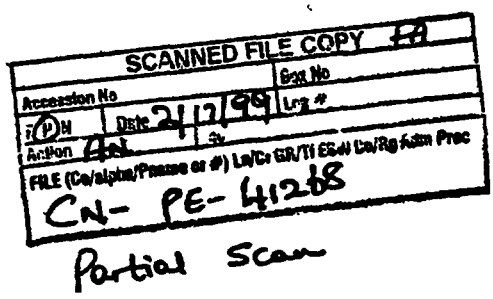
A world Bank Loan Application Project

ENVIRONMENTAL IMPACT STATEMENT FOR TONGSHAN—CHONGYANG—PUQI HIGHWAY OF NATIONAL HIGHWAY PROJECT Ⅳ IN HUBEI PROVINCE



Xian Highway Transportation University

Feb. 1999 P. R. China

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Xian Highway Transportation University

FEB. 1999 P.R.China

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Cooperation Unit:

Hubei Provincial Communication Planning & Designing Institute

Environmental Protection Monitoring Station of Xianning Prefecture in Hubei Provinc

Preface

The total length of the proposed Tongshan~Chongyang~Puqi Highway (Class 2) is 95. 245km, including 22.31km new road, 56.95km renovated road, and 15.985km original road. It is a part of the National Highway Project Ⅳ in Hubei Province (World Bank loan project), belonging to the poverty region helping projects of World Bank loan. According to the negotiate memorandum between WB deputy group and Hubei Provincial Communication Department (HPCD) in Nov. 1997, also the demand in Nov. 1997 from WB to compliment the EIA work of Tongshan~Chongyang~ Puqi Highway (Class 2), both Chinese & English versions of EIA & EAP reports should be submitted before Mar.31, 1998. Then in Dec. 1997, Xian Highway Transportation University has been entrusted by HPCD to undertake the EIA work of this project. (Xian Highway Transportation University is undertaking the EIA work of the National Highway Project Ⅳ in Hubei Province, namely Southern Section of the Jingzhu National Trunk Line in Hubei Province.)

Based on the EIA working principle in this project for assuring quality, simplifying procedure, and satisfying time limitation, from Dec.14 to Dec.26 in 1997, an on-the-spot survey along the proposed highway was done by the EIA working team from Xian Highway Transportation University. The first version of EIS of this project was compiled in Mar. 1998 according to the working guidance in EIA Outline of National Trunk Line Project Ⅳ. Following the comments and recommendations made in the May and November 1998 and January 1999 Aide Memoire of World Bank (WB) experts, the fourth version of EIA is compiled (Feb. 1999).

The present monitoring data used in the statement is provided by Environmental Monitoring Station of Xianning Prefecture, while Meteorological Bureaus of Xianning Prefecture, Tongshan County and Chongyang County provided the meteorological information. Thanks very much to the concerning agencies who provided assistance and convenience to the EIA works.

CONTENTS

I GENERAL DESCRIPTION

1.1 The Source of the Project and Its Preliminary Work

The Southern Section of the Jingzhu National Trunk Line Project in Hubei Province has been listed in the WB Loan Projects in commercial year of 1999. According to the arrangement of WB Loan Highway Projects in China, the Southern Section of the Jingzhu National Trunk Line Project in Hubei Province is called as the WB Loan National Highway Project Ⅳ in Hubei Province.

During the visiting of WB deputy group to Hubei Province (Apr.29~May 8,1996), Communications Planning and Designing Institute of Hubei Province(CPDIHP) put forward the scheme of Tongshan~Chongyang~Puqi Highway, in which suggested that the road designing should base on Class 2 highway standard, and for it is connected with Southern Section of Jingzhu Line it should join to the National Project as a consisting part. Document [1996] No. 198 of HPCD in May 1996 specified the preliminary working plan of Tongshan~Chongyang~Puqi Highway scheme in National Project Ⅳ. Feasibility study report of the project was compiled in Apr.1997 by CPDIHP.

During visiting to Hubei Province in Nov.1997, WB deputy group demanded that EIS and EPA of this road should be compiled. Then in Dec. 1997, Xian Highway Transportation University has been entrusted by HPCD to undertake the EIA work of this project. From Dec.14 to Dec.26 in 1997 , an on-the-spot survey along the proposed highway was done by the EIA working team from Xian Highway transportation University.

1.2 Purposes of EIA

Make quantity & quality analysis of the impact of the project by the investigation and assessment of present natural & social environment along the proposed highway, to attain the following purposes.

(1)To provide basement for rational alignment by prognosis, demonstration and assessmemt of the impact scope and extent of the construction project on surounding environment.

(2)To provide feasible environmental protection measures & suggestions as instructions for design, construction, and operation management, as to mitigate and eliminate unfavorable impact of the project, to attain the purpose of the coordinate development of economic construction & environmental protection.

(3)To provide scientific basement for the local government in making developing plan and adopting environmental management.

1.3 Bases of Statement

(1) " Managerial Methods for Environmental Protection about Constructive Projects, Document 003 (86)", issued by the National Environmental Protection Agency.

(2)" Managerial Methods for Environmental Protection about Constructien Projects in Transportation, Document NO..17(1990), issued by the Ministry of Communications.

(3) "A Circular on Strengthening Management in EIA of the Projects Using Loans from the International Financial Organizations" issured by the State EP Agency, State Planning Commission, Finance Ministry and the People's Bank of China. No.324 (1993);

(4) World Bank OD4.01, Oct. 1991;

(5)" EIA Technology Guide " HJ/ 2.1~2.3 -93, Trade EP Standard of P. R. China.

(6) "Feasibility Study Report on Tongshan~Chongyang~Puqi Highway of National Highway Project IV in Hubei Province" prepared by CPDIHP in Apr.1997.

(7) WB Deputy Group Memorandum of National Highway Project IV in Nov.1998.

1.4 Scope and Standards of EIA

1.4.1 Scope of EIA

The Scope of EIA for this highway constructive project is shown in Table 1-1.

Table 1-1 The EIA scopes for the Proposed Highway

Assessment contents	Assessment scope
Social economy environment	The counties and cities that the project will pass through
Ecological environment	On both sides of the route within 500m away from the road center-line
Water environment	Waterbody on both sides of the rout within 1000 m away from the road center-line
Acoustic environment	On both sides of the route within 200m away from the road center-line and pay attention to a farther scope at the sensitive spot
Atmospheric environment	On both sides of the route within 200m away from the road center-line and pay attention to a farther scope at the sensitive spot
Cultural relics	On both sides of the route within 200m away from the road center-line

1.4.2 Standards of EIA

The EIA standards of the proposed highway are as follows:

(1) The acoustic environment quality is judged by "Standard of Environmental Noise of Urban Area (GB3096-93)". For schools, observe class 1. For villages, observe class 4. See Table 1-2.

Table 1-2 Standard of Environmental Noise of Urban Area (GB3096-93)

Classification	Daytime dB(A)	Nighttime dB(A)	Applicable area
0	50	40	Special resident area
1	55	45	Resident, education and institution
2	60	50	Resident,commercial,industrial mixed area
3	65	55	Built-up industrial area
4	70	55	Both sides of trunk road

(2) The ambient air quality is judged by class 2 in "Ambient Air Quality Standards, (GB3095 -1996)", see Table 1-3.

Table 1-3 Ambient Air quality standards (GB3095-1996)

Pollutants	Limitation concentration mg/Nm³	
	Time	Class 2
TSP	Daily average	0.3
CO	Daily average One hour average	4 10
NO_x	Daily average One hour average	0.1 0.15

Note:Standard Class 2 is suitable for the residential regions; commercial, communicative and residential mixed regions; ordinary industrial and rural areas.

(3) The water quality is judged by Class Ⅲ in "Surface Water Environment Quality Standards, (GB3838-88)". See Table 1-4.

Table 1-4 Surface Water Environment Quality Standards (GB3838-88)

Pollutants	Classification				
	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ
PH	6.5 ~ 8.5				6~9
COD_{Mn} (mg/l) ≤	2	4	6	8	10
Oil (mg/l) ≤	0.05	0.05	0.05	0.5	1.0
Pb (mg/l) ≤	0.01	0.05	0.05	0.05	0.1

Note:
Standard Class Ⅰ is suitable for the sources of water and the natural protection regions ;
Standard Class Ⅱ is suitable for the Class 1 protection areas of sources of centralized drinking water; precious fish protection areas; fish and shrimp aquiculture areas;
Standard Class Ⅲ is suitable for the Class 2 protection areas of sources of centralized drinking water; ordinary fish protection areas; and swimming areas;
Standard Class Ⅳ is suitable for the ordinary industrial area and indirectly contact amusement areas;
Standard Class Ⅴ is suitable for the agricultural areas and ordinary scenery areas;

Table 1-5 Standards For Irrigation Water Quality (GB5084-92)

Pollutants	crops classification		
	waterfarming	dryfarming	vegetable
BOD_5 (mg/l) ≤	80	150	80
COD_{Cr} (mg/l) ≤	200	300	150
SS (mg/l) ≤	150	200	100
Oil (mg/l) ≤	5.0	10	1.0
PH	5.5 ~ 8.5		
Pb (mg/l) ≤	0.1		

Table 1-6 Integrated Wastewater Discharge Standard (GB8978-1996)

Pollutants	Scope of application	Class 1	Class 2	Class 3
PH ≤	Any construction project	6 ~ 9	6 ~ 9	6 ~ 9
SS (mg/l) ≤	Normal construction project	70	150	400
BOD_5 (mg/l) ≤	Normal construction project	20	30	300
COD_{cr} (mg/l) ≤	Normal construction project	100	150	500
Oil (mg/l) ≤	Any construction project	5	10	20
Pb (mg/l) ≤	Any construction project	1.0		

Note: Observed by construction projects after Jan.1,1998.
Standard Class 1 is suitable for the wastewater discharged into water areas observing GB3838-88 Ⅲ Standard;
Standard Class 2 is suitable for the wastewater discharged into water areas observing GB3838-88 Ⅳ, Ⅴ Standard;
Standard Class 3 is suitable for the wastewater discharged into drainage system of cities or towns with sewage treatment plants observing GB3838-88 Ⅲ Standard.

(4) For the aspect of ecological environment, lead content in soil is judged by the " Environmental Quality Standard for Soils (GB15618-1995)" class 2, and crops quality is judged by the " Hygienic Standards for Limitation of Pb in Food,(GB14935-94)",issued by NEPA. See Table 1-7 and Table 1-8.

Table 1-7 Environmental quality standard for soils GB15618- 1995 Unit: mg/kg

Pollutants	class 1	class 2			class 3
	Background PH	PH < 6.5	PH 6.5~7.5	PH > 7.5	PH >6.5
Pb ≤	35	250	300	350	500

Note:
Standard Class 1 is suitable for the natural protection regions and the sources of centralized drinking water;
Standard Class 2 is suitable for the ordinary farmlands, tea plantations, orchards and pastures;
Standard Class 3 is suitable for the farmlands near forestlands and minerals.

Table 1-8 Hygienic Standards for Limitation of Pb in Food GB14935-94 Unit: mg/kg

Pollutants	Crops	
	Grain	Vegetable
Pb ≤	0.4	0.2

1.5 Contents of EIA

According to the TOR for the Southern Section in Hubei Province of the Jingzhu National Trunk Highway and comments on the TOR from the National Environmental Protection Agency, the contents of this EIA are determined as the following:

(1) Impact assessment of the social economic environment
(2) Impact assessment of the water environment
(3) Impact assessment of the ecological environment
(4) Impact assessment of the acoustic environment
(5) Impact assessment of the atmospheric environment

1.6 Assessment Periods

The environmental impact assessment periods of this project are specified as follows:

(1) Construction phase;

(2) Short operation phase: 2000 Yr.

(3) Middle operation phase: 2010 Yr.

(4) Long operation phase: 2020 Yr.

1.7 Assessment Methods

"Fanning out from points to lines and combining points and lines" method is used. Atmosphere, acoustics, ecology and water environment are predicted and assessed by means of modeling and analogous analysis, while social economy environment is assessed through investigation and analysis.

1.8 The Major Environmental Sensitive Spots along the Highway

The major sensitive spots of environment along the proposed highway are shown in Table 1- 9 to Table 1-11. The other sensitive spots along the proposed highway are shown in appendix table.

Table 1-9 Environmental Sensitive Spots along the Proposed Highway (Schools)

No.	Pile Number	Name	Belong to	Distance from the road center—line(m)
1	K1+200	Mingshui Prim.Sch.	Tongshan Couty	150
2	K3+600	Tongyang No.3 Prim.Sch.	Tongshan Couty	10
3	K3+750	Tongshan Forest Prim.Sch.	Tongshan Couty	80
4	K4+300	Tongyang No.2 Prim.Sch.	Tongshan Couty	80
5	K4+800	Tongyang No.1 Prim.Sch.	Tongshan Couty	100
6	K6+500	Tongshan Profession High Sch.	Tongshan Couty	120
7	K31+800	Lukou Town Qiaobian Prim.Sch.	Chongyang Couty	60
8	K48+700	Daqiao Xintangling Prim.Sch.	Chongyang Couty	70
9	K55+000	Tiancheng Sec.Sch.	Chongyang Couty	50
10	K59+300	Lumen Sec.Sch.	Chongyang Couty	100
11	K71+500	Wuliu Prim.Sch.	Chongyang Couty	200
12	K74+200	Lumen Dongliu Prim.Sch	Chongyang Couty	80
13	K84+300	Fenghuangshan Qianjin Prim.Sch.	Puqi City	60
14	K91+900	Puqi High Sch.	Puqi City	120

Table 1-10 Environmental Sensitive Spots along the Proposed Highway (Villages)

No.	Pile Number	Name	Belong to	Distance from the road centre-line(m)
1	K2+600	Tangjia Village	Tongshan Couty	30
2	K3+400~K6+200	Tongyang Town	Tongshan Couty	10(across)
3	K13+000	Dalu Township	Tongshan Couty	100
4	K17+600	Shentangpu Village	Tongshan Couty	60
5	K21+500	Fantou Village	Tongshan Couty	40
6	K30+300	Hongshiqiao Village	Chongyang Couty	30
7	K36+000	Lukou Township	Chongyang Couty	10(across)
8	K45+000	Bainiqiao Township	Chongyang Couty	80
9	K53+800~K55+300	Tiancheng Town	Chongyang Couty	10(across)
10	K67+600	Hongxia Village	Chongyang Couty	30
11	K72+000	Wulipai Village	Chongyang Couty	50
12	K78+100	Shuangpailin Village	Puqi City	20
13	K89+300	Chezhan Township	Puqi City	10(across)

Table 1-11 Environmental Sensitive Spots along the Proposed Highway (Rivers)

No.	Pile Number	Name	Belong to	Distance from the road center—line(m)
1	K3+000	Fushui River	Tongshan Couty	pass over
2	K8+200	Tongshan River	Tongshan Couty	pass over
3	K13+300	Yuchangfan River	Tongshan Couty	pass over
4	K21+200	Nanlin River	Tongshan Couty	pass over
5	K47+400	Baini River	Chongyang Couty	pass over
6	K53+500	Lushui River	Chongyang Couty	pass over
7	K63~K69	Lushui Reservoir	Chongyang Couty	pass nearby

I SURVEY OF THE PROPOSED PROJECT

2.1 Geographical Location of the Project

2.1.1 Geographical Location of the Project

Tongshan~Chongyang~Puqi Highway of National Highway Project Ⅳ in Hubei Province Situated in the southeastern part of Hubei Province, central of China. It passes Tongshan County, Chongyang County, and Puqi City of Xianning Prefecture in Hubei Province, see the geographical location map of the project (Figure2-1).

2.1.2 Alignment

The Class 2 Tongshan~Chongyang~Puqi Highway starts from Xinqiao of Meigang Township at the east of Tongshan County , extending westwards to Chongyang County (this section has been involved in the National Highway No. 106), from there on, extending northwestwards to Puqi City, the ending point is the Puqi interchange of Southern Section of Jingzhu Line. The total length of the proposed Tongshan~Chongyang~Puqi Highway (Class 2) is 95.245km, including 22.31km new road in short sections, 59.95km renovated road, and 15.985km original road.

2.2 Traffic Volume

The predicted traffic volume of the proposed highway is shown in Table 2-1. The proportion of heavy, middle and light vehicles is shown in Figure 2-2. The calculated traffic volume of these three types of vehicle are shown in Table 2-2.

Table 2-1 Traffic Volume Predicted for the Proposed Highway
Unit: converted into middle truck (veh./day)

Year / Road section	2000Yr.	2005Yr.	2010Yr.	2015Yr.	2020Yr.
Tongshan~ Nanlin	2583	3415	4546	5455	6556
Nanlin ~ Lukou	1363	1884	2613	3167	3840
Lukou ~ Baini	2207	2947	3978	4794	5792
Baini ~ Chongyang	3915	5342	7335	8922	10868
Chongyang ~ Puqi	2121	2884	3947	4759	5747

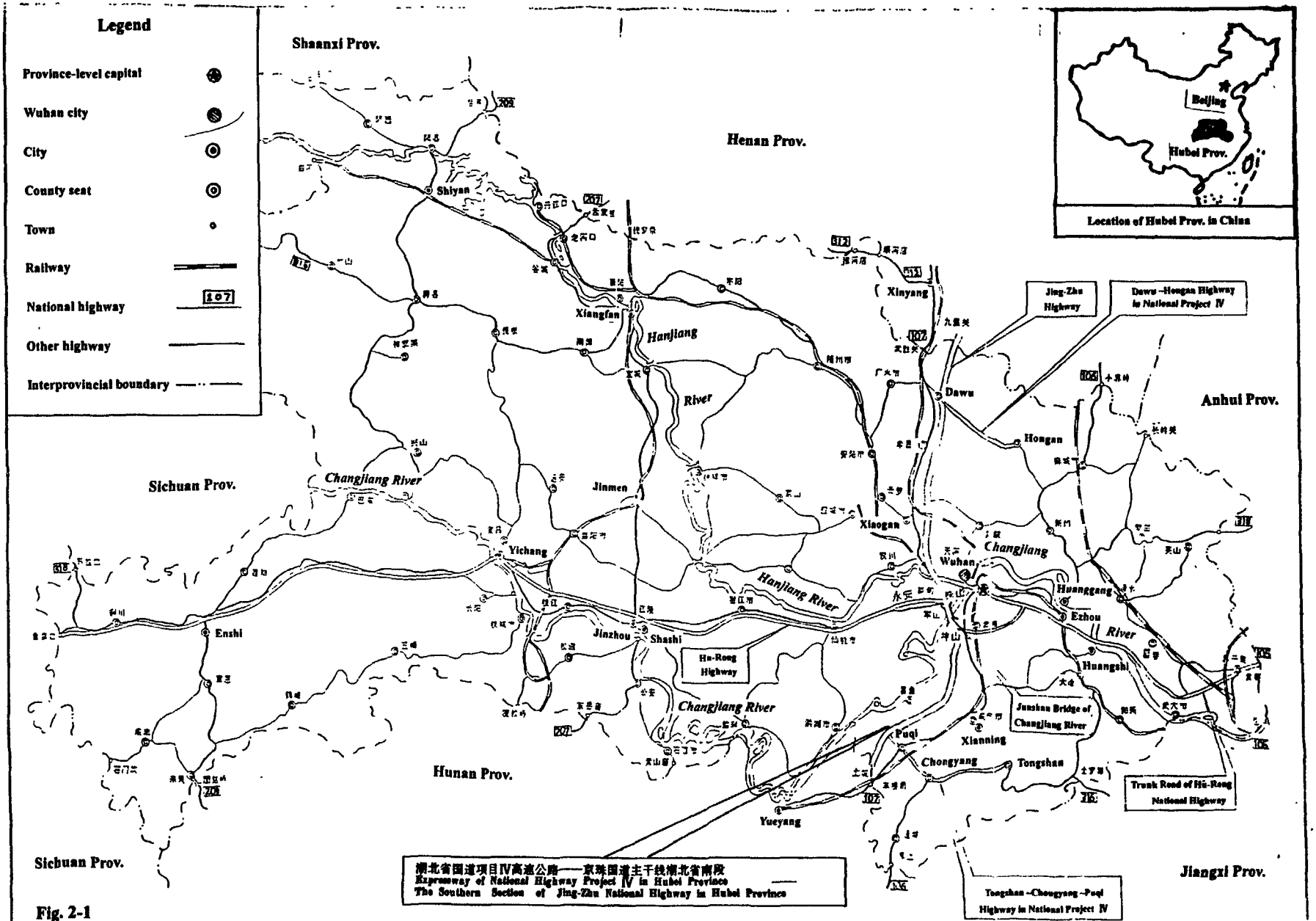

Fig. 2-1

Geographical Location Map of Tongshan~Chongyang~Puqi Highway (1:1750000)

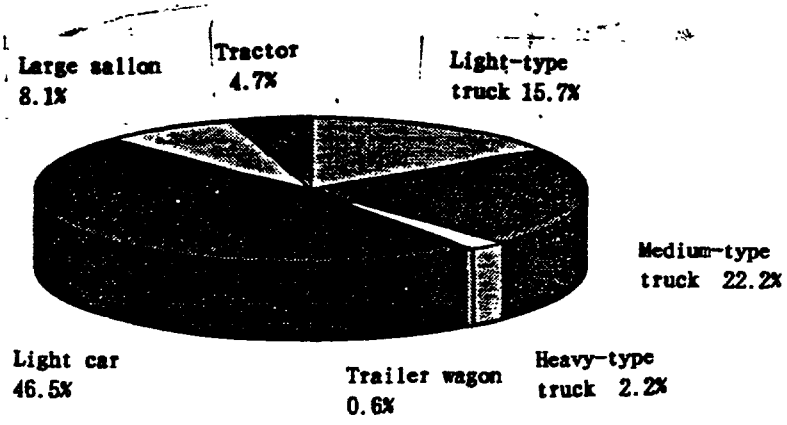

Figure 2-2

Figure 2-2 Ratio of Vehicle Type

Table 2-2 Predicted Traffic Volume for Various Types of Vehicle Unit:veh./day

Section	Year	Time	Heavy	Middle	Light	Total
Tongshan	2000	day	28	40	111	139
		night	10	14	39	63
	2010	day	49	70	196	315
		night	17	25	69	111
Nanlin	2020	day	71	101	282	454
		night	25	36	100	161
Nanlin	2000	day	15	21	59	95
		night	5	7	21	33
	2010	day	28	40	113	181
		night	10	14	40	64
Lukou	2020	day	41	59	165	265
		night	15	21	58	94
Lukou	2000	day	24	34	95	153
		night	8	12	34	54
	2010	day	43	61	171	275
		night	15	21	60	96
Baini	2020	day	63	89	250	342
		night	22	31	88	141
Baini	2000	day	42	60	169	271
		night	15	21	60	96
	2010	day	79	113	316	508
		night	28	40	112	180
Chongyang	2020	day	117	167	468	752
		night	41	59	165	265
Chongyang	2000	day	23	33	91	147
		night	8	12	32	52
	2010	day	43	61	170	274
		night	15	21	60	96
Puqi	2020	day	62	88	248	398
		night	22	31	87	140

Note: traffic volume in 16 hours of daytime is 85%, of that of whole day

2.3 Construction Scale and Main Technical Indices

This project is a consisting part of the National Highway Project IV in Hubei Province. Total

length of the highway is 95.245km, including 22.31km new road in short sections, 59. 95km renovated road, and 15.985km original road. There is a 175m long new large bridge, with 6 middle bridges 395m long. The proposed highway will be constructed according to the Class 2 Highway standard. For the main technical index, see Table 2-3.

Table2-3 Main Technical Index for the Proposed Highway

Item	Unit	Indices	
Pile No.		K0+000~K57+000 K85+000~K95+245	K57+000~K85+000
Highway classification	class	2	2
Designed speed	km/h	80	40
Width of lane	m	9	7
Width of subgrade	m	12	8.5
Minimum radius of horizontal curve	m	250	60
Max. longitudinal	%	5	7
Designed load for bridge		Truck-20,Trailer -100	Truck-20,Trailer-100

2.4 Main Work Quantity and Investment

2.4.1 Main Work Quantity

For the main work quantity of proposed highway, see Table 2-4.

2.4.2 Investment

The estimated total cost is 171.4 million yuan (RMB), including 65 million yuan (RMB) of bank loan. The average cost is 1.799 million yuan (RMB) per km .

2.5 Construction Working Schedule

Construction work will start in June 2001, end in June 2003. Total construction stage will last 2 years.

2.6 Analysis on the Environmental Impact of the Project

Through analysis of the characteristics of the proposed project and that of the environment, the major unfavorable impacts from the project are shown in table 2-6.

Table 2-6 Major Unfavorable Impacts on Environment

Project action		Possible environmental impact	Impact category
Construction period	Land requisition and building removal	Loss of cultivated land	Social economy, Ecological environment & Public participation
		Removal of houses and public facilities	
	Earth and rock work	loss of water and soil	Ecological environment
		Damage of vegetation cover	
	Subgrade work and pavement work	Capacity of floodwater store & detention basin	Water environment
		Dust, waste gas	Atmospheric & Ecological environment
		Noise	Acoustic environment
	Bridge work	Water quality, water amount	Water environment
	Transportation of materials	Dust	Atmospheric environment
		Goods scatter & disappear	
		Waste gas	
		Noise	Acoustic environment
		Traffic accident	Social environment
		Traffic jam	
	Construction camp	Waste water from living	Water environment
		Garbage from living	
Operation Period	Running of vehicles	Noise	Acoustic environment
		Waste gas, dust	Atmospheric environment
		Quality of soil & crops	Ecological environment
		Runoff from road surface	Water environment
		Risk from the transport-ation of dangerous goods	
	Alignment	Separation of villages, Blocking the traffic	Social environment
	Toll management station	Wastewater and garbage	Water environment

Ⅱ THE STATUS QUO OF THE ENVIRONMENT

3.1. Natural Environment

3.1.1. Geographical Position & Topographic Features

The project of Tongshan-Chongyang-Puqi second class highway, which is a branch line of the drafting Jing-Zhu national highway in Hubei Province, is located in the southeastern part of the province. The area along the route between east longitude 114° 14′ to 114° 30′ and north latitude 29° 19′ to 30° 20′ is rolling ground. The highway projects of K0+000~K57+000 and K85+000~K95+245 located in the plain and light undulated area is 67. 245kms long; the highway project of K57+000~K85+000 located in the muntainous terrain and heavy undulated area is 28kms long.

3.1.2. Climate Features

(1) Climate

The project area is located in the middle reaches of Changjiang River belonging to the seasonal moist monsoon continental climate of the north subtropical zone with a long frost-free period and abundant water resources. Both of the temperature and light intensity depends considerably on season of the year. It is cold and dry in winter times for the control of northwester; it is humid and rainy in early summer time while hot and arid in midsummer time for the control of warm and humid southeaster. The weather may change significantly and often likely to be cloudy or rainny in spring times. Autumn is sunny and bright with few records of windy or rainy days.

(2) Temperature

The annual average temperature is 16.1℃ ~ 16.3℃ in the area. July and Augest are the two hottest months. The monthly average temperature of July and Augest is 28.3℃ ~ 29.0℃ and the extremes is 40.5℃ . January is the coldest month. The monthly average temperature of January is 2℃ ~ 5℃ and the extremes is -13.3℃ . The frost-free period ranges between 141 days and 246 days.

(3) Precipitation

The precipitation of the area is abundant and varies from 1100mm to 1563mm.The precipitation of the flood period from April to October equals that of 80 -85 percent of a year. The peak rainfall in 24hour is 413.4mm. Table 3-1 gives monthly precipitation of the three areas along the route.

Table3-1 Monthly Precipitation of the Three Areas

Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spet.	Oct.	Nov.	Dec.	Annaul Average
Tongshan	846.6	76.2	128.8	196.2	215.5	254.7	152.6	150.5	95.7	77.5	63.7	50.5	1503.0
Chongyang	647.1	74.3	139.6	190.0	228.0	257.1	147.5	145.4	78.6	76.2	65.6	45.0	1494.6
Puqi	450.8	78.2	125.4	187.8	211.4	261.9	140.8	133.8	97.9	92.2	77.8	50.5	1507.5

(4) Wind

Heavy winds rarely take place (1 or 2 times a year) in Tongshan County and Chongyang County, located in the bottom of a mountainous terrain and protected by a large mountain lying to the north of the two counties. There are two mountains lying to the north and the south of Tongshan County. Easters and westers are commonly seen. The average wind velocity of a year is 1. 4m/s. Puqi City is located at riverside of Changjiang River. Its landform is plain area. The strong winds take place (4 ~ 5 times a year) in Puqi City more times than the other two counties. It is mainly northwester (of which the extremes is the tenth grade and the average velocity is 1 .8m/s).

Figure 3-1 gives the wind-velocity roses of the area according to the five-year (1992 - 1996) climate information statistics offered by local meteorological observateries. It is shown that the stable wind frequancy of the triangle area is 32% ~ 39%.

(5) Atmospheric Stability

According to three local meteorological observatories' information of surface winds and cloud amount of the three years (1994 ~ 1996) which are calculated according to Pasquil Method. It is shown that the neutral weather (D type) is the most frequent (49~54%) one and the stable weather (E and D types) follow behind.

Table 3-2 Frequency of Each Atmospheric Stability Type (%)

Station	Changeable(A~B)	Subchangeable(C)	Neutral(D)	Stable(E~F)
Tongshan	8.5	10.1	45.4	36.0
Chongyang	7.0	6.5	48.0	45.5
puqi	17.9	12.9	41.6	27.6

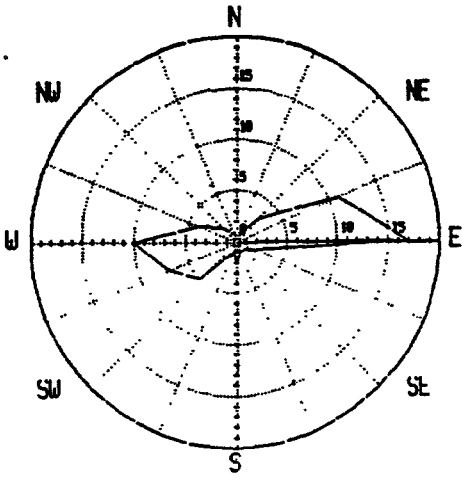

Figure 3-1-(1) The Wind Rose of Tongshan County

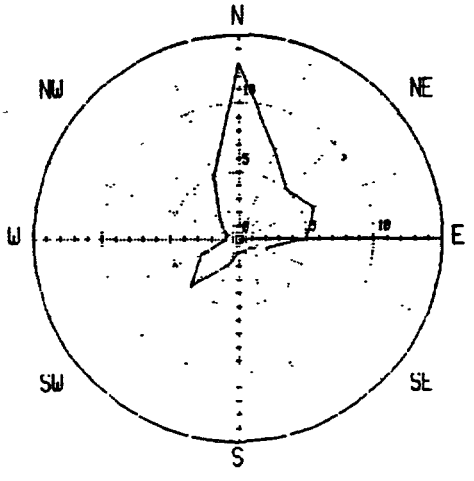

Figure 3-1-(2) The Wind Rose of Chongyang County

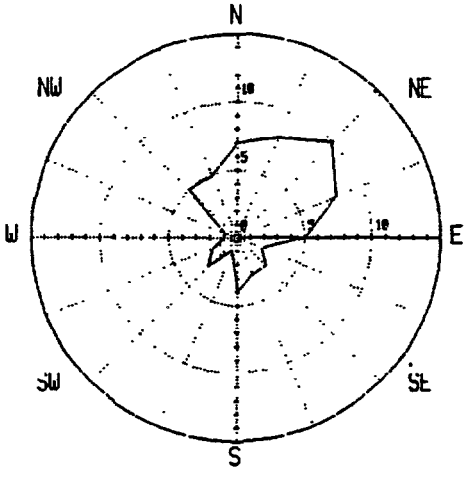

Figure 3-1-(3) The Wind Rose of Puqi City

3.1.3. Hydrographic Net

The surface water systems are well developed in the project area. There are many rivers, creeks, pools and reserviors. Fushui River and Lushui River are the related large water-systems to the project.

(1) Fushui River

Fushui River rises in the north foot of Sanjiejian Mountain, passing through Tongshan County , flows into Changjiang River at Fuchikou in Yangxin County. The upper reaches of Fushui River from Xiapu Town to Tongyang Town are 74kms long; its drainage area is 571km ^{2} . The average gradient is 13.3/1000; the flow rates is 19.53m^3/s; the runoff rates is 6.06×108m^3/s.

Tongshan River, a primary branch of Fushui River, rises in the east foot of Beiyang Mountain . It flows from west to east, via Nanlin, Shilong, Gangban, Dalu and Tongyang towns, into Fushui River at Tangjiadi. It is 35.1kms long. Its drainage area is 246km^2. The average gradient of the river course is 6.6/1000; the flow rates is 5.61m^3/s; the runoff rates is 1.74×108m^3. The river basin is light undulated area. Because of the gentle and wide landform, there are many farmlands on its middle reaches and lower reaches. The route acrosses Fushui River several times by bridges in Tongshan County and a large one in the county town.

(2) Lushui River

Lushui River rises in the north foot of Mufu Mountain, which is located at the juncture of Hubei Province and Jiangxi Province. It passes through Tongcheng, Chongyang, Puqi and Jiayu counties, flows into Changjiang River at Hongmiao. It is 208kms long. Its flood level varies obviously. The peak flow rates is 2900m^3/s and the smallest is 0.11m^3/s. The annual largest flood usually takes place in May or June. There are three bridges over Lushui River at Chongyang County town. The highway project will utilize them.

3.1.4. Hydrogeologic Features

The water resources of the project area is due to abundant precipitation, flouring surface water-system and several types of groundwater, commonly existing in unsolidated rocks as porewater and distributing in Chongyang basin, river valley and low land. The aquifer is made up of sand layer and grit layer. Many aquifers are confined and they are more than 10m in thickness. Water table is 3 ~ 8m in depth.

3.1.5. Vegetation

The vegetation cover of the project area is relatively satisfied. According to the investgation, the forest coverage of Tongshan is about 55%; Chongyang is about 59.4%; Puqi is about 32.6%. Masson pine, cedar, cypress and nanbamboo are the commonly natural vegetation. Industrial crops include tea-oil tree, mulberry, cotton and fruit tree; cereal crops include paddy, wheat, maize, rap, soybean and peanut. These are the main artificial vegetations.

3.1.6. Wild-life

The physical geographic situations of Tongshan County and Chongyang County are suitable for wild-lifes. Surveys show that bears, foxes, hares and goats appear in forests, mountains and remote villages. The route of the project does not pass through the national and provincial natural reserves. Not any rare wild-lifes has been seen in the project area.

3.1.7. Soil Erosion

Rainfall is a major facter for soil erosion in the highway area. In Tongshan County and Chongyang County, 80% of the land is light undulated area. The annual precipitation is relatively large (the average of multi-years in Tongshan County is 1500mm; Chongyang County 1495.6mm). Rain-storms take place more frequent in the two counties than any other areas of Hubei Province. The soil erosion area is 626.9km^2 and equals 25% of total area in Tongshan County. 205 villages among 43 town, most of them are distributed in Damu Mountain and Mufu Mountain, are subject to soil erosion. Soil erosion area is 766.7km^2 in Chongyang County. The amount of soil erosion is about 2.29×10^6 ton/year including 1.5×10^4 ton/year organic matter. The soil erosion coeffecients the two counties are almost the same as 3000 t/km^2.a. The drafting route in the two counties is located in the valley of Damu Mountain and Mufu Mountain. The vegetation coverage is relatively large (55% and 59.4% respectively). There are few eradible soil types such as limestone soil and ruddle. Soil-forming matrix is hard carbonate rocks. According to the Survey, the route area of K0+000~K57+000 is plain and light undulated area. The erosion coefficient is 2200t/km^2.a belonging to light erosion; the project area of K57+000~K74+ 800 is mountainous terrain and heavy undalated area, the average erosion coefficient of the county is 3000t/km^2.a belonging to mean erosion.

The soil erosion area is 288.1/km^2 in Puqi City, equals 16.7 percent of the city's area. The annual amount of soil erosion is 1.2467×10^6 ton/year including 3895 ton/year organic material. Its average soil erosion coefficient is 4300/km^2.a. The forest coverage is 32.6%. The majority of soil-forming matrix is made up of pelite and ferruginous sandstone. The route of K74+000~K85+000 in Puqi City is located in mountain terrain and heavy undulated area. Its soil erosion coefficient is 4300t/km^2 belonging to mean soil erosion. The route of K85+ 000~ K95+ 245 is located in plain and light undulated area. The soil erosion coefficient is about 2000t/km^2 belonging to light soil erosion.

Comparing with Puqi City, soil erosion is much more serious in Tongshan County and Chongyang County. Artificial activities mainly contribute to soil erosion besides natural causes such as naked weathering. The farming of hillside field has chiefly led to soil erosion.

3.2. Socioeconomic Environment

3.2.1. Impacted Areas of the Project

The directly impacted areas of the project are Tongshan County, Chongyang County and Puqi City of Xianning District of Hubei Province. It is 6317 km^2, the total polulation is 13667.

3.2.2. Socioeconomy of the Project Area

Table 3-3 Socioeconomic Indicators Comparing Items (1996)

Item	Tongshan	Chongyang	Puqi	Hubei province
Population (10^4 Person)	41.09	45.45	50.13	5825.43
Gross Output of agriculture(10^4 RMB)	25596	44326	58945	6746240
Gross National product(GNP)(10^4 RMB)	92761	139382	313430	29702000
Per Capita GDP(RMB)	2257	3066	6252	5099

Note: (1) Gross output of agriculture remains the value of 1990. Others are of 1996.
(2) All data are quoted from the statistics the three areas annals.

The statistics data in table 3-3 show that neither the gross agriculture output nor the per capita GDP of Tongshan County and Chongyang County can be compared with those of the whole Hubei Province. The poor traffic of the two counties limits the economic development of mineral , local specially and tourism resources, and has resulted in poverty-stricken areas now.

3.2.3. Traffic Network in the Impacted Areas of the Project

(1) Traffic Condition in the Impacted Areas

The freigh transportation relies on the highway in the impacted area. There are No. 106 national highway, No.107 national highway, Chongyang ~ Puqi highway and Xianning~ Tongshan highway etc. The Tong~Chong part of No.106 national highway was built in 1936 according to low geometric standards. Although it has been reconstructed many times and reaches to the standard of the third class highway or the fourth class highway. This highway also goes through Nanlin, Lukou and Baini Town, butit is becoming poorly conditional and not suitable for driving. Chong -Pu highway, being a third or forth class highway, was built in 1988. The main task of the project is to reconstruct the national highway No.106 and Chong-Pu highway.

(2) Freights of the Impacted Areas

The major freights of the impacted areas are mine construction materials and cement, which are the main local resources. See table 3-4.

Table 3-4 Freights of Present Highway

Items	Coal	Petroleum	metal ore	Iron & Steel	Mine construction materials	cement	Timber	Nonmetallic ore	Chemical fertilizer & pesticide	salt	Graion	Others
Percent (%)	9.65	4.37	2.97	3.68	23.86	13.38	7.31	2.51	4.18	1.20	6.44	20.44

3.2.4. Tourism Resources, Cultural Relics & Historic Sites

The main tourism resources in the directly impacted areas are Jiugong Mountain scenic pot in Tongshan County, the Gold sands scenic pot in Chongyang County and the Wuchibi in Puqi City. They are 20 - 30kms away from the drafting route.

Trough consultation with the designer of the project and Hubei Provincial Archaeology Research Institute, in the study area no significant cultural relics occur along the projected highway.

3.3. Ecological Environment Quality Status

3.3.1. Surveillance of the Environment Quality

(1) Environment Surveillance Elements

The assessment factors of the soil are PH value, Pb concentrition and organic material concentrition; that of the crops is Pb concentrition of packchoi and cabbage.

(2) Time and Sites

The environment monitering station of Xianning District of Hubei Province studied the soil and vegetables along the route of the project in Dec, 1997. The monitering data and sites are given in table 3-5.

Table 3-5 Monitoring Data and Sites of Soil and Vegetables

No.	Site	Chainage	sample	PH	Organic material (%)	Pb (mg / kg)
1	Yuchangfan	K13+350	soil	6.0	2.10	25.5
			packchoi			0.05
2	Bainiqiao	K45+300	soil	6.0	1.75	19.7
			cabbage			0.03
3	Hejiacun	K84+900	soil	6.9	1.93	23.4
			cabbage			0.04

(3) Sampling and Preparation Methods

Sample collection sites are distributed as quihcunx. The distance between every two pots of the quihcunx is 50m. Every sample of the five pots weights 1000g. They are mixed completely. Take out 1000g from the mixture as the monitering sample for analysis according to quatering methods. Vegetables are selected from the eatable part. The depth of soil sample collection is between 0cm and 20cm. The soil and vegetable samples are collected at the same time. The sample preparation and analysis according to the book named as Analysis of Environmental Surveillance edited by the National Environment Protection Dept. of China.

3.3.2. Assessment of Ecological Environment Quality Status

(1) Assessment Standards

The second class of GB 15618-1995 Soil Environment Quality Standards and GB- 14935- 94 Standards of Pb Limit in Foods

(2) Status Assessment

In table 3-5, the Pb data in every observation sites are 25.4mg/kg, 19.7mg/kg and 23.4 mg/kg respectively, and they are far below the standard (250mg/kg). It is clear that the soil of the project area is not polluted by Pb. The background value of organic material ranges between 0 .37% and 1.22% .The geometric mean is 2.3% .It is showed in table 3-5 that the organic material concentration in the soil of the project area is somewhat smaller than that of the whole province. The soil fertility is low according to organic material content. PH value of soil sample is 6.0-6.9, which shows that the soil is acid soil.

The Pb concentration of vegetable sample range between 0.11mg/kg and 0.15 mg/kg, is smaller than the standard (0.2mg/kg). It is showed that the vegetables along the route of the project are unpolluted by Pb.

3.4. Water Environment Quality Status

3.4.1. The Surveillance of Water Environment Quality

(1) Monitoring Sites

See table 3-6 and attached figures.

Table 3-6 Water Quality Monitoring Sites & Items

No.	Chainage	Water body	Monitering Items
1	K3+000	Fushui River	PH、COD_{Mn}、Pb、
2	K8+200	Tongshan River	Oil
3	K47+400	Baini River	
4	K53+500	Lushui River	
5	K63 ~ K69	Lushui Reservior	

(2) Sampling Time

Samples are collected on 17-19th December 1997. River water samples are collected from the right, middle and left sites of rivers. Reservoir water samples are collected from water surface of 3-5 sites nearby the bank.

(3) Monitoring Items

See table 3-6 monitoring items.

(4) Analysis Methods

The methods of sampling storage, transportation and analysis are based on the related national standards.

(5) Results

See Table 3-7 for monitoring items.

Table 3-7 Water Qaulity Monitoring Data

No.	Monitoring item / Sample	PH	COD_{Mn}	Oil	Pb
1 #	Fushui River	7.2	6.51	0.025	0.005
2 #	Tongshan River	6.9	2.82	0.025	0.005
3 #	Baini River	7.2	6.88	0.025	0.005
4 #	Lushui River	6.9	3.12	0.025	0.005
5 #	Lushui Reservoir	7.4	2.51	0.025	0.005

Notes: The unit of the data in table 3-7 is mg/l except PH value. Pb and petroleum concentrations could not be detected and are given as the half of the limitation of detection.

3.4.2. The Assessment of Water Environment Quality

(1) Assessment Methods

The Standard Classification Method was used to assess the water environment quality. If all the monitoring data of a water sample are lower than the standard ones of the first class, water quality of the profile belongs to the first class. If one or more items are higher than the first class standards and lower than the second class standards, than it belongs to the second class. This method also applies to the third, the forth and the fifth class.

(2) Assessment Standards

The Ⅲ class of GB3838-88 The Standard of Surface Water Environment Quality is used. The criteria are showed in table 1-4.

(3) Assessment

Compared the monitoring data with the standard ones in table 1-4, the assessment of water quality is given in table 3-8.

Table 3-8 Water Quality Assessment

Water Body / Item / Data	PH	COD_{Mn}	Oil	Pb
Fushui River	I	Ⅳ	I	I
Tongsha River	I	Ⅱ	I	I
Baini River	I	Ⅳ	I	I
Lushui River	I	Ⅱ	I	I
Lushui Reservoir	I	Ⅱ	I	I

The assessment of water quality is given below: It can be seen in table 3-8, water qualities of Tongshan River, Lushui River and Lushi Reservoir are similar. PP index conforms to the standard of the second class of surface water. Other items conform to the standards of the first class. Water quality belongs to the second class.

The assessment of Fushi River and Baini River shows that CODMn reaches to the IV class standard of surface water and others reach the first class standard of surface water. The water quality belongs to the forths class, only one pollutant item (COD) slightly higher than the third class surface water standard (organic material).

3.5. Acoustic Environment Quality Status Assessment

3.5.1. Surveillance of Acoustic Environment Quality Status

(1) Noise Sensitive Points in the Assessment Area.

Surveying in the site, noise sensitive points of the project areas are schools and villages. There are more than 40 villages and 14 schools according to statistics. The distribution of some typical villages and schools can be seen in table 1-9 and table 1-10.

(2) Acoustic Environment Monitoring

The noise resources come from residential life and highway traffic. The monitoring data can be seen in table 3-9 and table 3-10.

(3) Monitoring Methods

Monitoring method and equipment conform to GB/T 14623-93 Monitoring Methods of Environmental Noise in City Area.

Table 3-9 The Data of Acoustic Environment Monitoring Unit:dB(A)

NO.	Site & Chainage	Day	Night	Notes
		Leq	Leq	
1	Mingshui Prim. Sch. (K1+200)	50.0	37.2	
2	Tongyang No.3 Prim.Sch. (K3+600)	68.1	50.6	Teaching Building besides a street
3	Dalu Country (K13+000)	57.1	40.5	
4	Qiaobian Prim.Sch. (K31+800)	51.5	34.8	
5	Tiancheng Sec.Sch. (K55+000)	57.0	40.2	
6	Hongxia Village (67+600)	49.7	35.6	
7	Shuangpailin Village (K78+100)	50.2	36.7	

Table 3-10 Current Traffic Noisy Monitoring Data (Leq:dB)

Site	Highway	Time	Distance Away From Roadside (m)					Taffic Flow (passenger car/day)
			0	25	50	100	200	
	No.106 National highway	Day	57.3	56.1	54.7	50.2	48.1	1486
		Night	45.5	42.8	41.2	36.8	34.1	

3.5.2. Assessment of Acoustic Environment Quality Status

(1) Villages and Schools in Line

It is shown in table 3-9 that noise levels of villages range between 57.1dB and 49. 7dB(A) (Leq) in the daytime and between 40.5dB and 35.6dB(A) (Leq) in the evening. They are much lower than the forth class standard of GB3096-93. The noise levels of schools are lower than the first class standard of GB3096-93 except Tongyang No. 3 primary school and Tiancheng middle school. The noise level of the monitoring points in Tongyang No.3 primary school and Tiancheng middle school are 68.1 dB(A) and 57.0 dB(A) respectively and higher than the first standard of GB3096-93. The schools located on a side of town street where traffic and market noise is much higher than the standard.

(2) Both sides of the highway

It is showed in table 3-10, the noise level of the both sides of the highway varies from 57 .3dB to 48.1dB (Leq) in the daytime and varies from 45.5dB to 34.1dB (Leq) in the evening. It conforms to the forth standard of GB3096-93.

3.6. Air Quality Status and Assessment

3.6.1 Surveillance of Air Quality Status

(1) Monitoring Points and Items

The monitoring points and items are given in table 3-11.

(2) Time

Air quality monitoring was taken continuously by air monitoring station of Xianning District of Hubei Province within 3 days on Dec. 1996.

Table 3-11 Monitoring Points and Items of Air Quality

No.	Site & Chainage	Sampling Itemes	Surrounding Status
1	Tongyang t.won (K4 + 500)	NO_x、CO、TSP	Schools,community,Tongshan county town and densely settled area.
2	Lukou Country (K36 + 000)	NO_x、CO、TSP	Mountainous town, fresh air and densely settled area.
3	Tiancheng Twon (K55 + 000)	NO_x、CO、TSP	densely settled area and schools
4	Puqi Middle School (K91 + 900)	NO_x、CO、TSP	Suburb of Puqi City, fresh air.

(3) Monitoring and Analysis Methods

The sampling frequences and analysis methods are in agreement with GB3095-1996.

3.6.2. Assessment of Air Quality

(1) Monitoring Data

The monitoring data of CO, NO_x and total suspended particulates in four monitoring points along the route of the project are given in table 3-12, table 3-13 and table 3-14.

(2) Analysis and Assessment of Air Monitoring

It can be seen from table 3-12, table3-13 and table 3-14.

Table 3-12 Monitoring Data of CO concentration Unit:mg/Nm³

No.	Point	Hourly Average Concentration			Daily average concentration					Mean
		Samples amount	Concentration range	Excess rate (%)	25th	26th	27th	Concentration range	Excess rate (%)	
1	Tongyang Town	12	0.50~0.99	0	0.65	0.53	0.78	0.53~0.78	0	0.65
2	Lukou Country	12	0.72~0.93	0	0.72	0.85	0.90	0.72~0.90	0	0.82
3	Tiancheng Town	12	0.80~0.97	0	0.95	0.93	0.88	0.88~0.95	0	0.92
4	Puqi High School	12	0.50~0.99	0	0.58	0.74	0.83	0.58~0.83	0	0.72

Table 3-13 Monitoring Data of NOx concentratration Unit:mg/Nm³

No.	Point	Hourly Average Concentration			Daily average concentration					Mean
		Samples amount	Concentration range	Excess rate (%)	25th	26th	27th	Concentration range	Excess rate (%)	
1	Tongyang Town	12	0.015~0.021	0	0.019	0.017	0.020	0.017~0.020	0	0.019
2	Lukou Country	12	0.017~0.045	0	0.031	0.035	0.020	0.020~0.035	0	0.029
3	Tiancheng Town	12	0.015~0.035	0	0.030	0.016	0.018	0.016~0.030	0	0.021
4	Puqi High School	12	0.015~0.022	0	0.016	0.020	0.018	0.016~0.020	0	0.018

Table 3-14 Monitoring Data of TSP concentratration Unit: mg/Nm³

No.	Point	Daily average concentration					Mean
		25th	26th	27th	Concentration range	Excess rate (%)	
1	Tongyang Town	0.27	0.26	0.31	0.26~0.30	0	0.28
2	Lukou Country	0.27	0.25	0.29	0.25~0.29	0	0.27
3	Tiancheng Town	0.25	0.24	0.27	0.24~0.27	0	0.25
4	Puqi High School	0.20	0.30	0.25	0.20~0.30	0	0.25

The hourly average of CO concentration ranges between 0.50mg/Nm³ and 0.99 mg/Nm³. The daily average ranges between 0.53mg/Nm³ and 0.95 mg/Nm³. All the mean data are conformed to the second class standard of GB3095-96.

The hourly average of NO_x concentration ranges between 0.015mg/Nm³ and 0. 045mg/Nm ³ ; the daily average range between 0.016mg/Nm³ and 0.035mg/Nm³.All the mean data are conformed to the second class standard of GB3095-96.

The daily average of total suspended particulates (TSP) range between 0.20 mg/Nm³ and 0. 30 mg/Nm³, which is conformed to the second class standard of GB3095- 96. But it is near the criteria (0.30 mg/Nm³).

In conclusion, the concentration values of CO and NO_x along the route of the project areas are lower than the creteria, while the concentration values of TSP are close to the creteria. Therefore, air quality has no problem, but more attention should be pay on TSP.

Ⅳ ENVIRONMENTAL IMPACT PREDICATION

4.1 Socioeconomic Impact Analysis

4.1.1 Economic Assessment of the Project

4.1.1.1 Investment Estimate of the Project

The length of the proposed highway is 95.245km in the recommended scheme. The total estimated investment is 171.369 million yuan RMB, on average, 1.7993 million yuan RMB per kilometer. The scheme funding consists of two parts. The loan from financial institution is 65 million yuan RMB accounting for 37.93%. Hubei Province raised fund is 106.369 million yuan RMB accounting for 62.07%.

4.1.1.2 Economic Benefit Calculation of the Project

According to the Feasibility Study Report of the Project, the direct benefit is resulted from two aspects. One is to lower all kinds of costs in transportation, packing and facilities maintain. Another is to shorten transportation time and improve the transportation quality. The contents of economic effect are shown in table 4-1.

Table 4-1 Economic Benefit for the Project Unit:10000 Yuan

Name of Benefit	Transportation Expenses Ecnomical Benefit	Transportation Time Ecnomical Benefit	Reducing Crowd Benefit	Improving Traffic Satefy Benefit	Improving Transporation Quatity Benefit	Sum up
Total Value of Benefit	55508.8	57914.82	23183.56	532.22	151.57	137290.97
Ratio (%)	40.43	42.18	16.89	0.39	0.11	100

4.1.1.3 Economic Assessment of the Project

The economic assessment is based on the costs and benefits of the project. The calculated indicators of economic assessment are shown in table 4-2. It shows that the IRR of the project is 17.41% and bigger than social discount rate (12%). The accumulated NPV of national economy of the project is 92.0420 million_yuan RMB and the cost benefit ration is 1. 61, while social chscount rate is 12%. It shows that the project is feasible and its economic efficiency is good.

Table 4-2 Index Value of Economic Assessment for the Proposed Highway

ENPV (10000 Yuan)	EIRR (%)	EBCR	n (Year)
9204.20	17.41	1.61	15.2

Because the data for economic assessment are quoted from the project estimation and prediction, which are somewhat uncertain, uncertainty analysis is made besides routine economic assessments. The sensitivity analysis data are shown in table 4-3.

Table 4-3 Economic Sensitivity Analysis for the Project

Floating of traffic volume / EIRR(%) / Floating of investment	+ 20%	+ 10%	0	-10%	-20%
+20%	17.51	16.45	15.33	14.14	12.87
+10%	18.57	17.47	16.30	15.07	13.75
0	19.77	18.62	17.41	16.13	14.76
-10%	21.15	19.92	18.68	17.34	15.91
-20%	22.77	21.51	20.17	18.76	17.25

It shows that the IRR attains 12.87% and is higher than the social discount rate (12%) , while the investment increases 20% and the traffic volume reduces 20%. It indicates that the project has a strong resitance to risks.

4.1.2 Social Benefit of the Project

4.1.2.1 Promoting the develpent of regional socioeconomic

There are no railway and waterway in Tongshan County and Chong Yang County except Puqi City. The condition of the existing road is worse and its traffic capacity is weak. The length of classified road is less than 10% of the existing road and commonly under the tertiary class. Thus, the socio-economic devecopment in this area is limited severely. The project will expend

the highway net of the area by improving its traffic capacity and connecting local road with highway. It will play an important role of the highway system in Huber Province and promote the socioeconmic development of Tongshan County, Chongyang Cunty and Puqi City directly by enlarging the communication with outside and speeding the developing pace. It will also drive the economic development of the south of Hubei Province and the north of Jiangxi Province.

4.1.2.2 Providing a Solid Basis for Helpping the Poor Areas

The area is located in the border district of Hubei, Hunan and Jiangxi Province, belongs to the old revolutionary base areas, poor border areas and areas inhabited by minority nationalities. Tongshan County is listed as one of the helped poverty-stricken counties of China. The means of annual personal incomes is less than 400 yuan RMB in some districts of Tongshan County and Chongyang County. The basic need has to assure. To eliminate poverty and become prosperous is a tough work. The poverty of the area is largely due to its backward traffic condition, which restricts its economic developent. There are abundant natural resources in the area. More than 50 kinds of mineral resources with large potential capacities of exploration have been proven. Therefore, the construction of the project is meaningful for expanding resources exploration, promoting econmomic development, helping the poor areas and speeding the pace to become prosperous.

4.1.2.3 Promoting the Development of Tourism

There are many famous and beautiful mountains, rivers and humanity scenes along the route. The Jiugong Mountain, which is a beautiful splendid steep mountain and famous state rank scenery in the middle part of China, lies in Tongshan County. It is the place in where Li Zicheng, who was a peasant uprising leader in Ming Dynasty, died. The project lies in the southern mountain area in Jiangxi Province, that is the E-Xiang-Gan Revolutionary Basis. Many old generation proletariat revolutionists such as Mao Zedong, Zhu De and Peng Dehuai worked there successively. The proposed road will be favorable to the tour traffic condition, the tourism resources exploring and the tourism development.

4.1.3 Social Problems in Construction

4.1.3.1 The Route Project and Town Layout

The proposed highway restricted by the topography passes through the North Street of Tongshan Town. The main commercial lies in the South Street at present. There are few people and vehicles in the North Street. According to the town layout, the planing route passing through the North Street will promote the commercial development in South Street. The project scheme and the town layout of Tongshan Twon are integrated well. Chongyang Town is the center of political, economy and culture of this county. The project using three existing bridges on Lushui River passes through the North Street of the town, where road is wide and houses are in order. The proposed highway has been listed in the total layout of Chongyang County, and that of Puqi City. The planing route passing through the south of Puqi Town untilizes the existing

road without many changes and any effect on town layout.

4.1.3.2 Land Acquisition and Buildinf Removal

The proposed road will cover 1185.5 mu land; the temporary construction sites will cover 458 mu land. The removal of buildings is 21780m² and that of power poles and telecom poles is 97 in estimation. Acquisition for land and removal is unavoidable in highway construction. Design unit considers it as a primary factor in location of line, Because it is concern to residents' private properties and profits directly. Wide propaganda of relevent state regulations is necessary to carry out it and ensure the acqusistion for land and removal unimpeded. The local governments are in faver of highway construction; all are willing to provide convenience. They will take part in acquisition for land, removal and resettlement positively and justify disagreement between the construction and residents.

4.1.3.3 Historical Relics Impact Analysis

Trough consultation with the designer of the project and Hubei Provincial Archaeology Research Institute, in the assessment area no significant cultural relics occur along the projected highway.

4.2 Prediction and Assessment of Ecology environment Impact

4.2.1 Prediction and Assessment of Pb Impact on Soil Quality

(1) Calculation for annual emission source intensity of lead

The formula is:

$$F = \frac{365\eta\ P}{G} \sum N_i\ Pb_i\ J_i$$

where:

J_i—the average amount of consuming gasoline for type i vehicles per km, heavy vehicle 0.41L/km, middle vehicle 0.27L/km, small vehicle 0.115L/km;

Pbi—the Pb content of gasoline used by type i vehicle, (the average value is 140mg/L);

η —the emission ratio in exhaust pipe , generally 75%;

N_i— the daily traffic volume of type i vehicle (not including diesel oil vehicles);

P— the precipitation of Pb within the assessment extent on both sides of the proposed highway, generally is 60%;

G—the mass of soil a kilometer long of cultivated layer on both sides of highway, is 8.96×10^7kg;

i—symbolizing heavy, middle and light vehicle.

(2) Calculation of Lead Concentration in soil

For predicting of the soil quality, the follow forecasting formula for lead (Pb) is used:

$$W_m = B + \sum_{i=1}^{m} R_i \cdot K^{m-i}$$

Where:

W_m—— Accumulated amount of lead in the A layer of the soil in the m year,(mg/kg);

K —— Residual percentage of lead in the soil ,(%);

B —— Background value of lead in the A layer of the soil ,(mg/kg);

R_i —— Annual input amount of lead in the soil, (mg/kg.year);

m —— Years of forecasting, (year).

The results are shown in table 4-4.

(3) Assessment of Impact on Soil Quality

Table 4-4 shows that the lead content of soil along the route will increase slowly as the traffic volume increases. The predicted datum is far below the assessment standard, 250mg/kg. It indicates that the construction and transportation of the highway will not result in lead pollution along the route. Meanwhile, leadfree gasoline will be used more and more widely in our cuntry. Therefore the lead content in the soil along the route may be smaller than that of calculated datum in table 4-4 in the coming years.

Table 4-4 Prediction result of lead amount in soil along the proposed highway **Unit: mg/kg**

Items	Prediction point		
	Yuchangfan Village	Bainiqiao Village	Hejia Village
Background value of lead in soil	25.4	19.7	23.4
Pb amount inputting to soil in 2000	0.131	0.112	0.108
Pb amount inputting to soil in 2010	0.232	0.203	0.202
Pb amount inputting to soil in 2020	0.335	0.296	0.292
Lead content in soil in 2000 Yr.	25.588	19.800	23.497
Lead content in soil in 2010 Yr.	26.789	20.915	24.609
Lead content in soil in 2020 Yr.	27.680	21.714	25.387

4.2.2 Prediction and Assessment of loss of Water and Soil

(1) Prediction Model of Loss of Water and Soil

The proposed highway lies to the south of Changjiang River, according to the Environment Assessment Regulations for Highway, the water loss and soil erosion during construction use the Universal Soil-Erosion Model provided by document[2], the model is as follows.

$$A = R \cdot K \cdot L_m \cdot C \cdot P$$

Where:

A —— Erosion strength , (t/ha.year);

R —— Erosion factor of average precipitation;

K —— Soil erodible factor;

L_m—— Topography factor, (slope length and slope degree);

C —— Vegetation cover factor;

P —— Soil conservation factor.

(2) Determination of Factors in Model and Prediction Results

The factors values are calculated according to the formula provided by document [2] and [3], the results are shown in table 4-5

Table 4-5 Prodiction result of soil erosion

Sections		Values of factors					Erosion intensity during construction (t/ha.yr)	Erosion intensity before construction (t/ha.yr)	Increasing multiple
		R	K	LS	C	P			
Tongshan County	K0+000~K28+200	205.42	0.38	1.80	1.0	1.0	140.50	22.00	6.4
Chongyang County	K28+200~K57+000	265.53	0.38	1.80	1.0	1.0	181.62	22.00	8.3
	K57+000~K74+380 Mountainous area	265.53	0.42	2.76	1.0	1.0	307.80	30.00	10.3
Puqi City	K74+380~K85+000 Mountainous area	149.21	0.42	2.76	1.0	1.0	172.96	43.00	4.0
	K85+000~K95+245	149.21	0.38	1.80	1.0	1.0	102.05	20.00	5.1

(3) Impact Assessment of Soil Erosion

The prediction in table 4-5 shows that the soil erosion caused by highway construction is 4 -10 times as much as before. The potential erosion grade of K0+000-K28+200 section in Tongshan County and K85+000-K95+245 section in Puqi City will attain the extremes grade (80-150 t/ha • a). Others attain intensive grade (more than 150 t/ha • a). However, the total of soil erosion volume is not large, since the proposed highway is mainly to reconstruct existing road. New road is only 22.31 kms long. The annual volume of soil erosion (in recommended scheme) may attain 18000 ton without taking environmental protection measures (the soil erosion in construction of existing road is considered to be the half of new construction) . The construction period is 2 years with several rainy seasons. There are 1477200m^3 stone and earthwork in roadbed construction, which will destroy vegetation cover, change the original gradient of land surface, and disturb the original stable surface. So, the soil erosion is

unavoidable. Furthermore, the vegetation cover during initial service stage cannot recover to a good state immediately. The soil erosion prevention in construction can not be ignored. The highway construction unit should recover vegetation cover according to the rule of Water and Soil Preservation Act of P.R.C while construction. The protection slide, drainage ditches, blocking wall should be built with as soon as possible. The concrete facilities for protecting engineering are shown in chapter 5.

The intensified soil erosion resulted from the highway construction can be recovered within 3-5years by the improvement of drainage system and the recovery of vegetation cover. The soil erosion along the route will be eased compared with before by the improved pavement and planting. Therefore, the intensified soil erosion in construction is temporary.

4.2.3 Analysis of impact on agriculture

The primary impact on agriculture is permanent land acquisition. The acquisite land will lose agricultural output ability, which do certain damage to agricultural production . The project will acquisite 1185.5mu land permanently (in table 4-6). The ratio of the acquisite cultivated land and the cultivated land in each county or city along the route as follows: Tongshan County 3‰,Chongyang County 1.9‰,Puqi City 0 (acquisite mountain land only) . It is shown that the ratio of acquisite cultivated land is low and the acquisite land disperses in many natural villages. Therefore, the structure of agricultural production is not affected seriously in this area. Since the average farm land per person in the area is small (Tongshan 0 .65mu/per, Chongyang 0.98mu/per, Puqi 1.38mu/per). The No. 11 regulation of 1997, The Information about Strengthening Land Management and Protecting Farmland Practically, should be carried out very well in design. The cultivated layer in the temporary sites should be piled up and recover back to the surface.

Table 4-6 Amount of Land Acquisition by the Project **Unit:Mu**

Type of land / Amount / Belong to	Paddy field	Dry farm	Vegetable field	Orchard-ing	Economic forest	Mountain land	Total
Tongshan County	183.3	90.3	25.8	-	41.7	28.9	429.7
Chongyang County	376.0	79.4	-	15.7	-	191.3	662.4
Puqi City	-	-	-	-	-	93.4	93.4
Amount	559.3	169.7	25.8	15.7	41.7	373.3	1185.5

4.2.4 Analysis of impact on ecology environment by using earth.

The total amount of earth and stone work is 1477.2×10^3 m^3, including 355.3×10^3 m^3 stone work and 1121.9×10^3 m^3 earth work, in the construction ,since most sections of the proposed road run along the natural land surface, the cut-fill volume is small. The land surface of K57

+000-K85+000 section is fairly rough; construction of the section includes cut and fill. Some of earth and stone work volume needed to fill can be satisfied by cutting work within 0.5-2.0km. Others can be provided by stone quarries and earth fields. Many stone quarries locate along the route and can satisfy the needs for stones. The area belongs to rolling terrain. Many little hills can provide earth for filling and be evened to cultivated land. Earth fields on farmland are built as less as possible in order to protect insufficient cultivated land.

4.3 Prediction and Assessment of Impact on Waterbodies

4.3.1. Runoff Pollution of Road Surface

Many factors influence road runoff pollution such as precipitation of the area, duration of rainfalls interval between two rainfalls, air and road surface pollution intensity relating to traffic volume, width of road surface and length of road sections for drainage. There is no unique assessment method confrom to now because of random elements. The pollutant concentrations in table 4-7 are generally used in environmental assessment of highway where vehicle flow is 2000-3000/d. The proposed road commonly belongs to second class road. The predicted daily vehicle flow of most sections is about 8000/d in the future corresponding of 1/3 or 1/4 as much as that of high-class roads. Therefore, the pollutant concentration of road surface runoff will be 1/3 or 1/4 of the value in table 4-7(except PH).

Comparing with the environmental impact prediction of National Highway Project IV (southern section of Jing-Zhu Highway) in Hubei Province, of which climate, geography position, river characters etc are similar to that of the proposed road, the comparative analysis shows that:

Table 4-7 Pollutant Concentration in Initial Runoff on Road Surface

Index	PH	COD_{Cr} (mg/l)	BOD_5 (mg/l)	Oils (mg/l)	Pb (mg/l)	SS (mg/l)
Average Value in Initial 120min.'s Runoff	7.4	107	20	7.0	0.19	221

(1) The weak impact of road surface runoff on river water quality(Fushui River, Tongshan River, Baini River and Lushui River) along the proposed highway can be ignored. Because the flows of the rivers are large and the rainfall in the project area is abundant (annual average is 1495-1507mm), the road surface runoff can be well diluted, and the pollutant concentration is 1/3-1/4 less than that of high-class highway.

(2) The impact of runoff on reservoirs can be ignored since the capacity of Lushui Reservoir is very large. In addition, when pollutant concentration decreases to 1/3-1/4 of the values in table 3-7 (except PH), they are below the discharging standard. The impact on water quality near the bank is weak.

4.3.2. Impact Analysis of Wastewater in Management Zone

Three management stations along the route will locate in Tongshan County, Chongyang County and Puqi City respectively. The domestic wastewater from management zone will be the only one fixed polluting source during service period. A survey shows that the staff and workers of a management zone is about 40, standard domestic wastewater volume is 150l/d each person, so the quantity of domestic wastewater will be 6.0 m^3 every day. The quality of wastewater is similar to normal domestic wastewater, and can be treated by septic tanks. Treated sludge can be used as fertilizer and effluent for irrigation (Standard of Irrigation Water shown in table 1-5). In addition, the garbage of management stations should be centralized.

4.3.3. Prediction of Water Pollution during Construction

(1) Water of the rivers may be turbid by digging bottom mud for bridge construction or washing construction materials(such as sand or stones). Improved bridge construction technologies such as cofferdam and deep-well are the main methods to alleviate water pollution of the rivers. Deep-well method is suitable for Fushui River and Lushui River. Cofferdam method is suitable for other rivers which bed is much wider than surface. It can prevent these rivers to become turbid by construction and polluted by construction refuse.

(2) Domestic waste without management will pollute waterbodies. The construction of the proposed road will be put into effect by local goverment and local highway bureau. The local villagers who live in their own homes are the main labor source. Only the construction management district produces domestic waste. Toilets and garbage plants should be built in management zone so that treated domestic waste can be used for irrigation and fertilizing.

(3) The leakage oil from machinery oil, construction boats and the pouring waste oil into rivers can pollute waterbodies. Therefore, management should be strengthened and environment education should be spread.

(4) Construction materials such as pitch, oil, chemical substances washed into rivers can pollute waterbodies if they are not well stored. Therefore, the stockyard should be far away from drinking wells, rivers and reserviors. Moreover, it should be equipped with canvas for temporary shielding.

4.3.4. Risk Analysis of Dangerous Goods.

The transportation of chemical and poisonous substance is unavoidable after completion according to the feasibility study report of the project. Oil, fertilizers and pesticide consist 7.55 percent of the total transportation freights. See table 3-4. The proposed highway run across some rivers and reservoirs, in order to guarantee waterbodies from pollution caused by freight transportation, the risk analysis of transportation is given below.

The formula for the possibility of traffic accidents caused by dangerous chemical substances transportation is:

$$P = \prod_{i=1}^{n} Q_i = Q_1 \times Q_2 \times Q_3 \times Q_4 \times Q_5$$

Where:

P——Probability of accident involving chemical dangerous cargoes occurred on road sections near water body in the predicting year;

Q_1——The frequency of serious traffic accident occurred presently on the district that the proposed highway passes through, (time/million veh.km);

Q_2——Traffic volume in the predicting year, (million veh./year);

Q_3——Truck percentage, (%);

Q_4——Chemical dangerous material percentage, (%);

Q_5——The length of road section near and over water body, (km).

The value of each factor was determined as follows:

Q_1——Reference to the traffic accident rate in 1994 in NH 106, Q_1=0.15;

Q_2——According to the traffic volume prediction , in 2010, Q_2=2.00, in 2020, Q_2=2. 90, in 2022, Q_2=13.55.

Q_3——According to the feasibility study report on the proposed highway, Q_4=80%;

Q_4——According to the feasibility study report, Q_5=8.55%;

Q_5——Determined based on the road section length that pass over rivers or lakes or fishing ponds, Q_6= 6.5km.

The prediction results are shown in table 4-8 .

Table 4-8 Risk Analysis of Dangerous Goods Transportation on the Road Section near Water Bodies

Year	Number of Traffic Accidents on the Road near Water bodies (time/year)	Number of Traffic Accidents on the Whole road (time/year)
2010	0.13	1.95
2020	0.19	2.83

The data from table 4-8 show that the possibility of serious accidents that can pollute the waterbody caused by the vehicles transporting chemical substance across waterbody in service time is 0.13 /year in 2010, 0.19 /year in 2020. Under this conditions, the possibility of accident is not to be neglected. So in service time, it is necessary to take management measures to contral the transportation of dangerous chemical substances and to prevent the accident from happening. For specific measures and suggestions, see chapter V and Ⅷ.

4.4 Prediction and Assessment of the Acoustic Environment

4.4.1 Calculation for highway traffic noise

4.4.1.1 Prediction Model:

(1) The prediction model of traffic noise in the daytime (06:00~22:00) is as follows:

$$Leq = 10\lg \sum_{i=1}^{3} 10^{0.1 Leq_i}$$

$$Leq_i = L_{Ai} + 10\lg\frac{N_i}{TV_i} + 10\lg\left(\frac{r_0}{r}\right)^{1+a} + \Delta S - 13$$

Where:

Leq—— total equivalent sound level A at the predicting spot;

Leq_i—— Hourly equivalent sound level (dB) of type i vehicle flow at predicting point

i—— Vehicle type, usually it can be classified into heavy, middle and light vehicles;

L_{Ai}—— Average radiate sound level A (dB) tested at reference point when type i vehicle running at a speed of V_i;

T —— Testing time, T=1 hour;

N_i—— Traffic volume of the ith vehicle, (No./hour);

V_i—— Speed of the ith vehicle,(km/hour);

r_o—— Distance between the reference spot and the lane, r_o=7.5m;

r —— Distance between the predicting spot and the lane,(m);

α —— The attenuation factors of sound waves related to the absorptive characteristics of ground covering;

ΔS—— The attenuation amount of sound level caused by objects like embankment, excavation etc. and the revised value concerned with the characteristics of the highway ,(dB).

(2) The prediction model of traffic noise in the night (22:00~06:00) is as follows:

Because the traffic volume per hour at night(20:20 ~ 6:00) is small, the model for nighttime is used as follows:

$$Leq_i = L_{Ai} + 10\lg\frac{N_i}{TV_i} + 15\lg\frac{r_0}{r} + 10\lg\left(\frac{r_0}{r}\right)^{a} + \Delta S - 13$$

The meaning of the symbols in this formula is the same as above.

4.4.1.2 Determination of Parameters in the Model

(1) Traffic Volume, Speed of Vehicles, Radiant Noise Level and Its Correction

For the traffic volume of heavy vehicles, middle vehicles and light vehicles on the proposed highway, see Table 2-2. For classification method of vehicle types see reference book [2].

The limit speed designed for the class 2 highway is 80km/h (light rolling areas) or 40km/h (mountainous areas). According to the reference book [2], determine the practical speed (V_i)

of vehicles in accordance with the following formulas.

light type: $V_s = 237\ N_s^{-0.1802}$

middle type: $V_m = 212\ N_m^{-0.1747}$

heavy type: $V_h = 0.8\ V_m$

Where: N_s is the traffic volume of light vehicles, time/h;

N_m is the traffic volume of middle vehicles, time/h.

According to the practical traffic speed (Vi) and the road surface materials (asphalt concrete pavement) recommended by the project feasibility study report as well as Regulations of Environmental Impact Assessment For Highway Project. Calculate the radiant noise level (LAi) of different vehicles on asphalt concrete pavement in accordance with following formulas:

heavy vehicles: $L_A = 77.2 + 0.18\ V_h$

middle vehicles: $L_A = 62.6 + 0.32\ V_m$

light vehicles: $L_A = 59.3 + 0.23\ V_s$

Where: V_h, V_m, V_s is the speed of each vehicle respectively.

The road vertical slope correction is calculated in accordance with the practical vertical slope of road section relative the sensitive spots[2].

The correction of road surface is calculated according to table 4-10.

Table 4-10 Correction of road surface

Type of pavement	Correction of road surface dB(A)
Asphalt concrete	0
Cement concrete	1~2 *

* : For the ratio of light vehicle more than 60%, adopt the higher value, otherwise, the lower value.

(2) Ground Attenuation Factor

The areas on both sides of the proposed highway are farmlands on the whole. The sound propagation attenuation factor(α) of ground covering is 0.5.

(3)Δ S

For the attenuation amount of sound level (Δ S) caused by objects like different neights of embankments, or high-level bridges and the different depths of excavation, use the following formula:

$N=\delta \times f / 170$

Where:

δ ——Difference of sound propagation length,(m);

f——Noise frequency, as for highway traffic , f=550Hz;

N——Fresnel Number.

The attenuation amount of sound level (Δ S) can be figured out from the Fresnel Curve by referring to the Fresnel number calculated.

4.4.1.3 Prediction Results of Traffic Noise of Different Road Sections

According to the traffic volume at different periods of service and the average height of embankments, the traffic noise levels of different road sections are shown in Table 4-11.

Table 4-11 Prediction Results of Traffic Noise of Different Road Sections Leq:dB(A)

Road section	Pile	Year	Time	Distance from the road center-line (m)						
				20	40	60	80	100	150	200
Tong-shan	K0+000	2000	Day	61.4	56.9	52.4	49.7	47.8	46.4	43.7
			Night	56.5	50.4	44.4	40.9	38.4	36.5	32.9
		2010	Day	64.2	59.7	55.2	52.6	50.7	49.2	46.6
			Night	59.2	53.2	47.1	43.6	41.1	39.2	35.7
Nanlin	K22+000	2020	Day	66.1	61.6	57.1	54.4	52.6	51.1	48.5
			Night	61.1	55.1	49.1	45.6	43.1	41.1	37.6
Nanlin	K22+000	2000	Day	58.2	53.7	49.2	46.5	44.7	43.2	40.6
			Night	53.0	46.9	40.9	37.4	34.9	33.0	29.4
		2010	Day	61.4	56.9	52.4	49.7	47.8	46.4	43.7
			Night	56.5	50.5	44.4	40.9	38.4	36.5	33.0
Lukou	K36+000	2020	Day	63.3	58.8	54.3	51.7	49.8	48.3	45.7
			Night	58.5	52.5	46.5	43.0	40.5	38.5	35.0
Lukou	K36+000	2000	Day	60.6	56.1	51.6	48.9	47.1	45.6	43.0
			Night	55.4	49.3	43.3	39.8	37.3	35.4	31.8
		2010	Day	63.6	59.1	54.5	51.9	50.0	48.6	45.9
			Night	58.5	52.5	46.5	43.0	40.5	38.5	35.0
Baini	K45+000	2020	Day	65.5	61.0	56.5	53.8	52.0	50.5	47.9
			Night	60.5	54.5	48.4	44.9	42.4	40.5	37.0
Baini	K45+000	2000	Day	63.4	58.9	54.4	51.8	49.9	48.4	45.8
			Night	58.5	52.5	46.5	43.0	40.5	38.5	35.0
		2010	Day	66.7	62.1	57.6	55.0	53.1	51.7	49.0
			Night	61.7	55.7	49.7	46.1	43.7	41.7	38.2
Chong-yang	K54+000	2020	Day	68.7	64.1	59.6	57.0	55.1	53.7	51.0
			Night	63.7	57.6	51.6	48.1	45.6	43.7	40.1
Chong-yang	K54+000	2000	Day	60.4	55.9	51.4	48.7	46.8	45.4	42.7
	K57+000		Night	55.3	49.3	43.3	39.8	37.3	35.3	31.8
	K85+000	2010	Day	63.6	59.0	54.5	51.9	50.0	48.6	45.9
	K95+245		Night	58.5	52.5	46.5	43.0	40.5	38.5	35.0
		2020	Day	65.4	60.9	56.4	53.8	51.9	50.4	47.8
			Night	60.5	54.5	48.4	44.9	42.4	40.5	37.0
	K57+000	2000	Day	63.4	58.9	54.4	51.7	49.9	48.4	45.8
			Night	58.3	52.3	46.3	42.8	40.3	38.3	34.8
		2010	Day	66.6	62.1	57.6	54.9	53.0	51.6	48.9
	K85+000		Night	61.5	55.5	49.5	46.0	43.5	41.5	38.0
Puqi		2020	Day	68.4	63.9	59.4	56.8	54.9	53.4	50.8
			Night	63.5	57.4	51.4	47.9	45.4	43.5	39.9

4.4.2 Environmental Impact Assessment of Traffic Noise

(1) Critical line of traffic noise

The distance between road-center line and where traffic noise level on both sides of the highway conforms to the limitation value of class Ⅳ in standard of GB 3096-93 (70dB (A) in the day times, 50dB (A) in the evenings) in the typical year of its service stage is named Critical Line of traffic noise. See table 4-12.

Table 4-12 The Predicted Distance from the Road Center to the Point Where the Traffic Noise Level Equals to the Standard

Road section	Pile	Distance in 2000 (m)		Distance in 2010 (m)		Distance in 2022 (m)	
		Day 70dB(A)	Night 55dB(A)	Day 70dB(A)	Night 55dB(A)	Day 70dB(A)	Night 55dB(A)
Tongshan~Nanlin	K0+000~ K22+000	< 20	24	< 20	32	< 20	40
Nanlin~Lukou	K22+000~K36+000	< 20	< 20	< 20	24	< 20	30
Lukou~Baini	K36+000~K45+000	< 20	22	< 20	30	< 20	38
Baini~Chongyang	K45+000~K54+000	< 20	30	< 20	42	< 20	48
Chongyang~puqi	K54+000~K57+000 K85+000~K95+245	< 20	20	< 20	30	< 20	38
	K57+000~K85+000	< 20	30	< 20	42	< 20	47

It is shown in table 4-12 that in each road section while the spots are more than 30 meters away from road center can be conform to the class Ⅳ standard of GB3096-93 in 2000, 42 meters away from road center can be conform to the classⅣ standard of GB3096-93 in 2010 and 48 meters away from road center can be conform to the class Ⅳ standard of GB3096-93 in 2020.

(2) Assessment of Noise Impact on Sensitive Spots

Table 4-12 shows that within 20 year of service stage the noise level is each scetion, where is 48 meters away from road center can be conform to assessment standard. From the scope of acquisition and removal for highway construction, the main objects, are affected by traffic noise, are the buildings, which located within 10-48 m from road center.

By calculation and statistic in 2000, 2010 and 2020 year, the noise level on sensitive spots in the highway environmented assessment extent and corresponding standard are shown in table 4-13 and table 4-14.

Table 4-13 Prediction Result of Ambient Noise Level in Sensitive Spots

Leq dB(A) (Schools)

No.	Pile	Name of Sensitive Spots	Distance to Center-line (m)	Year	Noise Level		Exceeded Standard	
					Day	Night	Day	Night
1	K1+200	Mingshui Prim.Sch.	150	2000 2010 2020	51.6 52.6 53.8		- - -	
2	K3+600	Tongyang No.3 Prim.Sch.	15	2000 2010 2020	68.9 69.6 70.2		13.9 14.6 15.2	
3	K3+750	Tongshan Forest Prim.Sch. *	80	2000 2010 2020	51.8 53.5 54.7		- - -	
4	K4+300	Tongyang No.2 Prim.Sch. *	80	2000 2010 2020	51.8 53.5 54.7		- - -	
5	K4+800	Tongyang No.1 Prim.Sch. *	100	2000 2010 2020	51.0 52.4 54.0		- - -	
6	K6+500	Tongshan Profession High Sch. **	120	2000 2010 2020	50.8 52.0 53.1		- - -	
7	K31+800	Lukou Town Qiaobian Prim.Sch.	60	2000 2010 2020	53.5 55.0 56.1		- - 1.1	
8	K48+700	Daqiao Xintangling Prim.Sch. **	70	2000 2010 2020	53.8 55.4 57.2		- 0.4 2.2	
9	K55+000	Tiancheng Sec.Sch. *	50	2000 2010 2020	57.6 58.2 58.7		2.6 3.2 3.7	
10	K59+300	Lumen Sec.Sch.	100	2000 2010 2020	52.1 53.8 54.9		- - -	
11	K71+500	Wuliu Prim.Sch.	200	2000 2010 2020	52.5 52.9 53.4		- - -	
12	K74+200	Lumen Dongliu Prim.Sch. **	80	2000 2010 2020	51.8 53.3 54.5		- - -	
13	K84+300	Fenghuangshan Qianjin Prim.Sch. ***	60	2000 2010 2020	52.5 53.7 54.8		- - -	
14	K91+900	Puqi High Sch.	120	2000 2010 2020	50.1 51.0 51.7		- - -	

Notes: For schools, execute the GB3096-93 Standard for Class 1 (daytime 55 dB, night 45dB).
-: Stands for not exceeding standard.
*: Stands for that there are buildings located between the school and highway.
**: Stands for that there is wall enclosing the school.
***: Stands for the building towards the highway being used not for classroom but for office.

Table 4-14 Prediction Result of Ambient Noise Level in Sensitive Spots
Leq dB(A) (Villages)

NO.	Pile	Name of Sensitive Spots	Distance to Center-line (m)	Year	Noise Level		Exceeded Standard	
					Day	Night	Day	Night
1	K2+600	Tangjia Village	30	2000	55.7	47.3	-	-
				2010	59.2	50.0	-	-
				2020	60.5	51.8	-	-
2	K3+400~ K6+200	Tongyang Town	15	2000	68.9	57.5	-	2.5
				2010	69.6	59.8	-	4.8
				2020	70.2	61.4	0.2	6.4
3	K13+000	Dalu Township	100	2000	57.4	42.0	-	-
				2010	57.8	42.9	-	-
				2020	58.1	43.2	-	-
4	K17+600	Shentangpu Village	60	2000	52.9	41.2	-	-
				2010	54.5	44.5	-	-
				2020	55.8	46.2	-	-
5	K21+500	Fantou Village	40	2000	54.4	45.2	-	-
				2010	56.4	47.5	-	-
				2020	57.9	49.4	-	-
6	K30+300	Hongshiqiao Village	30	2000	54.3	44.0	-	-
				2010	56.1	47.8	-	-
				2020	57.5	49.2	-	-
7	K36+000	Lukou Township	15	2000	60.7	53.3	-	-
				2010	62.8	56.5	-	1.5
				2020	64.2	58.5	-	3.5
8	K45+000	Bainiqiao Township	80	2000	53.8	41.5	-	-
				2010	55.4	44.2	-	-
				2020	56.7	46.0	-	-
9	K53+800~ K55+300	Tiancheng Town	15	2000	62.0	55.4	-	0.4
				2010	64.7	58.5	-	3.5
				2020	65.8	60.5	-	5.5
10	K67+600	Hongxia Village	30	2000	57.2	49.0	-	-
				2010	59.9	52.0	-	-
				2020	61.6	53.9	-	-
11	K72+000	Wulipai Village	50	2000	54.7	44.9	-	-
				2010	56.7	47.9	-	-
				2020	58.6	49.7	-	-
12	K78+100	Shuangpailin Village	20	2000	59.5	52.4	-	-
				2010	62.4	55.5	-	0.5
				2020	64.1	57.4	-	2.4
13	K89+300	Chezhan Township	15	2000	62.0	55.4	-	0.4
				2010	64.7	58.5	-	3.5
				2020	65.8	60.5	-	5.5

Notes: For villages, execute the GB3096-93 standard for Class 4 (daytime 70dB(A), night 55dB(A)).

Table 3-13 and table 4-14 shows that comparing with the standard in GB3096- 93, which is adopted in the project assessment. The noise of some sensitive spots along the route will exceed the standard in the service stage. The noise level of four of total 14 schools along the route exceeds standard. Five of thirteen villages exceed standard (indicating the front row building in the evenings). There are 28 villages (other sensitive spots) within the assessment area (see appendix 1). The exceeding standard villages among the 28 other sensitive spots are

Hongshiqiao (K30+250), Shizui (K70+850), Taohuaping (K78+450) and Zhongmatou (K28+ 000) . So, mitigation measures for the 13 sensitive locations, which exceed standard, should be taken (see Table 5-1 and Table 5-2).

4.4.3 Analysis of Acoustic Environment Impact during Construction

The noise of construction sites along the proposed highway mainly comes from construction vehicles and equipment. For noise levels and their attenuation, see Table 4-15.

Table 4-15 Noise Level of Major Construcion Machanical Equipment **Unit:dB(A)**

Noise Level / Equipments	Distance from the equipment (m)							
	5	10	20	40	60	80	100	150
Loader	90	84	78	72	68.5	66	64	61.6
Road Grader	90	84	78	72	68.5	66	64	61.6
Roller	86	80	74	68	64.5	62	60	56.5
Scraper	84	78	72	66	62.5	60	58	54.5
Paver	85	79	73	67	63.6	61	59	55.6
Mixer	87	81	75	69	65.5	63	61	57.5
Bulldozer	86	80	74	68	64.5	62	60	56.5

In the Noise Standards for Construction Sites GB12523-90, the limiting noise value is 75dB during the daytime and 55 dB at night. It is shown from the noise level in Table 4-15 that the standard distance for the noise of construction machinery at daytime is about 40m, and about 150m at night. The noise of construction machinery in the daytime will not affect the environment greatly, but at night it will. So, it is suggested that the construction should be stopped from 20:00 to 6:00. If there is a school within 150m of a construction site, it is necessary to negotiate with the school and adjust the working hours so that teaching activity will not be greatly affected.

It is shown in Table 4-15 that the noise of construction machinery, generally speaking, exceeds 80dB(A), some even exceeds 90dB(A). This noise will affect constructors, especally the operators of construction machinery. The Noise Health Standards for Industrial Enterprises issued by the Minitry of Public Health of Chnia and the General Bureau of Labour are shown in Table 4-16. It is suggested that the Construction Unit should reasonably arrange for constructors and their work to protect their health and pay attention to the maintenance of machinery used for construction so that the noise levels could be reduced to the lowest. As for those workers who work longer hours near the source of noise, some measures should be taken to protect their health, such as ear plugs, helmets, etc.

Table 4-16 Noise Health Standard for Industrial Enterprises (Jan.1,1980)

Time of continuously being with noise (Hour)	Allowed noise level dB(A)
8	85
4	88
2	91
1	94

4.4.4 Summary

(1) The acoustic sensitive spots along the route will be affected in the highway service stage. Practical protection measures should be taken to sensitive spots which noise level exceeds standard.

(2) Construction goes usually at 6:00-22:00 in the day times. There is little influence on residents' sleep on sensitive spots. When the construction operations have to carry out at night, some noise-reduction measures should be taken like to slow down the speed and/or forbid to blow horns.

(3) The noise level of construction machines conforms to the Ⅳ standard in GB3096-93 at the place where are 40m away from the construction sites. The majority of villages are further than 40m from highway-center. Therefore, the construction machine noise has a little influence on the life of local inhabitants in the day times.

(4) There are many schools along the route. The construction noise on school section will cause a distinct impact on school teaching. The construction units should get agreement with schools. Besides, during construction at school sections some temporary noise- reduction measures such as wooden sound insulating boards should be taken.

4.5 Prediction and Assessment of Impact on Ambient Air Quality

4.5.1 Prediction of Impact on Ambient Air Quality

(1) Prediction Model

For predicting and assessment of the impact upon the ambient air quality during the service period , The Gauss linear source diffusion model was used. The model is:

$$C(x,y) = \int_{-L/2}^{L/2} \frac{q_1}{\pi \sigma_y \sigma_z U_R} \exp\left[-\left(\frac{y^2}{2\sigma_y^2} + \frac{H^2}{2\sigma_z^2}\right)\right] dl$$

where:

c(x,y)—— Pollutant concentration at prediction point (x,y), (mg/m^3);

q_1——Emission intensity of line-source,(mg/m.s);

$q_1 dl$——Emission intensity of length dl of line-source , namely equivalent point- source

emission intensity,(mg/s);

U_h——Wind velocity at the effective emission height of vehicles on the highway;(m/s);

σ_y,σ_z—— The revised horizontal standard deviation of the atmospheric diffusion and the vertical standard deviation of the atmospheric diffusion respectively, (m);

L——Length of line-source, (m);

H——The efficient emission height of line-source, (m).

(2) Emission intensity of linear source

According to the emission intensity tested by Xian Highway Transportation University and the traffic volume as shown in table 2-2, the pollutant emission intensity for different prediction spots are shown in table 4-17.

Table 4-17 Emission Intensity of Vehicles Unit: mg/m.s

Road section	CO			NOx		
	2000 Year	2010 Year	2020 Year	2000 Year	2010 Year	2020 Year
Tongshan~Nanlin(K0+000~K22+000)	1.09	1.47	2.12	0.17	0.23	0.34
Nanlin~Lukou(K22+000~K36+000)	0.61	0.85	1.25	0.09	0.14	0.20
Lukou~Baini(K36+000~K45+000)	0.94	1.29	1.88	0.15	0.21	0.30
Baini~Chongyang(K45+000~K54+000)	1.71	2.38	3.52	0.27	0.38	0.56
Chongyang~Puqi(K54+000~K57+000) (K85+000~K95+245)	0.92	1.28	1.86	0.15	0.21	0.30
Chongyang~Puqi(K57+000~K85+000)	1.10	1.52	2.22	0.13	0.18	0.27

4.5.2 Prediction Results and Assessment of impact on ambient air quality

(1) Daily average concentration of CO and NO_x for some typical cross-sections

According to the meteorological conditions, vehicle flow of each sections and topography state, the daily average concentrations of CO and Nox on 6 selected cross- sections along the proposed highway in 2000,2010 and 2020 year has been predicted. The prediction results are shown in table 4- 19.

It is shown in table 4- 19 that

(a) From the highway coming into operation to 2020 year, the maxmum CO daily average concentration on six cross-sections is 1.27mg/m^3. That is to say that all of the six road sections are conform to the CO standard of class 2 in GB3095-1996

(b) Until 2020 year, the maximum daily average NOx concentration is 0.075 mg/m^3, which shows that all the road sections can satisfy the NOx standard of class 2 in GB3096-1996. It is clear that the future road will affect the ambient air quality slightly.

(2) Daily average concentration of CO and NO_x at sensitive spots

For the prediction result of daily average concentration of CO and NO_x of some typical sensitive spots in 2000,2010 and 2020 during the service period, see Table 4-20.

The CO and NOx concentrations on sensitive spots along the route in table 4- 20 show that the daily average concentrations of CO and NOx are conform to the class 2 standard of GB3095 -1996 till 2020 year. There is a slight influence on sensitive spots along the route.

Table 4-19 Prediction results of daily average concentration of CO and NOx

Unit: mg/Nm^3

Road Section	Pollutant	Background value	Year	Distance from two sides of highway (m)							
				0	25	50	75	100	120	150	200
Tongyang Town (K4+500)	CO	0.78	2000	0.83	0.81	0.80	0.80	0.79	0.79	0.79	0.79
			2010	0.85	0.82	0.81	0.80	0.80	0.80	0.79	0.79
			2020	0.88	0.84	0.82	0.82	0.81	0.81	0.80	0.80
	NO_x	0.020	2000	0.028	0.025	0.024	0.023	0.022	0.022	0.021	0.021
			2010	0.031	0.027	0.025	0.024	0.023	0.023	0.022	0.022
			2020	0.036	0.030	0.027	0.026	0.025	0.024	0.023	0.023
Lukou Township (K36+000)	CO	0.90	2000	0.96	0.94	0.93	0.92	0.92	0.91	0.91	0.91
			2010	0.98	0.95	0.94	0.93	0.92	0.92	0.92	0.91
			2020	1.01	0.97	0.95	0.94	0.93	0.93	0.93	0.92
	NO_x	0.035	2000	0.044	0.041	0.039	0.038	0.038	0.037	0.037	0.037
			2010	0.047	0.043	0.041	0.039	0.039	0.038	0.038	0.037
			2020	0.053	0.046	0.043	0.042	0.040	0.040	0.039	0.038
Bainiqiao Township (K45+000)	CO	0.95	2000	0.98	0.95	0.94	0.93	0.93	0.92	0.92	0.92
			2010	1.02	0.97	0.95	0.94	0.94	0.93	0.93	0.92
			2020	1.07	1.01	0.98	0.96	0.95	0.94	0.94	0.93
	NO_x	0.030	2000	0.049	0.044	0.041	0.040	0.039	0.038	0.038	0.037
			2010	0.054	0.047	0.044	0.042	0.041	0.040	0.039	0.038
			2020	0.063	0.052	0.048	0.045	0.043	0.042	0.041	0.040
Tiancheng Town (K55+000)	CO	0.95	2000	1.06	1.02	1.00	0.99	0.98	0.98	0.97	0.97
			2010	1.17	1.09	1.05	1.03	1.01	1.01	0.99	0.98
			2020	1.27	1.15	1.10	1.06	1.05	1.03	1.02	1.00
	NO_x	0.030	2000	0.052	0.043	0.040	0.038	0.036	0.035	0.035	0.034
			2010	0.060	0.050	0.044	0.041	0.039	0.038	0.037	0.035
			2020	0.075	0.058	0.050	0.046	0.043	0.041	0.040	0.038
Wulipai Village (K72+000)	CO	0.95	2000	1.04	1.01	0.99	0.98	0.98	0.97	0.97	0.97
			2010	1.08	1.03	1.01	0.99	0.99	0.98	0.98	0.97
			2020	1.14	1.07	1.04	1.02	1.01	1.00	0.99	0.98
	NO_x	0.030	2000	0.041	0.037	0.035	0.034	0.033	0.033	0.033	0.032
			2010	0.046	0.040	0.037	0.036	0.035	0.034	0.033	0.033
			2020	0.053	0.044	0.041	0.038	0.037	0.036	0.035	0.034
Puqi High Sch. (K91+900)	CO	0.83	2000	0.89	0.87	0.86	0.85	0.85	0.85	0.84	0.84
			2010	0.91	0.88	0.87	0.86	0.86	0.85	0.85	0.84
			2020	0.95	0.90	0.88	0.87	0.87	0.86	0.86	0.85
	NO_x	0.020	2000	0.029	0.026	0.024	0.023	0.023	0.022	0.022	0.022
			2010	0.033	0.028	0.026	0.025	0.024	0.023	0.023	0.022
			2020	0.039	0.032	0.029	0.027	0.026	0.025	0.024	0.023

Note: The data in this table stand for the prediction results of the bigger one between two sides of the road.

Table 4-20 Prediction Results of Air Pollutants on Sensitive Spots

No	Pile No.	Name for Sensitive Spots	Distance From Road Center-Line (m)	Pollu-tants	Daily Average Air Pollutant Concentration					
					2000 Yr		2010 Yr		2020 Yr	
					Conc.	Exceeding	Conc.	Exceeding	Conc.	Exceeding
1	K1+200	Mingshui Prim. School	150	CO	0.79	0	0.79	0	0.80	0
				NOx	0.021	0	0.022	0	0.023	0
2	K2+600	Tangjia Village	30	CO	0.82	0	0.83	0	0.85	0
				NOx	0.026	0	0.028	0	0.031	0
3	k3+400 ~ k6+200	Tongyang Town	Cross over	CO	0.82	0	0.84	0	0.87	0
				NOx	0.027	0	0.030	0	0.035	0
4	k3+600	Tongyang No. 3 Prim. Sch.	10	CO	0.82	0	0.84	0	0.87	0
				NOx	0.027	0	0.030	0	0.035	0
5	k3+750	Tongshan Forest Prim. Sch.	80	CO	0.80	0	0.80	0	0.82	0
				NOx	0.023	0	0.024	0	0.026	0
6	k4+300	Tongyang No. 2 Prim. Sch.	80	CO	0.80	0	0.80	0	0.82	0
				NOx	0.023	0	0.024	0	0.026	0
7	k4+800	Tongyang No. 1 Prim. Sch.	100	CO	0.80	0	0.80	0	0.82	0
				NOx	0.023	0	0.024	0	0.025	0
8	k6+500	Tongshan Profession High Sch.	120	CO	0.80	0	0.80	0	0.82	0
				NOx	0.023	0	0.024	0	0.025	0
9	k13+000	Dalu Township	100	CO	0.80	0	0.80	0	0.82	0
				NOx	0.023	0	0.024	0	0.025	0
10	k17+600	Shentangpu Village	60	CO	0.80	0	0.81	0	0.82	0
				NOx	0.024	0	0.025	0	0.027	0
11	k21+500	Fantou Village	40	CO	0.81	0	0.82	0	0.83	0
				NOx	0.025	0	0.026	0	0.029	0
12	k30+300	Hongshi-qiao Village	30	CO	0.94	0	0.95	0	0.98	0
				NOx	0.041	0	0.044	0	0.047	0
13	k31+800	Qiaobian Prim. Sch.	60	CO	0.93	0	0.94	0	0.95	0
				NOx	0.039	0	0.041	0	0.043	0
14	k36+000	Lukou Township	Cross over	CO	0.95	0	0.97	0	1.00	0
				NOx	0.043	0	0.046	0	0.051	0

Continuation of Table 4-20 Prediction Results of Air Pollutants on Sensitive Spots

No	Pile No.	Name for Sensitive Spots	Distance From Road Center-Line (m)	Pollutants	Daily Average Air Pollutant Concentration					
					2000 Yr		2010 Yr		2020 Yr	
					Conc.	Exceeding	Conc.	Exceeding	Conc.	Exceeding
15	k45+000	Bainiqiao Village	80	CO	0.93	0	0.94	0	0.96	0
				NOx	0.040	0	0.042	0	0.045	0
16	k48+700	Xintang-ling Prim. Sch.	70	CO	0.93	0	0.94	0	0.97	0
				NOx	0.040	0	0.042	0	0.046	0
17	k53+800 ~ k55+300	Tiancheng Town	Cross over	CO	1.05	0	1.16	0	1.25	0
				NOx	0.051	0	0.058	0	0.073	0
18	k55+000	Tiancheng Midd. Sch.	50	CO	1.01	0	1.06	0	1.11	0
				NOx	0.041	0	0.045	0	0.051	0
19	k59+300	Lumen Midd. Sch.	100	CO	0.98	0	1.01	0	1.05	0
				NOx	0.036	0	0.040	0	0.044	0
20	k67+600	Hongxia Village	30	CO	1.02	0	1.09	0	1.15	0
				NOx	0.043	0	0.045	0	0.058	0
21	k71+500	Wuliu Prim. Sch.	200	CO	0.97	0	0.97	0	0.98	0
				NOx	0.032	0	0.033	0	0.034	0
22	k72+000	Wulipai Village	50	CO	0.99	0	1.01	0	1.05	0
				NOx	0.035	0	0.037	0	0.042	0
23	k74+200	Dongliu Prim. Sch.	80	CO	0.98	0	0.99	0	1.02	0
				NOx	0.034	0	0.036	0	0.038	0
24	k78+100	Shuangpai-lin Village	20	CO	1.02	0	1.05	0	1.10	0
				NOx	0.039	0	0.042	0	0.047	0
25	k84+900	Qianjin Prim. Sch.	60	CO	0.99	0	1.01	0	1.04	0
				NOx	0.035	0	0.037	0	0.041	0
26	k89+300	Chezhan Township	Cross over	CO	0.89	0	0.90	0	0.94	0
				NOx	0.028	0	0.032	0	0.037	0
27	k91+900	Puqi High Sch.	120	CO	0.85	0	0.85	0	0.86	0
				NOx	0.022	0	0.023	0	0.025	0

Note: The distance from the road center-line to the front line buildings of the village that the highway will cross over was supposed as 10 meters.

4.5.3 Analysis of Impact on Ambient Air Quality during Construction

(1) Major Air Pollution Sources during Construction

The impact on the ambient air quality during the period of construction is mainly from raised dust or total suspended particles(TSP) and asphalt smog.

There are 3 sources of raised dust. The first one is from the mixing and paving of lime and soil on the proposed highway during the construction of the subgrade. The second one is from the mixing plants of lime and soil. The third one is from vehicles and equipment used for construction or transportation on construction sites.

(2) Analysis of Impact on Ambient Air

① Reducing the dust

According to the analogical results, sprinkling water at the construction site can reduce 70% of the dust and obtain a good effect. So, it is suggested here, during the period of construction, the work of sprinkling water to the construction sits should be done timely in order to prevent the dust pollution.

② Controlling the asphalt smog

Because of the asphalt concrete used for pavement will be supplied by asphalt concrete mixing plants set up temporarily with fully-closed equipment, the asphalt smog will not bring an obvious pollution to the ambient air of the construction sites. An attention should be paid to the location of the plants, which should be chosen in light of the requirement of Distance Classification for Protection of Hygiene. The plants should be located at least 300m away from the sensitive spots such as residential quarters and schools and should be downwind of the nearest sensitive spot. It is also necessary to point out that open or half-close equipment for asphalt boiling cannot be used.

4.5.4 Summary

(1) The current concentrations of CO, NOx and TSP along the route is satisfy to the standard of class 2 in GB3096-1996, the air is clean.

(2) From the highway coming into operation to 2020 Yr, the concentration of CO and NOx on both sides of the highway is up to the class 2 in Ambient Air Quality Standard, so, the project will have a small influence on air quality along the route.

(3) All of the predicted pollutant concentrations on sensitive spots are up to the standard of class 2 in GB3095-1996. There is a slight influence on the air quality of sensitive spots in service stage.

(4) During construction, the dust produced by vehicle transportation will cause distinct impact on the air quality; necessary measures should be taken.

V. MEASURES FOR ENVIRONMENTAL PROTECTION ENGINEERING

5.1 Environmental Protection Measures in Design

Alignment of the proposed highway based on the natural environment should be perfected in the designing stage.

(1) Afforestation at road side and mountain slope protection by mortar slab stone should be considered in design, to prevent soil erosion and beautify highway landscape. High precipitation of the area along the highway may cause collapse and slope slide directly, therefore, at sections of large area side slope protection, collecting pipes should be constructed for drainage to prevent from erosion in flood season.

(2) Alignment scheme should be perfected for being away from villages & schools or less farmland occupation.

(3) Rational selection for the position of earth borrowing sites and spoil areas, should be considered. Pay attention to water and soil conservation of earth borrowing sites, the impacts of dusting and other problems caused to environmental sensitive area (for example, residential regions).

(4) Sensitive spots as cities & towns should be avoided in the highway design.

5.2 Environmental Protection Measures During Construction

5.2.1 Measures for Ecological Environmental Protection

(1) During construction, it is necessary to build temporary settling basins to allow mud and sand to settle at places where rainwater runoff occurs during digging of the subgrade. The average depth of the settling basin is 0.5m, its scale is determined in terms of the size of catchment area and its location in terms of the topography. Earth and cloth fences are placed when necessary near the outlet of the settling basin. When the highway construction is finished and the culvert pipes laid down, either trees should be planted on the sites of the settling basins or the area should be reverted to farmland.

(2) Afforestation and slope protection of cut slopes should be pay attention to when the line is cutting in rolling hills.

(3) It is recommended to limit the working area, to prohibit workers cutting trees out of borrow site. It is necessary to plant trees in the borrow area as soon as possible after the excavation has been completed. Earth will be borrowed from upland areas.

(4) The retaining walls, the drainage ditches, and the work of planting trees and grass should be constructed checked simultaneously.

(5) During construction, while the land is temporarily using, it will be necessary to remove the fertile surface soil and stack it nearby. Then after the construction is finished , restore the land to its previous condition.

5.2.2 Measures for Prevention and Control of Noise

(1) It is recommended that the construction unit should arrange for the workers to operate

the machines in turn for reducing the time of bearing excessive noise, pay attention to the maintenance of the machinery and to keep the noise level of the machinery as low as possible. For the workers working a longer time near the sound source, ear plugs should be provided for them to protect their hearing.

(2) When the distance between the residential quarters and the construction site is less than 150m, it is recommended that work be suspended from 20:00 to 06:00 in order to ensure that the residents have an undisturbed night rest. When the construction operations have to carry out at night, some noise-reduction measures should be taken like to slow down the speed of transport truck and/or forbid to blow horns.

(3) For the section near school, the construction unit should negotiate with the teachers about the time of construction to reduce the disturbance to teaching caused by noise. Besides, during construction at school sections some temporary noise-reduction measures such as wooden sound insulating boards should be taken.

5.2.3 Measures for Prevention and Control of Atmospheric Pollution

(1) It is recommended that bedding plants and lime-soil mixing plants should be set up in open areas, at least 200m away from residential quarters or schools .

(2) Material piling areas should be covered up or sprinkling to prevent from pollution of dust. Material transportation trucks should be covered by mufflers.

(3)For prevention and controlling of asphalt smog, the asphalt concrete mixing plant should be located at least 300m away from the environmental sensitive spots such as residential quarters and schools and should be downwind of the nearest sensitive spot.

5.2.4 Environmental Protection Measures for Water Pollution

(1) Pollution of river water from bridge construction can be prevented by innovation of construction procedures. For examples when the flow of a river is rather large (Fushui River and Lushui River), drop shoft sinking method should be used in the bridge construction to mitigate the pollution to river. For other rivers with wider river bed than river surface, cofferdam method should be adoped to prevent the river from being muddy and polluted by falling garbage.

(2) The domestic sewage, garbage and excrement of workers at construction site should be concentrated and treated, and cannot be discharged directly into the water body. If domestic sewage in the areas of construction cannot be connected with the municipal drainage system, it will be necessary to build dry toilet and septic tanks.

(3) During the construction of bridges, the machinery and ships used should be strictly checked to prevent the leakage of oil. The waste oil and garbage from construction are not allowed to discharge into the water body.

(4) It is not proper to pile up construction materials such as asphalt, oil and chemicals at places near wells for public use, rivers and lakes in order to prevent them from entering into the water body when it rains.

5.3 Environmental Protection Measures during the Operation Period

5.3.1 Plan for Areas on Both Sides of the Route

(1) The predicted results of traffic noise showed that during the long-term service period (2020Yr.) of the proposed highway, the noise level in the areas more than 48m away from the road center-line is lower than the limiting value of Class 4 in GB3096-93. Therefore, from a long-term point of view, it is recommended in planning for the areas on both sides of the highway that buildings and units such as residential quarters not be built within 60m away from the

road center-line. As for schools and hospitals that have a higher demand for acoustic environment quality, it is recommended that schools and hospitals not be built within 200m away from the road center-line.

(2) Set up traffic signs prohibiting the use of horns on the sections where schools are near.

(3) Strengthen traffic management by setting up traffic environmental monitoring stations at the entrance and exit to the highway and prohibiting old vehicles with higher noise levels to run on the highway.

(4) For engineering measures for prevention and control of traffic noise and cost estimates, see Table 5-1 & Table 5-2. The effect of noise-reduction of varied mitigation measures is shown in Table 5-3.

Table 5-1 Measures on Sensitive Spots for Prevention of Traffic Noise

No	Pile No.	Name of Environment Sensitive Spots	Distance From Road Center (m)	Year	Exceeded Standard dB(A)		Protection Measures	Executing Time
					Day	Night		
1	K3+600	Tongyang No.3 Prim. Sch.	10	2000 2010 2020	13.9 14.6 15.2		*(66 win.)	2001
2	K3+400~ K6+200	Tongyang Town	10	2000 2010 2020	- - 0.2	2.5 4.8 6.4	**	2001
3	K31+800	Lukou Town Qiaobian Prim.Sch.	60	2000 2010 2020	- - 1.1		***	
4	K36+000	Lukou Township	10	2000 2010 2020	- - -	- 1.5 3.5	**	2010
5	K48+700	Daqiao-Xintangling Prim.Sch.	70	2000 2010 2020	- 0.4 2.2		****	2010
6	K55+000	Tiancheng Mid.Sch.	50	2000 2010 2020	2.6 3.2 3.7		**	
7	K53+800~ K55+300	Tiancheng Town	10	2000 2010 2020	- - -	0.4 3.5 5.5	**	2001
8	K78+100	Shuangpailin Village	20	2000 2010 2020	- - -	- 0.5 2.4	**	2010
9	K89+300	Chezhan Township	10	2000 2010 2020	- - -	0.4 3.5 5.5	**	2001

Notes:

(a) For villages, execute the GB3096-93 standard for Class 4 (daytime 70dB(A), 55dB(A)) . For schools, execute the GB3096-93 Standard for Class 1 (daytime 55dB(A), night 45dB(A)).

(b)* stands for sound insulation window which should be installed to the windows of schoolroom at the side toward the road.

(c) ** stands for sound insulation window which should be installed to the windows of residences.

(d)*** stands for doing monitoring regularly in the operation time.

(e)**** stands for heightening the existing enclosing wall.

Table 5-2 Measures on other Sensitive Spots for Prevention of Traffic Noise

No	Pile No.	Name of Environment Sensitive Spots	Distance From Road Center (m)	Year	Exceeded Standard dB(A)		Protection Measures	Executing Time
					Day	Night		
1	K30+250	Hongshiqiao	10	2000 2010 2020	- - -	- 1.5 3.5	*	2010
2	K70+850	Shizui Village	10	2000 2010 2020	- - 0.2	2.5 4.8 6.4	*	2001
3	K78+450	Taohuaping	20	2000 2010 2020	- - -	- 0.5 2.4	*	2010
4	K82+000	Zhongmatou	20	2000 2010 2020	- - -	- 0.5 2.4	*	2010

Notes:

(a) For villages, execute the GB3096-93 standard for Class 4 (daytime 70dB, 55dB) . For schools, execute the GB3096-93 Standard for Class 1 (daytime 55 dB, night 45dB).

(b)* stands for sound insulation window which should be installed to the windows of residences. (400yuan/window) .

Table 5-3 The effect of noise-reduction of varied mitigation measures[5][6][6]

Measures	Noise reduction dB(A)
Sound insulated windows	15~20
Sound insulation wall	10~15
Enclosing wall	7 ~12
Afforestation	The first 30m make a 5dB(A) reduction. The second 30m make another 5dB(A) reduction. The maxmum reduction is 10dB(A).

5.3.2 Measures for Prevention and Control of Ambient Air Pollution during Operation

(1) Planting Trees by the Roadside

It was reported that the planting of frees can purify and absorb the pollutants from the exhaust of vehicles[7].

The area along the proposed highway is fairly suitable for the growth of trees and shrubs. Therefore, it is recommended that trees and shrubs be planted in the area near the roadside, especially in sensitive areas ,so that the air pollutants from the exhaust of vehicles can be absorbed , the TSP can be purified, the environment can be beautified and the landscape along the route can be improved . As the atmospheric sensitive spots are basically the same as that for acoustic sensitive spots, the measures for planting trees in these places can produce effects in both two aspects.

(2) Strictly examine vehicle exhausts by selectively sampling at toll stations and vehicles

with exhausts greatly exceeding the standard are not be allowed to run on the highway.

5.3.3 Water Pollution and Potential Risk during Service

(1) Sewage form three toll station and management regions (Tongshan, Chongyang, Puqi) should be treated by septic tanks, then used for irrigation and fertilization, garbage should be assembled and treated.

(2) Cargo vehicles which leak and overloaded vehicles are not allowed by the toll stations to run on the highway to prevent them from polluting the water body.

(3) For preventing the pollution to water bodies by leakage accidents of dangerous articles, collision-proof concrete stakes should be set at the road section near Lushui reservoir (K63~K69).

(4) Certifications from public security, fire control, & transportation agencies must be required for passing of vehicles carrying dangerous goods. These vehicles should have obvious marks on them, and should be supervised strictly.

(5) Vehicles carrying dangerous articles should not be permitted running, or should be speed limited on the icy road and in snowy & smoggy weather.

(6) An emergency leading group consisted by local transportation, fire control, and environmental protection agencies should be organized for dealing with the accidents of dangerous article transportation in time and scientifically.

5.3.4 Plantation for Beautification

Planting shrubs & trees in the highway management regions to beautify environmental landscape.

VI ALTERNATIVE SCHEMES

6.1 Route Alignment of the Comparative Scheme

There are three comparative sections: Tongshan town city comparative section, Pufang main plant comparative section, and Puqi outskirts comparative section.

(1) Tongshan town city comparative section

Recommended scheme: K0+000-K19+000, 19.0km long.

Comparative scheme: K0+000 ~ K18+218 (K19+000 in recommended scheme), 18.218km long.

(2) Pufang main plant comparative section

Recommended scheme: K74+800 ~ K84+500, 9.7km long.

Comparative scheme: K74+800 ~ K83+006 (K84+500 in recommended scheme), 8.206km long.

(3) Puqi city outskirts comparative section

Recommended scheme: K90+500 ~ K94+700, 4.2km long.

Comparative scheme: K90+500 ~ K94+357 (K94+700 in recommended scheme), 3.857km long.

See the appendix map for comparative scheme alignment.

6.2 Comparison of the Alternative Schemes

In the determination procedure of alignment scheme, consultations and discussions are made many times among designing unit (Hubei Provincial Communication Planning and Designing Institute), EIA unit(Xian Highway Transportation University) , government agencies, environmental protection departments, city planning departments, deputies to the National People's Congress, and affected masses along the proposed highway. To eliminate the unfavorable impacts by the highway construction, the route makes detour to avoid big villages, schools, etc. In the mean time, the route avoids lakes as far away as possible to eliminate the impacts on water bodies. The comparison of the alternative schemes in the aspects of engineering, economic, environmental and resettlement is shown in table 6-1.

6.3 Conclusion

(1) Tongshan town city comparative section

Advantages of Recommended Scheme:

①In spite of the greater total length of the recommended section, the practical length is 0.386 km shorter when by using 1.15 km of the existing road. Therefore, the land used will be less than the comparative section. Land is very important to the people in Tongshan where it is scarce, so it worth considering in choosing the alignment.

② Located in the light rolling areas, the soil erosion extent of the recommended scheme is 140.5 t/ha.a., while the comparative section is near the mountainous areas where the erosion extent is 210.75t/ha.a. As a result, the loss of water and soil of recommended scheme during the construction stage is less than that of the comparative scheme (See Table 6-1).

③ The recommended scheme passes less rivers, thus causing less impact on water environment.

④ The cost for recommended scheme is lower than that of comparative scheme.

⑤ The recommended scheme is in favour of the public.

Disadvantages of the Recommended Scheme:

① There are more sensitive spots effected by traffic noise and air pollution.

② There are more demolition of housing.

According to the analysis above, the recommended scheme in the Feasibility Study Report has been put forward mainly based on the consideration of the factors as local government and public opinions, engineering investment, and local economic development. Therefore, to mitigate the unfavorable impacts on the environmental sensitive spots, proper environmental protection measures must be adopted.

(2) Pufang main plant comparative section

Advantages of Recommended Scheme :

① Although the total length of the recommended scheme is 1.494 km longer (9.7- 8.806), 5.88 km of highway would be built for the comparative scheme. For the recommended one no new section will be built, thus saving much land.

② The soil erosion resulting from improvement to the existing road is half that of building a new one. The greater erosion resulting from new building (5. 5 km) makes the comparative scheme impractical.

③ The recommended scheme is in favour of the public.

④ Both schemes pass the same number of rivers, but the recommended one passes less streams(same number of culverts), causing slighter impact on water bodies.

Disadvantages of Recommended Scheme

① There are more sensitive spots affected by noise and air pollution for the recommended scheme.

② There is more demolition of housing.

③ The cost for the recommended is higher.

According to the analysis above, the recommended scheme in the Feasibility Study Report has been put forward mainly based on the consideration of the factors as local government and public opinions, and local economic development. Therefore, to mitigate the unfavorable impacts on the environmental sensitive spots, proper environmental protection measures must be adopted.

(3) Puqi city outskirts comparative section

Except for the mileage, the recommended scheme is superior to the comparative scheme in the following ways: land use, house demolition and support from the public. So, the recommended scheme is better than the comparative scheme.

Table 6-1 Comparison of the Alternative Schemes

Factor	Item	Unit	Comparative section						Note
			Tongshan town city		Pufang main plant		Puqi city outskirts		
			Rec.	Com.	Rec.	Com.	Rec.	Com.	
Engin. factor	1. length	Km	19.000	18.218	9.700	8.206	4.200	3.857	
	①original road	Km	1.150	0	0	0	3.900	0	
	②reconstruction road	Km	10.190	10.998	9.700	2.406	0.300	1.000	
	③new road	Km	7.660	7.220	0	5.880	0	2.857	
	2. earthwork	Km^3	286.0	336.0	142.1	213.4	2.3	7.7	
	3. stonework	Km^3	92.8	70.0	68.2	77.8	0	3.4	
	4. drainage protection	Km^3	21.7	17.2	12.9	14.7	0.60	1.90	
	5. culvert	pass	59	70	25	35	0	15	
	①extended	pass	13	13	5	3	0	0	
	②new built	pass	46	57	20	32	0	15	
	6. small bridge	m/ bridge	34/1	207.4/9	30/2	43.5/2	0	0	new built
	7. mid. bridge	m/ bridge	149/3	0	0	0	0	0	new built
	8. large bridge	m/ bridge	170/1	176/1	0	0	0	0	new built
Econom. factor	total cost	x10000 yuan	4843.0	4350.1	2410.2	1874.5	85.3	495.4	
	cost per km	x10000 yuan/ km	239.1	266.2	248.4	288.4	19.4	128.4	
Environment factor	No. of sensitive spots								
	village	No./No.	2/6	1/5	4/6	3/6	0/2	0/1	A/B
	city or town	No./No.	1/1	0/0	0/0	0/0	0/0	0/0	
	school	No./No.	1/6	0/1	0/1	0/1	0/1	0/0	
	hospital	No./No.	0/0	0/0	0/0	0/0	0/0	0/0	
	river	course	5	10	2	2	0	0	
	soil erosion	t/Yr.	3580	5360	1695	2460	31	686	*
	public opinion		agree	oppose	agree	oppose	agree	oppose	
	land taken	mu	292.7	336.1	69.2	235.2	4.5	77.4	
Resettle	house removed	m^2	11589	8300	4970	2400	0	500	

Note: ① The soil erosion of reconstruction road is calculated as half value of the soil erosion intensity of new road.
② A/B= spots beyond standard/total spots
③ *= during construction

Ⅶ LOSS AND BENEFIT ANALYSIS OF THE ENVIRONMENT

7.1 Investment Estimation of Environmental Protection

7.1.1 Investment for Environmental Protection Engineering

Based on the environmental protection measures suggested in this assessment, the lump- sum cost of environmental protection engineering needed for this project is estimated and shown in Table 7-1. Total lump-sum investment for environmental protection is 3,255,000 yuan.

Table 7-1 Investment Estimation of Environmental Protection Measures

Items	Content & estimated method	Cost (x10000yuan)	Environmental benefit
Environmental assessment & design	Environmental monitoring, EIS compiling and EP engineering design	26	Environmental survey & prognosis, EP measures & implementation
Plantation	Grass & trees 2×10000yuan/km×95km	190	eliminate pollution of air &acoustics, protect ecosystem & health of people beautify landscape
Noise control	sound insulation windows & doors,see Tab.5-1 & 5-2	30	mitigate pollution of noise,protect the health of residents & students
Water & soil preservation	earth settling ponds 5000yuan×8pond	4	prevention of soil erosion
Construction dust sprinkling	600day×300yuan/day	18	mitigate air pollution
Water treatment facilities in toll manage-mental station	altogether 3 stations, one septic tank for each station	12	control the pollution of water, especially protect the surface water quality
Staff training	construction unit , management unit, emergency team & other EP concerning agencies	8.5	develop working ability of management, supervision, & emergency dealing experts
Protection of historical relics	investigation cost (not including the unforeseen cost)	20	Protect the historical relics
Cost of environmental monitoring & equipment	monitoring cost 4×10000yuan×3 (use the equipment of Jingzhu Northern Section)	12	environmental monitoring during construction
Measures for Emergency	50000yuan prepare for monitoring fee of emergent accident, the facilities of project Ⅱ can be used	5	Mitigate the pollution of accidents in chemical transportation
Total		325.5	

7.1.2 Yearly Operational Cost of Environmental Protection Facilities

See table 7-2 for the yearly operational cost of environmental protection facilities. Total operation cost in the 20 years long operation stage is 20 year×107,500 yuan = 2,150,000 yuan.

Table 7-2 Yearly Operational Cost of Environmental Protection Facilities

No.	Item	Cost (×10,000 yuan)
1	Yearly maintenance cost of EP facilities	1.5
2	Cost for energy, power, chemicals etc.	2.5
3	Wage and other working pay	5
4	Staff training cost (yearly average during operation stage)	0.25
5	Yearly monitoring cost	1.5
Total		10.75

7.1.3 Comparison of Environmental Protection Costs and Project Costs

The estimated total cost of this construction project is 171.4 million yuan (RMB). The lump-sum cost of environmental protection is 3.255 million yuan. Yearly operation cost of environmental protection is 2.15 million yuan. Environmental protection investment of the whole project takes 3.16% of the total investment in this project. Which shows that the cost of environmental protection is not a major part in the total investment of this project, and the environmental pollution of this project is not serious.

7.2 Analysis of Environmental Loss and Benefit

7.2.1 Analysis of the Environmental Benefit of Environmental Protection Costs

(1) *Direct Benefit*

During operation of the highway, vehicle exhausts will pollute the atmospheric and water environment; dust and noise will impact on the environmental quality in residential areas. The health of people living on both sides of the highway will be affected to some extent and the normal life and work of these people will be affected as well. Therefore, practical environmental protection measures must be taken, such as sound proof measures and plantation along the road sections near sensitive spots to reduce the negative effects caused by traffic on the environment. After taking environmental protection measures, the economic loss that can be retrieved each year or the direct economic benefit of environmental protection will be about 0.642 million yuan, which includes the net output value lost because of workers illness caused by traffic noise and atmospheric pollution; the medical expenditure on illness caused by pollution; the expenditure from social welfare funds on illness and death caused by pollution; the devaluation in real estate in polluted sections; the loss of means of production and livelihood, etc, when environmental protection measures are not taken. See Table 7-3.

Table 7-8 **Direct Economic Benefit Estimation**

Item		Basement	Cost (x10000yuan)
Cost for loss of pollution impact on health of people	Net output value lost because of illness of worker;	Net loss of product value:250yuan/person worker:600 person;	15
	Social welfare for medical cost;	Welfare:50yuan/person patient:1200 person;	6
	Medical cost of hospital for patient ent	Medical cost:200yuan /person, patient:1200 person	24
Cost for loss of Product & living materials	Devaluation of the real estate	1000room, rent price: 80yuan/month.room, devaluation 20%	19.2
Total			64.2

Note: First line house along the roadside:2600room, popullation:3600person, in Which about 1000room and 1200person will be protected by EP measures.

(2) Indirect Benefit

If no effective environmental protection measures were taken along the proposed highway, there would be some indirect negative effects, such as the reduction of the quality of teaching and the quality of life, the agitation of people and social instability factors, etc. in the affected areas. Therefore, after some environmental protection measures being taken, the negative effects mentioned above will not arise and be replaced by positive benefits as a result of this environmental protection investment.

7.2.2 Analysis of Environmental Loss and Benefit

The following formula is used to analyze the economic loss and benefit of the environmental protection measures.

$$E = S / H$$

Where

E—— economic benefit of environmental protection expenditure

S—— economic loss that can be retrieved each year after environmental protection measures are taken

H —— expenditure of environmental protection investment per year

By calculation method mentioned above, we know that after effective environmental protection measures are taken, the economic loss retrieved per year will be 0.642 million yuan, and there will be numerous uncountable indirect economic and social benefits. The expenditure used for environment protection yearly average is 0. 2703million yuan and the economic benefit for environment protection each year is E=2.38, Which illustrates that the investment of environment protection is reasonable. Thus, it is of great importance to execute the environmental protection measures suggested in the EIA when building the highway. The construction unit should take environmental protection measures step by step as suggested in the assessment to ensure the coordinate and sustainable development of construction and environmental protection.

Ⅷ PLAN FOR ENVIRONMENT MANAGEMENT AND SUPERVISION

8.1 Plan for Environment Management

8.1.1 Environment Management Agencies and Responsibilities

Agencies Environmental protection of this project can be divided into two part, management agencies and supervision agencies. See Fig.8-1.

(1) Management Agencies

The Environmental Protection Office of the Ministry of Communications: Be in charge of coordinating the management of environmental protection work in the transportation field. Responsible for pre-examination of the EIA outline and EIA Report.

Hubei Provincial Communication Department (HPCD): General responsible for EP management of the project environmental protection.

Environmental Office of HPCD (has been organized already): responsible for the organizing of EIA work, making EP working plan of the project.

WB Loan Project Office of HPCD: In charge of EP management in design and construction stage.

Hubei Provincial Highway Bureau (HPHB): Be in charge of the implementation and management work during operation stage. See Figure 8-1.

Highway Environmental Monitoring Unit: has been organized in project Ⅲ. Environmental monitoring work during construction & operation stage can be undertaken by the provincial highway monitoring unit, or be entrusted to environmental monitoring station of prefectures or cities.

During construction stage of this project, 3 environmental supervising engineers will be sent by WB Loan Project Office of HPCD to supervise execution of EAP and EP measures regulated in contract. When the construction of this project is finished, Highway Bureaus of Tongshan County, Chongyang County, and Puqi City will assign corresponding specialists in charge of EP work to every road section. Fire control and first aid arrangement will be managed by local county or city governments.

(2) Supervision Agencies

NEPA: the summit authority at the central government for administration of national environmental protection, including overall in charge of the environmental projection management of projects, examining and approval the terms of reference of EIA, examining and approval of EIA report, directing the provincial environmental protecting bureaus to implement various laws and regulations.

HPEPB: Be in charge of project EP supervision and administration, organization and coordinating of project environmental protection service provided by different departments, examining EIA report, or entrusted by the NEPA examining & approval of terms of reference of EIA and EIA report; supervision of implementation of environmental protection action plan; check and acceptance of project environmental protection facilities; identifying

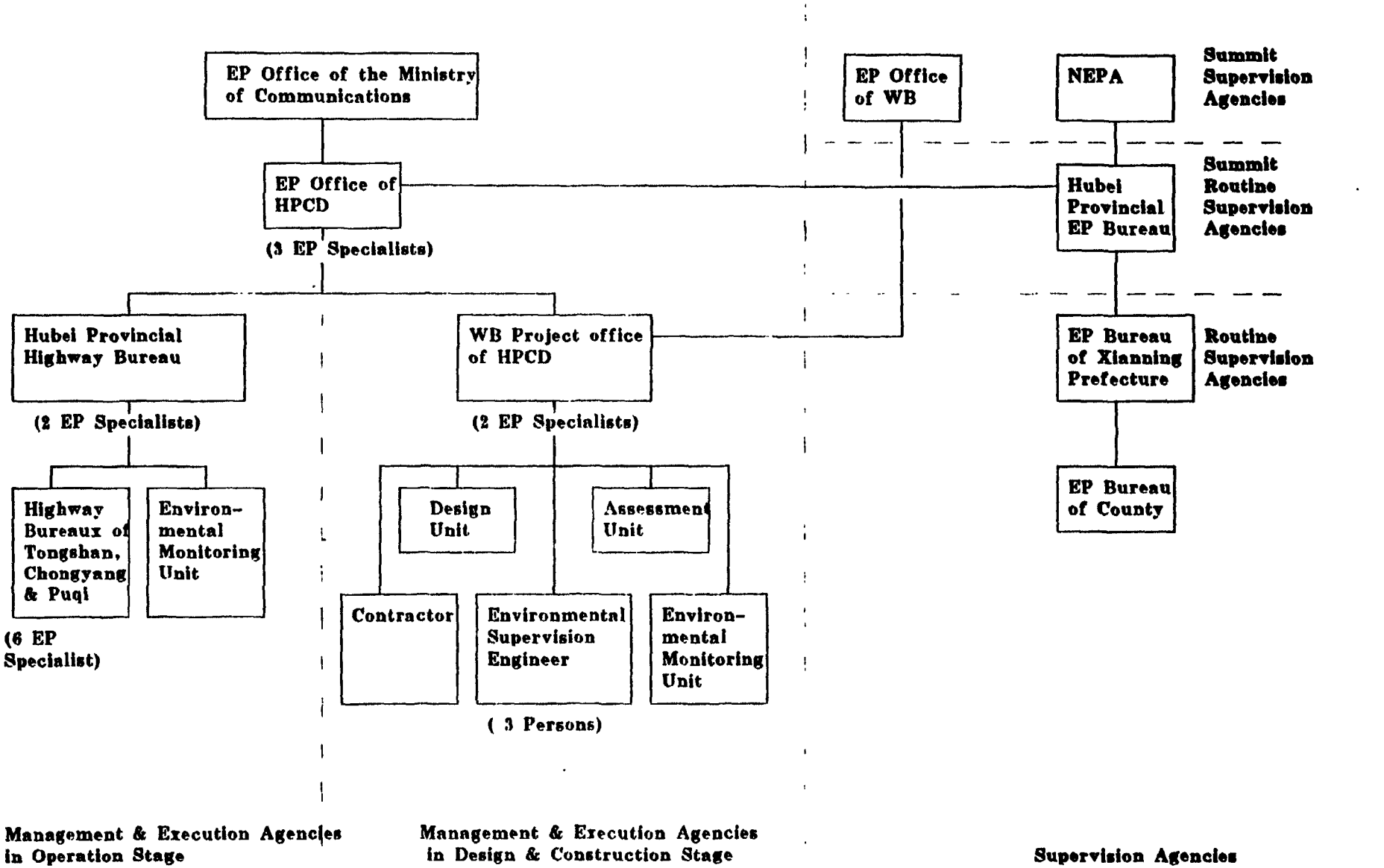

Figure 8-1 Environmental Protection Organizations of the Project

applicable laws, regulations and standards for project environmental protection, directing environmental protection departments or divisions at municipal or district level for project environmental protection management during project construction and operation periods.

Prefecture, City or County EPB: receive instruction from HPEPB; supervising execution of EAP by construction units; administration of the EP management laws & regulations; coordinating EP works of concerning agencies, supervision of project EP facility construction, check and acceptance, operation, within their jurisdiction areas.

8.1.2 Plan of Environmental Management and Environmental Supervision

The plans for environmental supervision and management are shown in Table 8-1 & 8-2.

Table 8-1 Environmental Management Plan

Environmental problems	Mitigation measures	Action unit	Agencies in charge
A . Design stage			
1. Farmland occupation	Compare alternate schemes to select a recommended scheme for being far away from villages and schools, less farmland occupation.	Design & assessment units	WB Project Office of HPCD
2. Soil erosion	Afforestation and plantation on roadside along the route, construction of soil retaining wall, intercept ditch and mortar bound.	Design & assessment units	WB Project Office of HPCD
3. Noise	Adopt mitigation measures at sensitive spots beyond standard.	Design & assessment units	WB Project Office of HPCD
4. Air pollution	Proper selection of quarry or earth borrowing site, spoil area, location of mixing plant, taking into account of sensitive receivers.	Design & assessment units	WB Project Office of HPCD
5. Historical relics	Investigation for the historical relics along the proposed expressway.	Provincial Historical Relics Research Institute	WB Project Office of HPCD
6. Land acquisition & resettlement	Land acquisition & resettlement will be done properly by the local governments.	Local governments	WB Project Office of HPCD
7. Accident caused by dangerous articles leakage in transportation	Collide-proof banisters will be strengthened on bridges to prevent from vehicles dropping into the rivers in accidents of dangerous article transportation.	Design & assessment units	WB Project Office of HPCD

Continuation of Table 8-1 Environmental Management Plan

Environmental problems	Mitigation measures	Action unit	Agencies in charge
B.Construction stage			
1.Ecological resource	.No earth borrow site in forest land. .Avoid earth borrowing from farm land. As to the temporarily occupied lands, the surface layer soil will be preserved and put back after construction for reducing the impact as much as possible. .Education and training of the workers to protect the wild animals & plants,hunting is prohibited strictly. .Earth borrowing site will be better chosen at the location of future fish pond. .Disposal of engineering earth and rock will made without plight farm land and other facilities or blocking rivers, disposal sites will be decided in consultion with local Environmental Protection Bureaus.	Contractor	WB Project Office of HPCD
2.Soil erosion and irrigation	.Tree or grass plantation on roadside will be done three months after construction of subgrade, and also rehabilitation or reconstruction of damaged irrigation or drainage facilities. .Necessary measures will be adopted to prevent the river,water channel or existing irrigation & drainage system from being blocked by soil & stone. .While permanent drainage system being built,temporary ditch or pipeline will be built for irrigation & drainage. .Reasonable measures will be taken to prevent direct discharge of waste water into the river & irrigation system.	Contractor	WB Project Office of HPCD
3.Water pollution	.Reasonable procedures will be taken as cofferdam method or drop shaft sinking in bridge construction to prevent water pollution of rivers. .Sewage, garbage of construction camp will be assembled and treated before discharge Dry toilets and septic tanks must be built for sewage disposal. Garbage will be concentrated in the garbage heaping plants .Environment management and protection education to workers will be strengthened for strictly checking the machines and ships to prevent oil leakage.Dumping of waste oil into water bodies will be banned .Construction materials as asphalt,oil & chemical articles will not be allowed piling up near wells or rivers,and mufflers will be prepared for covering these materials from being washed into water bodies in windy or raining days.	Contractor	WB Project Office of HPCD

Continuation of Table 8-1 Environmental Management Plan

Environmental problems	Mitigation measures	Action unit	Agencies in charge
4.Noise	.Strictly implementation of industrial noise standard to protect the workers from being hurt by noise. Using ear plug & helmet,and strictly limiting working time schedule. When the construction operations have to carry out at night, some noise -reduction measures will be taken like to slow down the speed of transport truck and/or forbid to blow horns. .No night time work (22:00~6:00)when there is residential areas within 150m. .Construction unit will negotiate with the teachers about the working schedule to reduce the noisy disturbance to routine teaching of schools. .Meticulous maintenance of the machine & work shifting time to mitigate the noise impact.	Contractor	WB Project Office of HPCD
5.Air pollution	.All reasonable measures including sprinkling (especially in dry season)to reduce air pollution of construction, pay attention to the impact on nearby residential sites .Materials yards and concrete mixing plants will be at least 200m away from residential regions. .The bulk materials will be covered either in storage or transportation. .Mixing plant of asphalt will be at least 300m away from sensitive spots and downwind of the nearest sensitive spot. .Space of mixers will be separated to prevent air pollution.Pay attention to the health of workers.	Contractor	WB Project Office of HPCD
6.Historical Relics	Excavation will be stopped immediately when a historical relic site is found,and domestic historical relic management agencies will be informed simultaneously.Excavation must be prohibited before appraisal of the site and adoption of protection measures.	Contractor	WB Project Office of HPCD
7.Trasportation management	.Careful route selection for construction materials transport,avoiding long distance transport and impact on existing highway facilities. Mitigate pollution of traffic dust and traffic noise. .Rational scheme and measures will be carefully considered when temporary road for construction crosses existing road. .Construction material transportation will be planned to avoid traffic peak hour of existing road.	Contractor	WB Project Office of HPCD

Continuation of Table 8-1 Environmental Management Plan

Environmental problems	Mitigation measures	Action unit	Agencies in charge
8. Construction safety	.Lighting and safety signs and marks will be provided on temporary road, rational traffic regulation will be adopted .Effective safety and warning signals will be adopted during construction stage, such as careful checking and thoughtful arrangement in explosion work to prevent any accident, strict management of explosive materials by following safety requirements set by the public security department.	Contractor	WB Project Office of HPCD
C. Operation Stage			
1. Noise and air pollution	.Set horning banned marks at sections near schools . . In regional planning, units as residential sites are avoided within 60 m and schools and hospitals are avoided within 200m along the highway, which should have a better environment. . Insulated windows and other noise proof measures will be adopted at sites beyond standard. See table 5-1 & 5-2. .Afforestation and plantation at both sides of the road to mitigate air pollution.	Highway Bureau of city or counties Governments of city or counties	Hubei Provincial Highway Bureau
2, Water pollution	. In toll management zone, septic tank will be built to treat sewage. Only after treatment, can it be used in irrigation or fertilization, Garbage will be assembled then disposed. .Small style waste water treatment facilities will be set up in service regions along the expressway. After treatment, the waste water can be discharged or used for irrigation. Garbage will be assembled for disposal.	Highway Bureau of city or counties	Hubei Provincial Highway Bureau
3. Management of vehicles	Strenthen vehicle maintenance & management to insure road worthness of the vehicles, strenthen vehicle emission inspection & implementation of the noise and emission standards, no permission or certificate issued for unqualified vehicles	Highway Bureau of city or counties & Police and communication agencies	Hubei Provincial Highway Bureau

Continuation of Table 8-1 Environmental Management Plan

Environmental problems	Mitigation measures	Action unit	Agencies in charge
4. Risk of dangerous article transport	.An emergency leading group consisted by the concerning agencies in Highway Management Bureau and EP Bureau of Hubei Province in project Ⅲ, which is for dealing with the leakage accidents of dangerous articles specially. Now this group is in charge of the management of dangerous article transportation on this proposed highway too. .Three certificate are required for dangerous article transportation: transportation permission, driver's license and safety escort certificate. Dangerous marks must be set on the vehicles. .Special route and parking spots will be specified by the public security bureau . . In case of the accident caused by dangerous article leakage, concerning agencies will be informed immediately, emergency actions will be followed based on the plan	Highway Bureau of city or counties & Police and communication agencies	Hubei Provincial Highway Bureau
D. Environmental Monitoring	Implement environmental monitoring work according to the specifications issued by NEPA in forms of monitoring standard and method.	Montoring units belong to HPCD	Hubei Provincial Highway Bureau

Table 8-2 Environmental Protection Supervision Plan

Stage	Agency	Work content	Purpose
Feasibility study stage	NEPA HPEPB WB	1. Examine the TOR of EIA. 2. Examine the EIA report. 3. Examine the EP action plan.	1. To ensure the EIA content has a fully covered topic arrangement, with key points highlighted. 2. To ensure the possible serious problems of the project to be addressed properly. 3. To ensure the feasibility of action plan.
Design & construction stage	NEPA HPEPB EPB of city or counties	1. Examine preliminary design for environment protection & EAP. 2. To examine the realization of cost for environmental protection. 3. To check material handling, asphalt and concrete mixing plants arrangment. 4. To check dust & noise control measures & work time schedule. 5. To check the storage & emission of poisonous or harmful material. 6. To check discharge & disposal of waste water or waste oil. 7. Cutting & borrowing site, spoils disposal, soil erosion, blocking of drainage system & rivers. 8. To check the implementation of "Three simultaneous" policy & EPA, to perfect the implementation work. 9. To examine the environmental protection facilities.	1. To carry out the "Three Simultaneousness" policy and EAP. 2. To ensure investment for environmental protection. 3. To make sure the work site meet the requirements of environmental protection. 4. To reduce the impact. To ensure the implementation of regulations 5. To reduce the impact on the surrounding & to implement the regulations 6. To make sure surface water not to be polluted. 7. To make sure the landscape & the land resources being preserved & resumed. 8. To make sure the implementation of EP policies. 9. To make sure the environmental protection facilities meet the acceptance level.
	Hubei Provincial Historical Relics Bureau	10. To check if there are any historical relics.	10. To protect historical relics.
Operation stage	HPEPB EPB of city or counties	1. Check the implementation of EPA. 2. Check the implementation of monitoring plan. 3. Inspect the sensitive spots to find environmental problems. 4. Inspect the enviroment of sensitive regions based on the standard. 5. Check waste water and garbage disposal in toll station and management zones. 6. Strengthen accident management and monitoring system, set up emergency action plan for emergencies and to prevent pollution from spreading once accident happens.	1. To ensure realization of EPA. 2. To ensure realization of monitoring plan. 3. To ensure consideration of various environmental problems. 4. Strengthen environmental management, to protect health of people. 5. To ensure waste water discharged meet the discharge standard. 6. To eliminate the causes of accident in traffic to avoid pollution accident.

8.2 Environmental Monitoring Plan

8.2.1 Monitoring Purpose

The environmental impact during construction stage mainly includes river water pollution caused by construction of bridge; noise from construction machines, soil erosion caused by

earth and stone cutting & filling, flying dust and asphalt smoke from the mixing plants, and other pollution. During operation stage, the impact on environment is mainly by traffic exhausting gas, flying dust, and noise, serious pollution caused by emergent accident. Therefore, it is necessary to understand the environmental situations and development trend to improve environmental management in implementation of monitoring plan.

8.2.2 Monitoring Agencies

Environmental monitoring work in construction & operation is in charged by Hubei Provincial Highway Environmental Monitoring Unit. This agency has been organized in project Ⅱ already. The monitoring work of proposed highway is also taken care by it.

8.2.3 Monitoring Plan

The routine monitoring work is undertaken by the Hubei Provincial Highway Environmental Monitoring Unit. See (1) ~ (4) in monitoring plan of table 8-3.

The key points in monitoring is air, water, and noise, according to the requirement environmental monitoring, on-the-spot or mobile monitoring, fixed time or random time sampling methods are all be arranged in the work.

In the implementation of monitoring plan, the problems as monitoring method, purpose, staff training, etc. should be determined by the monitoring unit under HPCD and the entrusted unit together. The monitoring plan will be implemented according to the contractor.

Table 8-3(1) Air Environmental Monitoring Plan

Phase	Location	Item	Frequency	Duration	Sampling	Action unit	Unit in chage
Construction period	Asphalt mixting plant	TSP, asphalt smoke	once per week	1 day	construction time, twice/day (am. & pm.)	Monitoring unit under HPCD	WB Project Office of HPCD
	Concrete mixing plant, unpaved road section	TSP	Inspect randomly	1 day	Ditto	Ditto	Ditto
Operation period	Tongshan Town Lukou Town Tiancheng Town Puqi High Sch. Mingshui Prim.Sch. Dalu Township Qiaobian Prim.Sch. Hongxia Village Shuangpailin Village	NOx CO TSP	twice/year (1 each in Jan & July)	5 days	7:00 10:00 14:00 17:00	Ditto	Hubei Provincial Highway Bureau

Note: Frequency of monitoring can be increased as required during construction.

Table 8-3(2) Ambient Noise Monitoring Plan

Phase	Location	Item	Frequency	Duration	Sampling	Action unit	Unit in chage
Construction period	Mingshui Prim.Sch. Tongyang No.3 Prim.Sch. Dalu Township Lubian Prim.Sch. Tiancheng Mid.Sch. Hongxia Village Shuangpailin Village Tongcheng Town Lukou Town Tiancheng Town Puqi High Sch. Tongyang Town Chezhan Township	Noise	once per week	1 day	construction time, twice/day (am. & pm.)	Monitoring unit under HPCD	WB Project Office of HPCD
Operation period	Mingshui Prim.Sch. Tongyang No.3 Prim.Sch. Dalu Township Lubian Prim.Sch. Tiancheng Mid.Sch. Hongxia Village Shuangpailin Village Tongcheng Town Puqi High Sch. Tongyang Town Chezhan Township	Noise	4 times per year	1 day	One in day-time,another in night	Ditto	Hubei Provincial Highway Bureau (HPHB)

Note: Frequency of monitoring can be increased as required during construction.

Table 8-3(3) Water quality monitoring plan

Action phase	Location	Item	Frequency	Duration	Sampling	Implement agency	Agency in charge
Constuction stage	Fushui River Tongshan River Baini River Lushui River Lushui Reservoir	COD_{Mn} Pb oil	once / week	1 day	twice/day am. & pm.	Monitor-ing unit under HPCD	WB Project Office of HPCD
Operation stage			twice / year (normal water level & low level)				HPHB

Note: Frequency of monitoring can be increased as required during construction.

8.2.4 Monitoring Equipment, Cost and Report Institutional Arrangement

Monitoring equipment in project Ⅱ can be used in this project too, no acquisition for new equipment.

Monitoring cost during construction: 40,000yuan/year × 3year= 120,000 yuan;

During operation: 15,000yuan/year ×20year= 300,000 yuan;

Contingent accident monitoring cost (unforeseen): 50,000 yuan.

Monitoring report institutional arrangement is shown in Fig 8-2.

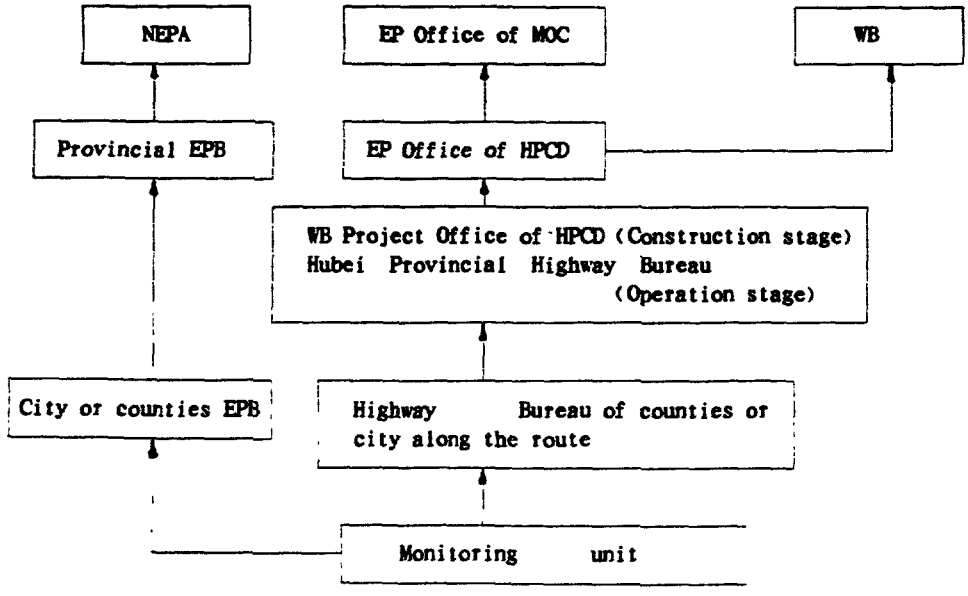

Fig.8-2 Monitoring Report Procedure

8.2.5 Environmental Protection Staff Training

For the proposed highway is Class 2 highway, abroad training will not be arranged. Staff training in our country includes environmental management, environmental supervision engineer, and emergency dealing experts. The national training plan of environmental protection in this project is specified as follows: 14 persons of environmental management expert, 3 persons of environmental supervision engineers, 6 persons of emergency dealing experts (toll station environmental monitoring experts are the same as emergency dealing experts) , altogether 23 persons, total cost for training is 135,000yuan. See table 8-4.

(environmental monitoring experts are same people in project Ⅱ)

Table 8-4 **EP Staff Training Plan**

Stage	Speciality	Personnel assignment	Subtotal	Time (Yr.)	Cost (yuan)
Constr-uction	Environmental management expert	Provincial Highway Bureau, Highway Bureaus of Tongshan County, Chongyang County, and Puqi City one person for every agency	4 persons 2 weeks	2000	20,000
	Environmental supervision engineer	Tongshan County, Chongyang County, and Puqi City one person for every road section	3 persons 2 weeks	2000	15,000
	Emergency dealing expert	Highway Bureaus of Tongshan County, Chongyang County, and Puqi City 2 persons for every agency	6 persons 2 weeks	2000	50,000
Opera-tion	Environmental management expert	3 persons for toll management stations of cities or counties one person for Provincial Highway Bureau	10 persons 2 weeks	2000~ 2002	50,000
Total			23 person		135,000

Ⅸ PUBLIC PARTICIPATION AND ITS ANALYSIS

9.1 Scope of and Method for Public Participation

In Dec.1997, the EIA group of this project made public surveys in the areas that will be affected by the proposed highway in Tongshan County, Chongyang County and Puqi City. We held meetings and delivered questionnaires to collect opinions from representatives of NPC (National People's Congress), people's governments at different levels, social organizations along the route, and members of the public in the affected area on both sides of the route. They also consulted environmental protection organizations, agricultural organizations, forestry organizations and transportation organizations about environmental protection along the route. 96 peoples took part in the meetings and consultations.

9.2 Statistical Result of Public Participation

The hearings along the proposed highway were carried out in Dec. 1997. The issues discussed (e. g. the impact of noise and air pollution) with the villagers and the opinions from the participants (the impacted people , social organizations and peoples governments along the proposed highway) are summarized as follows.

The statistical results of public participation are shown in Table 9-1, the results show:

(1)Concerning government agencies of cities and counties show warm attitudes to this project. They promise to cooperate in land acquisition and resettlement, also provide convenience for construction.

(2)Local government agencies along the proposed highway support the recommended scheme. Among them, government agencies of Tongshan County insists the recommended scheme of Tongshan section extremely.

(3)Among the investigated people, 77% of the public had understood the highway project, other 23% of the public understood the route alignment and the project through our investigation and introduction.

(4)98% of the public hope that it would be built as soon as possible. It can be see that the public hope the construction of this project would greatly change the present poor transport situation.

(5) 92% of the people believe that the construction of the highway would be favorable for local economic development.

(6) As to the requirement about removal and resettlement, 90% of the people hope that they could be resettled in their own village.

(7) Teachers of the impacted schools ask for construction of surrounding walls to minimize noise and protect safety of their students.

9.3 Analysis of Public Participation and Solutions to Problems

(1)Land acquisition and removal: Economic compensation for land acquisition & removal is strictly based on the regulations of polices. Ensure the compensation be paid practically, no

Table 9-1 Statistics of Public Suggestions about the Proposed Project

Content of Investigation		Number of People	Percentage of People (%)
Understanding extent of the highway	Much	26	27
	A little	48	50
	No	22	23
Satisfaction degree of the present traffic situation	quite satisfied	22	23
	Basically satisfied	48	50
	Not satisfied	26	27
Unfavorable impact on residential, living environment	Great	6	6
	Slight	78	81
	No idea	12	13
Attitude to removal & resettlement	Expect to be resettled in their own village	86	90
	Expect to be resettled in the other village	10	10
Relation between the highway construction and local economic development	Favorable	90	94
	Unfavorable	-	-
	No idea	6	6
Whether agree to the route alignment	Yes	88	92
	No	6	6
	No idea	2	2
Attitude to this project	Start as soon as possible	94	98
	Postpone the work	-	-
	Cancel	2	2
Time of Investigation	December 14~26, 1997		
Site of Investigation	Tongshan Couty, Chongyang Couty, Puqi City		
Number of People	96		

other usage is permitted. Works of this part for public or individuals should be done carefully and considerately. It is critical for highway construction.

(2)Resettlement: Resettlement of removed families should be in time & rationally. Every family of removal will be asked for its permission before construction. Contractions will be signed to local governments. Reasonable resettlement as no economic loss, no reducing of living conditions should be achieved.

From the analysis above, demands and suggestions of public opinions have already been considered in highway design stage. Land acquisition, house removal and resettlement during construction should be implemented gradually and rationally which can be accepted by the local public. Thus, the unfavorable impact of this construction project can be reduced to a smallest extent.

In order to know the comments about the construction of the project and the attitude of the public toward the mitigative measures in the EIA, public hearings were held by the Environmental Assessment Panel of Xian Highway University and the designers of Hubei Provincial Communication Planning and Design Institute among the masses concerned. In short words, the public likely to be affected by the project is in favor of the mitigation measures in the report of EIA, expressing very high enthusiasm in construction of the highway. They express their genuine thanks to the World Bank and the Chinese Government for their concerns about the issues of environmental protection in the highway construction. The major schools investigated and villages are: Tongyang No. 3 Primary School, Tongyang Forest Primary School, Tiancheng Sec. School, Puqi High School, Dalu Village and Hongxia Village, etc.

X CONCLUSION

10.1 Assessment Conclusion of the Present Environment

(1) Farm crops (vegetables) and soil environmental quality along the route have not polluted by Pb yet. Organic matters content of soil is met the medium or lower level in the average level of Hubei Province.

(2) Among the 7 acoustic monitoring spots (villages or schools) along the route, except Tongyang No.3 Primary School and Tiancheng Middle School, all other spots satisfied pertinent class in GB3096-93 noise standard. As to these two Schools, for they are locating at a street side of Tongyang Town or Tiancheng Town, noise from present traffic and trade center has made the schools beyond standard already.

(3)There are 5 rivers and 1 reservoir in the assessment scope. Among them, water quality of 3 rivers and 1 reservoir (Tongshan River, Lushui River, Lushui Reservoir) meets Class Ⅱ of original standard, which is better than the Class Ⅲ of present excecuting standard (GB3838-88) . While water quality of other 2 rivers (Fushui River, Baini River) meets Class Ⅳ of original standard, which is a little beyond Class Ⅲ of present excecuting standard (GB3838- 88) , the major beyond standard item is organic matter which is caused by organic pollution.

(4) Ambient air quality along the route is quite good, 4 air monitoring spots distributed in town, village or school all satisfied class 2 in Ambient Air Quality Standard (GB3095-1996).

10.2 Prediction and Assessment Conclusion of Environmental Impact

10.2.1 Stages of Design and Construction

(1)The impacts upon the ecological environment during highway construction are the occupation of farmland, damage to vegetation, and loss of water and soil. They can be alleviated if environmental protection measures are undertaken, such as the reasonable selection of route alignment, the timely recovery of farmland and the building of intercepting ditches, retaining walls and settling basins.

(2) As to the impact upon the surface water environment during construction, if the EP administration and education are strengthened, rational construction procedures are adopted in bridge construction, and measures are carried out at toll management stations, the quality of surface water will not be obviously polluted.

(3)The impacts upon acoustic and air environmental quality during construction are mainly the noise of construction machinery, dust and asphalt smoke pollution. The environmental quality of sensitive spots, such as villages and schools along the route will not be affected to a great extent if construction time and locations of asphalt concrete mixing plants are reasonably arranged and selected.

(4) There is no distribution of rare animals and plants in the assessment area along the proposed highway, therefore, the construction of it will have no effect on them.

(5) No important historical relics existed in the assessment scope along the proposed highway.

(6) The scheme of the proposed highway is supported by the local governments and most of the

people along the route.

(7) The recommended scheme in the Feasibility Study Report has been put forward mainly based on the consideration of the factors as local government and public opinions, engineering investment, and local economic development. Therefore, to mitigate the unfavorable impacts on the environmental sensitive spots, proper environmental protection measures must be adopted.

10.2.2 Operation Stage

(1) Lead content in traffic dust and exhaust gas is the primary reasons caused the impact on ecological environment during operation stage. However, because of the little amount of dust worn on the surface of plants, and the abundant precipitation, influence of traffic is relatively light. According to the prognosis of lead content in soil, in the end of year 2022, it will still remain a large range between the lead content in soil and the limitation of standard (calculated by vehicle exhausted lead).

(2) The road surface runoff will have little impact on water quality of the rivers and reservoir. The slight impact on the whole reservoir can be neglected. Sewage of toll management station will be treated by septic tank before using in irrigation, which can be a solution of the surface water pollution problem by waste water utilization .

(3) Risk of the transportation of dangerous articles must be pay attention to, especially in the section of Lush reservoir, the protection measures must be implemented.

(4) During the middle operation stage (in year 2010), there will be 10 sensitive spots (9 villages and 1 school) beyond the standard, noise proof measures will be necessary.

(5) Exhaust gas from vehicles will reduce the ambient air quality along the route, but the ambient air quality of affected area will not surpass the limitation of Class 2 in "Environmental Air quality Standard" (GB3095-1996).

(6) It is shown in the analysis of the environmental economic loss and benefit that the social and economic benefit is remarkable to carry on these environmental protection measures suggested in this EIS.

In brief, the construction project (Tongshan-Chongyang- Puqi Highway of National Highway Project Ⅳ in Hubei Province) will greatly improve the present state of transportation, and accelerate the economic development of local poverty regions. It will also promote the tourism of the remote regions of Hubei province. The construction of the project will result in some negative environmental effects along the route, such as loss of land resources, damage to vegetation and the reduction of environmental quality, etc. But when corresponding mitigation measures are taken, the negative effects upon the environment can be alleviated or eliminated. Therefore, this environmental impact assessment believes that the construction of Tongshan -Chongyang-Puqi Highway of National Highway Project Ⅳ in Hubei Province is feasible.

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Appendix I

The Other Environmental Sensitive Spots along the Proposed Highway

No.	Pile Number	Name	Belong to	Distance from the road centre-line(m)
1	K2+700	Zhujia Village	Tongshan Couty	50
2	K10+000	Wujia Village	Tongshan Couty	120
3	K16+400	Fengjiawu Village	Tongshan Couty	40
4	K19+150	Qiaocaicang Village	Chongyang Couty	30
5	K22+000	Nanlinqiao Village	Chongyang Couty	150
6	K30+250	Hongshiqiao Village	Chongyang Couty	15
7	K31+300	Chengjia Village	Chongyang Couty	130
8	K42+600	Chengshanbu Village	Chongyang Couty	120
9	K59+100	Lumenpu Village	Chongyang Couty	150
10	K62+000	Lumengong Village	Chongyang Couty	50
11	K68+900	Madibian Village	Chongyang Couty	50
12	K70+400	Dawulijia Village	Chongyang Couty	40
13	K70+850	Shizui Village	Chongyang Couty	15
14	K71+300	Fengshuwangjia Village	Chongyang Couty	50
15	K71+400	Xujia Village	Chongyang Couty	80
16	K73+100	Zhushuwan Village	Chongyang Couty	40
17	K74+300	Dongliupu Village	Chongyang Couty	30
18	K77+450	Xietang Village	Chongyang Couty	30
19	K78+450	Taohuaping Village	Chongyang Couty	20
20	K79+300	Yanmatang Village	Puqi City	30
21	K80+800	Zhangjiabian Village	Puqi City	100
22	K81+500	Tongjiazui Village	Puqi City	80
23	K81+700	Chenjiawan Village	Puqi City	40
24	K82+000	Zhongmatou Village	Puqi City	20
25	K82+750	Shangfangzi Village	Puqi City	100
26	K83+650	Puerling Village	Puqi City	40
27	K84+400	Zhushanchengjia Village	Puqi City	100
28	K84+800	Hejia Village	Puqi City	50