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>1.37</td>
<td>37</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle</td>
<td>1.42</td>
<td>38</td>
<td>0.05</td>
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<td></td>
<td></td>
<td>Right</td>
<td>1.42</td>
<td>35</td>
<td>0.05</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>1.415</td>
<td>36.2</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Standard value</td>
<td></td>
<td></td>
<td>4</td>
<td>150</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Assessment result</td>
<td></td>
<td></td>
<td>Class I</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Environment Monitoring Center of Yunxi County

It is clear that the water quality in Hanjiang River was good, meeting the Class I standard near the bridge site at the time of sampling.

3.5.3 Ambient Air Quality and Assessment

According to the site survey, the EA team has found no large industries within the project area which would be sources of air pollution. No air pollution sources other than the exhaust gas emission from the motor vehicles on the road.

Jiangjunhe Village is identified by the EA team as the baseline site for a 5-day air quality
monitoring program. Table 3-5-3 below shows the results.

Table 3-5-3 Ambient Air Quality and Assessment Result

<table>
<thead>
<tr>
<th>Monitoring location</th>
<th>date</th>
<th>NO₂ (mg/Nm³)</th>
<th>Assessment result</th>
<th>PM₁₀ (mg/Nm³)</th>
<th>Assessment result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily average</td>
<td></td>
<td>Daily average</td>
<td></td>
</tr>
<tr>
<td>Jiangjunhe Village</td>
<td>10/04/2003</td>
<td>0.058</td>
<td></td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11/04/2003</td>
<td>0.055</td>
<td></td>
<td>0.064</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12/04/2003</td>
<td>0.050</td>
<td>Class I</td>
<td>0.115</td>
<td>Class II</td>
</tr>
<tr>
<td></td>
<td>13/04/2003</td>
<td>0.058</td>
<td></td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14/04/2003</td>
<td>0.080</td>
<td></td>
<td>0.089</td>
<td></td>
</tr>
</tbody>
</table>

Source: Environment Monitoring Center of Yunxi County.

It can be seen from the above table that NO₂ falls into Class I standard while PM₁₀ falls into Class II standard. In general, the air quality in the project area is good and can meet the designated standards.
Chapter 4 Environmental Impact and Mitigation Measures

The proposed Hanjiang Bridge Project will cause potential adverse impacts on the surrounding natural, ecological and social environments during both the construction and operation phases. As there is no significant natural habitat, scenery, forestland or cultural property within the assessment area, EA team identified that the potential impact is limited to the water quality of Hanjiang River, the soil erosion caused by hill cutting and Jiangjunhe Village which is the only sensitive receptor to Project activities, based on a safeguard screening. Following the impact assessment, specific mitigation measures have been developed to minimize these impacts.

4.1 Impact on Surface Water Environment and Mitigation Measures

The water pollution sources in the construction phase are expected to be domestic wastewater from the construction camp and the waste (machine oil, construction debris, sediment, etc.) dropped to the river and in-water construction during construction of the new bridge. In the operation phase, the major water pollution sources are surface run-off from the road surface and the accidental spills of hazardous materials occurring on the bridge. This section provides detailed analysis of these impacts and proposed mitigation measures.

4.1.1 Construction phase

**Domestic wastewater and solid waste**

The new bridge will cross the Hanjiang River, at the location 50 m downstream from the existing suspended bridge, and two construction camps will be set up at the south and north side of the river. If not carefully selected, such as too close to the river or other areas vulnerable to quick surface runoff, and there is no any wastewater treatment, the camps will result in certain impacts to water quality of the river from their discharges. It is expected that each of the camps will have about 50 workers, and as such the total wastewater generated from the two camps will be 2.5 m$^3$/day based on the unit rate of 50 l/capita/day. Because the construction period of the bridge will last for 3 years, the total domestic waste will be a large amount.

**Material Stockpile**

There will be a large amount of materials stockpiled near the construction site. Without efficient and effective measures against strong wind and surface runoff, the materials can be released to the river either directly (airborne and then precipitate) and/or through surface runoff. The oil dripping from construction equipment will also cause water pollution in the river.

**Barge Shipping of Excessive Earth**

The barge shipping of excessive earth from Yun county to Yunxi county side may generate some impacts to water quality if soil spilled during shipping. The impact would be primarily
increased suspended solids in the river.

**Construction of the New Bridge**

According to the engineering design, the main span of the reinforced concrete piers is 110 m and the total length is 350 m. The arrangement of span is 61+110+110+61 m. The pier is 1.2 m thick.

The bridge construction will take 3 years to complete. The piers will be constructed using the cofferdam method, which will firstly piled with steel pipes, then with steel sleeves to the designed height before casting concrete into the drilling holes. The water remained in the dammed space will be pumped out to the river for final concrete casting to build supporting cap. The dams will be removed after the piers are built.

From the above process, it is clear that the major pollutants are most likely to be oil and suspended solid, as analyzed as follows:

- Suspended solids will be generated primarily from piling, erection and dismantling of the cofferdam which disturb the sediment in the river bottom, as well as materials transported to and used in the construction site such as mixed cement. The disturbance to the sediment is expected to be limited to 100 m from the pier location as the river bottom is well compacted. The materials dripping is also limited to the area immediately adjacent to the site and expected to be a small amount. Both sources of suspended solids are expected to affect a small area of water body, approximately less than 100 m from the pier sites. The impacted water may not be suitable water consumption or aquatic life and will be visually unpleasant. There is no water intake within a 20 km area from the bridge, however.
- The piling and drilling for piers will also generate a large amount of spoiled materials which if dumped to the river will cause rising suspended solids in the water. This spoiled materials will however be transported to the land for disposal according to the engineering plan;
- Pier construction machines, particularly boat-based machines, may leaks and machine maintenance may also cause oil dripping. Such leaks and dripping could cause oil pollution of the river. The impacted time, unless suspended solids which can easily participate, may last relatively long period of time.
- As the Hanjiang River is also a water navigation channel, the bridge construction will have a certain effect to the water transportation traffic, including water traffic accidents. Should such accidents involve oil spills or leaks, major pollution events may occur.

**Mitigation Measures during Construction**

Mitigation measures to be taken during bridge construction are to:

- Enhance construction management, especially orderly, well organized and scheduled construction activities;
- Monitor the water quality closely at areas near the bridge, to detect any abnormal or pollution promptly so that appropriate mitigation and, if necessary, remediation measures
may be taken.

- Locate the construction camps far from the river and all of the domestic wastewater from the camps will be treated by septic tanks. Solid waste from the camps will be disposed at designated sites.
- Locate material stockpiles far away from surface water bodies and the area subject to heavy surface run-off. The powder materials will be bagged and/or covered. Interception ditches will be built around the stockpile site to catch the surface runoff and direct it to appropriate discharge locations.
- Earth work shipping across the river will have high enough free board to prevent it from dropping to the river during shipping. The loading and unloading will also be conducted following the pre-designed procedures to prevent spills, and earth will be compacted well in the barges.
- Provide steel net at the pier construction location to prevent the construction solid waste from dropping to the river. Outside the cofferdams there will be filter cloths to further intercept sediment from the construction areas. Disposal of sediment to the river will be strictly banned. Instead, the sediment will be removed to the bank for proper land disposal. The solid waste will be used as the materials for road construction wherever possible; otherwise it will be disposed in the small disposal areas designated for this Project.
- Well manage equipment maintenance and operation to prevent spills and oil dripping.
- During the in-water construction, the contractor will be requested to contact the water navigation authority to properly arrange and schedule the construction activities. As the project area has a certain amount of the navigation activities during the high water seasons but none during the dry season, the in-water construction will be arranged to the extent possible during the dry season to minimize the potential impact to navigation. In addition, the contractors will ensure that appropriate lighting and warning signs will be provided to alert the water traffic. When necessary, the contractor will invite the navigation authority staff to the site to guide the in-water traffic.

4.1.2 Impact in the operation phase and mitigation measures

The major pollution during operation phase to water environment would stem from two sources: one is waste accumulated on the road surface from the motor vehicle exhaust emission, tire wore out, waste dropped from vehicles and other waste materials which could be washed to the receiving water bodies along with surface runoff. The other is accidental pollution such as hazardous material spills and leakage resulting from traffic accidents involving tanker trucks near the river.

**Road Surface Run-off**

The accumulated pollutants on road surface, debris of abraded tiers, soil attached on vehicle body, oils dripped from passing vehicles and spills of various materials would all be discharged into water bodies by surface run-off. Clearly the major pollutants are oil, organic matter and particulate matter. These pollutants will contaminate water in the river. According to the monitoring results for road surface run-off from other road projects, the load of oil and SS will be the highest during the first 30 minutes of a rainfall. Then the pollutant loads/concentrations in surface run-off will gradually reduce and remain stable after 40-60
minutes of the rainfall as the road surface is cleaned by the continuous rainfall. At this time, the average concentrations of SS, BOD and oil are expected to be 100 mg/l, 5.08 mg/l and 11.25 mg/l, respectively.

Based on the previous experience on similar road projects, in the operation period the road surface runoff will have limited impacts to the river, since the catchment area of the bridge is only 5000 m$^2$. Minor increment of some pollution parameters are expected with the run-off being discharged into the river, however by the assimilation of the river, the impact will be small, typically without changing the water quality classification. However in order to deal with accidental pollution events, preventive measures are necessary especially considering the sensitive nature of the Hanjiang River.

**Accidental Events**

As the critical transportation corridor for Shiyan City to cross Hanjiang River. According the traffic volume projection, there will be 1292 MTV/d traffic on the bridge at the early operation period. The goods or material flow on the existing suspended bridge include coal, minerals, chemical fertilizer, oil, pesticide and sand. When the new bridge is built, and the suspended bridge will be out of service and the current goods flow will be shifted to the new bridge. At that time, the proposed bridge will carry some amount of oil and pesticide. Although there is no water intake around the proposed bridge, in view of its strategic position in water supply both to the national water diversion project and the local water purification plants downstream, any accidental events will cause severe impact on drinking water source. In addition, as a Class VI navigation channel, once ship crash occurs, leakage of material from the crashed ship would pollute the water in Hanjiang River.

Probability analysis method is commonly used in China to estimate the likelihood of such accidental events. In general, such accidents are very rare, about once in a couple of ten years, according to the past traffic accidents records. Although the probability of leakage of dangerous material for this proposed bridge is very low, about 0.030/a. the consequence is severe and could even be catastrophic if a major accident occurs on the bridge. Effective mitigation measures, such as strengthened management, intensified traffic signal and good maintenance of road, should be taken to decrease the probability.

There is a certain level of risk of water traffic accidents. The environmental consequences will be severe should a barge involved in the accidents contain hazardous materials. It is therefore essential to enhance management during the operation phase while emergency plan needs to be prepared and implemented to minimize such risks.

**Water Pollution Mitigation Measures**

- In order to prevent trucks involved in a traffic accident over the bridge from falling directly into the Hanjiang river, the bridge will include a special design to reinforce its guardrails. Such a design is so strong that it will prevent vehicles from falling even driving directly toward the guardrails. In addition, at the both ends of the bridge will include accident prevention designs.
- The bridge will have sufficient and appropriate lighting. In addition, warning signs for
safety as well as speed limits will be erected on the both ends of the bridge.

- A complete drain collection and diversion system (totally 176 diverged drains has been designed) will be designed and installed on the bridge to collect surface runoff from the bridge. The system will also include holding tanks off the bridge to receive the surface runoff, which will have a certain settling, oil/water separation and holding capacities, with a total volume of 10 m$^3$ each. At the normal time, it would help hold and provide a certain level of treatment for storm surface runoff while during an accidents resulting in spills and leaks, the tanks will serve as holding tanks to intercept and hold spilled hazardous materials and prevent them from discharged into the Hanjiang river.

- A management station, with the joint toll service and full-time staff, will be set up to manage and take emergency plan. Suggest use the management station of the suspended bridge.

- Besides crashing prevention design of the piers themselves to be included with consultation with the experts in the field, guiding lights and warning signs will be designed to minimize the risk of barges crashing to the piers. Neon lights will be installed on the piers above the highest water table, to ensure safe navigation under the bridge even under fogging weather. The piers will be coated with flexible materials such as thick rubber, etc. to help absorb the impacts in an event of a crash and minimize the risk of damage to the barge, as well as piers.

**Emergency Plan**

An emergency plan will be established including the duties and responsibilities of the leading group and associated departments, the emergency technology, process, equipment and staffing, monitoring system and reporting system.

*Establishing emergency leading group and designating emergency leadership*

The Traffic Bureaus of Yunxi and Yun Counties will coordinate the various governmental agencies, such as local EPBs, water supply company, public security bureaus, fire department, environmental monitoring center and navigation authority. Staff from the above departments will form a leading group for the emergency plan and one person will be designated as emergency leader. The emergency center will be set in the bridge administration station, with hotline being manned by full-time staff around the clock. If an accident occurs, the leader of the group will be immediately informed, and the remaining procedures in the emergency plan will then be kick-in.

Yunxin county communication bureau will be responsible for daily maintenance, toll collection and administration of the bridge once it is completed. The bureau will utilize the staff working on the Hanjiang river suspension bridge and utilize the same toll and administration facilities currently in service for the suspension bridge for the new bridge. At the same time, the traffic inspection station by the traffic police, which is located near the suspension bridge will also be reserved and used as the inspection station for the new bridge. The bridge administration station is therefore an ideal selection for setting up the emergency response facility. Under the normal operation conditions, the bridge administration station will have staff on duty 24 hours a day. These staff, following proper training, will possess ability for preliminary responses of accidents and other emergency events, responding first time of the accidents and taking appropriate emergency measures. The police station at the bridge site will continue to be responsible for inspection of
trucks with hazardous materials in their payloads. The inspections will include three certificates, in accordance with the Guidelines for Chemical Hazardous Materials Transportation Administration issued by the State Council, as well as physical inspections of the trucks for their fitness for such materials transportation.

Once accident occurs, the staff of the bridge administration station can take appropriate emergency measures. In addition, the station will also be responsible for informing the accidental event occurred near the bridge to the emergency leader who will in turn take further actions.

Emergency facilities
The emergency facilities and resources, including chemical agent, fire-fighting equipment are required to for the emergency center. These facilities will be stored near the bridge site, at the bridge management station. More elaborated and additional materials and equipment will be stored in the emergency center. Table 4-1-1 below gives the details.

<table>
<thead>
<tr>
<th>Table 4-1-1 List of emergency equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of equipment</td>
</tr>
<tr>
<td>Water pollution control</td>
</tr>
<tr>
<td>Cleaning and recovery equipment</td>
</tr>
<tr>
<td>Fire-fighting</td>
</tr>
<tr>
<td>Potable annihilator</td>
</tr>
<tr>
<td>Trammer annihilator</td>
</tr>
<tr>
<td>Gas mask</td>
</tr>
<tr>
<td>Medical aid</td>
</tr>
<tr>
<td>First-aid box, hand barrow, medicine</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Staff training
The emergency staff will participate in the training on environmental protection, emergency response and environmental cleanup, to be held by Hubei Provincial Communication Department regularly to develop and maintain the skills and to familiarize with the procedures for emergency. Emergency response drills will be held every year to test the readiness and identify any flaws in the emergency plan for improvement. The training program is as follows.

<table>
<thead>
<tr>
<th>Table 4-1-2 Training Plan for Emergency Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project phase</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Operation</td>
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<tr>
<td></td>
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Note: each training will include a group leader.

Emergency Procedures
Once accidental event occurs, the staff of management station at the proposed bridge will take primary action to prevent discharges of pollutants or toxic matters into the water body. The emergency leader will be noticed right away and he or duty staff in the center will call
upon the other staff immediately to the site to take necessary actions, to prevent discharges of pollutants or toxic matters into the water body. If the water is polluted, the leading group would inform the various water intakes to stop operation as may be appropriate, and remediation measures will be taken to deal with the event. The bridge will be closed temporary if necessary to allow appropriate and orderly handling of spills if any and other matters in the accidents.

The process of emergency treatment is shown in Figure 4-1-1 below.

![Diagram](image)

**Figure 4-1-1  Emergency Treatment Process**

### 4.2 Impact on ecological environment and mitigation measures

The focus of this section is on the issue of soil conservation caused by digging for access road connection.

#### 4.2.1 Soil Erosion Analysis and Mitigation Measures

The proposed Hanjiang Bridge will connect with the existing Yunyang Road and G316 Road. Since Hanjiang River flows in a valley, surrounded by high mountains, and Yunyang and G316 Road are all located at hillside. It is therefore inevitable to cut the hill in order to build the connection and access.

The project is located at the foot of a mountain where it connects with Yunyang road and G316. As such, the earth work is limited. On the Yun county side, there will be some excavation for road base which will generate 25,800 m³ excessive earth requiring disposal. At the same time, on the Yunxi county side, there will be a demand of 26,600 m³ filling materials. It has been planned to ship the excessive earth materials from Yun county to Yunxi county side by barge. With this plan, earth materials are expected be mostly balanced and thus there will be no need for dedicated excessive soil disposal site in this project. However, hill cutting will interrupt the geological structure of the mountains and destroy vegetation cover, causing soil erosion. The possible soil erosion may occur from the construction activities and filling areas before protective works are complete and borrow pits, as well as any areas where surface soil and vegetation is disturbed. In particular, soil erosion is most
like to occur in the raining season from June to September each year.

The following mitigation measures have been developed against soil erosion:

- Temporary, simple drainage system will be built before the construction of road base and deep cutting. The system will include echelon shaped ditches adjacent to the road base to be expanded and interception ditches in sites where there are large catchment areas.
- Guard or protective facilities will be completed within 15 days after the construction of road base and mountain cutting. The road slope will be protected by grass and mortar-brick embankment will be built on water saturated road base.
- The access road involving amount of earth work will be scheduled to avoid draining season, and the construction contractor will be requested to keep close contact with local climate stations to take protective measure before heavy storms. The drain system will be cleared in a timely manner prior to draining season. The surface slope of each earth layer will be 2-5% and be compacted before rainfall and end of each work shift.
- Certain protective materials, such as grass matting, will be kept ready for rain day when they may be used to cover the deep slope bare soil and other vulnerable sites from heavy soil erosion.
- 0.5 m deep holding/sedimentation ponds and retaining wall will be built at the steep slope, disposal and borrow pits. When the construction is completed, the ponds will be filled and flatted.

4.2.2 Other Ecosystem Impact Mitigation Measures

- As April to June of each year are the spawning season, the in-water construction activities will be banned during this period to minimize the impacts to fish. The construction will be scheduled for the dry season where possible.
- The connection roads will occupy a small amount of mountainous land in the Yunxi County side, which is currently covered by wild grass and shrubs. There is no large tree in this area. The occupied land will be compensated according to the relevant requirement from the local forest authority, prior to the construction. Furthermore, the construction sites will be well defined and any construction activities outside the pre-defined areas will be strictly prohibited.
- The land in Yun County within the project area is covered by cultivated land which is valuable in such mountain region. Construction activity should be well managed to limit land occupation to the defined boundary of the site and avoid damage of plant beyond the site.
- The construction camps and material stockpile sites will be carefully selected on waste land where possible, to avoid occupy cultivated or wood land. When the construction is completed, the land will be leveled, restored and re-landscaped by the contractors.

4.3 Impact on Acoustic Environment and Mitigation Measures

Construction Phase
Noise during the construction phase will mainly arise from construction equipment and transportation vehicles, causing increased noise levels in the areas surrounding the construction sites. According to EA team's site survey, there is only one sensitive receptor along the project, Jiangjunhe Village. Therefore the focus of the acoustic assessment is placed on the village area.

According to the Noise Limit at Boundary of Construction Site (GB12523-90), the limit for noise level for day time and night time are 70-75 dB(A) and 55 dB(A) respectively. Based on the experience of similar works, the impact distance of noise from construction equipment is 40 m in day time and 200 m in night time. In addition, the transportation of construction material on road will cause noise impact to the receptor. Currently, houses of Jiangjunhe Village spread closely along the access road to the proposed bridge, overlapping of noise from the current traffic on G316 Road, construction activity and material transportation will pose severe impact on some residents. The mitigation measures are as follows:

- Provision of noise insulation windows to 9 houses in Jiangjunhe Village, with the total cost of RMB 10,800.
- The construction materials will be transported on the existing road to the construction sites. The transportation schedule will be carefully designed to minimize the adverse impact on residents, as well as the traffic on the existing road. The transportation vehicles will be requested to slow down and banned from honing when passing houses.
- The construction activity in residential area will be scheduled in daytime only, and the noisy equipment should be prohibited from night operation.
- The construction equipment will be well maintained to keep it best operating conditions and lowest noise levels possible.

**Operation Phase**

According to the traffic flow projection, the traffic volume will be doubled in 2007 after the proposed project is complete, reaching 1292 MTE/day and 1562 MTE/day in 2010 and 3019 MTE/d in 2020. At these, however, the total projected traffic is still very low. There is no suitable mathematical model for projection of such low traffic flows, therefore the traffic noise level has not been modeled in this EA. In fact the increased traffic will certainly increase the noise levels from the current 61 dB(A) at the day time and 51 dB(A) at night. Although no specific modeling data is available, based on experience from other roads with similar traffic volumes, noise levels will be raised by 3-5 dB(A) during the operation phase, which are expected to exceed the Class III standards designated for such sensitive receptors. However, by provision of noise insulation windows, 10dB(A) noise level will be reduced in the affected house. Therefore the noise impact could be effectively controlled by the proposed mitigation measures in operation phase. The following additional measures will also be taken to mitigate the increase noise impacts to sensitive receptors:

- Enhanced management on vehicle on the bridge, to prohibit over-load trucks;
- Motor vehicles speed will be limited by warning and traffic control signs to be erected near the sensitive receptors.
- The road will be well maintained to ensure good surface conditions to avoid increased noise from poor road conditions.
4.4 Impact on Ambient Air and Mitigation Measures

As the bridge and connecting road will adopt concrete surface instead of asphalt, there is no hog mixing plants, and thus no asphalt emission issues. The major air emissions in this project are expected to be airborne dust from construction sites and construction traffic.

Concrete Mixing Impact Assessment and Mitigation

Concrete mixing will likely to cause airborne dust, particularly during materials loading and mixing, affecting air quality in the surrounding areas. However, as the road surface work is not very large, requiring only 4770 m² of surface pavement, there will be a need of a small mixing plant. If the site of the mixing plant is not well planned, it could impact the surrounding areas so a major mitigation measure is to properly select the site to have sufficient distances leeward form sensitive receptors, such as Jiangjunhe Village and Lijiapeng Village. The mixing plant will also be covered to the extent possible to minimize the potential of dust airborne. Otherwise, provide sufficient protection to workers at these stations is needed.

Air-borne Dust Impact and Mitigation

The main factors affecting air-borne dust are the traveling speed of vehicles, wind speeds, handling of bulk and powdering materials, dust fall on road and moisture on road. The traveling distance of air-borne dust is closely related to wind speed. According to the monitored data on Jing-Jin-Tang expressway during construction phase that, at the 150 m leeward, the TSP is 5.093mg/m³, exceeding the Class 2 standard of National Environmental Air Quality Standard (GB3095-1996). As described previously there are a few sensitive receptors within this distance including schools, hospitals and residential housing which could be impacted by the dust. However, the air-borne dust could be effectively controlled by water spraying.

Following measures are to be taken:

- Contractors will be requested by contracts to provide water spray vehicles to water the unpaved ground, storage piles and other areas where airborne dust may originate. The water spray operation will be carried out in dry and windy day, at least twice a day (morning and afternoon). The frequency of water spray near sensitive receptors, such as villages and school, will be increased as may be needed.
- Speed of transportation vehicles entering in the construction sites and passing through the villages will be restrictedly limited. The truck transporting powder materials, such as cement, sand and lime, will be covered.
- In order to avoid air-born dust pollution, the excessive earth work should be collected using as filling material or trucked away rather quickly with minimum storage at the sites,

Motor Vehicle Emission during Operation Phase

According to traffic volume projection for this Project and EA team's past experience, the low volume of this project will not cause significant impact on ambient air quality. The limited amount of emissions is expected to quickly dispersed with little impacts to the overall air quality in the area. It is anticipated that the current Class II standard will be maintained during the operation phase.
4.5 Assessment of impacts of the bridge auxiliary facilities

As this project is very close to the current suspension bridge, about 50 m, and the existing five stories administration station building for the suspension bridge is also very close to the new bridge (see Figure 3), it can be utilized as the administration station for the new bridge. According to the arrangement of the project owner, after the new bridge construction, the facilities and staff at the current administration station will be transferred to the new bridge for toll collection, maintenance and administration. Clearly, there will be no new sources of pollution for the new bridge auxiliary facilities. Based on EA team's site investigation, the main pollutants form this administration station includes a small amount of domestic wastewater. This wastewater is treated in septic tanks and the supernatant is drained by local farmers for agricultural land uses. The sludge is collected by the local sanitary unit for proper proposal. Following these measures, there is expected very little adverse impacts. Similarly, the existing police inspection station will also be used for the new bridge and there will be no new sources of pollution.

4.6 Assessment of existing suspension bridge

According to an inspection report for the suspension bridge prepared by the Hubei Highway Bureau in March 2003, the bridge has a certain safety concern. In the end of 2002, the Yunxin county communication bureau conducted a major repair of the bridge but that repair can only last another 2.5 years safe operation of the bridge, i.e., to the mid 2004, when the bridge will reach its designed life. As the current World Bank financed new bridge will be constructed by 2007 the project owner plans to conduct another repair and strengthening to ensure the safe operation until 2007. The suspension bridge will be phased out when the new bridge is constructed and put in operation.

According to project plan, after the new bridge construction and operation, the existing suspension bridge will be dismantled. But there is no detailed plan or timing for the dismantling yet. However, in order to eliminate the safety concern, the suspension bridge will be closed immediately following the new bridge operation, prohibiting motor vehicle and pedestrian traffic. Traffic and warning signs will be erected to guide the traffic through the new bridge. As the new bridge has 1.5 m wide pedestrian lanes on both sides, it can also meets the pedestrian traffic and the closure of the suspension bridge will not have impacts to the pedestrian traffic and local residents river crossing needs.

The suspension bridge dismantling will have certain impacts, including mainly:

- Short term impact to water quality. As this is a suspension bridge and has no columns or any other in-water structure, there will be no in-water dismantling. The impact to water quality will be mainly from dripping of materials when the suspension bridges are dismantled. As the dismantling is expected to be short (about a week), the impacts from materials dripping to the river will be short and will disappear when dismantling activities are complete.
- As Hanjiang river is a navigation channel and if the timing of dismantling is not...
appropriately selected, the activities will affect water navigation and potential safety concerns.

- Dismantling activities pose safety risks. If the site is not well sealed from the public, it could be a safety concern to the surrounding residents.

As the impacts are mostly shorted termed, the following mitigation measures will be adopted:

- Prior dismantling operation, the contractor will be requested to inform the public, navigation and hydrology authorities and coordinate with the authorities for the optimal timing.
- Reasonably arrange the construction time, and prohibit dismantling activities in the period of April to June, which is the spawn time. The dismantling will be arranged in the dry season if possible to avoid impact to navigation.
- Strengthen the site management and completely seal off the construction sites to ban strictly access of any vehicles and pedestrians into the dismantling sites. Dedicated staff will be assigned to the site for safety.

4.7 Land Acquisition and Resettlement

**Land Acquisition and Resettlement**

The total land to be occupied by the proposed project will be 18.25 mu, with about 10 mu cultivated land. Most of the cultivated land to be occupied is in Jiangjunhe Village. Because there are 200 mu cultivated land and about 200 people in the village, occupation of about 10 mu cultivated land would result in a 5% loss of the agriculture of the village. As the per capita land ownership is 1 mu/person, some people will lose a large portion or all of their land if the loss is not shared by the whole village. Therefore their livelihood will be severely affected. Sufficient compensation will be paid to the affected people, to ensure them recovered livelihood.

In addition, there are 1527.86 m² houses to be demolished. About 12 households will be relocated.

**Mitigation Measure**

A resettlement team has been set up by HPCD to prepare a Resettlement Action Plan (RAP). At the time this report was prepared, the project RAP had been completed and submitted to the World Bank for review. HPCD has promised to follow the policies and guideline of the World Bank and national laws to carry out the land acquisition and resettlement compensation.

4.8 Social Impact

Significant positive social impact will be brought by the proposed Project, such as the following:

- Improved local transportation conditions, reduced traveling time and traffic accident;
- Easy access to services and markets. In particular, the vulnerable groups will have better access to medical and education services.
- The bridge design has the provisions for pedestrian traffic, including a 1.5 m wide pedestrian lane on each side. This is in compliance with relevant design code of the country and meets the expected pedestrian traffic volume. On both sides of bridge are small communities with no large markets. Most traffic on the bridge is motor vehicles with minimum pedestrian. At the present, the pedestrian traffic across the river is about 150 per day. The expected pedestrian traffic after the new bridge is expected to not exceed 300 per day. For this volume of traffic, the two 1.5 m wide pedestrian lanes on the bridge will be adequate.
- Promoting economic growth in the region, promoting flows of goods and providing easy access to market. The improved transportation infrastructure will also help attract outside investment and support the local economic development.
- The Project construction and operation will bring funds to the local economy and provide employment and income opportunities. This will help the poverty alleviation effort in the Project region.

At the same time, however, some negative social impacts will be brought as the result of project construction, including land occupation and house demolition, traffic blocking during construction, interruption of some irrigation facilities, safety of people during construction, especially to vulnerable group as school children and elderly, inducing some epidemic diseases spread, such as SARS etc. These impacts could be effectively mitigated by the following measures:

- Construction activity will be limited to the site and any damage of vegetation cover outside should be prohibited.
- The existing irrigation facilities will be protected, and any interruption will be minimized and restored as soon as the construction is complete. Spoil materials are prohibited from dumping into the irrigation canals.
- Enhance construction management, especially orderly, well organized and scheduled construction activities. Warning signs like “construction ahead, reduce speed” will be installed by contractors on their road sections, a staff will be designated by the contractor to guide traffic when necessary to avoid traffic blocking in G316 road and Yunyang road.
- Traffic warning signs will be installed at some sites, such as Jiangjunhe village, access road entrances and bridge, and a safety education program will be carried out on the people affected.
- Transportation of material and operation of equipment will be carefully scheduled based on public consultation although these will not cause significant impact.
- The construction camps will have a management system for hygiene, sanitation and environmental control. Health training will be provided to all construction workers particularly the knowledge for prevention and control of epidemic diseases such as severe acute respiratory syndrome (SARS), AIDS and hepatitis B, etc. The construction camps and living quarters will be cleaned and disinfected regularly, providing a clean and healthy living environment to construction workers. All workers will be checked for their health regularly including temperature checks. An emergency plan will be in place to quarantine workers who suspected of having SARS or other infectious diseases and
hospital authority will be informed immediately.

4.9 Management of Construction Camps

According to the construction schedule, the workers will live in two camps at each side of the river. But a certain area of land will also be required to store construction equipment and materials. Two such temporary camps will be set up. The construction camps will have a management system for hygiene, sanitation and environmental control. Health training will be provided to all construction workers particularly the knowledge for prevention and control of epidemic diseases such as severe acute respiratory syndrome (SARS), AIDS and hepatitis B, etc. The construction camps and living quarters will be cleaned and disinfected regularly, providing a clean and healthy living environment to construction workers. All workers will be checked for their health regularly including temperature checks. An emergency plan will be in place to quarantine workers who suspected of having SARS or other infectious diseases and hospital authority will be informed immediately. Septic tanks will be provided for construction camps, which will be cleaned regularly. The drinking water quality will be ensured to meet the national standard for drinking water.

The contractors will be selected based on competitive bidding. They will be requested to prepare various construction management plans and rules under the supervision of the Project owner and to provide training, including environmental training to workers. The environmental training program will cover environment management, construction safety, noise, dust, camp management and health. In addition, environment management will be included in the contract and its implementation will be under the supervision of the Project owner and the environmental supervisor designated by the owner.

4.10 Environmental Benefit

The potential positive environmental benefits of the proposed project are:

- Reduced soil erosion by improved drainage system along road and protective works
- Saving on resources by increasing vehicle operation efficiency, lowered fuel consumption, reduced air-borne dust, noise and air emission;
- Improved transportation condition between the west and east area of Shiyan City, saving traveling time of vehicles on road and reducing likelihood of traffic accidents on the road and during the ferry;
- The degree of impact on the sensitive receptors will be monitored and effective mitigation measures will be taken wherever necessary, thus the environmental quality of the sensitive receptors will be ensured.

4.11 Safeguards Assurance and Compliance

There are nice other safeguards policies, besides OP 4.01, in the World Bank which could
apply to a Bank financed project. The Project EA includes an initial screening and, where triggered, full application of the safeguards policies. The following summarizes the safeguard issues for this Project.

- **OP 4.04 Natural Habitats** – There are no natural reserves or significant natural habitats within the project area, thus this policy is not applied.
- **OP 4.11 Cultural Property** - The EA team has undertaken a cultural property survey and assessment. No cultural sites have been found within the assessment area, thus this policy is not applied.
- **OD 4.20 (being converted to OP 4.10) Indigenous Peoples** – There are no indigenous people settlement centers within the project area, thus this policy is not applied.
- **OP 4.36 Forestry and OP 4.09 Pest Management** – There are no forest, even large area of woods, and the storage of pesticide is not increase as the result of the project implementation, thus these policies are not applied.
- **OP 4.37 Safety of Dams, OP 7.50 International Waterways and OP 7.60 Disputed Area** – These policies need not to be applied.
Chapter 5  Public Consultation and Information Disclosure

5.1 Methodology

The EA team has carried out a public consultation during March-April 2003 to understand the exact opinion of the public about the proposed Hanjiang Bridge. The consultation was focused on the affected people and entities, including residential centers, township governments and county government agencies. Through questionnaires and interviews, 83 individuals have expressed their concerns and opinions. Table 5-1-1 summarizes the objects surveyed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Categories surveyed</th>
<th>No. organizations</th>
<th>No. of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Directly affected people</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Township government and congress</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Municipal government officials</td>
<td>-</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>-</td>
<td>83</td>
</tr>
</tbody>
</table>

The statistics of the people surveyed are summarized in Table 5-1-2 below.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Education background</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Statistics</td>
<td>53</td>
<td>30</td>
</tr>
<tr>
<td>%</td>
<td>64</td>
<td>36</td>
</tr>
</tbody>
</table>

5.2 Survey Result

The EA team at first briefed the public members the project information, such as works description, alignment, possible benefits to people and negative impacts. The focus was placed on the collection of concerns from the roadside residents and organizations.

Table 5-2-1 summarizes the survey results.
### Table 5-2-1 Survey Result

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>No. of people (male/ female)</th>
<th>Method</th>
<th>Major concern/opinions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/24/03</td>
<td>Water Conservancy Bureau</td>
<td>1/0</td>
<td>Interview</td>
<td>Shiyan city</td>
</tr>
<tr>
<td></td>
<td>Hanjiang River that the proposed project will cross is the water source for the National Water Transfer Work, and the key area for soil conservation. In order to protect the water quality of the head water source for the South-North water Transfer Project, soil conservation should be paid with high attention during the implementation. Drain system and guard works should be well constructed. Spoil is forbidden from dumping into the river. Water conservancy department well support this proposed project provided all of the mitigation measures are effectively taken.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/24/03</td>
<td>Forestry Bureau</td>
<td>1/1</td>
<td>Interview</td>
<td>The access road to the bridge will destroy plots of woods in Yunxi County. Only can the woods land be occupied after the agreement is got from related government agency. The boundary of construction site should be clearly defined, and all of the construction should be limited to within the boundary.</td>
</tr>
<tr>
<td>3/24/03</td>
<td>EPB</td>
<td>1/0</td>
<td>Interview</td>
<td>The residents would be affected by the project during both construction and operation. High-noise equipment should be prohibited from operating in residential center. Also mitigation measures should be taken to control the air-borne dust.</td>
</tr>
<tr>
<td>3/25/03</td>
<td>Forestry Bureau</td>
<td>2/1</td>
<td>Interview</td>
<td>Yun County</td>
</tr>
<tr>
<td></td>
<td>Director Zhang of the bureau said that vegetation cover outside the site boundary should be protected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/25/03</td>
<td>Water Conservancy Bureau</td>
<td>0/1</td>
<td>Interview</td>
<td>Due to great forestation effort soil erosion has been effectively controlled in Hanjiang River catchment. Hill cutting, spoil and borrowing pit are likely to be the source for soil erosion. Therefore effective mitigation and compensation measures should be taken. The irrigation facilities should be protected. Spoil is prohibited from dumping into Hanjiang River.</td>
</tr>
<tr>
<td>3/25/03</td>
<td>EPB</td>
<td>1/0</td>
<td>Interview</td>
<td>According to function zoning, the water quality in Hanjiang River is Class II, and the current water quality is very good. Care should be taken in construction activity. Spoil should be forbidden from dumping into the river when constructing the pier. The wastewater from camp and construction site should be treated before discharging into water body. Construction should be prohibited from night time.</td>
</tr>
<tr>
<td>3/25/03</td>
<td>Transportation Bureau</td>
<td>0/1</td>
<td>Interview</td>
<td>The bridge project will promote the local economy. The project need to be started as soon as possible. This bureau would actively cooperate to make the road project be a model project.</td>
</tr>
<tr>
<td>4/1/2003</td>
<td>Forestry Bureau</td>
<td>2/0</td>
<td>Interview</td>
<td>Yunxi County</td>
</tr>
<tr>
<td></td>
<td>The area along Yunyang Road is well planted. The proposed project will involve hill cutting and occupation of woodland. Therefore the project is pending on the agreement of the local forestry department. In the deep mountains, there are several kinds of wild animals.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/1/2003</td>
<td>Water Conservancy Bureau</td>
<td>2/1</td>
<td>Interview</td>
<td>Yunxi County is the key area for soil conservation. With years of forestation effort, the soil erosion status has been effectively curbed. Soil conservation should be paid with high attention during the implementation.</td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>No. of people (male/female)</td>
<td>Method</td>
<td>Major concern/opinions</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------</td>
<td>----------------------------</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>4/1/2003</td>
<td>EPB</td>
<td>1/1</td>
<td>Interview</td>
<td>According to function zoning, the water quality in Hanjiang River is Class II, and the current water quality is very good. Care should be taken in construction activity. The wastewater from camp and construction site should be treated before discharging into water body.</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Town of Yun County</td>
<td>3/0</td>
<td>Interview</td>
<td>Township Government would actively support this project and cooperate to deal with the preparation work. This project should be implemented as soon as possible to gain benefits to the local economy. The implementing agency should seriously consider the compensation for the land occupation.</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Jiangjunhe Village</td>
<td>22/1</td>
<td>Questionnaire</td>
<td>Support the project, since it will promote local economy and personal income. But occupation of cultivated land should be minimized, the labor of the village should be hared to earn additional income. Sufficient compensation should be paid for land occupation. The affected people should get new land. The residents are used to the noise and hope to live in the roadside houses, since they want easy access to the road.</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Yangwei Town of Yunxi County</td>
<td></td>
<td>Interview</td>
<td>Strongly support the proposed project. But construction activity should be well managed to avoid disturbance on the traffic on Yunyang Road.</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Lijiapeng Village</td>
<td>12/7</td>
<td>Questionnaire</td>
<td>Support the project. Since the project is far from the village, villagers expect minor impact from the project. Villagers should be employed by the project to earn income.</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Management Station of Hanjiang Suspended Bridge</td>
<td>2/0</td>
<td>Interview</td>
<td>The staff are satisfied with the site of the proposed bridge. Since the proposed bridge is close to the existing suspended bridge, it is easy for drivers to get to the proposed bridge, and the existing administrative building for the suspended bridge can be utilized to save money. They hope to be employed to manage the proposed bridge since they are familiar with the local condition and well experienced.</td>
</tr>
</tbody>
</table>

Note: The people surveyed in township government included local people's representatives and township directors.

The EA team has distributed 80 copies of a questionnaire during the public consultation, with 60 copies returned. The return rate is 75%. The statistics of the questionnaire survey are summarized in Table 5-2-2 below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Are you satisfied with local transportation condition?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)yes (2)no (3)do not know</td>
<td>10 72 18</td>
</tr>
<tr>
<td>2</td>
<td>What do you think about the Hanjiang Bridge project?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(necessary (2)unnecessary (3)do not know</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Do you think you will get easy access to transportation after the project?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)yes (2)no (3)do not know</td>
<td>82  -  18</td>
</tr>
<tr>
<td>4</td>
<td>Do you think the bridge project will bring benefit to the roadside residents?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)yes (2)no (3)do not know</td>
<td>60  5  35</td>
</tr>
</tbody>
</table>
### Jiangjunhe Hanjiang River Bridge EIA and EMP

#### Impact in construction phase

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>What is your opinion about land acquisition?</td>
<td>10 3 87</td>
</tr>
<tr>
<td></td>
<td>(1) agreement (2) disagreement (3) agreement provided with reasonable compensation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>If the project needs to acquire your land, what do you expect?</td>
<td>100 - 95</td>
</tr>
<tr>
<td></td>
<td>(1) cash compensation (2) against (3) new land</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>If the project needs to demolish your house, what do you expect?</td>
<td>87 95 5</td>
</tr>
<tr>
<td></td>
<td>(1) cash compensation (2) new house (3) against</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>If your house is demolished by the project, where do you want to be relocated?</td>
<td>100 - -</td>
</tr>
<tr>
<td></td>
<td>(1) same village (2) near village (3) no matter</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Which do you think will cause most significant impact?</td>
<td>65 21 14</td>
</tr>
<tr>
<td></td>
<td>(1) noise (2) air-borne dust (3) safety</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Do you hope the worker to rent your house?</td>
<td>94 - 6</td>
</tr>
<tr>
<td></td>
<td>(1) yes (2) no (3) do not know</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Which safety issue need to be paid most attention on?</td>
<td>67 52 43</td>
</tr>
<tr>
<td></td>
<td>(1) blasting (2) children on road (3) speed of construction vehicle</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>What kind of impact will be brought on your income during the construction?</td>
<td>36 18 46</td>
</tr>
<tr>
<td></td>
<td>(1) increased income (2) decreased income (3) no impact</td>
<td></td>
</tr>
</tbody>
</table>

#### Impact in operation phase

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Which kind of impact do you think will be brought on your daily life when the traffic volume rise?</td>
<td>64 23 13</td>
</tr>
<tr>
<td></td>
<td>(1) noise (2) decreased agricultural income (3) air-borne dust</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Will you feel it is noisy when the traffic volume rise?</td>
<td>6 64 30</td>
</tr>
<tr>
<td></td>
<td>(1) noisy (2) little bit noisy (3) no</td>
<td></td>
</tr>
</tbody>
</table>

#### Other requirement and concern

1. Farmland occupation should be minimized. If necessary, villagers should get reasonable compensation and new land. The compensated house should be of higher quality than the old one and should be provided within the village nearby.
2. Local farmers should be hared to work on the project to earn income.
3. Construction should be well managed, and traffic should be well coordinated to avoid traffic blocking.
4. Plant cover should be protected, the drain system of road should be improved to avoid soil erosion.
5. EPBs concern about impact on water quality in Hanjiang River when constructing the bridge pier. The construction should be well managed to avoid such impact.

#### 5.3 Response to Public Concerns

The public consultation shows that the local people are very supportive of the Project and want the Project to be completed as soon as possible. The people surveyed well understood the Project contents and had most concerns related to the noise and traffic safety. Their concerns have been recorded. EA team has cooperated with the design team to develop the responsive mitigation measures which have been included in the report. Following are the responses to these concerns:
**Concern: Land Acquisition and Resettlement**

Land occupation is inevitable to any road projects. The roadside residents understand the necessity of land acquisition. Most of the residents agree the land acquisition plan provided they get reasonable compensation. The residents asked for direct compensation to their hands. The compensated house should be within the same village.

**Response:** A resettlement team has been designated by HPCD to prepare the RAP and the team has already had the feedback about these opinions from the public. The HPCD has promised to safeguard the public interest based on the national laws. Therefore the affected people would not suffer loss of living quality.

**Concern: Employment of local labor force**

The public and government wanted the project to employ the local labor so that they could have more income opportunities from the Project construction and operation.

**Response:** The EA team has transferred the requirements to HPCD who have demanded the Yunxi Counties Transportation Bureau to give full consideration of employing labor from the local sources. The locals can be used as hard labor and after technical training, the locals can also be employed for jobs requiring more skills.

**Concern: Traffic Blocking.**

The public is concerned that construction activities could close the roads and impede the traffic.

**Response:** The construction will be carried out in half of the road at a time to minimize the impact on traffic. Warning signs like “construction ahead, reduce speed” will be installed by contractors on their road section, a staff will be designated by the contractor to guide traffic when necessary.

**Concern: Soil Erosion**

The public is concerned on the increased soil erosion due to construction activities.

**Response:** EA team and design team have given this issue a serious consideration. Effective measures have been designed to control soil erosion, such as clear defined boundary, provision of drain and protective works. Vegetation cover will be restored after the work is completed.

**Concern: Water Quality in Hanjiang River**

Hanjiang River is the source for the National South-North Water Diversion Project. The construction of the bridge should be well managed, and effective measures should be taken to address the concern of water quality.

**Response:** EA team is particularly concerned about the water quality impact on Hanjiang River, and has designed mitigation measures for each state of project process. The risk of dangerous material leakage has been analyzed. Detailed management plan and emergency plan have been prepared. It is believed that the impact on water quality will be minimized by these measures.

### 5.4 Information Disclosure
Both of the Environment Impact Assessment Report and the Environment Management Plan will be disclosed to the public when they are prepared. In view of the difficult distribution of information in such remote mountainous region, the EA team has carefully designed the means for information disclosure. The EA documentation will be placed in the village committee, and another copy will be placed in the Library of Yunxi County which is easily accessible to other stakeholders. As newspaper is not well distributed in the villages, the village's broadcasting and the public bill board are used to disclose information. In addition, the following means will also be used:

- Shiyan TV station will be used to broadcast the information, covering the brief introduction about the project, and the location where the EA documentation is placed.
- Information which covers the brief introduction about the project, and the location where the EA documentation is placed, is announced on the bill board of Jiangjunhe and Lijiapeng Villages.
- Some printed booklets are placed in the existing bridge administration station to be given to passing vehicles and pedestrians by the station staff. The booklets include a brief project description and key results of EIA, as well as the places for the full EIA report for public review.

Table 5-4-1 below shows the timing, location and means of information disclosure.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr. 2004</td>
<td>Existing bridge administration station</td>
<td>Booklets</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>Shiyan TV Station</td>
<td>Broadcasting information</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>Village's bill board</td>
<td>Disclosure of information</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>Committee of Jiangjunhe Village</td>
<td>EA documentation (Mar. 2004 edition) for this project and the record of public comments</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>Library of Yunxi County</td>
<td>EA documentation (Mar. 2004 edition) for this project and the record of public comments</td>
</tr>
</tbody>
</table>
Chapter 6   Conclusions

The main conclusions drawn from the EA process are as follows:

**Current Environment Status**

- This proposed project is located in the west region of Hubei Province. By the proposed bridge, Yunxi and Yun Counties, both are national level poverty counties, will be connected. The proposed bridge will be a vital linkage to the Jiangnan and Jiangbei and will provide the short cut road to the counties in Shiyan City.
- Hanjiang River flows in a valley formed by two mountains. The slope on the Yunxi side is flat which is cultivated by the local people, on the high land underbrush and grass dominate the vegetation cover. On the side of Yunxi County, the gradient of the land is steep which is covered by woods. However at the bridge site, there is no trees around, but underbrush. No cultural properties, scenic region or natural reserves are found during the EA site survey.
- Soil erosion is severe in this project area. The soil erosion mode falls into the medium degree.
- Hanjiang River is the source for the National South-North Water transfer Project, and the current water quality of the river is very good, can meet the Class II standard.
- The acoustic environment is affected by the current traffic noise on Yunyang Road and G316 road.
- The ambient air quality is very good, with monitored NO$_2$ can meet Class I standard and PM$_{10}$ is within the applicable Class II standards.

**Environment Assessment Conclusions**

- It is inevitable to cause impact on the water quality in Hanjiang river by the proposed project. EA team is particularly concerned about the water quality impact on Hanjiang River, and Efficient and effective measures have been developed in this report for each state of project process. The risk of dangerous material leakage has been analyzed. Detailed management plan and emergency plan have been prepared. It is believed that the impact on water quality will be minimized by these measures.
- Soil erosion would be likely caused by hill cutting. Mitigation measures have been designed to minimize the potential impact on soil erosion.
- Noise arising from both construction and operation phases will cause negative impact on the roadside Jiangjunhe Village. Responsive mitigation measures have been developed in this report to minimize the impact.
- Because the limited quantity of work for this proposed project, the concrete surface is only 4770m$^2$, the mix station will be very small. Such impact arising from mixing operation will be effectively mitigated by careful site selection and enclosed operation of mixing station as well as water spray on dirt road and storage piles. Although the traffic volume is expected to rise as the result of improved transportation condition, it will still remain low. Based on comparative analysis, the ambient air quality can still meet Class II standard during the operation phase.
- A resettlement team has been designated by HPCD to prepare the RAP. The public interest will be safeguarded based on national laws. And the living quality of the affected people will be improved by the resettlement.
- The construction activity will be carefully designed and coordinated by transportation department. Staff will be designated to guide the traffic on road to avoid traffic blocking and minimize the impact on traffic.
- With appropriate management of construction camps, treatment of wastewater generated, and disposal of the solid waste from the camps, the impact of the camps will be minimized.
- Extensive benefits to the local transportation infrastructure, economic development as well as convenience and standard of living of the local residents will result when the project is completed.

This bridge project will significantly improve the local transportation condition, thus bring substantial benefits to the local economy, people's income and agricultural restructuring. It will also provide an easier access for the roadside residents to market, service and education. As a result, life quality of the local residents will be improved, and poverty alleviated. As the negative impacts to environment will be minimized and mitigated, this project has received strong supports from local people and governments. As a general conclusion, this EA has found this Project environmentally acceptable, provided all mitigation measures designed for this Project are well implemented.
Chapter 7 Environment Management Plan

7.1 Contents of Environmental Management Plan

The environmental management plan consists of environmental protection action plan, environmental supervision plan, and environmental monitoring plan.

Environment Protection Action Plan: An environmental protection action plan is a series of measures that have been developed and will be taken during the design, construction and operation phases in order to mitigate or avoid negative environmental impacts, including management and monitoring plans for the operation phase.

Environment Supervision Plan: An environmental supervision plan is the plan to supervise the implementation of the mitigation measures and ensure to achieve the environmental protection objectives.

Environment Monitoring Plan: An environmental monitoring plan is to monitor environmental performance, evaluate environmental projection, identify unexpected impacts and develop new mitigation measure as may be necessary. Figure 7-1 shows the environment management procedure for the proposed Project.

Figure 7-1 Hanjiang Bridge Project Environmental Management Procedures

7.2 Management Organizations

Figure 7-2 lists the names and responsibilities for environmental management organizations (EMO) involved in this Project. The detail responsibilities for environmental management organizations lists in the following content.
It can be seen from the above figure that the management organizations can be divide into management organization and monitoring organization, with their responsibilities and duties presented in Table 7-2-1 and 7-2-2 respectively.

### Table 7-2-2 Main Responsibilities for Supervision Organizations

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| Shiyan EPB                  | • Project environmental supervision and administration.  
                              | • Enforce applicable laws, regulations and standards.  
                              | • Coordinate environmental protection effort between departments concerned on .  
<pre><code>                          | • Check and supervise the construction, completion and operation of environment facilities                                                |
</code></pre>
<p>| EPB of Yun and Yunxi Counties | • Assist EPB of Shiyan City to complete its daily work.                                                                                          |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>Responsibilities</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design and Construction Stage</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| HPCD PMO | ● Environmental management during project design and construction  
● Ensure to include environmental requirements and mitigation measures in the bid documents | One full time environmental staff to supervise and implementation and monitoring plan |
| Design Team (HBCPDI) | ● Incorporating environmental requirements and mitigation into the design | | |
| EA Team (SSSRI) | ● Analyze the environmental feasibility, and potential environmental impacts, propose mitigation measures and prepare EIA and EMP  
● Assist the design team and PMO to incorporate the mitigation measures into the bid documents | | |
| Environmental Supervision | ● Participate in environmental training organized by SPCD PMO  
● Supervise environmental performance and EMP implementation during construction, record any issues found and propose mitigation measures.  
● Prepare monthly environmental supervision reports for SPCD reviews | | |
| Contractor | ● Incorporate environmental requirements in their bids and implement all mitigation measures outlined in EMP.  
● Participate in SPCD environmental training.  
● Record environmental performance and prepare regular environmental reports for SPCD review. | One environmental staff in each contractor |
| Environmental monitoring stations of Yun and Yunxi counties | ● Monitoring air, noise and water quality during construction  
● Prepare regular environmental monitoring reports for SPCD reviews. | | |
| **Operation Stage** | | |
| Communication Bureaus of Yun and Yunxi Counties | ● Environmental management during operation stage | One environmental staff in each bureau |
| Environmental monitoring stations of Yun and Yunxi counties | ● Environmental monitoring during construction and prepare regular monitoring reports | | |

### 7.3 Environment Management Plan

#### 7.3.1 Detailed management plan

Together with the Project design team, the EA team has developed a series of mitigation measures for the design, construction and operation phases. All the mitigation measures have been agreed by HPCD and local Transportation Bureau. As the Project owner, local Transportation Bureau will be responsible for implementation of the measures. Table 7-3-1 below presents the detailed management plan.
<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Implementation Organizations</th>
<th>Responsible Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Design phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Traffic noise       | • Noise insulation windows for 9 affected houses before construction.  
                      • Construction activity will be limited to daytime.               | Design team and EA team | HPCD Transportation Bureau of Yunxi County |
| Soil erosion        | • Drain and guard works will be constructed  
                      • The road slope will be protected by grass cover and mortar-brick embankment will be built on the saturated road base.  
                      • The site boundary should be clearly defined with signs.       | Design team and EA team | HPCD Transportation Bureau of Yunxi County |
| Surface water pollution | • Emergency plan for leakage of dangerous material has been prepared.  
                         • Road surface drain system on the proposed new bridge to collect runoff  
                         • Construction camp and material stockpile should not be close to river | Design team and EA team | HPCD Transportation Bureau of Yunxi County |
| Air pollution       | • Locate mixing stations and other emission sources leeward from residential areas. | Design team and EA team | HPCD Transportation Bureau of Yunxi County |
| Cultural sites      | • According to the confirmation from the local cultural bureau and EA team site investigation and observations, no above ground cultural property is found within the project site and no record of underground archaeological finds are in the inventory lists of local cultural authorities for the area. | Design team and EA team | HPCD Transportation Bureau of Yunxi County |
| Land acquisition and resettlement | • Optimize design to occupied less cultivated land;  
                              • A resettlement team has been designated by HPCD to carry out the work. | Design team and EA team | HPCD Resettlement team |
| **B. Construction Phase** |                     |                            |                           |
| Construction management | • Hubei Traffic Commission will appoint staff to carry out residence construction management;  
                          • HPCD will provide training on environment protection to contractors  
                          • Septic tank will be constructed to collect domestic wastewater, solid waste will be collected to designated place, and be cleaned by sanitation agency | HPCD Contractor | HPCD Transportation Bureau of Yunxi County |
| Construction Noise | • Install noise insulation windows for 9 affected houses before construction.  
                        • Forbid night time construction (22:00-6:00) with noisy machines  
                        • Use temporary barriers if necessary to control noise at sensitive spots  
                        • Maintain machinery in good conditions. | Contractor | Traffic Bureau of Yunxi County |
<p>| Restoration of plant cover | • Within 15 day after the completion of construction, the plant cover should be restored. | Contractor | Transportation Bureau of Yunxi County |</p>
<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Implementation Organizations</th>
<th>Responsible Organizations</th>
</tr>
</thead>
</table>
| Soil erosion control | • Drainage system should be built before the construction of road base and mountain cutting.  
• Drain system should be constructed before hill cutting exercise  
• Protective works should be completed within 15 days after the construction of road base and mountain cutting, road slope will be protected by grass cover and mortar-brick embankment will be built on the saturated road base.  
• The construction contractor should keep close contact with metrology agency so as to take guard measure before rainfall., certain amount cover materials, such as grass matting, should be kept ready for rain day. | Contractor | Transportation Bureau of Yunxi County |
| Surface water pollution | • The workers' camps should be located far from the water body, all of the domestic wastewater should be treated by septic tank and the solid waste be dumped at designated site before collected by sanitation agency.  
• The construction solid waste produced by pier construction should be collected and conveyed to designated place for safe disposal in timely manner. The solid waste should be used as the materials for road construction wherever possible, otherwise should be disposed in the small deposit area invulnerable to surface run-off, along with soil erosion prevention measures.  
• Earth work shipping across the river will have high enough free board to prevent it from dropping to the river during shipping. The loading and unloading will also be conducted following the pre-designed procedures to prevent spills, and earth will be compacted well in the barges. | Contractor | HPCD  
Transportation Bureau of Yunxi County |
| Air Pollution | • 1 central concrete mixing stations is at most, and enhance the management of the stations.  
• The mixing station should be remote from human settlement center, at least 300 m leeward from receptors.  
• Enhance sanitation safeguard for workers.  
• Water spray vehicles should be provided by contractors to water the unpaved ground. The water spray operation should be carried out in dry day or windy day, at least twice per day (morning and afternoon). The frequency of water spray at sensitive receptors, such as village, school and rest home, should be increased.  
• The truck transporting powder materials, such as cement, sand and lime, should be covered.  
• Speed of material transportation vehicles entering in the construction site should be restrictedly limited. | Contractor | Transportation Bureau of Yunxi County |
<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Implementation Organizations</th>
<th>Responsible Organizations</th>
</tr>
</thead>
</table>
| Irrigation system         | • Minimize earth work  
  • Avoid earth dropping into irrigation system  
  • Prohibit stockpile of materials at the irrigation system area.                                                                                             | Contractor                    | Transportation Bureau of Yunxi County    |
| Traffic interruption      | • Enhance construction management  
  Construction plan should be disclosed to the roadside residents who will then arrange their own daily work;  
  • The construction will be in turn carried out at half of the road surface area to minimize the impact on traffic.                                        | Contractor                    | Transportation Bureau of Yunxi County    |
| Cultural Relics           | • If a large number of valuable or invaluable articles such as fabrics, coins, artifacts, structures, or other geographic or archeological relics are discovered under ground at one spot, the local related department should be notified immediately. Excavation should be stopped until authorized department identifies articles. | Contractor                    | Transportation Bureau of Yunxi County    |
| Fish protection           | • From April to June is the spawn season of fish. The construction of underwater structure should avoid such season.                                                                                                     | Contractor                    | Transportation Bureau of Yunxi County    |
| Social impacts            | • The land occupation should be restrictedly limited to within the boundaries defined before construction. Construction activity is prohibited from occupying more land than the pre-defined, otherwise Hubei Provincial Traffic Commission should pay compensation to the people affected according to relevant regulations  
  • The existing irrigation facilities should be protected, and spoils are prohibited from dumping to the irrigation canals.  
  • Transportation of material and operation of equipment should be carefully scheduled based on public consultation although these will not cause significant impact. | Contractor                    | Transportation Bureau of Yunxi County    |
| Health and Safety         | • Provide education on disease to workers, contractor is recommended to provide recreational facilities to workers.  
  • The construction camps will have a management system for hygiene, sanitation and environmental control. Health training will be provided to all construction workers particularly the knowledge for prevention and control of epidemic diseases. The construction camps and living quarters will be cleaned and disinfected regularly, providing a clean and healthy living environment to construction workers. All workers will be checked for their health regularly including temperature checks. An emergency plan will be in place to quarantine workers who suspected of having SARS or other infectious diseases and hospital authority will be informed immediately.  
  • Provide safety protection to the workers at the site with high noise and dust.                                                                                       | Contractor                    | HPDC Project Office                     |
C. Operation Phase

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Implementation Organizations</th>
<th>Responsible Organizations</th>
</tr>
</thead>
</table>
| Noise and Air Pollution             | • Warning signs on road for honking bans and speed control  
                                  | • Respond to monitoring results which show higher noise and air emission than projected by Project EA  
                                  | • Regular maintenance on road to keep good road surface condition.                                                                                          | Transportation Bureau of Yunxi County | Transportation Bureau of Yunxi County |
| Environmental Performance           | • Carry out environment monitoring exercise.  
                                  | • Improved irrigation efficiency, control of soil erosion, reducing river siltation and flooding risk;  
                                  | • Saved resources by increasing vehicle speed, lowered fuel consumption, reduced air-borne dust, noise and waste gas emission;                                                                                                               | Transportation Bureau of Yunxi County | Transportation Bureau of Yunxi County |

7.3.2 Environmental Supervision Plan

Environmental supervision plan is designed to ensure effective mitigation to negative impacts. Also this plan is to ensure the required environmental standards are achieved. Details are presented in Table 7-3-2.

Table 7-3-2  Environmental Supervision Plan

<table>
<thead>
<tr>
<th>Project phase</th>
<th>Responsible organization</th>
<th>Content of supervision</th>
<th>Objectives of supervision</th>
</tr>
</thead>
</table>
| Design and construction | Shiyan EPB And EPBs of Yun and Yunxi Counties | • Review EA report  
                                  | • Review and approve cost for environmental protection and mitigation measures  
                                  | • Review monitoring reports and conduct site inspections for air emissions, noise, water quality, waste management, hazardous materials storage and handling and other mitigation actions items.  
                                  | • Monitor the implementation of EMP/EAP  
                                  | • Review and accept pollution control facilities built in the Project  
                                  | • Inspection of measures for diseases control measures.  
                                  | • Monitor and conduct site inspection for explosive handling and explosion operations                                                                                                                         | • Strictly comply with the principle of environmental control measures taken simultaneously design-construction-operatio n policy and Project EAP  
                                  | • Ensure environmental protection at the sites satisfactory and compliance with relevant laws, regulations and standards  
                                  | • Ensure land acquisition and erosion control carried out as planned  
                                  | • Ensure pollution control facilities meet the design                                                                                                                                                    |
| Operation Phase | Shiyan EPB And EPBs of Yun and Yunxi Counties | • Review monitoring report  
                                  | • Review new mitigation measures  
                                  | • Check the environmental performance at receptors  
                                  | • Response to environmental accident  
                                  | • Coordinate the investigation on environmental accident                                                                                                                                             | • Ensure implementation of monitoring plan  
                                  | • Endure the unexpected environmental problems to be resolved  
                                  | • Reduce the likelihood of environmental accident.                                                                                                                                                    |
7.3.3 Environmental Monitoring Plan

7.3.3.1 Implementation of Environmental Monitoring Plan

In order to ensure the implementation of mitigation measures and timely updating of EMP, the EA team has designed the following monitoring plan which will be carried out by the Environmental Monitoring Center of Yunxi County. Details of the monitoring plan are given in Table 7-3-3 below.

Table 7-3-3 Environmental Monitoring Plan

<table>
<thead>
<tr>
<th>Item</th>
<th>Monitoring location</th>
<th>Monitoring item</th>
<th>Monitoring frequency</th>
<th>Monitoring duration</th>
<th>Sampling time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mixing station</td>
<td>PM$_{10}$</td>
<td>Once/week</td>
<td>1 day</td>
<td>One each time in mooring and afternoon</td>
</tr>
<tr>
<td></td>
<td>Unpaved road</td>
<td>PM$_{10}$</td>
<td>Random sampling (increase in dry and strong wind day)</td>
<td>1 day</td>
<td>One each time in mooring and afternoon</td>
</tr>
<tr>
<td></td>
<td>Jiangjunhe Village</td>
<td>PM$_{10}$</td>
<td>Random sampling (increase in dry and strong wind day)</td>
<td>1 day</td>
<td>One each time in mooring and afternoon</td>
</tr>
<tr>
<td>Noise monitoring</td>
<td>Jiangjunhe Village</td>
<td>$L_{Aeq}$</td>
<td>Once/week</td>
<td>1 day</td>
<td>Twice time per day, 20 minutes each time</td>
</tr>
<tr>
<td>Surface water</td>
<td>Location of the Hanjiang Bridge</td>
<td>SS, COD oil</td>
<td>Once/week</td>
<td>1 day</td>
<td>One each time in mooring and afternoon</td>
</tr>
<tr>
<td>Operation Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise monitoring</td>
<td>Jiangjunhe Village</td>
<td>$L_{Aeq}$</td>
<td>4 times/year</td>
<td>One day</td>
<td>One each time in day and night</td>
</tr>
<tr>
<td>Air</td>
<td>Jiangjunhe Village</td>
<td>PM$_{10}$ and NO$_2$</td>
<td>Once/a</td>
<td>5 days</td>
<td>Continuous 5 days</td>
</tr>
<tr>
<td>Surface water</td>
<td>Location of the Hanjiang Bridge</td>
<td>SS, COD and Oil</td>
<td>Once/a</td>
<td>2 days</td>
<td>~</td>
</tr>
</tbody>
</table>

7.3.3.2 Monitoring Reporting System

Environmental monitoring reports for both the construction and operation phases will be prepared by the Environmental Monitoring Center of Yunxi County. During the construction period quarterly reports need to be prepared and submitted to the HPCD and Yunxi county EPB and for the operation phase annual reports are to be submitted to Yunxi County Transportation Bureau and EPB. The monitoring result will be discussed in the report to identify whether the environmental standards are met, and whether new measures are needed to mitigate any new and unexpected adverse environmental problems identified during monitoring. These new measures will be implemented after approval from the HPCD and/or local Transportation Bureau.

As the Project owner, HPCD and local Transportation Bureau will respond to the report.
When any unexpected environmental impacts are monitored and identified, the Bureau will organize the review, approval and coordination of the implementation of new mitigation measures.

The construction period will be three years and each year environmental monitoring cost will be RMB30,000. For the operation phase, RMB 20,000/year will be required for the monitoring. In addition, a contingency of RMB 50,000 will be set aside for accidental monitoring and mitigation/remediation planning. A full-time staff at the bridge management station will be provided for maintenance of greening, drain system and bridge.

7.4 Personnel Training

The success of environmental management for the Project relies on the knowledge, and experience of the personnel involved in environmental management. As contemporary methodologies and approach towards environmental management for road construction and operation are still new to the agencies in the local department concerned, extensive training will be needed. HPCD is responsible for organizing the training.

The personnel training will cover environmental regulations, standards, and responsibilities, etc. The details of the personnel training program are presented in Table 7-4-1.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Department</th>
<th>Number of people</th>
<th>Training period</th>
<th>Time</th>
<th>Cost (RMB Yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Traffic bureau of Yunxi County, Contractor</td>
<td>4</td>
<td>1 week</td>
<td>Beginning of 2004</td>
<td>4000</td>
</tr>
<tr>
<td>phase</td>
<td>Environmental supervisor</td>
<td>1</td>
<td>2 weeks</td>
<td>Beginning of 2004</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td>Emergency staff</td>
<td>3</td>
<td>2 weeks</td>
<td>Beginning of 2004</td>
<td>7000</td>
</tr>
<tr>
<td>Operation</td>
<td>Management staff of the bridge management</td>
<td>5</td>
<td>2 weeks</td>
<td>Before 2007 when the road</td>
<td>10000</td>
</tr>
<tr>
<td>phase</td>
<td>station, and emergency staff</td>
<td></td>
<td></td>
<td>is operational</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environment management staff</td>
<td>2</td>
<td>1 week</td>
<td>Before 2007 when the road</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>is operational</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total cost</td>
<td></td>
<td></td>
<td></td>
<td>26000</td>
</tr>
</tbody>
</table>

7.5 Cost Estimate for Environmental Protection

The costs are presented in Table 7-5-1.

From the table, the total cost for the environmental management is RMB 2,348,280 (excluding the engineering cost for drainage system and road maintenance). With the total capital cost of the project is RMB 38.00 million, the environmental management cost will be 6.18% of the total.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Cost (RMB)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction phase</td>
<td>EIA</td>
<td>Preparation of EIA report and EMP</td>
<td>One set</td>
<td>180,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personnel training</td>
<td>Environmental supervisor, Traffic bureau of Yunxi County, Contractor</td>
<td>8 people</td>
<td>14,000</td>
<td>Domestic training</td>
</tr>
<tr>
<td></td>
<td>Environmental monitoring</td>
<td>Noise, water quality and ambient air</td>
<td>3 years</td>
<td>90,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental supervisor</td>
<td>-</td>
<td>1 people</td>
<td>30,000</td>
<td>Total for 3 years of construction period</td>
</tr>
<tr>
<td></td>
<td>Soil conservation</td>
<td>Retaining wall, sedimentation tank and other safeguard facilities</td>
<td>Along the project</td>
<td>10,000</td>
<td>Comparative calculation</td>
</tr>
<tr>
<td></td>
<td>Water pollution control</td>
<td>Septic tank in worker’s camp</td>
<td>2</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise control</td>
<td>Noise insulation window for Jiangjunhe Village</td>
<td>9 houses</td>
<td>10,800</td>
<td>Prior to construction</td>
</tr>
<tr>
<td>Operation phase</td>
<td>Noise control</td>
<td>Speed limit and horn banning Signs</td>
<td>4</td>
<td>4,000</td>
<td>RMB 1,000 for each piece of sign</td>
</tr>
<tr>
<td></td>
<td>Water pollution emergency measure</td>
<td>Drain system on Bridge, reinforced crash-proof facilities</td>
<td>1000,000</td>
<td>1000,000</td>
<td>Comparative calculation</td>
</tr>
<tr>
<td></td>
<td>Emergency equipment</td>
<td>Emergency equipment</td>
<td>1 set</td>
<td>392,000</td>
<td>Details refer to Table 4-1-1</td>
</tr>
<tr>
<td></td>
<td>Salary and training for management staff</td>
<td>Salary and training for management staff</td>
<td>3</td>
<td>150,000</td>
<td>RMB 5,000/person</td>
</tr>
<tr>
<td></td>
<td>Environmental management and monitoring</td>
<td>Ambient air, noise and surface water</td>
<td>-</td>
<td>200,000</td>
<td>RMB 20,000/year for 10 years</td>
</tr>
<tr>
<td></td>
<td>Contingency</td>
<td>-</td>
<td>-</td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Sub-total</strong></td>
<td></td>
<td></td>
<td><strong>2,134,800</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contingency (10%)</td>
<td></td>
<td></td>
<td><strong>213,480</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>2,348,280</strong></td>
<td></td>
</tr>
</tbody>
</table>