

World Bank Financed  
**Yichang to Badong Section of  
Shanghai-Chengdu Inter-Provincial Highway**

**Environmental Assessment**

**Executive Summary**

(July 2008)

**1. Introduction**

This document is the Executive Summary of Environmental Assessment (EA) for the World Bank financed Yichang to Badong Section of the Shanghai-Chengdu Inter-Provincial Expressway Project (hereinafter known as Yiba Expressway or the Project). The document provides a general summary of the findings in the Project Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), including legal and policy framework and applicable environmental standards, major potential adverse impacts to the physical and socio-economic environments in the Project area, analysis of alternatives, mitigation measures, public consultation programs, and environmental management plan for the Project. The Executive Summary could serve as a concise environmental report to environmental administrators, Project decision makers, project-affected groups, non-government organizations and the general public, as well as to the executive board of directors of the World Bank.

**1.1 Project Background**

As a section of the Shanghai-Chengdu Inter-provincial Expressway, the Project is one of the key infrastructure projects in the Hubei province and a segment in the strategic national trunk highway network. As the expressway will eventually link Shanghai at its east end with Chengdu, the capital city of northwestern province of Sichuan, at its west end, Yiba expressway will be a critical connector between the more developed coastal region in eastern China and the interior in the middle and the west, and will play an important role in the enormous Develop China's West program. Within the province, it will form part of the "automobile" corridor, alleviating transportation bottleneck between the provincial capital and the fast growing automobile manufacturing industry in northwest Hubei. Together with the connecting road in the same Project region in Hubei province, the Project will be a significant contributor in development of regional economies, improvement of standard of living and poverty alleviation in the project area.

In December 2003, the Shanghai Ship and Shipping Research Institute (SSSRI) was contracted to carry out the Environmental Assessment (EA) for the Yiba Expressway project. With the assistance of the Hubei Provincial Communication Department (HPCD) and other relevant government departments, the EA team undertook field work including site investigations and data collection between September 2005 and March 2006. During this time period, public consultation and information disclosure was conducted. Additional follow up public consultation was conducted in June and July 2007 and again in January 2008. A draft EIA report was submitted in February 2007 to a World Bank preparation mission for review and comments received from the mission were

incorporated into new draft EIA report. The later versions of the EIA report (from the fourth to the current sixth version) had all been prepared in both Chinese and English languages. Since the third version, the EIA report had been updated based on the Preliminary Design of July 2007 and the following revision in the design. The fourth version of the EIA report was submitted to the national government for review and the full approval was received from State Environmental Protection Administration (SEPA, now Ministry of Environmental Protection, or MOEP) on October 12, 2007 following the reviews by a SEPA's expert panel and by Environmental Protection Office of MOC. The versions after the official approval and clearance by the government were mainly due to additional changes and newly available information in the design as well as additional comments from the World Bank.

As required by the domestic procedures and the potential concerns of the project area, the HPCD also engaged independent qualified institutes to prepare the following reports for the project: the Soil Conservation Planning Report; the Cultural Property Investigation Report; the Cave Biodiversity Report and the Feasibility Study Report for the Yiba Expressway.. The findings and mitigations in these reports have been included in the project EIA where applicable.

The Yiba Expressway is classified as a Category A project since it involves construction of a major expressway on a new alignment and grade highway upgrading partially on new alignment, with potential increased noise, motor vehicle air emission, occupation of fertile and barren land, community severance, soil erosion and resettlement.

This is the fourth World Bank financed expressway projects in Hubei province and HPCD and its EA team have capitalized the previous experience in preparing the project EIA and EMP and EMP implementation particularly during project construction. The project EA included the field study and assessment of all, one by one, access roads, spoil soil disposal sites, and every Karst caves, which is the first time in China where EA covered the every individual auxiliary sites in addition to the main expressway alignment area. Learning from lesions of previous projects in EMP implementation and EA requirements enforcement during construction, HPCD has decided to engage professional "Client Environmental Supervision Consultant (CESC)", also the first in China, to ensure better environmental management and control during expressway construction. These details have been reflected and included in the project EA documents.

## **1.2 Basis of the EA**

The regulatory and policy requirements for environmental assessment of this Project were followed during the preparation of EA, as were the World Bank's safeguard policies. Major laws and regulations applied to the EA are as follows:

- Environmental Protection Law of PRC, December 26, 1989;
- Environmental Impact Assessment Law of the PRC, October 28, 2002;
- Land Management Law of PRC of August, August 28, 2004;
- Noise Pollution Prevention Law of PRC, October 29, 1996;
- Air Pollution Prevention Law of PRC, April 29, 2000;
- Cultural Relics Protection Law of the PRC, October 10, 2002;
- Water Pollution Prevention Law of PRC, February 28, 2008;
- Highway Law of PRC, January 1, 1998;
- Water and Soil Conservation Law of PRC, June 29, 1991;

- Rules of Environmental Protection Management for Construction Projects, issued by the State Council of PRC, November 29, 1998;
- Classification Inventory for Environment Protection of Engineering Project issued by the MOEP, January 1, 2003;
- Highway Project Environmental Impact Assessment Guidelines, MOC, JTGB03-2006.
- Measures Concerning Environmental Protection and Management for Transportation Construction Projects, issued by MOC, May 22, 1990; and
- Notice to Strengthen the Environmental Impact Assessment and Management of Construction Projects Financed by Loan from International Financial Organizations, jointly issued by MOEP, the State Planning Commission, the Ministry of Finance and the People's Bank of China, June 21, 1993.

The following local regulations have been considered in this EIA:

- Hubei Provincial Environmental Protection Regulations, Hubei Provincial Congress, Dec. 2, 1994;
- Hubei Provincial Farm Ecological Conservation Regulations, Hubei Provincial Congress, Sept. 29, 2006;
- Hubei Provincial Construction Project EIA Management Method, Hubei Government, Oct. 1993;
- Notice on Enhancing the Protection of the Lawful Rights of Farmers to be Acquired with Land, Hubei Government, Feb, 27, 2005;
- Notice on the Classification of Surface Water Bodies. Hubei Government, Jan. 31, 2000; and
- Decision on the Zoning of Guanzhuang Reservoir as Drinking Water Supply Area, Yichang Government, May, 2006.

The following standards and technical documents have been considered in this EIA:

- General-EIA Technical Guideline, HJ/T2.1-93;
- Ambient Air- EIA Technical Guideline, HJ/T2.2-93;
- Surface Water- EIA Technical Guideline, HJ/T2.3-93;
- Acoustic Environment- EIA Technical Guideline, HJ/T2.4-95;
- Ecological Impact without Pollution- EIA Technical Guideline, HJ/T19-97;
- Design Specifications for Environmental Protection in Road Project, JTJ/T006-98;
- Specifications for EIA for Road Project, (pilot). 1996.7.8;
- Notice on the Noise Issue in the EIA for Road and Railway projects, Huanfa [2003] 94; and
- Letters confirming the standards to be applicable in EIA for the Yiba Road Project, Hubei EPB, Ehuhan [2006] 279.

Of the World Bank safeguards policies, Environmental Assessment (OP 4.01) is the primary requirements and thus the focus of this report. In addition, policies on Indigenous People (OD4.20), Involuntary Resettlement (OP4.12), Cultural Property (OP4.11), and Forest (OP4.36) are also screened in the EIA and applied if triggered. Since no project components will involve international waterways, dam construction or in disputed areas or usage of pest control substance as defined in OP7.50, OP4.37, OP7.60 and OP4.09, respectively, policies related to these subjects are not applied in the EA. Regarding Natural Habitats (OP4.04, 2001), the project will not involve critical natural habitats as identified in OP4.04, ANNEX A, but part of the project impacted area will go through

habitats for some commonly seen wildlife. The general principle of this policy is applied to the EA. Relevant international environmental agreements in which China is a signing party has also been the considered as a basis for the EA if deemed applicable.

## 2. Project Description

This highway project starts at a spot some 3 km to the south of Baihe service area under Jingyi expressway (K75+720 of Jingyi expressway), a newly planned Baihe interchange will connect this Project, with a directional ramp, onto the Jingyi expressway, then passes Huanghua, Wuduhe, Gaolan, Gaoqiao, Xiquiwan, Shenlongxi, and ends at Huoshao'an which is the border between Hubei and Chongqing (4 km to the south of Liujiaya), and links, with a tunnel, onto Wushan to Fengjie expressway in Chongqing. Total length of this project is 173.614 km, total length of bridge is 70,076.5m/148, total length of tunnel is 61, 046.5m/45, 7 interchanges are planned. Design vehicle velocity under this Project is 80 km/h and 4-lane expressway standard is applied, subgrade width is 24.5m, and bridge deck width is the same as that of subgrade, clearance deck width of long bridge is 2x11m, clearance width of tunnel is 10.25m, bituminous concrete pavement is planned (except that long/large tunnel will adopt cement concrete pavement). Total investment of this Project is 15.13926 billion RMB .

The construction of the Project expressway is scheduled to commence June 2009 and complete in December 2013, with 54 months duration.

The specific geographic location of the expressway section is shown in Map 2-1. The proposed expressway section alignment is shown in Map 2-2.

## 3. Baseline Environment

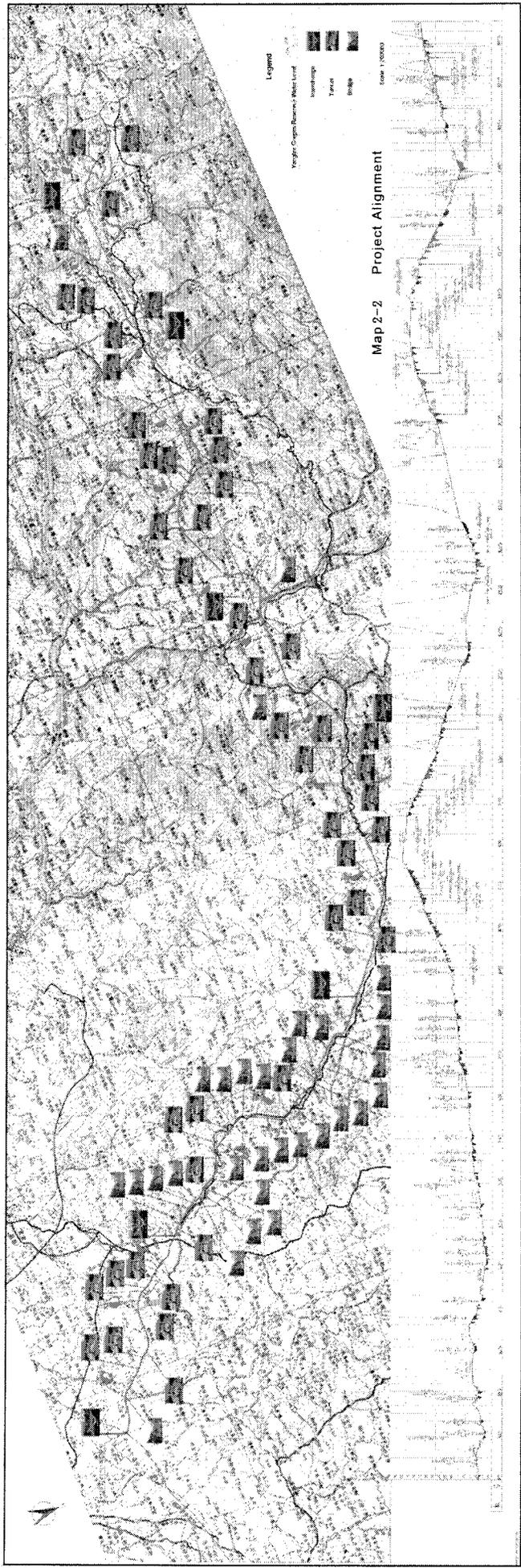
### *Physical Setting*

The Project area is located in the north semi-tropical region with a continental monsoon climate. The average annual temperature ranges from 12.7 to 17.6°C, and average annual precipitation is about 1132 mm. The terrain configuration of the Project area has a general gradient sloped in general from northwest to southeast with elevations from 1800 to 200 m. The expressway alignment is in general in the same orientation with that of the area mountains. The area from the east starting point to Huanghua is of mild terrain, with the elevation ranging within 100-200 m. From Huanghua to Gaolan, the hills become more steep, with the elevation ranging between 500 to 1000 m. From Gaolan to the west end point, the terrain is rolling drastically, with the elevation between 800 to 1800 m.

### *Sensitive Receptors*

Along the expressway alignment, a total of 41 villages/townships and three schools are identified through field investigation as sensitive or otherwise vulnerable receptors to changes and activities in the environment which surrounds them, such as construction





activities, air pollution, increased noise, etc. These sensitive receptors are located about 15 to 150 m from the proposed expressway central line.

The sensitive receptors are the focus of the monitoring program for the baseline environmental conditions as well as the environmental impact assessment. They are also the key areas for impact mitigation measures designed to protect or otherwise minimize the adverse impacts at these sensitive locations.

### ***Ecology***

Through field survey and analysis of collected data, it has been identified that within the area 300 m from the both sides of the expressway, there are 888 species of seed plants, including 9 species of gymnosperm plants and 879 species of angiosperm plants. The vegetation growth in this area is dominantly shrubs with no major forest, including *Liquidambar formosana*, *Rhus chinensis*, *Miscanthus floridulus*, *Lespedeza bicolor*, *Pyracantha fortuneana*, *coriaria sinica*, *Conyza conadensis*, *Citrus reticulate*, *Camellia sinensis*, *Phyllostachys puoescens*, *Pinus massoniana*, *Cupressus funebris*, *Cunninghamia lanceolata*, *Quercus variabilis*, *Quercus acutissim*.

The proposed Project is to cross Xiangxihe and Shennongxi rivers at K113 and K160. Some fisheries resources were observed in the rivers due to their suitable hydrology although none projected species. The expressway will have one span across over the rivers with no in water structure and thus no in water construction activities. Other rivers in the Project area have rapid current, minimum plankton presence and no year round flows due to natural or manmade conditions such as hydro stations. No meaningful fisheries resources were observed in these rivers.

There are reportedly a total of 13 species of amphibious animals in the assessment area, none belong to any levels of protected species. There are also reportedly 17 species of reptile animals including six poisonous snakes, again none belong to protective categories. In addition there are reported 40 species of birds and 23 species of mammals in the assessment area including eight belong to provincial protection categories. The EA team understands from the data sources that the above mentioned wildlife are generally as reported as they may possibly exist in the project area. The extensive site investigation during EA did not observe these many species suggesting the population of these wildlife, if still do exist as reported, is limited.

### ***Air Quality***

Based on the national EA requirement, existing ambient air quality was monitored during the EA to determine the baseline conditions. The monitoring was conducted near four selected sensitive receptors such as villages and schools between October 15 and 19, 2006, with five consecutive-day continued measurements each time. The representative results of the monitoring at the main expressway and country road are presented in Table 3-1.

The monitoring results show that all measured parameters in the project area were below their respective national ambient air quality standards, indicating good existing ambient air quality at the Project areas.

**Table 3-1 Ambient Air Quality Monitoring Results (mg/m<sup>3</sup>)**

Location	Time (2006)	Monitoring results (daily average)	
		NO <sub>2</sub>	TSP
Yanjiahe Village	October 15	0.005	0.095
	October 16	0.014	0.110
	October 17	0.015	0.078
	October 18	0.010	0.082
	October 19	0.013	0.110
Gaolan Primary School	October 15	0.017	0.072
	October 16	0.017	0.065
	October 17	0.019	0.086
	October 18	0.017	0.118
	October 19	0.016	0.096
Shujiachao Village	October 15	0.012	0.087
	October 16	0.016	0.093
	October 17	0.010	0.106
	October 18	0.021	0.093
	October 19	0.019	0.077
Standards		0.12	0.30
Exceedance (%)		0	0

\*: NO<sub>x</sub> was monitored at this location instead of NO<sub>2</sub>

**Noise**

According to the national EA requirements, existing noise levels in 44 sensitive locations along the expressway were measured between May 27 and 30, 2006. The locations of the monitoring points are shown in and the results are presented in Table 3-2.

The noise monitoring results show that both day and night time noise levels in the areas along the proposed main expressway alignment were below the applicable standards, some reaching Class I standards, showing excellent existing acoustic environment. This is because there are no major noise sources in these areas except farming activities. In general, the acoustic quality in the monitored villages was good, while near or in township the noise was higher because of the heavier traffic and other urban activities.

The schools along the existing roads were hardly impacted by traffic on the existing roads. The noise level at the primary schools ranges from 45.0 dB(A) to 50.7 dB(A) in daytime. The good acoustic quality was because of the distance of the monitored schools from the existing roads.

**Table 3-2 Existing Noise Level at Selected Locations along Project Alignment**

No.	Monitoring spots	Piling	Average noise intensity		Remarks
			Day	Night	
1	Guanchong	K9+500	50.2	43.9	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
2	Guanzhuang school	K19+700	50.7	42.9	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
3	Yanjiahe	K35+700	52.9	40.5	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
4	Shibazi	K45+800	49.5	41.3	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
5	Yangjiahe	K50 + 000	53.4	45.4	Noise from daily activity, in daytime can meet Class I, in night can meet Class II
6	Dengjiaping	K53+500	59.8	44.9	Noise from daily activity, in daytime can meet Class II, in night can meet Class I
7	Qinjiaya	K58+000	54.7	43.3	Noise from daily activity and traffic, in daytime can meet Class III, in night can meet Class III
8	Xiadengjiafan	K63+500	50.3	39.5	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
9	Huawu	K66+400	46.2	39.6	Noise from daily activity, and traffic in daytime can meet Class I, in night can meet Class II
10	Yaomeijiachang	K70+400	45.6	39.0	Noise from daily activity and traffic, in daytime can meet Class II, in night can meet Class I
11	Licunping	K86+300	43.0	38.8	Noise from daily activity, in daytime can meet Class I, in night can meet Class I
12	Nanduihe	K90+300	54.5	43.9	Noise from daily activity, in daytime can meet Class 0, in night can meet Class 0
13	Gaolan primary school	K96 + 000	49.1	45.2	Noise from daily activity, in daytime can meet Class 0, in night can meet Class II
14	Shijiaba	K103+500	40.9	36.0	Noise from daily activity, in daytime can meet Class 0, in night can meet Class 0
15	Yangzhou-Zigui primary school	K118+100	45.0	37.2	Noise from daily activity, in daytime can meet Class 0, in night can meet Class 0
16	Shujiacao	K161+850	42.2	39.5	Noise from daily activity and traffic, in daytime can meet Class I, in night can meet Class I

***Water Quality***

According to the surface water function zoning classification issued by Hubei EPB, Shennongxi River is categorized as Class II standard water body in Surface Water Environment Standard (GB 3838-2002), while Huangbo River, Wudu River and Xiangxi River are Class III. The water quality monitoring conducted between October 9-12, 2005 showed that all measured parameters (COD, Oil, and SS) were within their respective applicable standards.

***Soil Erosion***

The primary type of soil erosion in the project area is water and colluvial erosion, particularly surface and ditch erosion, caused by unfavorable land form, topography, soil and hydrology conditions, coupled with disturbance to the surface vegetation without appropriate control. Common forms of soil erosion include movement of surficial

materials, ditch failures due to the lack of vegetation, soil dissolution following heavy rainfalls, and landslides. Soil erosion intensity in the main expressway area is in general around 500 t/km<sup>2</sup> or lower. The most serious erosion area within the Project area is in Xingshan County where 69.6% of the area is deemed as heavy to modest soil erosion areas. .

### ***Cultural Property***

A survey by professional archeology, cultural relics institutes and local cultural relics specialists was conducted in September 2005 and again in April 2006, covering the main expressway line, the proposed alternative alignments in considerations, borrow pits and spoil soil disposal sites. The survey included walk-through of the entire alignment and the other above mentioned areas, visual observation and limited sub-surface investigation through drilling and/or sampling where deemed needed by the experts. Four cultural relics have been identified, including the Xingpin Suspended Tombs, Niejiahe Ancient military barracks remains, Baihuguan Site, and Pingyikou Tombs. The Xingpin Suspended Tombs and Baihuguan Site are close to the proposed alignment.

According to the protection plan, there are two cultural properties under the protection at provincial level on the alignment K, they are Xinning Suspended Tombs and Niejiahe Ancient Military Barracks. This proposed road is carefully aligned to avoid the Niejiahe Ancient Military barracks. However, this project will bypass the protected area for Xinning suspended Tombs, at K32+050-K34+050.

The information on the cultural sites on alignment K is summarized in Table 3-3 below.

**Table 3-3 Distribution of Cultural Properties along the road**

No.	Name	Pile No.	Dynasty	Protection level	Area (m <sup>2</sup> )	Current Status	Relation with the road
1	Baihuguan relics	K10+250	New stone	No level	3000	Good	Cross in the middle
2	Xinning Suspended Tombs	K33+050	Zhanguo, Song, Ming	Provincial	500	Good	Cross the perimeter
3	Niejiahe Ancient military barracks remains	K45+800~K46+300	Chunqiu-Liuchao	Provincial	10000	Good	Avoid
4	Pingyikou Tombs	K113+700	Donghan	No level	3000	Normal	Cross

### ***Socio-economic Baseline***

The total population in the expressway impacted area is approximately 1.22 million and the total serviced area is approximately 11737 km<sup>2</sup>, including approximately 1811 km<sup>2</sup> of cultivated land. A large portion of the impacted area is currently poorly served by road transportation and the people in the area is rather isolated as result. The Project area has a significant poverty population including 3 poverty county and 900 thousands poverty people mostly living in the remote mountainous areas. The major cities/urban centers along the expressway include Yiling District, Xingshan county and Zigui county of Yichang City, and Badong county of Enshi State although the expressway will not go through the any of these urban areas directly. The expressway will affect directly 41 villages, 3 schools, five major rivers and some small rivers, creeks, irrigation channels,

and fish/water ponds, because of their proximity to the expressway alignment. All the alternative alignments of the proposed road are within the national Three Gorges Geological Park, but the proposed alignment doesn't go through the core geosite area of the Geological Park.

Locations of the Sensitive Receptors and Monitoring Spots see Map 3-1.

#### **4. Environmental Impacts**

##### **4.1 Soil Erosion**

Soil erosion will occur during the Project construction phase when surface vegetation and soil are damaged. The primary area of potentially increased soil erosion includes deep cuts, high fills, earth borrow pits, construction waste/excessive earth disposal sites, temporary construction sites, treatment of special geological conditions and other areas where surface soil will be disturbed. According to the modeling result, the soil erosion intensity will reach 10,519 t/km<sup>2</sup>a during construction and for the whole construction period the total soil lost is expected to be 0.44 million t (without mitigation matures), which is 0.38 million t higher than the current level of soil erosion over the same number of years if there were no project, according to the project soil conservation assessment and planning report. It is anticipated that the most severe soil erosion would occur in the areas of spoil deposit pits, main structure and bridge/tunnel, which thus are considered to be the focus for soil conservation. The increased soil erosion will also occur in the early operation phase in areas where vegetation planting is not fully matured to rehabilitate the disturbed soil. It is expected that about 2 years after project operation, the soil erosion will reach about 80-100% erosion level before the land disturbance, when newly planted vegetation will mature. Some of soil control measures, such as concrete sloping, however, will reach its 100% effectiveness immediately after it is completed.

##### **4.2 Impact on land uses and vegetation**

The Project will permanently occupy 8395.3 mu (15 mu to a hectare) of land including 31.84% of woodland, and 36.72% of cultivated land. In addition, while borrow pits are not needed according to the excessive earth from tunnel and excavation, the amount of spoil is a lot, so that a number of deposit sites are required. The total of 63 disposal sites will occupy approximately 2564.2 mu land.

The vegetation, including crops, shrubs, trees and other vegetation on the occupied land will be impacted by the Project. Compared with the total cultivated land in the Project areas, that occupied by the Project and thus the impacts to agriculture is relatively small (the decrease of cultivated land per capita range from 0.05% to 0.78%). Except in the expressway pavement area itself, impacts on vegetation in other portion of the expressway areas will be short termed as the slopes, central separation media, open space of the interchange areas, borrow pits, disposal sites and other temporary occupied areas will be landscaped and rehabilitated with lawns, trees bushes and other vegetation. In fact, it is expected, these landscape programs will result in a net increase in vegetation coverage rate in areas along the expressway.

##### **4.3 Impacts on Ecology**



In the construction stage, the majority of ecological impacts are to come from site clearance, removal of vegetation at the beginning of construction which would result in loss of habitat and vegetation for animals. Threats of the local ecosystem, biodiversity, animal activities within the cleared and occupied areas and their immediate vicinities will be affected. Unplanned land occupation at ecological sensitive areas, damage to vegetation beyond proposed working areas, and illegal hurting by construction workers, etc. due to lacking of awareness or training could result in certain impacts to the area ecology. During the operation phase, the expressway, where it runs on the ground instead of elevated viaduct or tunnels would divide the land or habitats. However, the expressway has a large portion of the tunnels and elevated viaducts (totally 75% of the total expressway length) including some in the relatively sensitive areas, greatly minimize the impacts such as habitat severance and surface vegetation damages.

#### 4.4 Impacts on Water Environment

##### Construction Phase

Impacts on the water environment during the construction phase include primarily discharge of sanitary sewage from the construction camps and in water construction activities for some of the bridges. Each construction camp, with an estimated 100 workers, will generate about 5m<sup>3</sup>/d of sanitary sewage per day which, if not treated properly, would affect the water quality of the receiving environment, such as Boling River, Huangbo River, Wudu River, Gaolan River, and Xiangxi River. In addition, municipal solid waste generated from the camps, if not handled properly could also affect water quality through contaminated surface runoff.

Bridge construction could result in re-suspension of river sediments. The construction machines operating in or near the rivers could also be a risk for oil contamination from potential leaks or spills. The area affected will generally be a short distance downstream from the bridge construction sites.

Tunnel construction often modifies groundwater pattern. In areas where a tunnel is to be constructed beneath local groundwater tables, groundwater will discharge from the cuttings or roadbed, leading to lowered groundwater tables, dead vegetation cover due to the water cut off, and soil erosion. The wastewater generated within the site of tunnel construction is mainly from drilling and dust removal, and muddy water intruded from groundwater. As the wastewater often contains oil and sand, it tends to appear alkaline. If the wastewater from tunnel construction is discharged directly into rivers or aquifers underneath the tunnel, the river or groundwater quality will be affected.

Based on *the national list of hazardous waste*, some of the construction solid waste such as deposable lubricating oil, mineral oil, organic solvent, acid and alkali, oil paint belong to hazardous waste. If these solid wastes are not properly management, storage, transportation and disposal, it will be lead to serious impact to the water body.

##### Operation Phase

Wastewater sources from the operation phase will include sanitary sewage from service stations and parking lots, car washing effluents and pavement runoff of the first flush in a rainfall event. The wastewater from point sources will be treated to the applicable

standards before discharge so the impacts will be limited. The surface runoff is very small compared with the receiving river flows and as such the impact is expected to be insignificant, based on EA modeling result.

The transportation of hazardous materials, both road transportation and water navigation could pose a risk of water contamination from traffic accidents occurring near the rivers which involve vehicles and water vessels loaded hazardous materials and result in major spills. Based on the frequencies of occurrence of such severe accidents, the prediction results indicate that there existing a very small probability of water contamination from this source. If they do happen, catastrophic consequence may result to water quality, aquatic life and eco-system, health and safety of the people living downstream from the accident locations.

The Three Gorges reservoir located downstream from the Xiangxi River and Shennongxi River super bridges, which are part of expressway component. The hydraulic modeling shows that the designed dam increase and the resulting water level rise in the river, will not affect the bridges and the navigation under the bridges as the bridges is designed for 100 year flood which is able to accommodate the water rise. The proposed project will have no effect on the hydrology of the water body along the alignment, and have no effect on the flood control in the rain season.

#### **4.4 Noise Impacts**

##### Construction Phase

Construction noise will be primarily from construction machinery and trucks. Based on the noise intensity and compounded effect of simultaneous operation of multiple machines, an noise attenuation model predicts that at 40m from construction machines, the noise levels will be reduced to below the applicable day time noise standards. It will take about 250 m for the noise to meet the standards at night. Based on the site investigation, there are only a very small number of mostly rural residents who live within 40 m from the construction sites so the impacts will be very limited. There are, however, a large number of people within the 200 m area from the construction sites. There would be a significant noise impacts if construction machines operate at night. In addition, residents living on both sides of access roads will be impacted by the higher noise levels from increased traffic of construction transportation vehicles.

##### Operation Phase

Noise levels for the 41 villages and three schools which are located near the proposed expressway are predicted for the years 2013, 2019 and 2027. The results show that the noise at 9 villages will be within the applicable standards during the day time during the predicted years. With the increase of traffic on the expressway, some villages will start to be exposed in higher noise. With regard to the schools near the expressway, the noise model predicts that three schools will be impacted by noise. The noise will exceed the standard by 1.1-6.8 dB(A) in the day time and by 4.5-10.3 dB(A) in the night time.

#### **4.5 Air Impact**

##### Construction Phase

Airborne dust will be a primary air contaminant during the construction phase. The sources of the dust will be unpaved access roads, Disposal areas, materials storage areas and transportation. The factors affected dust airborne will include climate conditions and type of construction activities. The impact area can be up to 150 m from the source of dust. Another source of air emission is asphalt and concrete mixing stations. The impacted area can be up to 200 m leeward from the source. As the asphalt stations are flexible in terms of exact location, the impact can be avoided if the asphalt station positions are carefully selected with environmental considerations.

#### Operation Phase

Using an air dispersion model and motor vehicle emission model, it is predicted that NOx concentrations are expected not to exceed the standards during whole the operation stage under the normal weather conditions (stability of Class D) but maybe exceed the standards under the unfavorable weather conditions. The green house gases will be in general reduced.

The project has a total of 45 tunnels which will all have emissions from ventilation on both ends. The site investigation showed that within 100 m of all tunnel exits, there are no sensitive receptors. Based on the model calculate, the emissions from tunnel exits are not expected to cause air quality in the ambient air to exceed the applicable standards, following dilution and dispersion.

## **4.6 Socio-economic Impact**

#### Community Severance

There are 7 interchanges, 2 overpasses and 41 underpasses in the proposed expressway. In addition, where the road passes large farmland, agricultural vehicle passages are designed to ensure the agricultural operation convenience. As the expressway will have a large proportion of tunnels and elevated viaducts, the actual severance impact will not be as high as the expressway length implies. Under the project, there will be 148 bridges and 44 culverts. As such, the existing river and irrigation systems will be intact, so as to ensure irrigation system functioning.

#### Cultural Relics

According to the report prepared by of Hubei Provincial Relics and Archaeological Research Institute during the Project EA, the proposed expressway will affect four cultural relics. It will go through the Baihuguan site of the New Stone Age (3000-4000 BC), with a total area of 5000 m<sup>2</sup>, and bypass Xingpin suspended tomb of Zhanguo-Song-Ming Dynasties (400 BC-1300AD) with a total area of 3000 m long in the north and south. Preservative excavation will be conducted at Baihuguan and Pingyikou sites. in order to avoid the blasting effect during the tunnel construction, the design team adopted the EA option to cross the Xingpin suspended tomb via a bridge instead of tunnel. No actions are needed for the other two sites due to their distances to the proposed expressway alignment. Although the Xingpin suspended tomb is a provincial protection culture relic site, the proposed bridge is 195 m far away from the control zone and necessary consolidation works will be conducted. While the Baihuguan and Pingyikou Tombs cultural relics sites do not have significant historical, cultural or architecture

values and are not included in any of the state, provincial or county level cultural relic lists. Based on the current assessment by provincial archaeologists, as well as further consultation with other specialists, a cultural heritage protection plan including the necessary mitigation and budget had been prepared and approved by Hubei Provincial Cultural Bureau in August 2007.

### Three Gorges National Geological Park

The expressway will go through Shennongxi Scenic Spot of Badong Zone and Xiaofeng Scenic Spot of Yinchang Zone of the national Three Gorges Geological Park. The original K alignment, K30-K60 section through the Xiaofeng Scenery zone and about 2500 m to one Class I Geology Protection Site (at K38) and about 500 m to another Class I protection site (at K29+500) and about 500 m to a Class II protection site. While at this distance it would not impact the geology protection sites. All the spoil soil disposal sites and access roads are far away from the above geology protection sites, and have no impact to them.

### Cave Diversity

In the winter of 2007 and in June, 2008, the cave biodiversity experts made two surveys for the caves along the alignment within the range of 500 meters. The survey reports show that the location of caves a relative far away from the alignment, no new and endangered species are found. But before and during the construction, proper efforts will be made to minimize the possible impact the caves. The details can be referred to the annex 1 of EIA.

### Health and Safety

Health risks are primarily related to increased transit population during construction (construction workers) and operation (visitors) in the regions. The increased mobile population could potentially bring and spread infectious diseases in the Project area. The in-hygiene and un-healthy life style of the workers could spread diseases such as hepatitis and HIV-AIDS to local residents as well as among themselves.

The safety risk is primarily in the construction phase with the local residents, particularly children who have little awareness of construction site safety and traffic safety. In a linear construction site there will be hardly full control of the site and the construction areas will be mostly open with no control from public access. The curious students may hang around the sites after the school causing safety risks. Deep cuts and other excavation, if near normal roads could also be a safety hazard at night. The explosion operation for deep cuts and materials borrowing and the resulting flying stones, as well as explosive handling, will be among the most dangerous activities on the construction sites which pose risks to residents. The explosive operation could also affect the safety and structure integrity of houses in a 500 m radius area through strong vibration of the explosion as well as damaging roof tiles and windows from flying stone from explosion.

### Tourism

The proposed expressway will greatly improve the accessibility to the Project areas including local tourist attractions and as a result, more visitors are expected to visit local parks and conservation areas, such as the Yangze River Three Gorges. The proposed road will pass through three local important tourist attractions, they are Shennongxi Scenic Spot, Gaolan Scenic Spot and Xiaofeng Tourism Spot. The increased tourists and motor

vehicle traffic will bring higher loads to the environment and eco-system in the park, including air emission, sewage, and solid waste generation as well as potentially excessive developments in hotels, restaurants, shops and other services.

#### Economic development and poverty alleviation

The expressway will greatly improve the transportation conditions of the project area. Currently from the Badong to the provincial capital of Wuhan will take 8-10 hours while when the expressway is in operation this trip will only take about 5-6 hours. The greatly improved transportation conditions will help shipping of local agricultural produces and resources out to the urban centers, contributing to local economic development. In addition, the greatly improved transportation conditions will help attract outside investment to the region contributing further economic development. As the lack of transportation infrastructures and relative isolation of the region is one of the major causes of the under development and poverty in the region, the Project will help the poverty reduction effort and improve the standard of living to the local urban and rural residents for the access to services and others in the urban areas.

#### **4.7 Resettlement and Relocation**

The resettlement and relocation of the proposed expressway will occupy permanently 8395.3 *mu* of land, including 3083.2 *mu* farmland, 2673 *mu* woods, 1386.8 *mu* garden. The proposed project will affect four counties, 11 townships, 53 villages and 138 village groups. The total directly affected families who either lost land, houses or both will be 302652.1m<sup>2</sup> with 8204 people. The Project will also occupy yards, water wells, walls, tombs, trees, irrigation systems, country roads and utilities within the expressway area. The impacts will also include mismanagement of land and house compensation funds, unsatisfactory with land re-assignment and insufficient compensation for house replacement. However, in general, the new houses following the relocation are expected to be better and bigger than the houses they replace with using the resettlement and relocation compensation funds, representing an improvement of housing conditions and the standards of living.

The total cost of resettlement and relocation, including compensation to all affected, is estimated to be US\$ 82.86 million.

#### **5. Analysis of Alternatives**

The analysis of alternatives and determination of expressway alignment include the following process: first, three transportation corridors between Yichang and Badong, the ultimate destination of this expressway, were identified and compared and the one with the least environmental impacts was selected (in which this expressway is a section). Within this corridor, two alternative alignments were then identified and compared with the one with the least environmental impacts selected as the preferred alignment. Finally on the preferred alignment, fine modifications were introduced in several sections to compare with the original alignment in an attempt to further avoid and minimize potential adverse impacts of the expressway. The expressway alignment is determined based on these three steps in analysis and comparison of different alternatives.

The three corridor alternatives analyzed at the first stage are (see Map 5-1 for details):

North Corridor: starting from the Yichang (Shuanglian interchange of Yichang-Jingmen Expressway), through Huanghuachang, Gaoyang, Gaoqiao and Xiquiwan, and ending at Badong.

South Corridor: starting from Yichang point, through Yemingzhu, Letianxi, Guizhou and Xiquiwan, to the end point

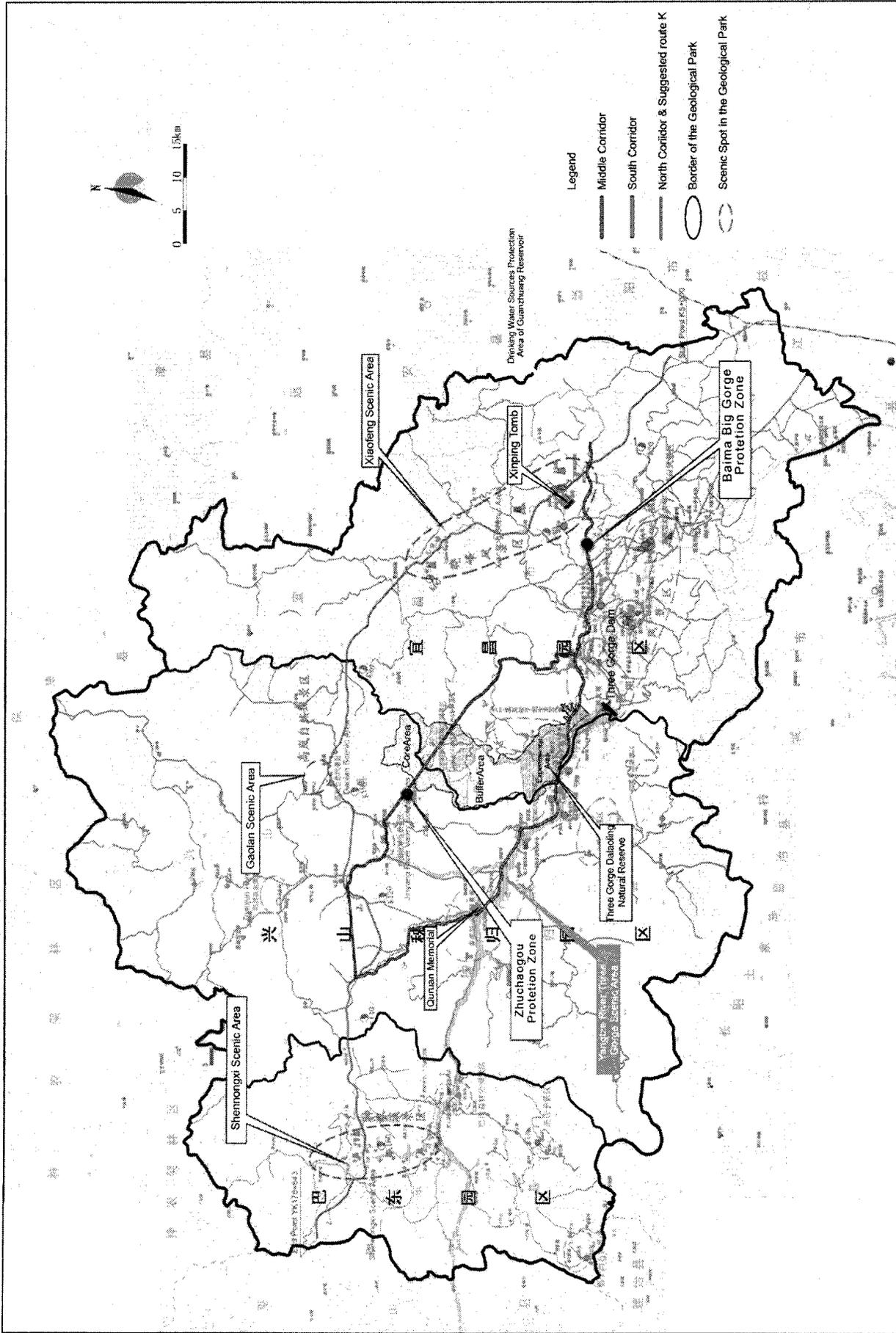
Middle Corridor: from the start point, through Huanghuachang, Letianxi, Xiakou and Xiquiwan, to the end point

North Corridor is selected based on the best transportation condition, which in turn would have smaller amounts of disturbance and impacts to the natural and socio-economic environments. Furthermore, the area within North Corridor is relatively stable geologically, with mild soil erosion. In addition, the cuts and fills within North Corridor would be the smallest compared with the other two corridors, implying least disturbance and least need for disposal. Thirdly, the North Corridor has the least negative effect on the three Gorges national geological parks of Yangtse River, and it also has the limited impact on the local ecology and environment. It also has the limited impact on the groundwater and the landscape, although the land occupation and the building demolition are big than the other two corridors, which may be alleviated by the appropriate mitigation and compensation measures during the project implement. The North Corridor also receives the widest supports from the local governments which is also an important consideration in the analysis of alternatives by the EA and other project teams. Mitigation measures have been proposed and included in the engineering design where appropriate as well as in the Project EMP for mitigating adverse impacts expected to be caused by North Corridor, particularly in areas where North Corridor has higher impacts than other corridors.

The other two corridors have obvious deficiency on construction and operation. The middle corridor includes a tunnel with 18.5 km length which is difficult in construction and expensive in operation. The south corridor has already been occupied by an exclusive road to the Three Gorge Reservoir. Thus it is very difficult to be approved that two high class roads be constructed within a same corridor. Besides as the exclusive road is enclosed and managed by the reservoir management, it is impossible to use it for the purpose of this project.

The alternatives analyzed at the second stage in the preferred corridor are (see Map 5-2 for details):

Within the preferred corridor, limited by the site topography and geology, there are two possible alignments for considerations and comparison, Alignment K (50.098 km) and Alignment A+B (51.574 km). The two alignments overlap at the Baihe Interchange of Jingmen –Yichang Expressway. The two alignments would go separate alignments before merged again near the end of this section of expressway at Qingjiahe. The Alignment K would have 41 bridges with a combined length at 17960 m and 12 tunnels with a combined length of 9638 m while the Alignment A+B, 40 bridges with a combined length of 14010 m and 11 tunnels with a combined length of 16270 m. Through a detailed analysis of the potential impacts, and comparison of the two alignments, Alignment K is selected as the preferred alignment based on 1.476 km shorter distance and thus less disturbance to the environment, lower soil erosion, less earth work, less cuts and fills and less tunnels, lower biodiversity and lower amount of



Map 5-1 Comparison of Alternative Corridors in Preliminary Study Stage



biomass, and less cultural relics, although the Alignment K has higher number of sensitive receptors such as scenic spots and higher amount of housing relocation and displaced persons. The most important, Alignment A+B passes through the upstream of Guanzhuang Reservoir, which is the drinking water source. Thus this may lead to potential impacts in the construction and operation phase, particularly including accidental pollution of water quality. In addition, Alignment K receives better supports from local governments and less community severance and social impacts by the expressway construction and operation.

The section of Gaolan to Baiwan is of the most complex geological and topographical conditions. Three Alternatives, K, C and D have been developed detailed comparison. From the technical factors, Alignment K is better than C and D. The total length of tunnel and bridge under Alignment K is 788 m and 638 m less than C and D respectively. Alignment K has the shorter length of bridge and tunnels. Alignment K is RMB 4.368 billion, RMB 225 million and RMB 482 million less than Alignment C and D respectively. Alignment K is also preferred in terms of geology, as the geological disaster is less frequent and intensity is not as heavy as in Alignment C. Alignment C and D, the geological disaster in the area is more frequent and intense. It is difficult to construct a road under such unstable geology conditions. Alignment D will disturb the weather station in Xingshan and Zhaojuntai history property.

The location selection of the largest bridge on Shennongxi River has been carefully investigated. It is found that the bridge to be constructed under Alternative E is located on a steep cliff where the geological stability is poor as carst topography dominates this area. Thus Alternative K is preferred.

Alignment K is preferred with less land occupied, but the earth work amount is substantial. As the ecological settings along the two alternative routes are almost identical, the potential impacts are thus similar. In addition, the social and water environmental setting are similar for the two alternatives. The major difference is the existing geological factors. The bridge to be constructed under Alignment E is located on a steep cliff where the geological stability is poor due to Karst formation in this area. It is difficult to construction the super large bridge.

## **6. Mitigation**

For the adverse environmental impacts of the Project, the EA has developed a series of measures to avoid, minimize, mitigate or otherwise compensate the adverse impact from the project. These mitigation measures are summarized below:

### **6.1 Design Phase**

#### **Soil Erosion**

To control soil erosion, all sections vulnerable to soil erosion will be applied to engineering control measures. For the most unstable areas, such as steep cuts above the expressway, concrete grids or stone pavement will be applied to the slopes to completely stabilize the soil surface. For the milder and more stable slopes, the area will be landscaped. The Project will have 63 spoil soil disposal sites. While some are in the

natural depression or valleys, other will be piled above ground. In these areas, retaining walls will be built to stabilize the piles and the piles will also be surrounded by interception ditches and drainage systems. All stockpiles of the spoil soil will be finally covered with native soil and landscaped.

**Noise**

A number of measures to minimize noise have been incorporated into the design for sensitive receptors at which the noise level is predicted to exceed the applicable standards. These measures, and the proposed implementation time, are summarized in Table 6-1. In addition, in several villages where no mitigation measures are planned because the predicted noise levels are below the applicable standards, increased noise monitoring will be implemented to ensure the actual noise levels after expressway operation comply with the predictions. Mitigation measures will be taken if the monitored data show noise levels exceed the standards.

**Table 6-1 Mitigation Measures on Traffic Noise**

Mitigation Measures	Sensitive Receptors	Implementation Time
Ventilated noise insulation window	Guanchong, Sunjiawan, Lianghekou, Chiqiping, Yuquantan, Nanbiandadui, Shibazi, Qinjiaya, Yangjiahe, Dengjiaping, Zaojiaoshu, Sigou, Heba, Najiahe, Wanlitan, Songshubao, Wangjiayuanzi, Shijiaba, Shujiachao, Lijiachao, Houbaisi, Gaolan school	Before Construction
Noise insulation corridor	Yangzhou-Zigui school	
Noise barrier	Guanzhuang school, Longwangdong, Xinping, Yanjiahe, Huangjiahe, Qinjiaya, Xiadengjiagan, Shangdengjiagan	Before Operation
Planting trees	Qinjiaba	

**Water**

To minimize the impact on water quality, wastewater treatment facilities will be designed and built at the service areas, including motor vehicle maintenance and repair shops, car washing operations, as well as other domestic facilities at the service areas along the expressway. Aerobic biological wastewater treatment process has been selected and incorporated into the design which is capable of removing COD and suspended solid to meet the applicable discharge standards as per Integrated Wastewater Discharge Standards (GB8978-1996). The car washing wastewater will first go through a pre-treatment for oil removal before enter into the biological wastewater treatment unit. In addition, the two branch management center and two maintenance center are very small and septic tanks will be installed for wastewater treatment before discharge.

**Community Severance**

To minimize the impacts of community and farmland severance, numerous rounds of consultation have been conducted with the affected villagers. In areas where the road will intersect with local roads, there are 7 interchanges, 2 overpasses and 41 underpasses. As the road is to be built in an area with highly rolling terrain which requires a large number of tunnels and bridges on the route, it is estimated that the traffic blocking impact on the

local people is minimum. The provisions in the crossing design have been provided to allow various farm vehicles to use as well as for future expansion.

### **Cultural Relics**

The measures to be taken in the protection area of Xinping Suspended Tombs include: the tomb and the surrounding area will be reinforced with physical and chemical methods, including provision of support and spray of reinforcement agent; the tombs and surrounding area will be investigated with record; monitoring equipment to monitor the movement of the cliff for long term will be procured and installed at site with specific management procedure in place; mitigation equipment to reduce the vibration will be installed at site to reduce the impact on the tombs.

Preservative excavation at the Baihuguan and Pingyikou relic sites will be conducted and completed prior to the commencement of expressway construction. During this process, all valuable archaeological and cultural articles from the sites will be uncovered, studies and kept by the county museum. The excavated sites will be photographed, measured, documented or modeled before handed over to contractors for expressway construction. Contractors will be educated to strictly follow the procedures in case there is any chance find during construction. The procedure calls for immediate halt of construction activities and contact relevant authorities. Contractors may resume work at the site if so instructed by authorities and cultural relics specialists following their on site investigation.

### **Three Gorges National Geological Park**

As the main project and all the spoil soil disposal sites and access roads are far away from the geology protection sites, the impacts to the **Three Gorges National Geological Park** will be insignificant. However, the Project will result in indirect impacts to the park through better access to the park and attraction to more tourists. To mitigate the indirect impacts, an environmental management plan for the parks will be prepared. The specific measures will include locating motor vehicle parking lot be carefully designed to minimize the land occupation and impact on landscape, and providing sufficient garbage bins and washroom facilities. Within the core area (geology protection sites) of the Park, high filling and deep cutting will be prohibited to conserve the landscape in the Park; borrow and deposit pits, service zone, road maintenance stations will be banned. The road and side slope of the roadbed will be covered with green materials or vegetation, so as to ensure a harmony with the surrounding environment.

### **Resettlement and Relocation**

All relocated residents will be properly compensated and received training for new employment. Special consideration will be given to the elderly, illiterate and farmers in terms of compensation. For people whose sources of well water will be disrupted by the construction by the construction of tunnels, additional water wells and other water supply sources will be developed.

## **6.2 Construction Phase**

### **Temporary Land Occupation**

The construction workspace will be minimized to reduce the impact of land occupation. Areas which must be occupied for temporary uses will be re-vegetated immediately after the completion of construction. Workers will be educated to protect trees and other vegetation as much as possible during construction. Temporary settling ponds will be built in soil stock piles, cuts and other excavation areas near water bodies to control erosion. To minimize soil erosion on disturbed soil and areas highly vulnerable to erosion, temporary protection measures such as grass mats will be applied in places where permanent protection works cannot be complete in time for the draining season.

### **Ecological**

The shrubs and trees in the project area are the primary concern for ecological protection for this expressway project. To protect wildlife in the area, the construction will be carefully scheduled to reduce construction duration and the blasting operation. The construction camps will be banned to build in the heavy treed areas. The contractors will be requested and bound by contracts to cooperate with the staff from local forest service in defining the red line for construction site and the marking of valuable plants for protection. All contractors must go through a training program before the start of construction for tree and wildlife protection.

### **Construction Noise**

Large and noisy construction activities will keep away from populated areas (150 m minimum) to the maximum extent possible. Operation of loud construction machinery and major construction activities will strictly restricted to the day time. Temporary noise barriers will be constructed to protect the sensitive receptors such as schools if the construction must be carried out in the short distance. Construction traffic will be directed to avoid sensitive locations if possible. Where such traffic must go through villages or townships, speed bumpers will be built on the roads to slow down the traffic to reduce noise and safety risks. Where night time construction must be conducted for technical reasons (e.g., continued concrete pouring for pillars of bridges and elevated viaducts), the affected residents must be noticed before hand and measures including temporary noise barriers and temporary relocation of the affected will be taken for the most vulnerable people such as the sick and elderly.

### **Water**

To minimize adverse impacts to surface water during construction, cofferdam techniques will be used in bridge column construction with complete isolation of work areas from the river water. River crossing construction activities will be scheduled to the extent possible during the low flow periods. To mitigate the potential impact from wastewater discharged from construction camps, no sewage from construction camps will be allowed to discharge without treatment. The sewage will be either held at the site and empties to treatment facilities regularly or through on site treatment such as septic tank (at least 20 m<sup>3</sup>) to meet the irrigation discharge standards. Environmental supervision will be enhanced on construction stage, especially on the bridges of the Huangbo River, Xiangxi River and Shennongxi River which has the Class II standards, the highest among all water bodies in the project area.

The wastewater produced in the construction of tunnels will be discharged into settling tanks to remove solids before discharge or recycle for use in construction. The dynamic

design and careful construction in Karst formation will be applied to handle this geology features.

To control the potential geological hazards mostly associated with Karst formation in the project area, the design has included construction methods including crossing over, strengthening, diverting and incepting of Karst water, piling, removing of loosing materials, seal of land depressions and diverting surface water and similar engineering measures to control the risk associated with this geology features and ensure project safety.

### **Air**

Unpaved access road and construction sites, if they are near villages or schools, will be water sprayed twice a day (once in the morning and once in the afternoon), or more on dry and windy days to suppress airborne dust. The mixing stations and other point sources of air emissions will be located leeward far enough from sensitive receptors (at least 300 m). Access roads will be paved with gravel to reduce generation of air-borne dust. Trucks loaded with soil and other dusty materials, as well as materials stockpiles will be covered with canvas. Tunnel construction will adopt wet drilling, with sufficient ventilation. Where needed, water spray will be used to suppress air borne dust in areas where be exposed. All workers in the tunnel construction sites must wear proper personal protection equipment (PPE) including facial masks to ensure worker health and safety.

### **Construction Camps**

Construction camps will be appropriately located to minimize the disturbance to the surrounding communities and the natural environment. Solid and liquid waste will be stored with proper protection and removed from the sites regularly with qualified vendors for disposal. The camps will be maintained in sanitary, hygiene, orderly and good housekeeping conditions to minimize the health hazards to the workers and adverse impacts to the surrounding environment. Any construction camp is forbidden on 200 m area of the both sides of the Huangbo River, Xiangxi River, Shennongxi River.

Workers will be educated for hygiene and healthy lifestyle at the construction sites to control infectious diseases and protect the workers and the local communities. Warning signs, public education, necessary barriers, etc. will be provided to protect public safety at the construction sites, especially during explosion operations.

### **Cultural Relics**

Two cultural relics which are right on the project alignment will undertake protective excavation prior to the commencement of construction. The result of excavation will be moved to provincial museums for permanent protection and displays. A procedure for handling “chance finding procedure” has been prepared and included in the EMP which will also be provided to the contractors in the bid document and eventually in the construction contracts. All contractors will be requested to halt construction until the chance finds have been studied by professional archaeologists and instructed to resume construction. Proper training on the chance finding procedure will be mandatory to all contractors before the start of construction.

## **Contractor Management**

Experience with previous World Bank financed expressway project in Hubei province has indicated that high awareness and full participation of contractors in environmental management at construction are critically important to ensure environmental performance. Environmental protection will start from pre-qualification of contractors when environmental awareness and management systems will be an evaluation criterion. The environmental mitigation measures, management and monitoring plans will be incorporated into bid documents to ensure there will be sufficient funding for these activities and the environmental management will be contractual obligations to the contractors. Finally, short course training will be provided to all winning contractors and construction supervision companies on environmental policies and regulations, potential impacts, mitigation measures, daily monitoring and reporting requirements, chance find procedures, and emergency handling.

## **Spoil Disposal Site**

The 63 spoil disposal sites have been carefully designed based on the 1:2000 relief map, including the retaining wall with enough strength, slope protection, drainage facilities and access road for construction. The spoil disposal sites located in the Gaolan tourist area and Xiaofeng tourist area will include landscape effects to minimize the visual impacts. If the contractors propose the new site area in the construction, it will need the agreement by the HPCD and local government particularly EPB to ensure sufficient technology and environmental considerations. If the spoil disposal site will be located near river ways, it will also need agreement from the river management authorities and approved by the local government.

For those spoil disposal sites near the residents, it is prohibited to conduct any filling or unloading activities at night. Water will be sprayed regularly to reduce the dust. The access road width and length will be controlled and replant the vegetations after the construction. In the vegetative area, it will be small-sized construction before the spoil disposal in order to drive the wildlife away.

## **Access roads**

The temporary access roads will be carefully located to avoid farmland, forest and crops; where possible, the access locations will be selected in such a way that they will be used by the local communities after the construction completion. Safety warning signs will be installed and safety considerations and engineering measures will be given full consideration in the access road design. Usage the existing road cooperated by the local government to avoid the traffic jam, especially much more heavy construction vehicles come-and-go, it will lead to the Yixing Road traffic increase. It may destruct the existing roads, impact the local transportation, and increase the risk of the traffic accident. So, it will be enhance the transportation safety management such as set the transportation caution signs, scientific construction arrangement, minimized the impact to the villagers along the proposed freeway. When through village, schools and hospitals, all access roads will be hardened from 25 m before approaching these sensitive receptors until 25 m after leaving them. When the construction is completed, the access road, if not beneficially used by the local communities, will be fully rehabilitated to its original state and landscaped as needed.

### 6.3 Operation Phase

#### Ecology

At the two side of the sections where wild animals are active (K75-K85, K97-K101+600, K120-K144), sing of whistle ban will be set up.

#### Noise

No new school, hospital or other sensitive facilities will be allowed to build within 250 m from the central line of the expressway to prevent noise impacts to these facilities in the future. If Huanghua Town and Wudu Town decide to modify their development planning in which they tend to extend toward the proposed road, it is suggested that in the area within the distance of 200 m from the road will be constructed with storehouse, plant and greening works. Traffic management will be enforced and motor vehicles will not be allowed for speedy which generate excessive noise as well as safety concerns. The road surface will be regularly maintained to reduce the noise with the vehicle movement. The main engineering mitigation measures are installation of noise barrier, noise window, planting, and relocation.

#### Air emission

Motor vehicle air emissions control requires integrated approach from numerous government agencies as well as private sector stakeholders. The province will enforce applicable standards for motor vehicles and usage the clean energy such as the electric and light oil with the low sulfur and implement the motor vehicle inspection programs to minimize the air emissions from the increased motor vehicle traffic on the expressway. Strengthen fire and traffic management, including no pass, control of explosive and flammable vehicles, etc. An emergency response team will be established consisting of Project Company, road bureau, fire department, traffic police, environmental bureau, local hospital and monitoring center. The team will be responsible to handle promptly accidents in the tunnels, minimizing the impact to the people, properties and the environment.

Establish emergency response plan with the following accident handling procedures: ① stop the traffic into the tunnel upon the notice of a fire in the tunnel; ② duty staff notice immediately the emergency response team and other organizations as may be appropriate; ③ make public announcement to the people still in the tunnel to guide them to safety; ④ guide to emergency vehicles and personnel; ⑤ direct traffic away from the site; ⑥ control other equipment such as ventilation to help with the suppression of fire; ⑦ control other equipment such as lighting, monitoring, etc. to assist people evacuation.

#### Water

There are many auxiliary facilities such as service areas, parking areas, management centers of the proposed project. The wastewater produced from the auxiliary facilities will be discharged in to settling tanks to remove solids with the sediments cleared and transported in timely manner and the supernatant being recycled into the process of construction. Wastewater treatment facilities will be constructed at the service zone, parking zone and management center to treat the domestic wastewater before being

discharged into water body. The wastewater containing oil from the car washing process will be reused after treatment by oil-water separator. Any excessive wash water will go through oil water separator before sent to the treatment station together with the municipal wastewater. A septic tank with 20 m<sup>3</sup> volume will be used in each toll station. The effluent from septic tank can be used for municipal irrigation and the sediments will be cleared by local sanitation staff. A collection system and holding tank will be installed at each of the bridges in the two Class II water quality rivers to collect any potential accidental release of hazardous materials.

### **Transportation of hazardous materials**

A leading group including relevant government authorities had been set up to handle transportation of hazardous materials and emergency response in an event of a traffic accident involving trucks located with hazardous materials, particularly in sensitive locations such as bridges or other places near surface water bodies. Licensing and permitting procedures will be strictly enforced to control the traffic involving hazardous materials on provincial expressway.

### **National Geological Park**

The plan for vehicle speed limit, horn ban, fuel and material spillage control will be developed and implemented. Furthermore, the road will be well maintained, and environmental monitoring plan to the Geological Park will be carried out for long term. The Geology Park is already in the process to develop plan for the anticipated increase in tourists following the completion of the expressway. This will include carefully planned and controlled facilities developments such as hotels and restaurants, sufficient sanitation facilities such as washrooms and garbage bins, and waste collection and treatment and disposal systems.

### **Cave Diversity**

Before the start of construction, fence will be erected at the nearby caves, which could be impacted by the construction. No contractor workers or other personnel will be allowed to enter into the caves for hunting, collect stalactite or other activities. The contractor will be required to conduct all its on site activities including setting up construction camp at least 200 m from these four caves, to minimize the direct impact of construction activities to the caves. In addition, the contractors and expressway operators will also be required to maintain environmental quality and minimize pollution. Particularly during construction, the contractor will be demanded not to place any construction materials or waste near the cave exits. If a construction camp must be set up near the cave, the camp will not be allowed to discharge sewage directly to the surrounding environment with the sufficient treatment (at least septic tank treatment or further depending on the actual receiving water or area). The surrounding vegetation will be reserved to the maximum extent possible.

### **Monitoring**

Extensive environmental monitoring programs will be implemented during both construction and operation phases (details in the chapter 7) to ensure that adverse environmental impacts are as projected during the EA and the mitigation measures proposed will be implemented and effective. In adequate mitigation or new adverse

impacts emerged beyond the EA prediction will be detected by the monitoring programs promptly and appropriate new actions will be taken to address them.

## **7. Environmental Management Plan**

An environmental management plan (EMP) has been developed in a separate and stand alone document. The EMP includes policies basis and applicable environmental standards, environmental management system, mitigation measures and monitoring plans for both the construction and operation phases.

### **7.1 Objectives**

The EMP provides a framework for the implementation of mitigation measures and environmental management and monitoring during the Project implementation. As such, it represents the commitment of Project proponent as well as the governments of the Project area for environmental protection, pollution control and impact minimization. More specifically, the EMP is to:

- Set out the legal and policy framework as well as applicable environmental standards with which the Project will be compliance;
- Identify and design with sufficient details and specifics of mitigation measures for adverse impacts of the Project;
- Specify institutional roles and responsibilities for mitigation measures implementation and environmental management during Project;
- Outlines the requirements for environmental monitoring and reporting needs; and
- Provides an independent document which may be used during Project implementation for Project supervision.

### **7.2 Management and Supervision Organizations**

There will be two levels of organizations which will be responsible for environmental performance of the Project. The first is environmental management organizations including the Environmental Office of the Ministry of Communications, the HPCD, the Project Management Office (PMO) which is the Project proponent, the expressway company to be established which will be responsible for the expressway operation and various technical groups for environmental monitoring and design. The other level is the environmental supervisory organizations which include MOEP and Environmental Protection Bureaus of different levels of government in the Project region.

In order to achieve a satisfactory outcome of the Project's EMP, the project owner will appoint a Client's Environmental Supervision Consultant (CESC) to supervise and monitor the implementation of the EMP throughout the construction phase of the project. The CESC reports to the project owner directly. Involvement of the CESC can ensure that the Project's EMP is adequately implemented. The CESC will check, review, verify and validate the overall environmental performance of the Project through audits and inspections. This will provide confidence that the reported results are valid and the relevant monitoring program or codes of practice as provided in the Project EMP are fully complied with. In addition, the project owner will also engage an Environmental

Monitor Consultant (EMC), responsible for regular and focused environmental monitoring of the construction sites.

### 7.3 Environmental Monitoring

The EMP also includes environmental monitoring programs for both construction and operation phases. The parameters to be monitored include relocation and resettlement, soil erosion, noise, dust, degradation of water quality, stream sedimentation, solid waste disposal, and electromagnetic radiation. During the construction phase, environmental monitoring will be conducted in two approaches: daily and routine monitoring consisting of mainly visual observations and limited equipment measurements such as hand-held noise meters; and periodic monitoring by professionals using standard methods recognized by regulatory authorities. Monitoring reports will be compiled at intervals of once every three to four months, summarizing the findings of the monitoring. The reports will be submitted to project proponent as well as relevant agencies and the World Bank. During the operation phase, noise levels will be monitored once every six months while air and water quality will be monitored once a year.

The specific monitoring programs for air, noise and water are summarized in Table 7-1 through Table 7-3.

**Table 7-1 Monitoring Plan for Ambient Air Quality**

Phase	Monitoring point	Parameter	Frequency	Duration	Timing
Construction	Asphalt mixing station and cement mixing station	TSP Asphalt smoke	4 times per station per year, ad hoc	2 days	During construction
	unpaved road, outlet/inlet of tunnels	TSP	4 times /year, ad hoc	2 days	During construction
	In tunnels	TSP, temperature	4 times /year, ad hoc	2 days	In construction
	Guanzhuang Primary School, Gaolan Primary School, Yangzhou Zigui Primary School and Xiadengjiafan	TSP	4 times /year, but actual frequency is subject to the project progress	5 days	According to technical specifications
Operation	In tunnels longer than 1km	CO,NO <sub>2</sub>	2 times/year	5 days	According to technical specifications
	Guanzhuang Primary School, Gaolan Primary School, Yangzhou Zigui Primary School and Xiadengjiafan	NO <sub>2</sub> TSP	2 times/year	5 days	

**Table 7-2 Monitoring Plan for Surface Water Quality**

Phase	Monitoring point	Parameter	frequency	Duration	Timing
Construction	Huangbo River, Wudu River, Gaolan River, Xiangxi River and Shennongxi River	Permanganate index, SS, oil	4 times/year with each for consecutive during bridge construction	2 days	One each time in morning and afternoon
Operation	WWTW of service zone	COD, NH <sub>3</sub> -N SS, oil	2 times/year	2 day	

**Table 7-3 Monitoring Plan for Acoustic Quality**

<b>Phase</b>	<b>Monitoring Sites</b>	<b>Parameter</b>	<b>Frequency</b>	<b>Lasting time</b>	<b>Sampling time</b>
Construction	Lianghekou, Chiqiping, Yanjiahe, Yuquantan, Huangjiahe, Zaojiaoshu, Qinjiaya, Wangjiayuanzi, Xiadengjiafan, Guanzhuang Primary School	Leq, A	4 times/year, ad hoc	2 days	One time in the morning and in the night
Operation	In tunnels	Leq, A	2 times/year	2 days	One time in the morning and in the night
	Guanzhuang Primary School, Yangjiahe, Xiadengjiafan, Gaolan Primary School, Yangzhouzigui Primary School	Leq, A	2 times/year	2 days	

**7.4 Institutional Strengthening and Training**

To ensure the environmental performance of the Project, the EMP emphasizes the institutional building and strengthening. Besides an organizational structure involving various management and supervision organizations for environmental decision making, monitoring, reporting and further mitigation planning and implementation, the EMP includes detailed programs for personnel training. The programs involve training aboard and domestically for professional, managerial and technical personnel from the governments, project proponent and operation units, environmental institutions and contractors and construction supervisions.

The environmental training for contractors and construction supervisions will be held prior to the commencement of construction. The objective is to ensure that each contractor and construction supervision unit will have staff on site full time for environmental monitoring on a daily basis. The training will cover the basic knowledge of environmental protection and pollution control, the result of EIA and requirements of EMP, methodology of site environmental management and monitoring, and reporting requirements. The training for HPCD, PMO, the company of expressway, and environmental institutions will cover environmental management, regulatory framework, applicable environmental standards and their implications to the Project, mitigation planning, environmental decision making and pollution control technologies. Some of this training will be carried out overseas.

**7.5 Estimated Cost for Environmental Management**

The cost for environmental management and mitigation measures have been estimated and included in the Project budget. The estimated cost is summarized in Table 7-4.

**Table 7-4 Summary of Estimated Cost for Environmental Management**

Items	Stages	Estimated Cost (RMB x10000)
Mitigation measures	Construction/operation	2907.3
Environmental monitoring	Construction/operation	180
Cultural Relics	Construction	193
National Geological Park	Construction	316.445
Staff training	Preparation/construction	36.05
Ecological Engineering work (landscaping/soil erosion control)	Construction	14707.49
Environmental supervision	Construction	295.7
Acceptance	After Construction	80
Contingency		200
Environmental facility operation cost	First 3 years in operation	280.8
Total		19196.785

## 8. Public Consultation and Information Disclosure

Two rounds of public consultation have been carried out during the EA: the first round at the EA preparation stage in September 2005 and the second round at draft EA report between June and July 2007. Various methods have been used in public consultation, including public opinion surveys through questionnaires, public meetings at villages and with local people's representatives, and interviews with affected groups and individuals. The people consulted included mainly those who will be affected directly by the project. Relevant government and non-government organizations and experts on various environmental and socio-economic issues have also had been consulted.

In total, 320 copies of a public opinion questionnaire were distributed and 291 were returned. Among people surveyed, some are well aware of the Project (16.82%) or have some knowledge of it (54.21%). The vast majority of the people felt the expressway necessary and wish to see the construction start as soon as possible. Of the environmental concerns, 76.64% of people surveyed cited noise and 60.75% concerned about dust during construction. Most of the affected people (63.55%) would like to see landscaping and tree planting as a measure to mitigate adverse impacts of the project.

In total, 41 villages, 3 schools, more than 20 local government agencies and eight non-government groups participated in the two rounds of public consultation. There were 3 public meetings and tens of the group interviews. The main public concerns raised in the process included appropriate compensation for land acquisition and resettlement and relocation, timely rehabilitation or restoration of affected irrigation systems, construction safety, noise at schools, better access to and exits from the expressway, and sufficient passage ways across the expressway.

The EA team has responded the public concerns by including setting up land acquisition and resettlement offices under HPCD to develop, supervise and implement resettlement action plan (RAP), developing plans for irrigation system restoration, conducting public education and erecting warning signs for construction safety, constructing sufficient passageways and crossings with provisions for pedestrians and farm vehicles to mitigate community severance impacts, install fences at the sensitive sections of the access roads

to provide safety protection to students, residents and livestock, install noise barrier, ventilated noise insulation windows and tree planting to minimize the impacts of noise from the expressway, and provide full consideration to local economy and transportation needs such as appropriately locating access ramps/interchanges, employment opportunities during construction, etc.

In compliance with EIA process requirements of Chinese government and the World Bank, the completed draft EIA and EMP reports as well as part of the public consultation records were distributed in public places along the expressway, such as libraries, book centers, etc. The concerned public can have the access to and review of the reports at these places. In addition, the Project information and availability of the reports were advertised in Hubei Daily, the provincial wide newspaper and one of the most popular internet web sites in the province (www.hbjt.gov.cn). The public consultation and information disclosure are summarized in the tables below. The EA team plans to disclose the final EA reports in public places to the general public once the final version is completed.

Public consultation activities and information disclosure for this Project is summarized in Table 8-1 and Table 8-2, respectively.

**Table 8-1 Public Consultation**

<b>Substance</b>	<b>By whom, with whom</b>	<b>When</b>	<b>Where</b>	<b>Bank's requirement</b>
Explain the project contents and major work and collect concerns, using public meetings and interviews	By EA team with affected people and local agencies	March 2004	More than 20 relevant government agencies along the expressway	OP4.01
Draft EA report using public opinion questionnaires	By EA team with affected rural residents	September 2005	More than 10 relevant government agencies, 30 affected people and received 107 copies questionnaires	OP4.01
Draft EA report, public meetings and interviews	By EA team, with affected rural residents and local agencies	March to September 2006	three public meetings were held near the Xiaofeng tourist area, Xiping tomb relic site and Guanzhuang reservoir drinking water source	OP4.01
Draft EA report using public opinion questionnaires public meetings and interviews	By EA team, with affected rural residents	June to July 2007	Villages, schools and organizations along the expressway, received 184 copies questionnaires.	OP4.01

**Table 8-2 Information Disclosure**

<b>Document</b>	<b>Date of disclosure</b>	<b>Location</b>	<b>Disclosed Content</b>	<b>Bank's requirement</b>
Draft EA report	March 2006	Government offices of Longqian, Huanghua, Wudehe, Shuiyuesi, Xiakoui, Xiquiwan and Yanduhe towns	Public Notice on brief description of Shanghai to Chengdu Expressway Hubei Yichang to Badong section Environmental Impacts	OP4.01 BP 17.50
Draft EA report	March 2007	City/county libraries of Yichnang, Yiling, Huigui, Xinshan and Badong	Draft EA report for Shanghai to Chengdu Expressway Hubei Yichang to Badong Section	OP4.01 BP 17.50
Newspaper Advertising	April 5, 2007	Hubei Daily	Advertisement of Yiba expressway environmental information	OP4.01 BP 17.50
World wide web sites	April 5, 2007	Hubei Communication Website (www.hbjt.gov.cn)	Public notice of Yiba expressway environmental information	OP4.01 BP 17.50

## 9 Conclusions

The Yichang to Badong expressway will play an important role in alleviating transportation bottleneck between provincial capital Shanghai and Chengdu in the northwest province of Sichuan, promoting regional economic development, improving access to market and services, and the standard of living, and assisting in poverty alleviation. As a segment of a major transportation trunk road to northwest China, the expressway will also contribute to the Develop China's West program.

In general, the proposed Yiba Road fits into the legal framework, and the road network development planning of Hubei Province and China. Environmental considerations dominate the alignment selection process. One of such example is that the road route is carefully designed to avoid the concentrated drinking water source on Guanzhuang Reservoir, Xiangxi River and the Longquan Town Planning Zone. However, constrained by topographical and geological conditions, it has to cross the Yongze River National Geological Park, Shennong and Gaolan Scenic Spot Areas. So far, agreements from the regulatory departments have been granted for these road sections.

The construction and operation of the expressway will result in a number of adverse impacts to the physical and socio-economic environment in the Project regions. These impacts include permanent occupation of land, vegetation and agriculture, increased soil erosion, increased noise and air emissions along the expressway alignment, particularly in the environmentally sensitive receptors, community severance, health and safety of local residents, water quality and irrigation systems, and resettlement and relocations. Some of these impacts can be obvious.

However, with the mitigation measures designed specifically for the adverse impacts, the impacts will be prevented, reduced, minimized or otherwise compensated. Furthermore, an environmental management systems involving environmental management and supervision organizations, environmental monitoring, institutional strengthening and personnel training will be established to ensure the environmental performance of the

Project. In addition, to ensure successful implementation of these measures, an EMP will be developed to cover all the relevant aspects such as institutional arrangement for environmental management and supervision, environmental monitoring and training. The appropriate implementation of the mitigation measures, as well as the environmental management systems, the adverse impacts will be reduced to acceptable levels. The Project is environmentally acceptable and feasible when mitigation measures and EMP are implemented effectively.