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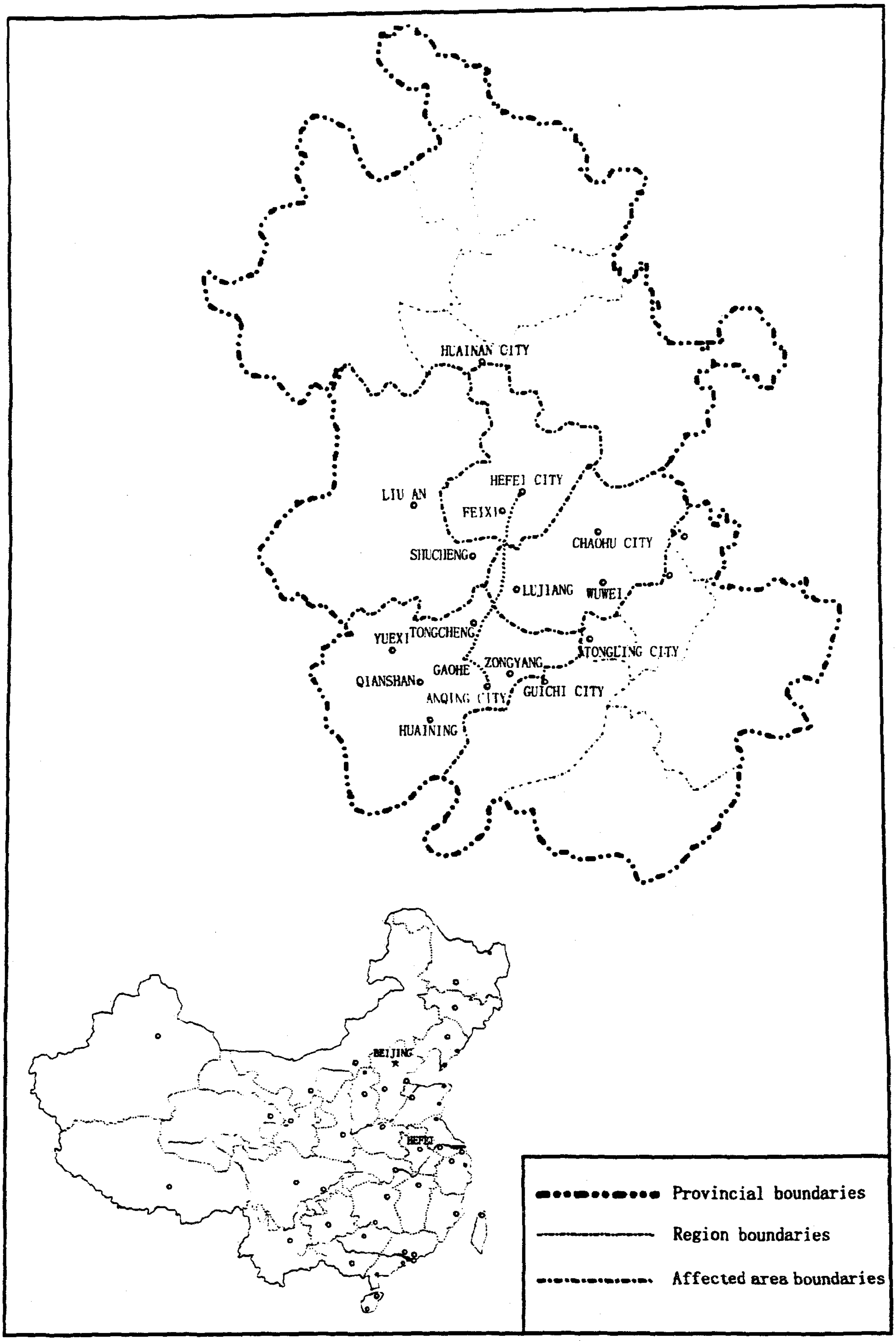
E-278
VOL.3

PEOPLE'S REPUBLIC OF CHINA
ANHUI PROVINCIAL HIGHWAY PROJECT
HEFEI ~ GAOHEBU ~ ANQING EXPRESSWAY

STATEMENT OF ENVIRONMENTAL IMPACT ASSESSMENT

HIGHWAY RESEARCH INSTITUTE
OF MINISTRY OF COMMUNICATIONS, P. R. CHINA

JUNE 1998



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ABBREVIATIONS

AHHAB: Anhui High-grade Highway Administrative Bureau
APCD: Anhui Provincial Communications Department
APEMCS: Anhui Provincial Environmental Monitoring Central Station
(A)PEPA: (Anhui) Provincial Environmental Protection Bureau
APHAB: Anhui Provincial Highway Administrative Bureau
EIA : environmental impact assessment
EMP: environmental monitoring plan
EP: environmental protection
EPO: Environmental Protection Office
GAH: Gaohebu-Anqing Highway
HAE: Hefei-Gaohebu-Anqing Expressway
HGE: Hefei-Gaohebu Expressway
HRI: Highway Research Institute
LEMS: local environmental monitoring station
MOC: Ministry of Communications
TOR: term of reference

PREFACE

The expressway section of Hefei ~ Gaohebu ~ Anqing in Anhui Province of the Shanghai ~ Chengdu Highway is part of the national artery highway framework which consists of two from-north-to-south highways and two from-west-to-east ones. It is one of the principal construction projects in the Ninth Five-year Plan of the country and of Anhui Province, and now it is trying to be listed into WB's construction loaning plans.

The feasibility studies of the project started in 1993, and resulted in the *Statement of Preliminary Feasibility Studies of the H ~ G Section and the G ~ A Section* which was compiled by the Anhui Provincial Highway Survey and Design Institute and the Highway Plan and Design Institute of MOC. In June, 1996 MOC examined and approved the *Proposal of the Hefei ~ Gaohebu Highway Project* and submitted it to the National Planning Committee. The *Statement of Engineering Feasibility Studies* of the project was completed in August of that year.

APHAB entrusted the HRI of MOC with the EIA job in July, 1996. In Jan., 1997, the environmental situations along GAH were investigated, and the TOR was revised according to *the Statement of Engineering Feasibility Studies.*

In April, 1997, WB carried out the highway project, and went to some of the sections of the highway for an on-the-spot survey.

The EIA work has been done under the support of departments of Anhui Province such as APCD, APHAB, the Provincial Highway Survey and Design Institute, the Provincial Environmental Protection Bureau and the Provincial Environmental Monitoring Station. We would like to express our hearty thanks to them.

CHAPTER ONE INTRODUCTION

1.1 Background

With the Anhui. High. Fr. [1996] No. 11 Document and according to relevant national environmental protection laws and regulations, the Anhui Provincial Highway Administrative Bureau entrusted the Highway Research Institute of MOC with the EIA of this project. A group of EIA workers made an on-the-spot survey to the Hefei ~ Gaohebu Section and the Gaohebu ~ Anqing Section in early September, 1996, and completed the first draft of the TOR. The draft of TOR ready for examination was finished in February, 1997 on the basis of the Statement of Engineering Feasibility Studies. In April, NEPA entrusted its Estimation Center of Environmental Engineering to sponsor the technical examination of the TOR, and on April 16, NEPA rendered its comments on the TOR in *the Envir. Super. Constr. [1997] No. 098 Document.*

The monitoring of environmental baseline has been undertaken by the Anhui Provincial Central Station of Environmental Monitoring, who provided the relevant data. Investigations on public participation have been done with the help of the local communications bureaus along the route. The monitoring data obtained from the control spots and other information have been analyzed, calculated and synthesized by the EIA group in different subjects, on the basis of which the Statement of EIA of this project was compiled.

1.2 Assessment Objectives

(1) Provide qualitative or quantitative description, prediction and assessment of the range and degree of impact of the project on the social, economic, natural and ecological environment and life quality of areas along the route in periods of design, construction and operation of the highway, and provide basis for the best choice in route selection;

(2) put forward feasible mitigate and compensative measures for the pollution and local damage of vegetation caused by the construction and operation of the project, and thus minimize the adverse effects and provide basis for further environmental engineering design;

(3) provide information and scientific basis in perspectives of environmental protection and macroeconomy for the environmental management of the project and the economic developing plan of areas along the line, and provide the policymakers with effective evidence of a coordinate and continuous development of socioeconomy, communications and environmental protection in areas along the line.

1.3 Assessment Basis

(1) The National Environmental Protection Law of P. R. China;

(2) The National Water and Soil Conservation Law of P. R. China;

(3) The National Land Administration Law of P. R. China;

(4) The National Noise Pollution Prevention and Control Law of P. R. China;

(5) "(86) National Environ. No. 003 Document: Environmental Protection Methods of Construction Projects";

(6) "NEPA et al. (1993) No.324 Document: Notice on Strengthening the Administration of EIA on Projects Funded by International Financial Organizations";

(7) "Ministry of Communications (90) No. 17 Order: Environmental Protection Methods of Communications Construction Projects";

(8) "Norms for EIA of Highway Construction Projects" JTJ005-96;

(9) " Technical Guidelines of EIA: Acoustic Environment" HJ/T2.4-1995;

(10) "Detailed Implementation Principles of Environmental Protection Management of Construction Projects", Anhui Provincial Environment Committee, Provincial Planning Committee and Provincial Economy Committee;

(11) "Temporary Provisions on EIA of Construction Projects" (for trial implementation), Anhui Provincial Department of Environmental Protection of Urban and Rural Construction;

(12) "Statement of Engineering Feasibility Studies of HGE in Anhui Province of the National Artery Highway Shanghai ~ Chengdu", Anhui Provincial Highway Survey and Design Institute and the Highway Planning and Design Institute of MOC, July, 1997;

(13) Comm. Let. Plan. [1996] No. 238 "Letter on the Examination and Comments on the Project Proposal of the Hefei ~ Gaohebu Highway", MOC of P.R. China;

(14) Anhui. Comm. Prin. (96) No. 27 Document: "Request Submitting the Preliminary Feasibility Studies (as the Project Proposal) of Constructing Section Hefei ~ Gaohebu of the Shanghai ~ Chengdu Highway with WB Loans", Anhui Provincial Communications Department;

(15) TOR of HGE in Anhui Province of the Shanghai ~ Chengdu Highway;

(16) Envir. Moni. Constr. [1997] No. 098 "Letter in Reply Concerning the Examination and Comments on the TOR of HGE in Anhui Province of the Shanghai ~ Chengdu Highway", NEPB;

(17) Nat. Envir. Est. Cen. [1997] No. 026 Document: "Estimating Comments on the TOR of HGE in Anhui Province of the Shanghai ~ Chengdu Highway", the Environmental Engineering Estimate Center of NEPB;

(18) Envir. Nat. Lets. [1997] No. 109 and [1997] No. 180: "On Confirmation of the EIA Implementation Norms of HGE in Anhui Province of the Shanghai ~ Chengdu Highway" and the Supplementary Comments, APEPB.

1.4 Assessment Scope and Assessment Duration

(1) Assessment scope. According to the characteristics of the environmental impact during the construction and operation periods, the assessment scope of ecological, acoustic and atmospheric environments is defined as within 200m from the central line of the proposed highway, which may be expanded if there are some sensitive spots such as schools, hospitals or residential areas. The assessment scope of socioeconomic environment is normally defined as within the directly influenced areas.

(2) Assessment duration. It is divided into 2 periods of construction and operation, with the years of 2001, 2010, and 2021 as the representatives.

1.5 Project Characteristics, Subject Selection and Environmental Protection Targets

1.5.1 Project characteristics

HAE is a newly constructed, large scaled project which has great significance. Since its construction and operation will bring far-reaching influence to bear upon the natural and social environments along the line, it is necessary to make a detailed EIA for this development project.

1.5.2 Subject selection

Ecological environment impact assessment;
Social environment impact assessment;
Acoustic environment impact assessment;
Atmospheric environment impact assessment;
Public participation;
Brief analysis of environmental economic costs and benefits.

1.5.3 Environmental protection targets

They are water and soil conservation in sections of cutting and high filling, and protection of residents' health and school activities within the assessment scope. See Table 1-5-1.

Table 1-5-1 Environmental Protection Targets

Period	Environmental impact	Main protection targets	Construction or pollution behavior
Pre-construction period	land occupation & resident's resettlement	resettlement of residents	land-occupation by the project
Construction period	damage to ecological envir.	within 30m from both sides of the road	cutting and filling
	damage to vegetation soil erosion	within 30m from both sides of the road & at borrowing sites	ditto
	water pollution	within 30m from both sides along the highway	filling & bridge construction
	construction noise	living quality of residents near the construction site and along the temporary roads	mechanical work and transportation of road-building materials
	TSP pollution	ditto	ditto
Operation period	traffic noise pollution & gas pollution	schools, residential spots with more than 50 families each	transportation & pollutant emissions from motors

1.6 Assessment Methods and Focuses

1.6.1 Assessment methods

According to the characteristics of highway projects, the principle of "combining spots and lines and taking spots in place of lines" is adopted. For acoustic and atmospheric environments, model calculation is used in the prediction; comparison with the implementation norms and the method of single-item index are used for the assessment. For ecological and social environments, investigations and analyses are used.

1.6.2 Assessment focuses

They are the impact assessment of ecological environment and acoustic environment.

1.7 Assessment Standard

(1) Type II in GB3838-88 "Ground Water Environment Quality Standards" is used for water environment.

(2) Type IV in GB3096-93 "Urban Local Environment Noise Standards" is used for the acoustic environment of residential spots within 200m from the central line of the road, whereas Type II is used for that of sensitive spots of culture, education and health.

(3) Grade II in GB3095-96 "Atmospheric Environment Quality Standards" is used for the atmospheric environment.

The specific value limitations are extracted as following tables.

Table 1-7-1 Soil Environment Quality Standard (extracts) (class-2)

mg/kg

PH	<6.5	6.5-7.5	> 7.5
Pb	250	300	350

Table 1-7-2 Irrigation Water Quality Assessment Standard (extracts) mg/L , Excluding PH

Items	PH	Suspended Substance	CODcr	Total lead	Petroleum oil
standard value	5.5-8.5	≤ 150	≤ 200	≤ 0.1	≤ 5.0

Table 1-7-3 Ground Surface Water Quality Assessment Standard (extracts) (class-2)

mg/L, Excluding PH

Items	PH	CODcr	Total lead	Petroleum oil
standard value	5.5-8.5	≤ 15	≤ 0.05	≤ 0.05

Table 1-7-4 Urban Environmental Noise Standards (extracts)

Equivalent Acoustic Level (L_{Aeq}dB)

Class	Daytime	Night
Class-2	60	50
Class-4	70	55

Table 1-7-5 Construction Working Sites Noise Limits

Equivalent Acoustic Level (L_{Aeq}dB)

Construction period	Main noise resource	Noise limited	
		day	night
cut and fill	bulldozers, excavators, trucks	75	55
pile driving	all kinds of pile drivers	85	forbidden
composition	concrete mixers,vibrating rods,electric saws	70	55
fitting up	cranes, elevators	65	55

Table 1-7-6 Noise Hygienic Standard of Industrial Enterprises

working hours in noise (h)	noise level permitted dB (A)
8	85
4	88
2	91
1	94
	105 is the maximum

Table 1-7-7 Atmospheric Environmental Standards (extracts) (class-2)

mg/m^3

Pollutants		Total Suspended Particles (TSP)	Nox	CO
concentration limit	daily average	0.30	0.10	4.00
	average per hour	/	0.15	10.00

CHAPTER TWO PROJECT SURVEY AND ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Necessity and Geographical Position of the Project

2.1.1 Necessity of the project

(1) It is necessary in the construction of national artery highway system and in the economic development of the Yangzi River Delta.

HAE is connected in Anhui Province to two national artery highways of Shanghai ~ Chengdu and Beijing ~ Fuzhou, and meanwhile it is part of the east-west passage of the Yangzi River Delta. The Shanghai ~ Chengdu Highway is a major project which is to be finished during the Ninth National Five-year Plan; it will function in forming an artery in the land transportation network of the Yangzi River Economic Zone and thus creating favorable conditions for the development of the Zone and especially, the Delta.

(2) It is necessary in the formation of transportation network along the Yangzi River in Anhui Province.

The transportation network of South Anhui Area locates its framework in the Yangzi River Basin, in which there are six cities and prefectures: Chaohu Prefecture, Anqing Prefecture, Ma'anshan City, Wuhu City, Tongling City and Chizhou Prefecture. With its development radiating its influence onto the development of the two wing-areas, this area occupies an important position in the economy of the province. The Hefei ~ Gaohebu Highway is a principal one among the north-south highways in Anhui, and is closely related to the highways along the Yangzi River in the economic zone.

(3)It is necessary in the development of the middle and south areas of the province.

The HGE will establish an artery expressway for the mountainous areas of South Anhui and the eastern areas of Dabieshan Mountains, which will connect these areas to the capital Hefei and the developed areas of Shanghai and Nanjing.

(4) It is necessary in bringing out the radiating influences of the open harbor of Anqing upon the inland, middle areas of the province.

(5) It will improve greatly the transport conditions of Section Hefei ~ Anqing of No. 206 National Highway.

(6) The construction of Section Hefei ~ Jiezidun will enhance the overall quality and capacity of the highways in Anqing City, and will bring great influence to bear upon the city's development in the Ninth Five-year Plan period and even in the next century. Furthermore, with Anqing being the economic and cultural center of Southwest Anhui and located between the Shanghai ~ Chengdu Highway and the proposed highway along the River, a reasonable connection of the city to the highway is required not only by the socioeconomic development of the city but by the establishment of highway networks. So it becomes a task of top priority to build the Gaohebu ~ Anqing Highway so as to bring out the radiating functions of the highway network.

2.1.2 Geographical position of the project

See Attached Maps 1 and 2.

2.2 Road Alignment and the Main Control Spots

2.2.1 Road alignment

The general extension of HGE is from north to southwest, and the general extension of GAH is from north to southeast.

2.2.2 Main control spots

(1) Hefei ~ Gaohebu Expressway. The recommended route starts from Xiaoxichong of Section Da-Long of No. 312 National Highway, through Yandunji, Sishilixiang, across the Zhongpai River, the Hefei ~ Tongling Highway (at Yandian), the Fengle River (at Fengle Town), the Shu—San Highway (at Sangshudian), the Hangbu River (through Guanghan Bridge), through West Fuyuan Township and across the Jun-Er Highway at Changgangtou, and then through Mayan, Ketan and Gemiao to Jigongmiao at the east of Tongcheng City, across the Tong ~ Zong Highway, through Baimamiao, Tianlin, across the Guache River, the Bonian River and the Renxing River, and ends at Gezidun.

(2) Gaohebu ~ Anqing Class I Highway. It starts from east of Gezidun, through Lake Sanyasi, Liangting, and Wuheng, and ends near Zongpu Town.

2.3 Traffic Volume Forecast

Table 2-3-1 Traffic Volume Forecast of HGE

(in terms of cars, vehicle/day)

Representative year		2001	2010	2021
Section	Traffic vol. plan			
Xiaoxichong-Yandian	high	22012	45256	73624
	middle	21100	41570	65468
	low	20346	36474	54522
Yandian-Shusan Line	high	24170	49028	76606
	middle	23176	46056	68694
	low	22334	41418	59690
Shusan Line-Changgangtou	high	21744	41044	67894
	middle	20914	38126	59938
	low	20172	33794	52090
Changgangtou-Mayan	high	15854	36996	64012
	middle	15194	33320	54860
	low	14634	28844	45522
Mayan-Tongcheng	high	15854	32506	56858
	middle	15194	29212	48492
	low	14634	25188	40002
Tongcheng-Gezidun	high	16490	31330	55236
	middle	15660	27984	46228
	low	15000	24288	38512
Total average	high	18947	37764	63547
	middle	18138	34480	55146
	low	17459	30225	46474

Table 2-3-2 Traffic Volume Prediction of GAH

(in terms of cars, vehicle/day)

Representative years		2001	2010	2021
Section	Traffic vol. plan			
Gezidun-Wuheng	high	22912	36990	59066
	middle	21788	33998	49520
	low	20956	30952	43906
Wuheng-Zongpu	high	22718	36854	60326
	middle	21584	33868	49900
	low	20790	30906	42600
Total average	high	22834	36936	59569
	middle	21706	33946	49672
	low	20890	30934	43385

2.4 Construction Scale, Main Technical Indices and Main Engineering Volume

2.4.1 Construction Scale

HGE is 126.02km long, with the subgrade being 28.0m wide. It will be constructed according to the standard for four-lane expressways.

GAH is 27.47km long, and adopts the standard for four-lane class-one highways with the design vehicle speed being 100km/hr.

2.4.2 Main technical indices

Table 2-4-1 Main Technical Indices

Item / Section	HAE	GAH
topography	plain & rolling area	plain & rolling area
grade of road	expressway	grade-1 highway
calculated vehicle speed	120 (km/hr)	100 (km/hr)
subgrade width	28.0 m	24.5 m
carriage way width	2*7.5 m	2*7.5 m
stopping sight distance	210m	160m
minimum radius of horizontal curve	1,550m	700m
maximum longitudinal gradient	2%	4%
design vehicle load for bridges and culverts	automobile-super 20, trailer- 120	
design flooding frequency	extra-large bridge: 1/300; large, medium or small bridge: 1/100	

2.4.3 Main engineering volumes

Table 2-4-2 Main Engineering Volumes of HAH

Item	Unit	HGE	GAH	Remarks
land-acquisition	mu	15160.502	2507.86	incl. that for interchange, borrowing & temporary acquisition
building remove	m^2	156790.92	8460	
removement of power/tele-comm. Wire	piece	251/25	57/6	
subgrade vol.	m^3	11380242	2644578	not incl. big & middle bridges
engineering protection vol.		222388.22	61044	not incl. big & middle bridges
bituminous pavement	m^2	2837155	55022	not incl. big & middle bridges, GAH paved with cement concrete
large bridge	m/br.	5488.46/9	764/1	
mid-sized brdg.	m/br.	1385.6/26	35/1	
small bridge	m/br.	770/37	36/2	
culvert		644	137	
interchange		7	1	
grade separation		53	20	
underpass for pedestrian & automobiles		203	23/9	
overcrossing		23	6	
safety facility	road km	126.018513	27.47	
service facility	road km	126.018513	27.47	1 service area on HGE
manag. facility	road km	126.018513	27.47	
toll coll. facility	road km	126.018513	27.47	5 tollhouses on HGE & 1 on GAH
enviro. protect.	road.km	126.018513	27.47	

2.5 Investment Estimates, Funds Raising and Time Arrangements

2.5.1 Investment estimates

The estimated cost of HGE is RMB 340697.1438 million yuan, with the average cost per kilometer being RMB 2703.5165 million yuan.

The estimated cost of GAH is RMB 496.843636 million yuan.

2.5.2 Funds raising

The construction funds are primitively supposed to be raised from three sources:

(1) HGE: US$ 200 million of WB loans; RMB 629.40 million yuan of MOC subsidy; RMB 1103.575084 million yuan of self-raised funds by Anhui Province, divided between APCD and the local governments.

(2) GAH: US$ 30 million of WB loans; RMB 82.70 million yuan of domestic loans; RMB 165.380636 million yuan of self-raised funds by Anhui Province, divided between APCD and the local governments.

2.5.3 Time arrangements

(1) HGE. All the pre-construction work was to be finished by the end of September, 1998; the construction is to begin in October, 1998; the construction is to be completed in October, 2001, lasting 3 years.

(2) GAH. the engineering feasibility studies were to be completed by the end of August, 1997; the prelimiary design is to be finished by March, 1998; the working drawing design and land occupation and resident re-location are to be completed by the end of September, 1998; the construction is to start in October, 1998; the construction is to be finished in October, 2001, lasting 3 years.

2.6 Environmental Impact Analysis

Impact in design period: the location of the alignment of the highway involves everlasting and temporary occupation of cultivated fields and forests and the remove of buildings. The impact thus produced on the community development, land use, residential life and natural and human views of the area should be reduced as much as possible.

Impact in construction period: at the borrowing sites and cutting and filling sections, damage will be made to the vegetation and to the living conditions of creatures here, and soil erosion will be worsened; meanwhile the water flowing state will be changed temporarily. The transportation and mixing of construction materials will produce a large quantity of flying dust and pollute the air. Noise made by the machinery will affect the normal activities of the nearby schools and the living conditions of the residents. The construction traffic will disturb the original traffic order the existing roads and thus cause more inconvenience and even accidents.

Impact in operation period: the impact of traffic noise will be more and more serious with the increase of traffic volume; the pollutants in tail gas emitted, like CO, TSP, NOx, lead, and petroleum oil , will pollute the air, soil and crops. Besides, as the local protection engineering needs time to be stabilized and vegetation be restored, soil erosion remains a problem.

Based on the above analysis and the environmental characteristics of the proposed highway, the screened impact factors possibly brought about by the project are shown in Table 2-6-1.

Table 2-6-1 Screened Environmental Impact Factors

Impact factor	Impact	Construction stage	Operation stage
social & economic	transport network and national economy	○	●
	land-acquisition, land utilization, development zone	●	○
	resettlement, division of village, living conditions	◎	◎
	traffic accident	○	○
natural view		●	○
ecological	plant destruction, water and soil erosion	●	○
	soil and crops	◎	○
	water environment	◎	○
noise	living conditions and school activities	◎	●
air	flying dust, TSP	●	○
	tail gas (NOx, CO)	○	◎

Note: ● serious impact; ◎ general impact; ○ small impact

2.7 Alignment Alternative Selection & Environmental Impact Analysis

2.7.1 Alignment alternative selection

Three alignment alternatives are proposed in *the Statement of Preliminary Feasibility Studies* completed in 1996, and Alternative I is recommended for construction. It is considered as feasible by provincial specialists. Based on this, *the Statement of Engineering Feasibility Studies* suggested 3 alternatives, which are Alternative I: the East Route (to the east of He-Jiu Railway), Alternative II: the West Route (to the west of He-Jiu Railway), and Alternative III: the middle Route (the incorporation of I and II). Through a synthetic comparison between the 3 and qualitative and quantitative analyses, *the Statement* proposes that the East Route is feasible.

2.7.2 Analysis of environmental impact of alignment alternatives

(1) the East Route

HGE is shared by 3 highways (2 national artery highways of Shang-Cheng and Jin-Fu, and the Hefei-Tongling-Huangshan Provincial Highway). So it must be as short and convenient as possible. Besides, a short route has less pollution on the environment, and lower transport cost and higher investment profit.

It avoids the adverse impact on the environment of Hefei City which is likely to be caused by the 10km-long detour around the southern part of the city in the other 2 alternatives.

It is well coordinated with the development plans of the major towns and cities, meets the requirement of "approach instead of enter, and benefit instead of interfere", and has less impact on the acoustic and atmospheric environment.

The land-acquisition covers 18128.4 mu. However, with the government-supported readjustment of the fields for the involved farmers, the impact will be reduced. Compared with the West Route, there is less cutting in the mountainous areas and thus less soil erosion during the construction.

(2) the West Route

It is 10km longer than the East Route, and brings about more air and noise pollution to the environment of Hefei City.

A large part of the route is located by the Dabie Mountains, and thus there are long cutting and filling sections. Hence large slope surface and serious soil erosion.

The areas passed are underdeveloped, and so the socioeconomic benefit will be less significant.

(3) the Middle Route

It as well causes bigger pollution to Hefei City. It has the longest alignment of the 3, and thus causes the biggest environmental pollution.

It can be seen from above that the East Route has the least impact upon the ecological, social, acoustic and atmospheric environment of the passed areas. Therefore, viewed from an environmental perspective, it seems reasonable for *the Statement of Feasibility Studies* to recommend the East Route.

CHAPTER THREE ENVIRONMENTAL BASELINE AND ASSESSMENT

3.1 Baseline of Ecological Environment and Assessment

3.1.1 Natural environment

3.1.1.1 Topography and landforms

In natural geography the project area belongs to the Changjiang River and Huaihe River Hilly Areas, and is located to the south of the Changjiang-Huaihe Watershed. The landforms along HGE are composed of two types: the low mountains and hills, and the river valley plains and waving plains. In the first type there are sections of K0-K13, K17-K26, K40-K106, K109-K114, K118-K119, and K124-K125+880; the ground elevation is between 12m and 50m, with ditches alternating with hills and the slopes gently extending. Sections in the second type are K13-K17 in the Pai River Alluvial Plain, K26-K40 in the Fengle River and Hangbu River Alluvial Plain, K106-K109 in the Longmian River Alluvial Plain, K114-K118 in the Guache River Alluvial Plain, and K119-K124 in the Bonian River and Renxing River Alluvial Plain. The ground elevation of the first three sections is between 6.50m and 9.00m, and that of the other two sections is between 15.00m and 17.10m. Totally, the sections in the hilly areas add up to 95.88m, while those in the alluvial plain areas add up to 30.00m.

The dominant landforms along GAH are low mountains and hills, with ditches and hills alternating with each other. The cutting sections add up to 7.25km, and the filling sections add up to 18.55km.

3.1.1.2 Geology

The project area is located in the jointing part of neocathaysian the second upwarping zone and the Qinling Mountain Latitudinal Structural Zone at the front arc of the east wing of Huaiyang E-shape structure. After many structural activities, the folds and rifts have grown, such as those rift zones of Tanlu, Shimenshan, Chihe River ~ Tai Lake, Jiashan ~ Lujiang, Shushan, Luan ~ Hefei and Mozitan.

3.1.1.3 Earthquake

According to the basic seismic intensity division, Hefei ~ Lujiang Section is in magnitude 7 zone, while Lujiang ~ Gaohebu Section in magnitude 6 zone.

3.1.1.4 Meteorology

The project area is within the subtropical moist monsoon climate zone, with characteristics of remarkable monsoon, distinct seasons, mild climate and moderate rainfall. It is cold in winter and in summer, and mild in spring and autumn; the seasonal changes are remarkable. The annual average temperature through years is 15-17 ℃; the winters and summers are long, whereas the springs and autumns are short. The lowest average temperature in winter is round -2 ℃, with December and January as the coldest months, and the low temperature extreme is -15 ~-20 ℃; the highest average temperature in summer is round 34 ℃, with July and August as the hottest months, and the high temperature extreme is 39.8 ~ 41 ℃.

The annual amount of precipitation is about 1000 ~ 1500mm, with the annual average through years being 989.3 ~ 1327.3mm; the minimum amount is 627.9mm, and the maximum is up to 2092.1mm. The daily maximum rainfall amount is as much as 214.7mm; the longest continuous rainfall lasted 18 days. The division of precipitation is uneven through the year: it is concentrated during the period of April ~ August, which is the flood season and takes 55 ~ 66% of the precipitation of the whole year; from November till the next February it has less rain which covers 13.7% of that of the whole year. The amount of precipitation tends to be distributed decreasingly with the increase of latitude. The annual evaporation amount is 1200 ~ 1600mm, with the annual average through years being around 1400mm; evaporation is concentrated in June ~ August, and becomes weaker in December ~ February. The annual average relative humidity is 76%, with the humidity in July, August and January being higher and that in November and December lower; the annual average relative humidity difference is as small as 7%. The frost-free season lasts about 230 days.

3.1.2 Vegetation

Apart from herbs and a small quantity of bushes, there are already no woods in the primitive natural vegetation along the highway. The project area is basically agricultural, so agricultural ecology becomes the dominant. The main crops are paddy rice, rape, wheat, cotton, beans, sweet potato, sesame, and corn. In winter there are planted some green manure crops. The paddy rice is reaped in two crops a year, with the average production as 800 ~ 1200kg/mu; the ginned cotton average production is 125 ~ 150kg/mu. The production of other crops is not quite high: about 150kg/mu of beans, about 100kg/mu of sesame, and about 350kg/mu of corn, etc. The paddy fields occupied by the highway are mainly high-production ones with high multiple crop indices, and are one of the main producing areas of grain, cotton and oil of the province. Besides, there are some vegetables planted near the villages, such as cucumber, egg plant, tomato and other vegetables of the season.

There is little forest in the project area. On the gentle slopes and hills there are some artificial forests, in which at present only young trees are found, which are mainly pines and China firs. In some townships there are some self-run tree farms. Other scattered trees include plane trees, white poplars, willows and Chinese scholartrees. It can be seen therefore that forests take a very small part in the project area, and the percentage of forest cover in the forestry area is lower than 10%. No protected wild plants are found in the project area.

3.1.3 Animals

The project area stretches from the south of the Changjiang-Huaihe Hilly Areas to the bank plain of the Changjiang River. This area has a long history of human cultivation, and the large wild animals which used to be here have long been migrated to somewhere else with the frequent human activities and the increase in population density. All that remained here are only frogs, snakes, field voles, insects and some ordinary birds like sparrow, turtledove, crow, and magpie. No protected wild animals are found in the project area.

The domestic animals are mainly cattle, horse, mule, sheep, pig and dog; the domestic fowls are mainly chicken, duck, and goose. In some pools there are some artificially grown fishes like carp, crucian carp, and grass carp.

3.1.4 Soil

3.1.4.1 Geology and the distribution of soil

The engineering geologies of the area passed by the highway belong to different alluvial layers. The sections of the alluvial layer of Qizui Group of Upper Pleistocene Series are K0-K14, K17-K28, and K40-K70; those of the alluvial layer of Fengle Town Group of Holocene Series are K14-K17 and K28-K40; those of the alluvial layer of Wuhu Group of Holocene Series are K70-K90 and K101-K102; those of the alluvial layer of Xiashu Group of Upper Pleistocene Series are K90-K110 and K102-K125+880.

The alluvial layer of Holocene Series, Quaternary System is distributed mainly at the river valley plains along the line and forms flood land. It is more developed at the river valley plains of the Pai River, the Fengle River, the Hangbu River, the Bainian River and the Renxing River. The upper river flood land phase accumulation is mostly of clay loam and sandy loam composed of a small amount of iron-manganese module and of organic substances.

The alluvial-pluvial layer of Upper Pleistocene Series, Quaternary System is distributed extensively on the interstream strips of the areas where the route stretches through, Class I and Class II terraces and generally mound-shaped landforms are formed. The lithologic character is stable; clay and clay loam are the main components. The soil consists of a large amount of grayish white Kaolin, iron-manganese nodule and calcareous concretion.

Other types of alluvial layers are also exposed in small amounts in the areas passed through or near the route, such as the alluvial-pluvial payer of Miopleistocene Series, Quaternary System, the Tertiary System, the Cretaceous System, the Jurrasic System, and the Presinian System.

Thanks to the long history of paddy rice planting, there has formed paddy rice soil, whereas the soil type of the hilly areas between the Changjiang River and the Huaihe River is brown-yellow soil.

3.1.4.2 Monitoring spots arrangement and sample collection

The factors influencing the soil quality in the project area should be considered in perspective. Four representative soil sample spots are selected, and the monitoring factors include pH, organic substance content and total lead content. For the monitoring spots position see Attached Figure 5.

3.1.4.3 Monitoring subjects and analytic methods

Table 3-1-1 Monitoring Item and Analytic Method of Soil

Item	Analytic method	Lowest detected limit
PH	glass electrode	0.01
Pb	atom absorption spectrophoto	0.01mg/kg
Organic substances	heavy chromium acid salt	

3.1.4.4 Monitoring result

Table 3-1-2 Soil Monitoring Result

location	environment	PH	organic substances	Pb(mg/kg)
Wuheng	vegetable field	6.28	2.95 (%)	19.49
Dazhonggu	wheat field	6.89	0.05 (%)	24.60
Changgangtou	wheat field	5.00	1.95 (%)	15.48
Caoguantang	vegetable field	6.94	0.71 (%)	23.24

3.1.4.5 Baseline assessment

The background value of organic substance content in the cultivated soil in Anhui Province is 0.36 ~ 11.25%, the 90% value is 4.69%, and the geometric average is 2.00%. From the status quo monitoring result it can be seen that the organic substance content in the soil along the highway is all within the limits of background value, except that of Dazhonggu (Yuzhuang). The soil is acid of medium. The status quo value of lead in the soil is smaller than the geometric average of national soil lead content. Table 3-1-3 shows the calculation result of the background value of soil lead content (layer A).

Table 3-1-3 Comparison between the Calculation Result of Soil Lead Content Background Value Unit: mg/kg

	Minimum	90%	Maximum	Geometric average
whole country	0.68	43.0	1143.0	23.6
Anhui	11.1	33.7	1143.0	26.0
paddy field soil	6.5	60.2	123.0	31.4
along the highway	15.48		24.60	20.7
Changjiang-Huaihe hills	8.75	36.25	74.13	25.38

The baseline assessment adopts the method of single factor index $P_i = C_i / S_i$, in which,

P_i ---- pollution assessment index;

C_i ---- the actual monitoring value;

S_i ---- the standard value chosen for the assessment.

The assessment uses Grade II in GB15618-95 "Norms for Soil Environmental Quality", with the concrete standard limits shown in Table 1-7-1. The soil sample status quo monitoring results in the fact that the pH value of the two samples from Changgangtou and Wuheng are both smaller the 6.5, using the lead assessment limit value of 250 mg/kg, whereas those of the two samples from Dazhonggu and Caoguantang are between 6.5 and 7.0, using the limit value of 300 mg/kg.

For the division of soil lead pollution levels see Table 3-1-4.

Table 3-1-4 Division of Soil Lead Environment Quality Indices

Pollution level	non-pollution	light pollution	medium pollution	heavy pollution
Index P value	$\leqslant 1.0$	$1.0 \sim 2.5$	$2.5 \sim 7.0$	> 7.0

Compining the soil lead status quo monitoring result and the corresponding assessment standard, calculations can be made on the soil lead environment quality indices. See Table 3-1-5.

Table 3-1-5 Soil Lead Environment Quality Indices

Location	Wuheng	Dazhonggu	Changgangtou	Caoguantang
Index P value	0.08	0.08	0.06	0.08

It can be seen from Table 3-1-5 that the lead environment quality indices of the four soil monitoring spots are all lower than 1.0. So conclusions can be made that the lead content in layer A soil along the highway is within the normal.

3.1.5 Baseline and assessment of ground surface water

3.1.5.1 Baseline of the main rivers and ponds along the highway

The main rivers crossed by HAE are the Pai River, the Fengle River, the Hangbu River, the Longmian River, the Guache River, and Bainian River and the Renxing River, the most of which are rain-source rivers that cease to flow in the dry season, whereas tend to have floods in the rainy season. Besides, the highway also crosses about 45 streams and irrigation canals, among which the Shulu Irrigation Canal is the largest one, which meets the highway at K63+850. See Table 3-1-6 for the general situations of the rivers.

Table 3-1-6 Baseline of Rivers along the Highway

<table>
<tr><th>No.</th><th>Stake number</th><th>River name</th><th>Trunk length</th><th>River basin area</th><th>Courses</th><th>20 years' flooding vol.</th></tr>
<tr><td>1</td><td>K14+870</td><td>Pai River, into Chao Lake</td><td>22.79 km</td><td>584.6 km²</td><td>level-3</td><td>710 m³/s (river mouth)</td></tr>
<tr><td>2</td><td>K29+600</td><td>Fengle River, into Chao Lake</td><td></td><td>2124 km²</td><td>level-6, 45km</td><td>1400 m³/s (river mouth)</td></tr>
<tr><td>3</td><td>K36+400</td><td>Hangbu River, into Chao Lake</td><td></td><td>2122 km²</td><td>level-6, 15km</td><td>2180 m³/s (river mouth)</td></tr>
<tr><td>4</td><td>K107+120</td><td>Longmian River, into Changjiang River</td><td>25 km</td><td>316 km²</td><td>no</td><td>/</td></tr>
<tr><td>5</td><td>K116+400</td><td>Guache River, into Changjiang River</td><td>26 km</td><td>328 km²</td><td>no</td><td>/</td></tr>
<tr><td>6</td><td>K120+550</td><td>Bonian River, (Dasha River) into Chang-jiang River</td><td rowspan="2">43 km</td><td rowspan="2">1359.9 km²</td><td rowspan="2">no</td><td rowspan="2">/</td></tr>
<tr><td>7</td><td>K122+550</td><td>Renxing River, (Dasha River) into Changjiang River</td></tr>
</table>

There are plenty of small ponds within the assessment scope. Table 3-1-7 gives the stakes numbers, distances from the highway and areas of all the named ponds (or reservoirs) within the assessment scope. The major function of all these water bodies is agricultural irrigation.

Table 3-1-7 Major Ponds (and Reservoirs) along the Highway

No.	Stake no.	Distance btw. Road central line & pond edge	Name of pond	Area (m^2)
1	K39+100	30m to west of road	Xiaotangwa Reservoir	150*250
2	K44+500	100m to east of road	Duotang	200*100
3	K46+500	60m to east of road	Liangqiaodatang	200*120
4	K54+000	road crosses the pond	Qixingtang	220*150
5	K66+400	150m to east of road	Lixin Reservoir	300*250
6	K73+150	100m to east of road	Dabaitang	200*50
7	K97+800	50m to east of road	Chungutang	250*150
8	K105+000	150m to west of road	Meitang	250*150
9	K113+800	100m to west of road	Yaoci Reservoir	200*500
10	K6 (GAH)	bridge crossing	Sanyasi Lake	

3.1.5.2 Monitoring results of surface water quality

Based on the situations of surface water along the highway, two sample collecting sections are located at K29+600, 50m of the lower reaches of the Fengle River Bridge and K122+550, 50m of the lower reaches of the Renxing River Bridge. Three sample collecting spots are chosen for each of the sections, located respectively at 10m from the left bank, the central line, and 10m from the right bank. See Attached Figure 5 for the details.

Monitoring items: pH, SS, CODcr, petroleum oil, and total lead.

Monitoring frequency: once in summer and once in autumn, two days for once, and two sample collections daily in the morning and in the afternoon.

Monitoring analytic method: using instruments, the lowest detective limits shown in Table 3-1-8.See Table 3-1-9 for the monitoring results.

Table 3-1-8 Monitoring Method, Instruments and Lowest Detective Limits

Item	Method	Analytic instrument	Lowest limit
pH	glass electrode	pHS-3C	0.01pH
SS	weighing	balance	2mg
CODcr	heay chromium acid salt	/	5mg/L
petroleum oil	ultraviolet spectrophoto	Oil-20 determiner	0.05mg/L
total Pb	atom absorption spectrophoto	WFX-1F-2BZ atom absorber	0.01mg/L

Table 3-1-9 Water Quality Monitoring Results

2-day average Unit : mg/l (except for pH)

Position	pH		SS		CODcr		Pb		Petroleum oil	
	Summer	Autumn	S.	A.	S.	A.	S.	A.	S.	A.
Fengle	River									
left	7.06	7.11	21.0	26.7	7.1	9.22	—	—	0.1	0.13
middle	7.18	6.68	12.5	12.0	7.0	9.55	—	—	—	—
right	7.28	6.54	14.2	9.3	8.2	10.65	—	—	—	0.08
average	7.17	6.78	15.9	16.0	7.4	9.81	—	—	0.05	0.09
Renxing	River									
left	6.04	7.28	83.5	21.8	6.4	6.29	—	—	0.09	—
middle	6.69	/	92.5	/	6.4	/	—	/	0.07	/
right	6.60	7.43	82.5	23.6	6.5	6.2	—	—	0.08	—
average	6.66	7.35	86.1	22.7	6.4	6.2	—	—	0.08	—

Remarks:

1. The monitoring time in summer was in June 1997; in autumn it was 10/26/97 and 10/28/97 for Fengle River and 11/03/97 and 11/05/97 for Renxing River.
2. The undetected part (-) indicates that the monitoring analytical value is lower than the minimum detected value, and is thus counted as 1/2 of the latter.
3. There is standard-surpassing in petroleum oil in the sample from Renxing River due to the pollution source caused by rainfall in the upper reaches.

3.1.5.3 Baseline assessment of surface water quality along HAE

The project area belongs to the agricultural zone, and the surface water is mainly used for agricultural irrigation. Among the major rivers, only parts of the Zhongpai River, the Fengle River and the Hangbu River are navigable, and the courses are graded as low as six or three. None of the other rivers allow navigation in them. From K10 to K26 the highway is about 8km at the shortest from the bank of Chaohu Lake, one of the country's Five Biggest Freshwater Lakes. As for the other lakes, the alignment is at least 15km away from them. So no assessment is made to those lakes including Chaohe Lake.

There is a bridge across Sanyasi Lake on GAH.

The assessment is based on the water sample monitoring results in Table 3-1-9; two days' total average values of each river are adopted, and the single factor indices method is used for the assessment. Type II in GB3838-88 "Ground Water Environmental Quality Norms" and the standards for paddy field crops (e.g. paddy rice) in GB5084-92 "Agricultural Irrigation Water Quality Norms" are followed. Refer to Table 1-7-3 and Table 1-7-2 for the specific standard limits.

The pH and SS contents, CODcr and Pb of the Fengle River and the Renxing River are all within the standard limits. The petroleum oil in the Fengle River is standard, but in the Renxing River, the two days' total average value is 0.08mg/L, which is 1.6 times higher than the standard ($\leqslant$ 0.05mg/L). The main reason for this is that the rainfall in the upper reaches caused the surface pollution source to enter the river while the samples were being collected.

Analyses of the monitored items result in the conclusion that surface water quality of the project area is generally good. No standard surpassing is found except that of the petroleum oil in the Renxing River.

3.1.6 Soil erosion along the route

The location of HGE is between the Changjiang River and the Huaihe River. The ground elevation of the sections in the hilly areas is 12-50m, and their total length is 95.88km; the ground elevation of those in the alluvial plain areas is 6.5-9.00m and 15.00-17.10m, and their total length is 30.00km.

The topography of areas along G-A Section is mainly hills with flat lands between them. The total length of cutting sections is 7.25km, whereas that of the filling sections is 18.55km.

The project area is an agricultural one, with a high rate of land using. The paddy crop is mostly two-season rice. The paddy fields occupied by HGE account for 77.32% of the total amount, while the dry land and other types only cover 22.68% of the total.

The paddy fields occupied by the GAH account for 69.61% of the total amount, while the dry land and other types cover only 30.39% of the total.

The above statistics show that in the land occupied by the project, the absolute percentage of paddy fields or level terraced fields is much larger than that of the dry land and the other types. Level terraced fields are a forceful means in preventing soil erosion in agriculture, and besides, the multiple crop indices here are high, and the ground surface vegetation is good. Therefore, the soil erosion in this area is slight. The soil erosion modulus is below 500t/km^2*y. It is shown in the Figure of Soil Erosion in Anhui Province that there is no remarkable eroded area along the highway.

3.2 Socioeconomic Conditions and Assessment

3.2.1 Position, area and population of the project area

The directly influenced area of the project includes Hefei City (incl. Feixi County), Liuan Prefecture (Shucheng County), Chaohu Prefecture (Lujiang County), and Anqing City (incl.. the city proper, Tongcheng City, Zongyang County, and Huaining County).

The total directly influenced area is 50,416 km^2, which is 36.2% of the provincial total. Up to the end of the year 1995, the total population here is 20.747 million, covering 34.5% of the provincial total.

3.2.2 Socioeconomic development and assessment

The developing conditions of the directly influenced area of the project are satisfactory, and the economy has been developing fast since the implementation of the open-door policy. Up to the end of the year 1995, the gross national product (GNP) is as high as RMB 4.41 billion yuan, and the gross output value of industry and agriculture is RMB113.15 billion yuan; the two respectively cover 35.9% and 36.1% of the provincial totals. Table 3-2-1 shows the yearly socioeconomic development situations of the cities and prefectures of this area, while Table 3-2-2 shows the survey of development of the cities and prefectures in 1995. Together they can give good illustration of the important position this area holds in the provincial national economy, and of the fast development here since the implementation of the open-door policy.

Table 3-2-2 Survey of Socioeconomic Development of the Cities and Prefectures in the Project's Directly Influenced Area in 1995

	Population(10,000)		Area (km^2)		GNP(100 mill. y.)		GPIA(100 mill. y.)	
Place	status quo value	in province	status quo value	in province	status quo value	in province	status quo value	in province
Hefei	408.3	6.8 %	7266	5.2 %	122.0	10.6 %	348.0	11.3 %
Liuan	640.2	10.6 %	18375	13.2 %	101.6	8.8 %	274.6	8.9 %
Chaohu	435.3	7.2 %	15352	11.0 %	87.5	7.6 %	235.2	7.6 %
Anqing	591.0	9.8 %	9423	6.8 %	103.0	8.9 %	273.7	8.9 %
Sum	2074.8	34.5 %	50416	36.2 %	414.1	35.9 %	1131.5	36.7%
Anhui	6013.0	100 %	139200	100 %	1154.0	100 %	3084.5	100 %

Table 3-2-1 Socioeconomic Development of the Cities and Prefectures in the Project's Directly Influenced Area through the Years

	Population (10000 persons)				GNP (100 million yuan)				Gross Output value of Indus. & Agri. (100 million yuan)			
year	Hefei	Liu'an	Chaohu	Anqing	Hefei	Liu'an	Chaohu	Anqing	Hefei	Liu'an	Chaohu	Anqing
1985	348.7	569.2	402.8	527.3	41.20	34.03	25.83	40.43	72.27	39.47	34.30	60.60
1986	353.0	576.3	403.4	532.8	-	-	28.08	-	43.82	43.82	38.99	68.74
1987	357.4	583.3	404.7	539.3	-	-	30.75	-	45.69	45.69	40.95	74.41
1988	364.8	592.5	409.7	549.3	-	-	33.95	-	105.12	51.72	48.07	83.47
1989	371.4	601.6	414.0	557.6	-	-	35.91	56.60	112.52	54.95	52.02	89.63
1990	380.9	613.5	422.4	567.0	58.45	42.03	36.02	53.94	118.42	58.98	58.98	95.57
1991	386.1	622.2	425.3	573.4	58.80	31.92	31.25	48.14	126.90	57.00	56.01	101.99
1992	392.2	626.7	427.3	578.1	69.01	44.18	42.75	53.99	161.09	77.75	78.37	120.79
1993	397.1	629.7	429.6	582.2	84.10	57.04	53.48	74.25	214.22	109.85	110.78	165.99
1994	402.7	634.9	432.6	585.4	101.50	80.08	70.85	92.07	271.99	177.24	162.99	213.25
1995	408.2	640.2	435.32	591.0	122.00	101.60	87.50	103.00	348.00	274.62	235.15	273.69
1985-1990	1.79	1.51	0.95	1.46	7.25	4.31	6.88	5.94	10.38	8.36	11.45	9.54
1990-1995	1.40	0.86	0.60	0.83	15.86	19.31	19.42	13.81	24.06	36.02	31.86	23.42
1985-1995	1.59	1.18	0.78	1.15	13.47	11.56	12.98	9.80	17.02	21.41	21.23	16.27

3.2.3 Baseline investigations and analysis of basic facilities

3.2.3.1 Transportation

(1) Regional transport network

The project area is located in the middle west of Anhui Province, in which the comprehensive transport has been developed fast. At present there are the Huainan Railway (multiple track), the Shang-Bu Railway and the He-Jiu Railway passing across the area; the national highway No. 206 crosses down through the area as the artery, and together with the national highways G318 and G105, the provincial highways S103, S319 and S228, and the county and township roads, it forms the network of road transportation; for inland water transport there are the Hefei Harbor, which is one of the ten inland water transport centers of economic zones of the country, and the Anqing Harbor, which is the only one big harbor on the northern bank of the Yangzi River in Anhui Province; the navigable courses include the Nanfei River, the Jianghuai Canal, the Fengle River, the Dianbu River, the Huayang River, the Wan River, the Caizi Lake, the Baidang Lake, and the Chenyao Lake, etc.; for air transport there are the Luogang Airport in Hefei and the Anqing Airport for Army-Civilian Uses. In a word, there has established a comprehensive transport system in which railway, highway, water and air transport means connect cooperate with each other.

(2) Highway transport system in the project area

The distribution of highway network in the project area is reasonable and with distinct administrative levels of grade-1, grade-2, grade-3, grade-4 and substandard. The most important of all the highways is the National No. 206 Highway in the province, which crosses Hefei City, Feixi County, Shucheng County, Tongcheng County and then reaches the city proper of Anqing. It is generally paralleled with the He-Jiu Railway, and is the major transport artery of this area. The Hefei—Tongling Grade-2 Motorway which was completed in 1995 goes from Feixi County via Lujiang County to Tongling City, and exercises its function in mitigating the traffic jams in this area. The main highways across the National No. 206 Highway in between Hefei and Anqing are the National No. 318 Highway, the Provincial Jun-Er Road, Tong-Zong Road, and He-Yue Road, and the County Roads of Shu-San Line and Yang-Xin Line. See Table 3-2-3 for the survey of the main highways in the project area.

Table 3-2-3 Main Highways in the Project Area

Route	No.	Ends	Areas passed	Length (km)	Grade	Pavement type
He-An Road	G206	Hefei-Anqing	Hefei, Feixi, Shucheng, Tongcheng, Huaining, Anqing	175	1,2	high, sub-high
An-Yue Road	S318	Anqing-Yuexi	Anqing, Qiaoshan, Yuexi	115	1,2	sub-high, inter-mediate
He-Tong Road	S103	Feixi-Tongling	Feixi, Lujiang, Tongling	127	grade-2 motorway	sub-high
Jun-Er Road	S319	Junbu-Erba	Shucheng, Lujiang, Wuwei	147	3	sub-high
Tong-Zong Road	S228	Tongcheng-Zongyang	Tongcheng, Zongyang	69	2,4	sub-high
An-Zong Road	S228	Anqing-Zongyang	Anqing-Zongyang	40	2,4	sub-high
Yang-Tao Road	S315	Yangxiao-miao-Taoxi	Liuan, Shucheng	43	3	sub-high
Shu-Yue Road	S317	Shucheng-Yuexi	Shucheng, Yuexi	70	3	sub-high, inter-mediate
Yue-Gao Road	S209	Yuexi-Gaohe	Yuexi, Huaining	80	2,4	sub-high, inter-mediate
Shu-San Line	-	Shucheng-Sanhe	Shucheng	30	4	inter-mediate
Yang-Xin Line	-	Xinan-Yangqiao	Tongcheng, Anqing	32	4	inter-mediate

It can be seen therefore that there has established a network of highway transport with the national and provincial highways as the framework and the county and township roads as the fabrics.

However, there are some common problems for this highway network: the grades of most of the roads are relatively low; the high-grade roads only cover a small percentage of the whole; the road conditions are generally unsatisfactory; more and more roads have come to be used as streets; the traffic volumes have surpassed the design capacity and thus have caused frequent traffic jams and accidents; the running conditions for vehicles have got worsened and thus badly hindered the development of this area. There is a good illustration of this in Tables 3-2-4 to 3-2-13 which give the statistics of city and county road grades and traffic accidents on these roads.

Table 3-2-4 Technical Grade of Roads in Feixi County

Grade	expressway	1	2	3	4	sub-grade	Total
Length(km)	3	39	36	228	186	443	934
%	0.3	4.1	3.8	24.4	19.9	47.4	100

Table 3-2-5 Statistics of Traffic Accidents in Feixi County

Year	accidents	dead	injured	direct eco. loss (10,000 y.)
1990	162	70	124	33.7
1991	202	62	156	52.5
1992	132	67	109	48.7
1993	101	64	84	50.0
1994	58	57	68	44.0
1995	79	82	53	56.1

Table 3-2-6 Technical Grade of Roads in Shucheng County

Grade	2	3	4	sub-grade	Total
Length(km)	38	78	163	29	608
%	6.3	12.8	76.2	4.8	100

Table 3-2-7 Statistics of Traffic Accidents in Shucheng County

Year	accidents	dead	injured	Direct eco. loss (10,000 y.)
1990	91	32	65	7.4
1991	88	31	64	6.4
1992	80	26	67	5.7
1993	47	26	34	13.5
1994	30	27	20	10.0
1995	27	26	16	19.1

Table 3-2-8 Technical Grade of Roads in Lujiang County

Grade	2	3	4	sub-grade	Total
Length(km)	67	65	187	337	656
%	10.1	9.9	28.5	51.4	100

Table 3-2-9 Statistics of Traffic Accidents in Lujiang County

Year	accidents	dead	injured	Direct eco. loss (10,000 y.)
1990	117	25	95	27.1
1991	135	48	128	42.5
1992	554	51	523	120.0
1993	528	37	399	91.8
1994	555	61	380	151.9
1995	695	74	695	211.3

Table 3-2-10 Technical Grade of Roads in Tongcheng City

Grade	1	2	3	4	sub-grade	Total
Length(km)	0	57	101	225	47	430
%	0	13.3	23.5	52.3	10.9	100
Pavement type	high	sub-high	intermediate	low	no pavement	Total
Length(km)	0	221	134	75	0	430
%	0	51.4	31.2	17.4	0	100

Table 3-2-11 Statistics of Traffic Accidents in Tongcheng City

Year	accident	dead	injured	Direct eco. Loss (10,000 y.)
1990	106	35	70	13.6
1991	170	64	203	24.4
1992	128	55	122	16.8
1993	137	73	111	32.0
1994	139	98	68	28.7
1995	140	103	70	43.3

Table 3-2-12 Technical Grade of Roads in Huaining County

Grade	1	2	3	4	sub-grade	Total
Length(km)	6	87	20	180	15	308
%	1.9	28.2	6.5	58.4	4.9	100
Pavement type	high	sub-high	intermediate	low	no pavement	Total
Length(km)	13	157	56	82	0	308
%	4.2	51.0	18.2	26.6	0	100

Table 3-2-13 Statistics of Traffic Accidents in Huaining County

Year	accidents	dead	injured	Direct eco. Loss (10,000 y.)
1990	362	41	271	24.9
1991	353	37	271	25.1
1992	243	44	211	22.1
1993	212	40	188	36.4
1994	265	69	248	58.1
1995	280	106	250	65.3

Besides, there has been a great increase in the traffic volume of the National No. 206 Highway since the 1980s: the annual daily average in 1994 was as high as above 10,000 vehicle/day, much higher than the operation capacity of grade-2 highways; the crowd degree reached 1.78 in 1996; many sections have been turned into streets with serious interference of mixed transport, and so the operation capacity of the highway is reduced and the running speeds of vehicles are getting lower; traffic accidents have increased considerably. All these badly hinder the development of this area. See Table 3-2-14 for the statistics of traffic accidents on the National No. 206 Highway.

Table 3-2-14 Traffic Accidents on the National No. 206 Highway

Item		Hefei City	Anqing City	Liuan Pre.	Total
1994	accident no.	17	261	14	292
	no. of dead	22	129	14	165
	no. of injured	30	173	7	210
	direct loss (10,000 y)	119500	612750	83050	185300
1995	accident no.	43	240	20	303
	no. of dead	44	137	16	197
	no. of injured	36	163	15	214
	direct loss (10,000 y)	313801	774729	169650	1258180
incre-asing (%)	accident no.	152.9	-8.0	42.9	3.8
	no. of dead	100	6.2	14.3	19.4
	no. of injured	20.0	-5.8	114.3	1.9
	direct loss (10,000 y)	162.6	26.4	104.3	54.3

3.2.3.2 Water conservancy facilities

Analysis on Table 3-2-15 which shows the water conservancy facilities in the fields of the cities and counties along the highway may result in such a supposition that the facilities are generally in good conditions. The percentages of effective irrigated areas in the total cultivated field areas of all the cities and counties are all above 90% except that of the Shucheng County, which is 89.5%; that of the Tongcheng City is the highest, 96.2%. However, the existing problem of the facilities is that they are against a relatively low standard, and thus are not put into full use yet. Some fields have still been untouched by water conservancy facilities and thus form some dry corners.

Table 3-2-15 Water Conservancy Situations in the Year 1995

Place	Total field area (ha.)	Effective irrigated area (ha.)	Area with ensured stable yields (ha.)	effective irrigated area in total field area
Feixi County	70533	65760	38510	93.23 %
Shucheng County	44145	39510	30800	89.5 %
Lujiang County	75731	72760	56590	96.08 %
Tongcheng County	34978	33650	26050	96.20 %
Huaining County	35931	33350	23830	92.82 %

3.2.3.3 Posts and telecommunications facilities

The posts and telecommunications cause of Anhui Province has been developing considerably. Up to the end of 1995, there have been 2,717 post offices around the province, and the total length of postal course has reached 53,088 km; long distance telegram communication has reached 730 routes, and telephone (long distance) communication has reached 21,232 routes. The development has provided good conditions for creating satisfactory investment circumstances.

3.2.4 Investigation and analysis on residential life quality

The living level of the people in the cities and prefectures of the project area has been enhanced much with the further implementation of the open-door policy. See Table 3-2-16 for the statistics of the main life quality indices.

Table 3-2-16 Main Life Quality Indices in the Investigated Area in 1995

Place	Hefei City	Anqing	Liu'an	Chaohu
annual average salary of workers (yuan)	5352	3962	3619	4051
income per capita of farmers (y.)	1300.00	1205.87	1209.80	1250.08
medical workers among each 10,000 people	54.13	25.75	20.83	23.67
higher educated persons among each 10,000 people	3831	1273	703	675
color TV in each 100 families	96	90	68*	-
bicycles in each 100 families	152	192	164	-

Remark: * is the data obtained in Tongcheng City.

It can be seen from the table that the life quality of the people in Hefei City is much higher than those of the other cities and prefectures, and that higher education is more developed in Hefei and Anqing.

3.2.5 Investigation and analysis on resources utilization

3.2.5.1 Mineral resources

Anhui Province has great advantages in mineral forming conditions. The mineral resources are rich, varied, and concentrated, and have great potentials in a further development. The cities and prefectures in the project area are mostly located in the mineral zones of iron, copper, sulphue, alum, and their associated products. Specifically, the Liuan Prefecture is rich in magnetite, gold, and construction materials; the alum reserves in the Lujiang County ranks the second in the country, while the iron reserves here ranks the first in the province and those of sulphur iron account for one- third of the total in the province; Anqing City enjoys a large variety of metal resources, among which the copper is rich and of a high grade, and it also has rich nonmetal resources such as sulphur iron, phosphorus, and alumstone. Hefei City is relatively poor in mineral resources and only has a distribution of construction materials.

3.2.5.2 Tourism resources

Anhui is proud of its tourism resources. Besides the famous natural scenic spots of the Huangshan Mount, the Jiuhuashan Mount, the Langyashan Mount, the Tianzhushan Mount and the Qiyunshan Mount, this land is studded with human scenes and historic relics.

The major scenic spots and historic relics along the highway include:

the Lilingshan Mount in the Feixi County which is praised as "the principal mountain of Luyang", the old town of Sanhe which is one of the ten famous towns of the country, the Shou Town in the Liuan Prefecture which is a nationally celebrated historic and cultural town, the Wanfuohu Scenic Spot, the Xitangchi Hot Spring and the Ruins of the Zhouyu City in Shucheng, and the Yefushan Mount, the Tomb of Zhouyu and the Tomb of Xiaoqiao in the Lujiang County. Besides, the Tongcheng City is not only one of the four well-known historical and cultural cities of the province, but also the place of origin of the "Tongcheng School", a literary school which dominated the Chinese literature for over 200 years around the 17^{th} and 18^{th} century; there are a lot of historic relics in the city, most of which have, however, not been fully developed because of inconvenient communications.

3.2.6 Development plan of urban layout

There are mainly two cities and five counties passed by the proposed highway, which are, in the forward going direction of the highway, successively Hefei City, Feixi County, Shucheng County, Lujiang County, Tongcheng City (at an administrative level of county), Huaining County and Anqing City. The urban layout of those cities and towns has important influence upon the selection of highway proposals. In other words, a reasonable coordination between the highway alignment selection and the urban development plans will make it possible to not only enhance the efficiency of the highway but also bring the economy of the project area into flourishment.

As the capital of the province, Hefei is the political, economic, financial, cultural and information center of the province. In the long run, the city is to become a scientific research and education city and a garden city; also it is to be an important national hub of communications, and a base of processing industry guided by high technology in the Yangzi River Basin. The city will ultimately become a multi-functional, open and modern city which has the strongest comprehensive capacity in the delta area of Nanjing, Wuhan and Zhengzhou.

Feixi County is one under the administration of Hefei, and is supposed to develop into city`s district, part of the city group with Hefei as the center. The county government is located in Shangpai Town, where the National No.206 Highway and the Hefei-Tongling Grade-2 Motorway meet. The future development of Feixi will take Shangpai as the center, and connect it with the principal town of the province – Sanhe Town by the He-Tong Motorway, and thus form a new economic corridor.

Shucheng County is situated at the jointing point of the Dabie Mountains and the alluvial plain of Chaohu Lake. The No.206 Highway passes through its east end, whereas the He-Jiu Railway passes the Hangbu Town in the east of the county's territary and there is a railway station there. The railway makes it a distant-future plan for the county to develop eastward along the Shucheng-Sanhe Highway so as to approach the railway.

The future design of Lujiang County takes the Town as the center and develops along the He-Jiu Railway, the He-Tong Highway and the Jun-Er Road. The proposed expressway is somewhere between the first two and near the South Lujiang Industrial Zone.

Tongcheng City has the No.206 Highway crossing down through it. In the future it will develop to the east of the Highway with the Town as the center, and by the year 2010, the city will have become a middle-sized one with a population of about 300 thousand.

Huaining County is passed by the ending section of the Hefei-Gaohebu Highway. Its developing strategy is to depend on Anqing, develop with an opened door, and quickly form the T-type industrial zone with a framework of the No.206 Highway and the Yueshan-Shipai Road. Those towns and townships along the No. 296 Highway will be specially focused upon.

Anqing is a key City in the area development along the Changjiang River in Anhui Province, and its window to the outside world, thanks to its important geographical position. In the future it will mainly develop to the northwest of the present layout.

3.3 Baseline of Acoustic Environment and Assessment

3.3.1 Investigation of acoustic environment

3.3.1.1 Statistics of the sensitive spots within the assessment scope

Table 3-3-1 and Table 3-3-2 show the sensitive spots of residential spots, villages and schools within the assessment scope.

There are 27 sensitive spots along H-G Section, among which there are 9 schools, 18 residential spots and villages, and 1 township government office. Along GAH, there are 6 major sensitive spots, including 2 schools, 4 villages, and 2 township and county government offices. Investigation shows that there are no hospitals or sanatoriums within the assessment scope; most of the sections are located in deserted fields or on hills.

3.3.1.2 Investigations on the existing noise sources

There are no noise sources of major factories or mines within the assessment scope. The Shuanghe Kiln at Gezidun has already been out of operation. At the 7 intersections between HGE and the existing roads interchanges will be constructed. Since the existing roads are all of low grades and the traffic volumes are small, the impact of traffic noise is insignificant. There is 1 interchange within GAH.

Table 3-3-1 Statistics of Environmental Sensitive Spots along HGE

No	Stake No.	Place	Environmental Features	Away fm. Road
1	K4+160 ~ K4+480	Yandunji	50-family village	edge
2	K6+440 ~ K6+540	Xinnian Primary School	250 faculty & students, 6 classes	35m right
3	K9+000 ~ K9+100	Dali	38-family village	across
4	K9+500 ~ K9+760	Hengbu	31-family village	across
5	K16+900 ~ K17+300	Huxiaoying/ Sunxiaoying	40-family village	across
6	K18+460 ~ K18+570	Mogang Pri. Sch.	263 faculty and students, 6 classes	60m right
7	K24+300 ~ K24+780	Zuotangkan / Caoxiaoying	40-family village	edge
8	K27+960 ~ K28+100	Sanligang	40-family village	edge

Table 3-3-1 Statistics of Environmental Sensitive Spots along HGE (continued)

No	Stake No.	Place	Environmental Features	Away fm. Road
9	K29+560 ~ K29+630	Guzhangwan	40-family village	across
10	K30+240 ~ K30+300	Zhashangdaying	40-family village	across
11	K32+550 ~ K32+640	Huangweinangeng	40-family village	across
12	K34+960 ~ K35+060	Longan Pri. Sch	270 faculty & students, 6 classes	30m left
13	K46+740 ~ K46+900	Dingxiafenfang	40-family village	across
14	K61+080 ~ K61+260	Tugang Pri. Sch	500 faculty & students, 12 classes	30m left
15	K68+540 ~ K68+720	Zhangwan	40-family village	edge
16	K69+000 ~ K69+160	Yangyuan	40-family village	edge
17	K79+030 ~ K79+300	Caizhuang	45-family village	across
18	K87+980 ~ K88+030	Nanxin Pri. Sch.	220 faculty & students, 6 classes	90m left
19	K94+130 ~ K94+200	Dawang Pri. Sch.	220 faculty & students, 6 classes	90m left
20	K98+360 ~ K98+720	Chenzhuang	40-family village	30m left
21	K108+500 ~ K108+620	Yuejin Pri. Sch.	120 faculty & students	40m right
22	K110+600 ~ K111+280	Chenlaowu	60-family village	edge
23	K113+650 ~ K113+710	Yaoci Pri. Sch	215 faculty & students, 5 classes	170m right
24	K115+770 ~ K115+940	Shiwan	40-family village	across
25	K116+820 ~ K117+040	Dalengshan	45-family village	across
26	K125+260 ~ K125+712	Gezidun	40 families scattered in the area	edge
27	K125+350 ~ K125+410	Shuanghe Pri. Sch.	260 faculty & students, 6 classes	65m right

Remarks: (1)left/right means to the left/right of the expressway extending in the direction of Hefei ~ Gaohebu; (2) villages with families fewer than 30 are not included.

Table 3-3-2 Statistics of Environmental Sensitive Spots along GAH

Stake no.	Spot name	Away fm. the route	Environmental features
K1+500	Wangjiachong	40m right	30 families, hills, some remove, a resident spot (Chengjiacitang) to east of road
K5+100	Renmin Pri. School	90m right	200 pupils in 6 classes, 11teachers, 2-storey bild.
K5+200	Pengjiazui	110m left, 70m right	consists of small villages of Pengwu, Gaohu, Wangyuan,etc., over 300 families, 1000 people, some remove, Sanyasi Lake nearby
K15+500	Wuheng Township, Banqiao	30m left and 30m right	government location, over 70 families, 300 people, far away fm. new highway, an old road nearby
K23+100	Lixin Pri. Sch., Lixin Village	90m right, 80m right	over 200 students in 6 classes, 11 teachers, classroom walls parallel with road, 20 families
K25+800	Dalongshan Town	edge	government location, some remove

Remarks: 1. "right" or "left" refer to the side of the highway in direction of Gezidun → Anqing; 2. Residential spots of fewer than 30 families are not included in the table.

It can be concluded from the above that the existing highways and railways have little impact on the acoustic environment along the proposed highway.

3.3.2 Baseline monitoring of acoustic environment

3.3.2.1 Distribution of monitoring of the sensitive spots

Based on statistics of sensitive spots, the assessment principle, and the consideration of different types of objectives, there distributed altogether 10 monitoring spots, which are shown in Table 3-3-3.

See Attached Figure 5 for the distribution of monitoring of the noise sensitive spots along the proposed alignment.

Table 3-3-3 Distribution of Monitoring Spots of Acoustic Environment Quality

Stake no.	Spot name	Away fm route	Spot no. & place	Environmental features
K4+000 K4+200	Yandun Middle Sch., Weidianzhuang	200m right 90m right	1 in school 1 in village	700 students, 1 or multiple storeyed bild., 30 families btw. School and highway
K24+500	Caoguantang	60 left	1 in village	40 families, road crosses btw. 2 villages
K54+700	Zhangjialoufang	30 left	1 in village	50 families, 250 people, some remove
K94+600	Yuzhuang	edge	1 in village	22 families, 110 people, governed by Dawangzhuang Village Comm., some remove, Tongcong Road nearby
K113+800	Sanba	edge	1 in village	40 families, 148 people, governed by Yaoci Village Comm., Yaoci Reservoir nearby
K125+700	Gezidun	edge	1 in village	50 families scattered around, Shuanghe kiln & No.206 Highway nearby
GAH				
K5+100 K5+200	Renmin Primary Sch. Pengjiazui	90m right 110m left, 70m right	1 in school 1 in village	200 pupils, 11 teachers, 2-storey bild. Consists of small villages of Pengwu, Gaohu, Wangyuan, etc.,300 families, 1000 people, some remove, Sanyasi Lake nearby
K15+500	Wuheng (Banqiao Village)	30m left	1 in village	location of Wuheng Township Government, 70 families, 300 people, old road nearby, away fm. new road
K23+100	Lixin Primay Sch.	90m right	1 in school	200 students in 6 classes, 11 teachers
K25+800	Dalongshan Town	edge	1 in village	location of town government, some remove in the village backward

Remark: The distance in the table is that from the sensitive spot to the central line of the highway.

3.3.2.2 Baseline data of acoustic environment

The monitoring methods and data treatment are carried out according to the National Standards GB/T14623-93 "Methods of Urban Environment Noise Measurement". The monitoring lasted one day at 10:00, 16:00 and 24:00; the characteristics of the surroundings and the major noise sources were recorded at the same time.

The on-the-spot monitoring undertaken by APEMCS resulted in the data shown in Table 3-3-4.

Table 3-3-4 Monitoring Data of the Representative Sensitive Spots

	No.	Spot name	Date	Time	LeqdB(A)	Acoustic source
HGE	1	Yandun High School	05/28/97 10/24/97	day/night	55.5/ 44.3 43.1/ 34.1	school activity/--
	2	Weidianzhuang Village	05/28/97 10/24/97	day/night	51.1/ 43.8 39.3/ 33.2	bird chirping domestic noise
	3	Caoguantang Village	05/29/97 10/24/97	day/night	44.5/ 40.8 41.8/ 33.4	bird chirping traffic & domestic noise
	4	Zhangjialoufang Village	05/29/97 10/24/97	day/night	44.9/ 41.5 36.0/ 32.1	bird chirping domestic noise
	5	Fuyuan High School	10/24/97	day/night	36.6/ 29.0	school activity/--
	6	Yuzhuang Village	06/03/97 10/24/97	day/night	43.1/ 39.5 43.9/ 32.7	bird chirping traffic & domestic noise
	7	Sanba Village	06/03/97 10/24/97	day/night	43.1/ 39.5 48.4/ 41.0	bird chirping domestic noise
	8	Gezidun	06/04/97 10/24/97	day/night	41.5/ 37.4 46.5/ 35.5	domestic noise traffic & domestic noise
GAH	9	Renmin Primary School	06/04/97 11/07/97	day/night	46.6/ 39.9 49.5/ 32.5	school activity/--
	10	Pengjiazui Village	06/10/97 11/07/97	day/night	48.6/ 36.6 45.7/ 37.1	bird chirping grain threshing
	11	Banqiao Village Wuheng own	06/10/97 11/07/97	day/night	44.9/ 40.7 42.5/ 39.6	bird chirping domestic noise
	12	Lixin Primary School	06/10/97 11/07/97	day/night	45.0/ 33.6 53.1/ 34.8	school activity/--
	13	Dalongshan Town	06/11/97 11/07/97	day/night	43.9/ 39.3 55.2/ 34.9	bird chirping traffic & domestic noise

3.3.3 Acoustic environment assessment

3.3.3.1 Monitoring statistics of standard-surpassing in present acoustic environment

See Table 3-3-5 which was composed on the basis of the monitoring data and the implementation standards of acoustic environment baseline assessment, which are 55 dB(A) in daytime and 45 dB(A) at night.

Table 3-3-5 Statistics of Standard-surpassing at Representative Sensitive Spots dB(A)

	Name	Leq (Summer)	Leq (Autumn)	Standard-surpass (Summer)	Standard-surpass (Autumn)
		day / night	day / night	day / night	day / night
HGE					
1	Yandun High School	55.5/ 44.3	43.1/ 34.1	0.5/ -	-/ -
2	Weidianzhuang Village	51.1/ 43.8	39.3/ 33.2	-/ -	-/ -
3	Caoguantang Village	44.5/ 40.8	41.8/ 33.4	-/ -	-/ -
4	Zhangjialoufang Village	44.9/ 41.5	36.0/ 32.1	-/ -	-/ -
5	Fuyuan High Sch.	—	36.6/ 29.0	—	-/ -
6	Yuzhuang Village	43.1/ 39.5	43.9/ 32.7	-/ -	-/ -
7	Sanba Village	43.1/ 39.5	48.4/ 41.0	-/ -	-/ -
8	Gezidun	41.5/ 37.4	46.5/ 35.5	-/ -	-/ -
GAH					
1	Renmin Primary School	46.6/ 33.9	49.5/ 32.5	-/ -	-/ -
2	Pengjiazui Village	48.6/ 36.6	45.7/ 37.1	-/ -	-/ -
3	Banqiao Village Wuheng own	44.9/ 40.9	42.5/ 39.6	-/ -	-/ -
4	Lixin Primary School	45.2/ 33.6	53.1/ 34.8	-/ -	-/ -
5	Dalongshan Town	43.9/ 39.3	55.2/ 34.9	-/ -	0.2/ -

Remark: "-" is for non-standard-surpassing.

3.3.3.2 Acoustic environment analysis

It can be seen from Table 3-3-5 that the acoustic environment of the representative sensitive spots of schools, villages and government offices within the assessment scopes is in good conditions.

Conclusively, the monitoring data are: schools: 45.2-55.5dB in the daytime and 33.6-44.3dB at night; villages and residential spots: 41.5-51.1dB in the daytime and 36.6-43.8dB at night. According to the noise standards for "Type-1 areas", there is no standard surpassing except that of the Yandun Middle School in the daytime which exceeds the standard by 0.5dB. The monitoring data of most sensitive spots approach the "Type-0 standard". The areas along the route corridor are mostly deserted fields and hills, which are quiet all the time.

3.4 Baseline of Atmospheric Environment and Assessment

3.4.1 Baseline survey

The proposed highway is located in the middle southwest of Anhui Province, and the topography of the project area is plain and slight hilly area. According to several on-the-spot investigations, except the Hefei New Technology Development Zone which is situated in between Xiaoxichong, the starting point of H-G Section, and Yandunji, the area crossed by the highway is mostly the rural area of open fields. (The alignment of the highway only takes a corner of the Zone which is not yet developed.) Besides, there are no major factories and mines here; there only scatter some small brickyards and kilns which have seasonal production and thus little impact on the air quality.

The main existing pollution sources include the tail gases of the automobiles on the roads, the second flying dust on the roads and the CO and TSP pollutants produced by the residents' living activities. But the emitted volume is small. Therefore, the present air quality is good.

On the basis of investigations and with reference to the "Statement of Engineering Feasibility Studies", it is concluded that the environment of the project area is relatively monotonous, with villages in small scales and residential spots scattered here and there and the surroundings are mostly agricultural fields in flat and open topography. The area along G-A Section is, however, more hilly in landscape. There are no big hospitals or sanatoriums within the project area; altogether there are 1 township government office, 18 big villages (with 30 families and above), and 9 primary schools along H-G Section, whereas along G-A Section there are 2 township government offices and 4 big villages, 3 of which are to be relocated, and 2 primary schools. See Tables 3-3-1 and 3-3-2 for the environmental sensitive spots statistics.

3.4.2 Baseline monitoring and analysis

3.4.2.1 Location of monitoring spots

With consideration of environment, socioeconomic situations, topography, climate and traffic volume distribution among road sections, there located 2 environmental air monitoring spots along H-G Section and 1 along G-A Section. See Table 3-4-3 for the situations of the above 3 spots, and Attached Figure 5 for their locations.

Table 3-4-3 Survey of the Environmental Air Monitoring Spots

Stake no.	Spot	Distance fm. Road Central Line	Environmental Features
K24+500	Caoguantang	60m left	40 families, road passes btw. 2 villages
K94+600	Yuzhuang (Dazhonggu)	edge	22 families, 110 people, governed by Dawang Village Comm., Tongcong Road nearby
K15+500	Banqiao	30m left	location of Wuheng Township Government, 70 families, over 300 people, old road nearby, away from new highway

3.4.2.2 Monitoring time and frequency

The monitoring is undertaken by APEMCS. There are two times of monitoring in the summer and autumn of 1997; each time it lasts 5 days continuously at each spot, and each day the monitoring is made at 7:00, 11:00, 15:00 and 19:00.

3.4.2.3 Monitoring subjects and monitoring analysis methods

According to the environmental impact characteristics in the construction and operation periods and following the requirements in the TOR, it is defined that NOx, CO, and TSP are the baseline monitoring subjects.

Table 3-4-4 Sampling and Analyzing Instruments and Methods

Item	Sampling Instrument	Sampling method	Analytic instrument	Analyzing method	Lowest detected limit
NOx	KB-6 Air Sampler	porous glass absorbing tube	751 Spectrometer		0.010 mg/m^3
CO	Bladder Sampler		CO analyzer	infrared analytical method	1.25 mg/m^3
TSP	KB-120 Air Sampling Pump	glass fibre filter film absorption	electric balance	weight-measuring	0.001 mg/m^3

3.4.2.4 Monitoring results and analysis

The baseline monitoring results are synthesized as shown in Table 3-4-5. The assessment norm is the Grade-2 Standard in GB3095-1996. See Table 1-7-6 for the concentration value limits.

• NOx

For HGE the average detected scope per hour is undetected ~ 0.020mg/m^3 , the daily average value measured scope is undetected ~ 0.018mg/m^3 , and the average concentration is 0.012mg/m^3 ; those values for GAH are respectively 0.010 ~ 0.021mg/m^3 , 0.010 ~ 0.016mg/m^3 , and 0.013mg/m^3. The average concentration per hour and the daily average of both sections are not beyond the standards of assessment.

• CO

For HGE the average concentration per hour detected scope is undetected ~ 1.49mg/m^3 , and the daily average value detected scope is undetected ~ 0.99mg/m^3, and the average concentration is 0.66mg/m^3; those values for GAH are respectively undetected, undetected, and 0.625mg/m^3. There are no standard-surpassing in the average concentration per hour and the daily average in both sections.

• TSP

For HGE the average concentration per hour detected scope is 0.101 ~ 0.72mg/m^3, the daily average detected scope is 0.118 ~ 0.465mg/m^3, (there is standard-surpassing at Caoguantang, Feixi) and the daily average concentration is 0.282mg/m^3; those values for GAH are respectively 0.065 ~ 0.137mg/m^3, 0.074 ~ 0.117mg/m^3, and 0.097mg/m^3. No standard-surpassing is found.

It can be concluded therefore that the air quality along the proposed highway is good, especially there are quite a lot “undetected” cases for CO, and a few for NOx.

Table 3-4-5 Baseline Monitoring Results of Atmospheric Environment

Route	Monitoring location	Item	Monitoring date (summer & autumn)	1hr. average		Daily average		Maximum standard surpass times	Total daily average mg/m³
				Concentration scope mg/m³	Standard surpass %	Concentration scope mg/m³	Standard surpass %		
H-G Section	Feixi Caoguan-tang Village	NOx	S. 06/03/97 ~ 06/10/97	—~ 0.020	0	—~ 0.013	0	0	0.008
			A. 10/24/97 ~ 10/28/97	—~ 0.021	0	0.007 ~ 0.011	0	0	0.009
		CO	S. 06/03/97 ~ 06/10/97	—~ 1.49	0	—~ 0.99	0	0	0.70
			A. 10/24/97 ~ 10/28/97	—	0	—	0	0	—
		TSP	S. 06/03/97 ~ 06/10/97	0.190 ~ 0.720	0	0.250 ~ 0.465	50	.55	0.430
			A. 10/24/97 ~ 10/28/97	0.043 ~ 0.488	0	0.083 ~ 0.326	25	0.087	0.186
	Tongcheng Yuzhuang Village	NOx	S. 06/03/97 ~ 06/10/97	0.012 ~ 0.020	0	0.014 ~ 0.018	0	0	0.016
			A. 11/03/97 ~ 11/07/97	—~ 0.009	0	0.004 ~ 0.007	0	0	0.006
		CO	S. 06/03/97 ~ 06/10/97	—	0	—	0	0	0.625
			A. 11/03/97 ~ 11/07/97	0.94 ~ 1.12	0	1.03 ~ 1.08	0	0	1.05
		TSP	S. 06/03/97 ~ 06/10/97	0.101 ~ 0.212	0	0.118 ~ 0.162	0	0	0.134
			A. 11/03/97 ~ 11/07/97	0.111 ~ 0.315	0	0.171 ~ 0.227	0	0	0.194
G-A Section	Huaining Wuheng Town, Banqiao Village	NOx	S. 05/26/97 ~ 05/30/97	0.010 ~ 0.021	0	0.010 ~ 0.016	0	0	0.013
			A. 11/03/97 ~ 11/07/97	—~ 0.009	0	0.004 ~ 0.008	0	0	0.006
		CO	S. 05/26/97 ~ 05/30/97	—	0	—	0	0	0.625
			A. 11/03/97 ~ 11/07/97	0.90 ~ 1.16	0	0.95 ~ 1.13	0	0	1.06
		TSP	S. 05/26/97 ~ 05/30/97	0.065 ~ 0.137	0	0.074 ~ 0.117	0	0	0.097
			A. 11/03/97 ~ 11/07/97	0.185 ~ 0.648	0	0.227 ~ 0.356	25	0.187	0.290

Remark: "-" stands for undetected.

3.4.3 Baseline assessment

3.4.3.1 Assessment method

The assessment of environmental air quality adopts the method of single-factor indices. The calculating formula is as follows:

$P_i = C_i / S_i$, in which

P_i – assessment index;

C_i – actually measured value mg/m^3;

S_i – implementation standard value mg/m^3.

3.4.3.2 Assessment results

Table 3-4-6 Pi Statistics of Environmental Air Pollutants

Route	Monitoring spot	Item	Status quo value mg/m^3	Standard value mg/m^3	Pi	Standard surpassing
H-G	Feixi County, Caoguantang	NOx	0.008	0.10	0.08	-
		CO	0.70	4.00	0.17	-
		TSP	0.430	0.30	1.43	+
	Tongcheng Yuzhuang (Dazhonggu)	NOx	0.016	0.10	0.16	-
		CO	0.625	4.00	0.16	-
		TSP	0.134	0.30	0.45	-
G-A	Huaining County Wuheng (Banqiaocun)	NOx	0.013	0.10	0.13	-
		CO	0.625	4.00	0.16	-
		TSP	0.097	0.30	0.32	-

Remark: +:over the standard; -:below the standard

It can be seen in the table that along HAE the averages of the pollutants' single assessment indices are all lower than 1.0 (except that of the TSP at some spots), i.e., the average pollutant concentrations of most of the spots are within the national Grade-2 standard. The single assessment indices of the pollution factors are listed from the biggest to the smallest as the following: $P_{TSP} > P_{NOx} > P_{CO}$.

It can be concluded therefore that the air quality along the proposed highway is good; the NOx and CO have large environmental capacity. All this provides good conditions for the construction of the highway.

CHAPTER FOUR ENVIRONMENTAL IMPACT PREDICTION AND ASSESSMENT

4.1 Prediction and Assessment of Impact on Ecological Environment

4.1.1 Assessment of impact on ecological environment during the construction period

4.1.1.1 Impact of highway land-acquisition on agricultural production

It is necessary and inevitable for the highway construction, just like the other construction projects, to occupy land. See Table 4-1-1 for the land-acquisition situations of this project.

Table 4-1-1 Estimates of Land-acquisition by the Highway

Unit: mu

Section	Total	Paddy field	Dry land	Other	Borrowing	Temporary
HGE	18228.4	7908.2	781.0	1539.2	4510	790
GAH	1764.45	1228.26	138.04	128.15	120	150

Remark: The total includes the earth-borrow occupation, temporary occupation and the interchange occupation.

According investigations, the average cultivated fields per capita is between 0.6 and 1.3 mu in the rural area along the highway, i.e., 0.6 mu in the suburbs of the cities, and 1.3 mu in the townships and counties away from cities. The figures are a bit lower than that of the national average.

According to investigations on the annual yield per unit area of the project area, normally, the yield per mu of the paddy fields is 800—1000 kg for double cropping of rice, and about 600 kg for single cropping rice; that of the dry land is about 400 kg. If estimates are made according to the yield of the dry land for the three kinds of land-occupation (i.e. for other purposes, borrowing, and temporary), and with the assumption that only grains are produced, there will be a loss of 6.327 million kg – 8.700 million kg of grains per year in the paddy fields along HGE, the average being 7.908 million kg; and the loss in the dry land and the three kinds of occupied land will be 3.048 million kg. As for GAH, the total loss of grains in the paddy fields, the dry land and the occupied land will be

1.443 million kg. To sum up, the grain production per year will be reduced by 12.3992 million kg because of the land-acquisition by the project. The amount could have fed 340 thousand people for one year with the assumption that the consumption of grains per capita per year is 365 kg. However, the land taken by the project is after all in a small amount compared with the total cultivated fields along the highway. See Table 4-1-2 for the survey of cultivated fields, population and total area of the major cities and counties passed by the highway.

Table 4-1-2 Statistics of Total Cultivated Fields and Population

City/County	Total area (km^2)	Fields (10,000mu)	Population (10,000)	Population density ($/km^2$)
Hefei	7266	/	408.3	562
Feixi	2168	107.25	95.9	442
Shucheng	2092	66.7	96.1	459
Lujiang	2352	102.0	117.0	497
Tongcheng	1644	54.0	76.26	464
Huaining	1515	54.6	77.1	509
Total		384.55	462.36	

Remark: The sum total of population does not include that of Hefei City.

It is calculated from Table 4-1-1 that the sum total of paddy fields, dry land and other land occupied by HGE and GAH is 19992.85 mu, which is 0.52% of the total cultivated area (3.8455 million mu). Therefore, land-acquisition here does not have great impact on the local agricultural production. But since now the fields are contracted to families, there will be impact upon some individual farmers. Still, as long as the local government make reasonable coordination or adopt the compensation money to establish some industries whose products are well-adapted for the market, the life quality of those whose land is occupied will not be affected considerably.

The land-acquisition by earth borrowing should be coordinated with the plan of the local government. For the fields which need re-cultivation after borrowing, the surface earth (0-30cm) should be piled aside before the borrowing and then restored after that; there will be reduction in the production, but things can be improved by means of artificial fertilizing and so on. The temporary land-acquisition with certain amount of compensation money will have little impact. If the borrowing sites are to be changed into ponds, aid should be enlisted from the construction department.

In another perspective, land-acquisition by the project may promote the value of the land through changing the investment conditions and communicative conditions of this area. This will be significant for the development and agricultural production of the area.

4.1.1.2 Impact on the plants and animals along the highway during construction

The impact of highway projects on the local ecological environment is concentrated in the construction period, especially at the beginning of it. The vegetation within the occupied area will be taken off, especially in the cutting sections and at the borrowing sites, whereas in the filling sections, the vegetation will be covered up by the filling. The project area is mainly an agricultural one, and the paddy fields and dry land taken here account for 84.95% (H-G Section) and 91.42% (G-A Section) of the total ever-taken amount, while other types of land taken only cover 10—15% of the total. Therefore, it is the agricultural vegetation that is damaged the greatest by the construction. Only in some low hilly sections does the cutting do harm to the herbs, bushes and the man-planted masson pines and China firs there. It is calculated that in H-G Section the cutting sections amount to 8.15 km, and in G-A Section, 7.25 km. As a conclusion, the construction has little impact on the vegetation beyond agriculture.

There are no protected plants or animals within the assessment scope. Since part of the vegetation is damaged, there will be impact upon those small animals living there.

In constructing the base course of the pavement, lime stabilized soil will be used. Two mixing methods are adopted: plant mixing and road mixing. When plant mixing is used, within 150 m in the lower wind the dust may fall onto the surface of the agricultural plants and thus affect the photosynthesis of the plants. If the lime content is high, it may burn the surface of the leaves and thus reduce the production. When road mixing is used, during the dispelling and sifting there will be fine lime dust flying to the surface of the plants in the lower wind, and it may even burn the surface of the leaves and affect the production. In order to reduce such pollution, the raw lime powder should be packed.

The pollution by the transport of construction materials should also be taken into account. The total volume of cutting and filling is 14024.82km^3; except using a little amount of cutting, the filling in the agricultural fields will adopt nearby concentrated borrowing, but the shortest transporting distance is about 2 km. The transporting distance of sand and stones varies among different sections from 15 km to 60 km; steel, cement and timbers are transported from Maanshan, Anqing, Chaohu and Qianshan in the same province; bitumen is transported from Shandong Province by railway, highway or water. Since all the materials for subgrade and pavement construction have to be transported here by temporary roads, there will be a large quantity of flying dust produced, which will affect the growth of crops 50m away from the road if fall on them. Therefore, water should be sprinkled on the roads to reduce flying dust pollution.

4.1.2 Impact on the surface water environment by the construction

4.1.2.1 Impact of subgrade construction on the surface water environment

Since there is an advanced surface water system in the project area, the highway occupies a large area of paddy fields. The subgrade construction may damage part of the irrigation canals or fill up some of the irrigation ponds. According to preliminary statistics there are about 40 streams or irrigation canals along H-G Section and 6 along G-A Section . And there are 10 named ponds (reservoirs) within the assessment scope; see Table 3-1-7. Tables 4-1-3 and 4-1-4 show the crossing situations of HGE and GAH with the local water system.

Table 4-1-3 Survey of HGE's Crossing with Local Surface Water

No.	Stake no.	Crossed water
1	K2+400	brook
2	K5+150	brook
3	K10	canal
4	K13+800	irrigation canal
5	K14+870	Zhongpai River Bridge
6	K17+000	canal
7	K18+100	canal
8	K20+000	irrigation canal
9	K24+900	irrigation canal
10	K26+600	irrigation canal
11	K28+100	irrigation canal
12	K29+600	Fengle River Bridge
13	K31+200	irrigation canal

Table 4-1-3 Survey of HGE's Crossing with Local Surface Water (continued)

No.	Stake no.	Crossed water
14	K32+500	irrigation canal
15	K33+200	irrigation canal
16	K33+950	irrigation canal
17	K35+000	irrigation canal
18	K35+400	irrigation canal
19	K36+400	Hangbu River Bridge
20	K37+800	Macao River
21	K38+100	irrigation canal
22	K39+100-K39+150	Xiaotangao Reservoir,150m*250m, 30m to the west of the highway
23	K39+950	irrigation canal
24	K40+800	irrigation canal
25	K44+500	Duotang Pool, 200m*100m, 100m to the east of the central line
26	K46+500	Quqiao Big Pond, 200m*120m, 60m to the east of the central line
27	K48+800	canal
28	K50+000	small river
29	K54	Qilitang Pool, 220m*150m
30	K55+700	small river
31	K62+300	irrigation canal, K61-K64 Shulu arterial canal is beyond 300m to the west
32	K63+850	Shulu Arterial Canal
33	K65+400	irrigation canal
34	K66+400	Lixin Reservoir, 300m*250m, 150m to the east, Kexi Branch Canal, 200m to the west
35	K72+800	irrigation canal
36	K73+150	Dabai Pool, 200m*50m, beyond 100m to the east
37	K75+950	boundary river
38	K75+400	brook
39	K79+600	irrigation canal
40	K84	small river
41	K85+400	small river
42	K90+500	small river
43	K97+800	Chungu Pool, 250m*150m, beyond 50m to the east
44	K105	Mei Pool, 250m*150m, beyond 150m to the west
45	K106	Daguan Pool, beyond 200m to the east
46	K107+120	Longmian River Bridge
47	K108+150	irrigation canal

Table 4-1-3 Survey of HGE's Crossing with Local Surface Water (continued)

No.	Stake no.	Crossed water
48	K113+800	Sanba Village, beyond 100m to the west, Yaoci Reservoir
49	K115+150	irrigation canal
50	K116+400	Guache River Bridge
51	K117+350	irrigation canal
52	K120+550	Bonian River Bridge
53	K121+250	irrigation canal
54	K121+650	small river
55	K122+150	irrigation canal
56	K122+550	Renxing River Bridge

Table 4-1-4 Survey of GAH's Crossing with Local Surface Water

No.	Stake No.	Crossed Water
1	K2	irrigation canal
2	K6	Sanyasi Lake Bridge
3	K11+950	brook
4	K13+300	brook
5	K15+400	brook
6	K16-K17+400	a brook is 50-100m to the west

In design of the highway enough consideration has been given to the coordination between the alignment and the water system. There are altogether 644 culverts on HGE and 137 on GAH (not including those underpasses functioning in drainage). As long as the construction is well-coordinated with the local agricultural irrigation, i.e., culverts are built in the non-irrigation season, and the wastes left by the construction are cleared out after the culverts are finished, there will be no impact on the irrigation and on the surface water environment.

For the subgrade crossing ponds, retaining walls must be built so as to resist erosion. With such techniques, the water environment will not be affected, either.

A certain amount of water has to be sprinkled in order to ensure the stability during subgrade construction. Since the annual rainfall is abundant here, the water resources are rich. So there will be no significant impact on them.

4.1.2.2 Impact of Bridge and Culvert Construction on Rivers

HGE crosses 7 rivers, whose stake numbers are shown in Table 3-1-6. There are bridges designed over all of the 7 rivers. On GAH here is a bridge over the Sanyasi Lake. Apart from 7 extra-large and large bridges, there are 26 middle-sized ones and 37 small ones on HGE, and 12 small ones on GAH. There are 781 culverts, too. The substructure of large and middle-sized bridges usually adopts column pier, gravity abutment or light-typed abutment, and the foundation is pile foundation or an enlarged one. Construction works of substructure will be carried during dry season, and MOC relevant regulations will be applied to civil works. Therefore, it is unlikely to foresee any significant water pollution during the construction works of bridges. Excavated bottom soil will be disposed in designated sites. Dumping waste soil to rivers and farmlands are prohibited to avoid secondary pollution. Environmental quality of sediment in Sanyasi Lake will be analyzed before commencement of actual construction works. Since a large quantity of borrowing is needed for the whole line, the cuttings here will not be wasted and thrown away.

There will be an amount of living waste water produced by the staff working on the river, which should be gathered and stored and disposed of properly on the bank.

When foundation construction is made on the navigable rivers like the Pai River, the Fengle River and the Hangbu River, coordination should be made with the shipping departments so as to avoid accidents which will cause pollution to the water.

4.1.3 Impact on soil erosion during construction period

4.1.3.4 Analysis of the factors affecting soil erosion

The factors can be sorted into natural ones and artificial ones.

The natural factors are:

(1) rainfall, which is a main drive to soil erosion. The size of raindrops, speed, duration of rainstorm and wind speed will all influence the eroding force of rainfall;

(2) vegetation, which functions a lot in water and soil conservation. Good vegetation can block the rainfall, reduce the strike of raindrops upon the ground and postpone the production of surface runoff. Meanwhile, the large root system of plants can stabilize soil; the withered parts of plants may gather on the ground and thus store water, increase the organic content of soil, and thus improve the composition of soil and enhance its erosion resistance;

(3) topography, which refers mainly to the grade and length of slope. A sharp slope provides conditions for soil erosion. When factors like rainfall, soil type and vegetation are the same, the quantity of erosion on sharp slopes can be a few times larger than that on a gentle slope;

(4) constituents of soil and ground surface, which is the substantial basis for soil erosion. Factors like soil type, characteristics of parent rock and so on will all directly influence soil erosion.

The artificial factors are various. It is laid down in the national "Water and Soil Conservation Law", Item 18 that "in projects of railway, highway and water conservation construction, damage to the vegetation should be reduced as much as possible; wasted sand, stone and earth have to be stored in regulated places and must not be thrown to rivers, lakes, and ditches and canals other than the regulated places; on the slopes on both sides of railways and highways, slope protection or other protecting means must be adopted; when the construction is finished, the exposed grounds like the borrowing sites, cutting sites and the storing sites for wasted sand, stone and earth must be planted by trees and grass so as to avoid soil erosion." Concerning this project, the sections built in agricultural fields cover 84.95% of H-G Section and 91.42% of G-A Section; the sections in rolling terrain are relatively short, so there is no significant change to the topography; but the cut and fill sections really change the local slope grade and length of the original ground, and the cutting and borrowing damage the vegetation. As a result, some soil of poor composition is exposed to the air, and besides, since the protection means cannot be fully taken at the beginning of the construction, local soil erosion is inevitable.

4.1.3.2 Prediction of impact on soil erosion

See Tables 4-1-5 and 4-1-6 for the statistics of cutting sections of H-G-A Expressway.

Table 4-1-5 Statistics of Cutting Sections of H-G Section

No.	Stake number	Length of cutting (m)
1	K46	150
2	K47	350
3	K59+700	200
4	K60+000-K60+550	550
5	K60+850-K61+300	450
6	K75	100
7	K79	200
8	K86-K87	900
9	K88-K91	900/4 section (total)
10	K92-K94	900/2 section (total)
11	K94+600-K95+300	800/2 section (total)
12	K98+000-K98+200	200
13	K109+000-K109+250	250
14	K111+000-K111+350	350
15	K117+650-K118+400	750
16	K124+000-K124+800	800
17	K125+700-K125+880	300
Total		8.15km/22 section

Table 4-1-6 Statistics of Cutting Sections of G-A Section

No.	Stake number	Length of cutting (m)
1	K1+700-K2+000	300
2	K2+100-K1+250	150
3	K3+500-K3+800	300
4	K6+500-K7+000	500
5	K7+700-K8+000	700
6	K8+700-K9+600 (in between)	350/5 section (total)
7	K10+700-K10+900	200
8	K11+700-K11+900	200
9	K12+200-K13+000	800
10	K13+300-K14+800	1500
11	K17+500-K17+750	250
12	K18+000-K18+350	350
13	K19+200-K19+500	300
14	K19+950-K20+100	150
15	K20+200-K20+450	250
16	K21+000-K21+200	200
17	K21+600-K24+300	750/5 section (total)
Total		7.25km/23 section

It can be seen here that there are 23 cuts in a total length of 8.15km in H-G Section and 23 cuts in a total length of 7.25km in G-A Section. The cuts are generally as deep as 5m, with only a few sections being 10m deep. The soil types on the hills and slight rollings along the line are yellow and brown soil, yellow and drab soil, and paddy rice soil which are cohesive. Before the construction, the soil had been slightly eroded; during the construction, since the protection and tree and grass planting are arranged backwards, the soil erosion will be increased. If the side slope of cut is regarded as in average of 5m, there is 0.082km^2 in H-G Section and 0.073km^2 in G-A Section , and the total is 0.155km^2. Calculated according to the local soil erosion model 500t/km^2*y, and assuming that the 45 cut sections in both sections are cut in both sides, the annual soil erosion volume will be 231.75 ton, and the sum total of the first two years of the construction will be 463.5 ton. From the third year, the protection engineering should partly be completed, and the erosion will be reduced.

Side slope will also be produced by fill subgrade. According to the "Feasibility Studies" in 1997, the total cut and fill of HGE is 11380.242km^3, while the cut of GAH is 922,044m^3, and the fill is 1,693,338m^3. All the cut is adopted without being abandoned. The average fill height of the whole line is 3.91m. If calculated by the side slope ratio of 1:1.5, the fill side slope is about 7.0m long. Taking off the total length of the bridges and the 7 interchanges and the culverts, the total fill section is 100km long, and the maximum area of the fill side slope in total is 1.4km^2. If all that is built with earth, the maximum soil erosion volume per year is 2100 ton, and 4,200 ton in two years. In the third year, thanks to the increase in protection engineering, the erosion volume will be much smaller than the predicted. Besides, because there is no abandoned earth and stones, there is no soil erosion in this aspect.

In the construction of H-G Section the protection engineering amounts to 222388.22m^3, and that of the subgrade of G-A Section is 49964.39m^3. It is required that the protection engineering should be designed, constructed and finished at the same time as the major construction, so the soil erosion in the later period of the construction will surely be reduced.

4.1.4 Prediction of impact on ecological environment in operation period

4.1.4.1 Impact on the vegetation

The filling and cutting in the construction take off all the original vegetation and thus produce serious adverse impact, which is difficult to be compensated during the construction period. However, in the later phases or in the operation period, planting can be designed and then implemented to the side slope, the central reserve, the interchange area, the service area, and the borrowing sites and the waste piles, so as to compensate for the damage done in the construction by means of artificial planting. It is designed in the "Feasibility Studies" that slope protection in diamond checks in which grass is planted is applied to the earth fill side slopes, and the total planted area will be above 1.0km^2. It is required in "Norms for Highway Environmental Protection Design" that the vegetation covering rate should not be lower than 70% within two or three years of operation. This not only follows the regulations in the national "Law of Water and Soil Conservation", but beautifies the road view and the views along the road, and ensures the stability of the subgrade and reduces pollution to the air and acoustic environment. It also does good to the biological diversity in this area. The socioeconomic profits and environmental profits brought by the restoration of vegetation are great, which are difficult to estimate in quantity at present.

4.1.4.2 Impact on water environment in operation period

Since the highway has its own complete drainage system, the runoff on the surface of the road produced after rain will flow together through the drainage ditches and side ditches into the rivers along the highway, which are of different water systems thanks to the length of the road. Thus no impact will be made on the water environment of the water systems. Besides, because the surface runoff is drained through the ditches, it will not flood the agricultural fields.

It is worth mentioning that around K71 there build a service area, in which the facilities include mainly: parking lot, garden, gas station, garage, comprehensive service building, dining hall, pump station, boiler room, transformer substation, toilet, waste water disposing facilities, etc. At present the scale and staff of the service area are not yet determined, but referring to the existing service areas in the country, the staff is likely to consist of 200 people. According to "Norms for Environmental Impact Assessment of Highway Projects", JTJ005-96, in East China the daily average water used per capita amount to 100 liter, so the waste water from living can be 20 ton. Assuming that everyday there are 100 automobiles washed clean here, and for each automobile the wash needs 400 liter, the water used in washing will amount to 40 ton; if 50% of it is recycled, the water wasted here will be 20 ton. In sum, the waste water from living and that from automobile washing is altogether 40 ton/day. There are already waste water disposing facilities designed, and according to the principle of total amount controlling required by NEPA, the waste water can only be emitted when it amounts to the standard quantity. Besides, the emission is usually into the irrigation system in small quantities, and there will not be much oxygen-consuming substance in the emission. Despite of all these, the emission of waste water must be controlled and proper treatment must be made to the waste water.

4.1.4.3 Impact on the soil environment along the highway

In a lot of EIA of highway projects there are prediction and assessment on lead, which is added to the gas for vehicles here in China. But now, lead-free gas has been produced and be used compulsorily in some large cities like Beijing and Shanghai. Since the project is to be put to operation in the year 2001, and by that time lead-free gas will have been applied all over the country, there is no specific prediction on the impact of lead in this statement.

In addition, the monitoring results of the status quo of lead in the sample soil collected along the line show that the lead content scope for the four sample spots is 15.48mg/kg $\sim$ 24.60mg/kg. It is defined in the implementation norm of the assessment, i.e., GB15618-95 "Standards for Soil Environmental Quality" that the limit value of Class-2 lead is $\leqslant$ 250 $\sim$ 300mg/kg. That is to say, the lead content in the soil within the assessment scope would not surpass the national standard even if it were increased by 10 times. It can be seem from the over 150 EIA statements on highway projects completed here in China that the lead content in the soil along the highway has never surpassed the national standard under conditions of the predicted traffic volume and the predicted 20-year-long operation.

4.2 Prediction and Statement of Impact on Socioeconomic Environment

4.2.1 Population

The operation of the highway will no doubt influence the distribution of population along it. Since the moved families are generally relocated just in the neighborhood, the population of the townships and counties will not change remarkably. But after the highway is put to operation, and with the establishment of industrial developing zones along the line and the development of tourism and commerce, there will be a trend of increase in the population from outside the region, and the distribution and density of population will also change considerably. There may appear new towns near the interchange areas and the connecting lines.

4.2.2 Economic characteristics, industrial composition and labor force

At the future economic distribution of Anhui, the project area is located at the joining point of the Changjiang River economic industrial zone and the high and new technological industrial zone with Hefei as its center, so the area plays an determining role in the development of the whole province. The highway project has, therefore, great influence to bear upon the socioeconomic development, industrial composition and the composing ratio of the labor force in the areas along HAE.

First, the developing objective of Changjiang River economic industrial zone is to reinforce the basis of agriculture, expand the advantageous industries of metallurgy, building materials, automobile, machinery, electronics, chemicals, light industry and textile industry, and develop in great efforts finance, trade, tourism, science and technology and education. The construction of the highway will certainly improve significantly the land communications conditions of this industrial zone, which will form a good communicative network together with the advanced water transporting system, and thus provide sound preconditions for the development of this area. Meanwhile, the highway will promote the development of the towns along it and the exploration and utilization of the land resources.

Secondly, the developing objective of the high and new technological industrial zone is to focus on building up the leading industries of high level, high technological content and high attending value. Namely, it is to develop the four new and high technologies of electronic information, new materials, and biological pharmaceutical engineering and the industries based on these technologies, and to form a group of high and new technological industries like machinery industry, electronic industry, light industry and chemical industry. It is trying to realize the objective that by the year 2000, the percentage of high technological production in the industrial gross production will be over 20%. It is obvious that the highway will provide good communicative conditions for the zone and will play an indispensable role in transforming the industrial composition of the zone to the target.

Besides, the improvement of the investment conditions of the two big industrial zones and the change in their industrial compositions, especially the strengthening of the communication between them will provide more jobs for the towns and cities along the highway, and thus increase the social labor force, the composition ratio of which will also be changed considerably. That is, there will be more industrial employees and self-employed workers whereas fewer farmers; there will also be an increase in the exchange of populations of the project area and the other areas. The ratio between three kinds of industries will be made more reasonable.

4.2.3 Fundamental facilities

4.2.3.1 Communications

In the directly influenced area of this project, the north-south arterial highway paralleled with the proposed highway is National No. 206 Highway, and there are also other roads like Hefei-Nanjing Highway, Hefei-Xuzhou Highway, Hefei-Wuhu Highway, Hefei-Liuan Highway, and the national highways of No.318 and No. 105, and the provincial highways of No. 103, No. 319, and No. 228. Through interchanges and the connections between arterial and feeder highways, the Hefei-Gaohebu Highway merges into the highway network of the area and thus exercises its function as a national trunk highway.

The proposed highway is in parallel with the Hefei-Jiujiang Railway. Interchanges will be built to connect the two, and the regional roads can be used to link the highway to the railway stations, so as to speed up the transference of passengers and cargoes between the two.

In water transportation, the highway can be connected with the Hefei Harbor and the Anqing Harbor through interchanges at the start and end of the road and other regional roads.

In air transportation, the interchange at the start of the highway and the Nanhuan Expressway can together link the highway with the Luogang Airport, and the interchange at the end of the highway and the Anqing Linking Line may link it to the Anqing Airport, so as to speed up the transference of passengers and cargoes between road and air transportation.

In general, a three-dimensional and comprehensive transporting system is to be built up with the proposed highway strengthening its capacity and efficiency.

4.2.3.2 Other facilities

There are such important facilities existing, or being built, or to be built along the highway as the Luogang Airport, the Hefei Economic and Technological Developing Zone, the high-tension wires at Feixi and Tongcheng, and the Hefei-Anqing long-distance communicative optical cable. It has already been considered in design and route selection that conflicts or interference should be avoid as many as possible between the highway and the above facilities, so there will not be remarkable impact on them. On the contrary, as the project will greatly enhance the development of this area, people's needs in the facilities of telecommunications, electricity, water, education and medical treatment will increase, and in a short term there will appear a contradiction between the demand and the supply. But in the long run, the project will speed up the improvement of these facilities and bring out their potential social and economic functions.

4.2.4 Utilization of land resources

See Table 4-1-2 for the statistics on the existing land quantity of the towns and counties along the line. And see Table 4-1-1 for the statistics on land-occupation of the project.

The cultivated field are per capita of some of the townships and counties will be slightly reduced. Since the land-occupation of the project is permanent, it will no doubt have impact on the agriculture and forestry here which are already short of land resources. However, with the great social and economic benefits brought about by the highway, the land occupied will undergo a special change in its value. Besides, new industrial zones will appear along the highway. So there will be an increase in the value of land nearby. In perspective of land type, the neighboring land will quickly change from cultivated fields to non-agricultural ones.

In addition, the borrowing and abandoning of earth will also have impact on the environment. Therefore, in design considerations must be made as to the longitudinal balance between cut and fill, and borrow and abandon should be reduced as much as possible. Barren and waste hills and deserted flat fields should be given priority in consideration of borrowing, so that the exposed ground can be changed into dry land for cultivation after the borrowing, or it may be used for stock-raising or for forestry. Thus the effective utility of land is expanded. In sum, the temporary land-acquisition will not have great impact on the agricultural production and the utilized value of land resources.

4.2.5 House remove and resident resettlement

In route selection it has been considered to avoid big and middle-sized towns and residential spots so as to reduced and simplify the removing and resettling job. But it is inevitable. According to the statistics in the "Statement of Feasibility Studies", the project will remove buildings of 119,560m^2, in which there are multi-storey buildings of 34,454m^2, brick-houses of 48,186m^2 and simplified houses of 36,920m^2.

Remove and resettlement is a social issue. The principle for tackling it in highway projects is to digest on the spot in villages. The construction department should enlist the aid of the local government, and, with consideration of the interest of the project as an integrity, negotiate in detail with the people concerned and make appropriate arrangements, and try to remove the cause of future trouble in develop the resettlement plan. The families involved should be visited from door to door so as to be listened to about their specific requirements. The compensating fund should be calculated according to the norms and regulations issued by the local government, so that the people would be satisfied and understanding as to the construction, and the remove and resettlement would be completed successfully.

4.2.6 Problem of separating impact on villages and fields

Since HGE is designed as all-sealed and no-grade-crossing (and GAH as Class-1 highway with entrances and exits partly controlled), the villages and fields on the roadside will inevitably be separated and thus inconvenience caused in people's living and working. Therefore, underpasses and overcrossings should be built in densely populated areas and cultivated fields and combine with the existing rural road networks. There are 203 pedestrian underpasses and 23 overcrossings in HGE, and 41 pedestrian underpasses and 6 overcrossings in GAH. On average there is 1 underpass in each 0.56km. This will be suitable for the distribution of rural road network at present.

4.2.7 Interference with the public facilities along the line

For the important facilities like high-tension wires, it has been mentioned in the previous context. Besides, there are 324 wire poles to be removed through the whole line, among which there are 293 for electrical power and 31 for telecommunication. According to the tradition here in China, the construction department held an negotiation with the departments of electricity and telecommunication, and for those have to be removed, alternative poles were elected before the original ones were removed. So no interference will happen to such public facilities.

4.2.8 Impact on scenic spots

Anhui Province is rich in tourism resources, including the unique scenic spots and humanistic scenes which stud the whole province. The highway will provide convenient transport for the scenic and cultural spots and thus promote the exploration of tourism resources. It will cause no remarkable interference with the scenic spots.

4.2.9 Impact on historic relics

Investigation shows that there is no national protected building or historic relic in the project area. But since the area used to be quite advanced in economy and culture in ancient times, there should be rich cultural accumulation here. So it is suggested that the headquarters should issue documents to inform the whole constructing staff of the law of historic relics protection. If there will be some relics exposed during the construction, civil works should be stopped immediately and the department concerned should be informed at once so as to make proper arrangements.

As long as cooperation is successful between the highway department and the cultural relics protection department, and the relevant national laws are followed, there will be no considerable impact on the historic relics along the route.

4.2.10 Impact on town and city planning along HAE

The project is relatively in parallel with National No. 206 Highway but somewhat distant from it, so the alignment avoids the towns, rural trade markets and densely populated residential spots distributed along No. 206 Highway. Most of the areas passed by the project are remote rural areas. As for the locations of the city and county governments, the route is selected on the basis of the principle of "approaching instead of entering the town, and providing convenience instead of interference for it". The project is in an effort to coordinate with the city planning of the important towns. For example, the Hefei Luogang Airport and the Hefei Economic and Technological Developing Zone have influenced the determination of the starting point of the route. The recommended alternative is passing through between the airport and the developing zone, so that no interference will happen to both. And it is suggested that entrance and exit are designed in the developing zone so as to benefit its construction. Besides, the positions of interchanges around the big cities and near the important towns are determined in consideration of the existing urban road networks and the developing plans of them, and the entrances and exits are located reasonably.

4.2.11 Assessment on dangerous articles transport risk

Thanks to short of survey and statistics of the annual dangerous articles transport in this area, it is difficult to get a general picture of its type and quantity. Considering that the risk lies in sudden traffic accidents, it can be prevented before hand through management. Necessary fire agencies should be set up so as to give duly control to accidental emissions. The operation of such transportation must follow the relevant national and trade regulations and processes; the transporting vehicles should be equipped with necessary protecting means and facilities, and be tagged with standard and remarkable signs. The professionals should be specially trained and the drivers should be impressed upon traffic regulations. Once the vehicles transporting dangerous articles are found confronting an accident, the local fire agencies and environmental protection departments should be informed immediately. As for the potential serious pollution caused by traffic accidents, report to the authorities should be made quickly.

As long as the above points are observed carefully, it can be assumed that there is little risk for dangerous articles transportation.

4.3 Acoustic Environment Impact Prediction and Assessment

4.3.1 Prediction and analysis on acoustic environmental impact in the construction period

(1) Noise sources in the construction period

The construction noise mainly comes from construction machinery and transport vehicles. The present construction machinery in China mainly include excavators, bulldozers, graders, stabilizers, rollers, pavers, and transporting vehicles. The boring and pile-driving will all pollute the acoustic environment to some degree. According to the data provided by the units concerned, if the stabilizers are 30 meters away from the machinery center, the noise level is 84 dB (A), if 10 meters away, 90 dB (A), and if 7.5 meters away, 95 dB (A). For the testing results of noise of such machines in full operation load, see Table 4-3-1.

Table 4-3-1 Testing values of acoustic levels from construction machinery

types of machinery	model	distance between the testing spots and machines	Leq max (A)
tyred loaders	ZL 40 /ZL 50	5m	90
graders	PY160A	5m	90
vibrating rollers	YZJ10B	5m	86
2-wheel vibrating rollers	CC21	5m	81
3-wheel tandem rollers		5m	81
rubber tyred rollers	ZL16	5m	76
bulldozers	Z140	5m	86
tyred hydraulic excavators	W4 - 60c	5m	84
pavers (British)	fifond 311 ABGCO	5m	82
pavers (German)	VOGELE	5m	87
generating set (2)	FKV-75	1m	98
drilling machines	22 model	1m	87
bituminous concrete mixers	PARKER LB1000 (British) LB30 /2.5 (Spanish) MARINI (Italian)	2m 2m 2m	88 90/84 90

Remark: The above data are obtained when the tested machines are in full load.

(2) Analysis of noise impact

During the construction, the noise of the machinery is generally beyond 80dB(A), with some exceptions even beyond 90dB(A). The heavy noise will badly affect the hearing of the operators of the machines. Besides, it can greatly affect the neighboring residential areas, schools and hospitals. In order to protect the staff members' health, according to the "Noise Hygienic Standard of Industrial Enterprises" (see Table 1-7-6), construction units should make proper arrangements for their work, make the workers operate the machines in turn so as to shorten the contact time with loud noise. For those who have to work long hours near the acoustic sources, protection measures such as wearing sound-proof earplugs should be taken. It is also necessary to maintain the machines properly and operate them rationally to keep the noise level as lower as possible.

Compared with that in the operation period, the noise in the construction is transient, temporary, and regional. According to the analogy prediction data of acoustic environment in the construction period, the normal construction noise will reduce at a distance of 200m, so within 100m it will affect people's sleep at night.

4.3.2 Prediction of traffic noise in operation period

4.3.2.1 Traffic noise forecasting model and the parameters

(1) The forecasting model is as follows :

$$L(_{Aeq})i = L_{w,,i} + 10lg\,(Ni / ViT) - \Delta Lj + \Delta Lz + \Delta Lm - 13$$

The traffic noise value of all types of vehicles received at the prediction spot is:

$$L(_{Aeq})j = 10Lg\,[10^{0.1\,(L_{Aeq})l} + 10^{0.1\,(L_{Aeq})m} + 10^{0.1\,(L_{Aeq})s}] - \Delta L_1 - \Delta L_2$$

The environmental noise prediction value is

$$L(_{Aeq})_y = 10Lg\,[10^{0.1\,(L_{Aeq})j} + 10^{0.1\,(L_{Aeq})c}]$$

In the above formulas, the meaning of different symbols is :

$L_{w,,i}$ – average radiating acoustic level of i-class vehicle ,dB (A)

Ni ---average traffic volume per hour of i-class vehicle in daytime or at night, (veh./h)

Vi ---average speed of i-class vehicle (km/h)

T ----predict time (1 hour)

i------large, middle and small types of vehicles

ΔLj --distance reduction volume of i-class vehicle running noise at prediction point r distance from the equivalent running line in the daytime or at night, dB(A);

ΔLz---traffic noise revised volume caused by longitudinal gradient, dB(A);

ΔLm---traffic noise revised volume caused by road surface, dB(A);

$\Delta L1$---traffic noise revised volume caused by curves or limited length of sections, dB(A);

$\Delta L2$---traffic noise revised volume caused by hindrance between the road and the prediction point, dB(A);

(2) Determination of the parameters in the forecasting models

1) Traffic volume and vehicles type composition ratio

According to the "Feasibility Study Report", the predicted traffic volume is at three levels of high, medium, and low, and is shown in Table 2-3-1 and Table 2-3-2. Vehicles type composition ratio is determined in Table 4-4-6.

The traffic volume of 16-hour (6:00 am—22:00 pm) in the daytime is takes up 90% of the total in a day , and the night traffic volume take up 10 % of the total.

2) The determination of the speed of vehicles in operation period

Table 4-3-2 Determination of speed (km/hr)

vehicle type	small	middle	large
calculate model	$Y_s=237X^{-0.1602}$	$Y_m=212X^{-0.1747}$	$Y_m*80\%$

Remarks: The average speed at night is of 20% discount of the calculated value; if the traffic volume of small vehicles is less than 50% of the total, the average speed reduces by 30% for every 100 vehicle reduction; in the above formulae,

Y – average speed, (km/hr);

X – traffic volume per hour of i-class vehicles in the predicted annual total, (vehicle/hr).

3) Traffic noise source strength

The noise produced by running vehicles on the highways mainly comes from the engine power system of the vehicles, the friction between road surface and the tyres and the vibrating vehicles bodies, etc. The noise source strength of types of vehicles is

large type: $L_{W.L} = 77.2 + 0.18V_L$

medium type: $L_{W.M} = 62.6 + 0.32V_M$

small type: $L_{W.S} = 59.3 + 0.23V_S$

4) Distance attenuation volume ΔL_j

The interval between class-i vehicles in daytime and at night:

$d_i = 1000V_i/N_i$ (m)

The distance from the prediction spot to the noise equivalent running line:

$r_2 = (D_N * D_F)^{1/2}$ (m)

Remark: r_2 is the distance from the prediction spot to the roadside plus the distance from roadside to the equivalent running line; whereas the distance in the traffic noise prediction table in later context is that from the prediction spot to roadside.

When $r_2 \leqslant d_i/2$, $\Delta L_{j,i} = K_1 * K_2 20 L_g r_2/7.5$

When $r_2 > d_i/2$, $\Delta L_{j,i} = 20K1 * [K_2 Lg 0.5d_i/7 + Lg(r_2/0.5d_i)^{1/2}]$,

In the above formulae,

V_i – average speed;

N_i – average traffic volume per hour;

D_N – distance from prediction spot to the near lane, (m);

D_F – distance from prediction spot to the distant lane, (m);

K_1 – ground surface constant from prediction spot to the highway, as Table 4-3-3;

K_2 – constant related to vehicle interval d_i, see Table 4-3-4.

Table 4-3-3 Ground Surface Constant (K_1)

hard surface	normal earth surface	lawn surface
0.9	1.0	1.1

Table 4-3-4 Constant Related to Vehicle Intervals (K_2)

di(m)	20	25	30	40	50	60	70	80	100	140	160	250	300
K_2	0.17	0.50	0.617	0.716	0.78	0.806	0.833	0.84	0.855	0.88	0.885	0.89	0.908

5) Traffic noise revised volume ΔL_1 caused by curves of limited length of sections:

$\Delta L_1 = -10 Lg\ \theta/180$ (dB(A)), in which

θ -- angle between the lines of sight from prediction spot to the ends of the road . (°)

6) Traffic noise revised volume caused by hindrance between the road and prediction spot ΔL_2

$\Delta L_2 = \Delta L_{2.s} + \Delta L_{2.j} + \Delta L_{2.y}$

Table 4-3-5 $\Delta L_{2.s}$ Revised Volume Unit: dB(A)

Depth of trees	$\Delta L_{2.s}$	Remark: line of sight is blocked by trees, which are 4.5m high.
30m	5dB(A)	
60m	10dB(A)	

Table 4-3-6 $\Delta L_{2.j}$ Noise Reduction Revised Volume Unit: dB(A)

Buildings in lines	Land-taking of 1st line buildings	Noise reduction
buildings in 1st line	area of 40%-60%	3.0
	area of 70%-90%	5.0
Each 1 more line of buildings	each 1 more line of buildings	increase by 1.5
	the maximum lines of buildings	taking 10.0

$\Delta L_{2.y}$ is the equivalent class-A acoustic attenuation caused by the prediction spot's being in the acoustic shadow regions on both sides of high embankment or cutting.

Since the different road structure (such as high embankment and cutting) serves as certain acoustic barrier for traffic noise, it can obstruct the linear transmission of sound wave and diffuse noise. According to the road composition and Figures 4-3-1 and 4-3-2, the acoustic distance difference d and the relevant Fresnel N, the relevant noise level reduced is figured out. The following is the formula for the acoustic distance difference.

$$\delta = a + b - c \quad a = (H^2+R^2)^{1/2}$$
$$b = [r^2 + (M-h)^2]^{1/2}$$
$$c = [(R+r)^2 + (M+H-h)^2]^{1/2}$$ In which,

H -- takes 0.6 m;
h -- average height of the observer (taking 1.2m)
r -- distance from the observing point to the roadside (m)
c -- straight distance from the acoustic source to the observer (m)
a -- distance from the acoustic source to the roadside (m)
b -- distance from the roadside to the observing point (m)
M -- height of the embankment (taking 4.5 m)

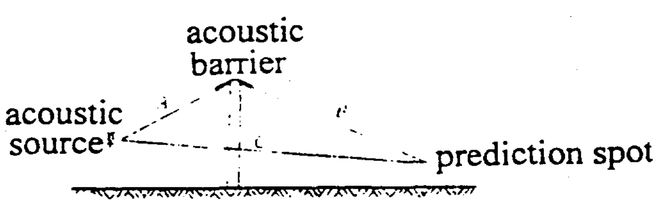


Figure 4-3-1 Acoustic Distance Difference Calculation

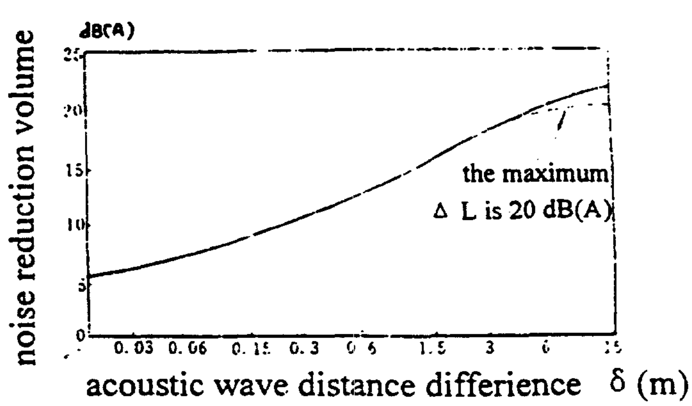


Figure 4-3-2 $\Delta L_{2.y}$ -- δ Relation Curve

7) Engineering technological indices and the subgrade

See the data in "Statement of Feasibility Studies" for part of the technological indices in highway engineering design. And see Attached Figure 6 for the standard subgrade sentional drawing.

4.3.2.1 Prediction of impact of traffic noise during operation period

See Tables 4-3-7 ~ 4-3-18 for the prediction values of traffic noise of different sections in different years.

Table 4-3-7 Predicted Traffic Noise Value of High Plan of H-G Section in 2000

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	67.5	65.0	63.7	62.9	62.1	60.4	58.8	57.9	57.3	56.3	55.4	54.6
~ Yandian	night	60.3	56.9	55.1	53.9	52.7	50.5	48.4	46.7	45.3	44.1	43.0	42.1
Yandian	day	67.9	65.4	64.1	63.4	62.4	60.8	59.2	58.3	57.7	56.7	55.8	55.0
~ Shusanxian	night	60.8	57.3	55.5	54.3	53.1	51.0	48.8	47.2	45.7	44.5	43.4	42.5
Shusanxian ~	day	67.4	64.9	63.7	62.9	62.1	60.4	58.7	57.7	57.2	56.2	55.3	54.6
Changgangtou	night	60.3	56.9	55.0	53.8	52.6	50.4	48.4	46.7	45.3	44.1	43.0	42.1
Changgangtou	day	66.1	63.6	62.3	61.6	60.7	59.0	57.3	56.4	55.8	54.8	53.9	53.2
~ Mayan	night	58.9	55.5	53.6	52.5	51.3	49.1	47.0	45.3	43.9	42.7	41.6	40.6
Mayan ~	day	66.1	63.6	62.3	61.6	60.7	59.0	57.3	56.4	55.8	54.8	53.9	53.2
Tongcheng	night	58.9	55.5	53.6	52.5	51.3	49.9	47.0	45.3	43.9	42.7	41.6	40.6
Tongcheng	day	66.3	63.8	62.5	61.7	60.8	59.2	57.5	56.6	56.6	55.0	54.1	53.4
~ Gezidun	night	59.1	55.7	53.8	52.6	51.4	49.2	47.2	45.5	44.1	42.9	41.8	40.8

Table 4-3-8 Predicted Traffic Noise Value of High Plan of H-G Section in 2010

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	70.1	67.6	66.3	65.6	64.7	63.0	61.4	60.5	59.9	58.9	58.0	57.2
~ Yandian	night	62.9	59.9	57.7	56.5	55.3	53.1	51.0	49.4	47.9	46.7	45.6	44.7
Yandian	day	70.5	68.0	66.7	65.9	65.0	63.4	61.7	60.9	60.2	59.2	58.3	57.6
~ Shusanxian	night	63.3	59.9	58.0	56.9	55.6	53.5	51.4	49.7	48.3	47.1	46.0	45.0
Shusanxian ~	day	69.7	67.2	65.9	65.2	64.3	62.6	60.9	60.1	59.4	58.4	57.6	56.8
Changgangtou	night	62.5	59.1	58.2	56.1	54.9	52.7	50.6	48.9	47.5	46.3	45.2	44.3
Changgangtou	day	69.3	66.7	65.4	64.7	63.8	62.2	60.5	59.6	59.0	58.0	57.1	56.3
~ Mayan	night	62.1	58.7	56.8	55.6	54.4	52.2	50.2	48.5	47.1	45.8	44.8	43.8
Mayan ~	day	68.7	66.2	64.9	64.2	63.3	61.6	59.9	59.1	58.4	57.4	56.6	55.8
Tongcheng	night	61.5	58.1	56.2	55.1	53.9	51.7	49.6	47.9	46.5	45.2	44.2	43.2
Tongcheng	day	68.5	66.0	64.7	64.0	63.1	61.4	59.8	58.9	58.3	57.3	56.4	55.6
~ Gezidun	night	61.3	57.9	56.1	54.9	53.7	51.5	49.4	47.8	46.3	45.1	44.0	43.1

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-9 Predicted Traffic Noise Value of High Plan of H-G Section in 2021

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	72.4	69.8	68.5	67.8	66.9	65.3	63.6	62.7	62.1	61.1	60.2	59.4
~ Yandian	night	65.2	61.8	59.9	58.7	58.0	55.3	53.3	51.6	50.2	48.9	47.9	46.9
Yandian	day	72.5	70.0	68.7	68.0	67.1	65.4	63.8	62.8	62.3	61.3	60.4	59.6
~ Shusanxian	night	65.4	61.9	60.1	58.9	57.7	55.5	53.4	52.3	51.3	50.0	49.0	48.1
Shusanxian ~	day	72.0	69.5	68.2	67.5	66.6	64.9	63.2	62.4	61.7	60.7	59.5	59.1
Changgangtou	night	64.8	61.4	59.9	58.4	57.2	54.9	52.9	51.7	50.8	49.6	48.5	47.6
Changgangtou	day	71.7	69.2	67.9	67.2	66.3	64.6	63.0	62.1	61.5	60.5	59.6	58.8
~ Mayan	night	64.6	61.2	59.3	58.1	56.9	54.7	52.7	51.5	50.6	49.3	48.3	47.3
Mayan ~	day	71.2	68.7	67.4	66.7	65.8	64.1	62.5	61.6	51.0	60.0	59.1	58.3
Tongcheng	night	64.1	60.6	58.8	57.6	56.4	54.2	52.1	51.0	50.1	48.8	47.7	46.8
Tongcheng	day	71.1	68.6	67.3	66.6	65.7	64.0	62.3	61.4	60.8	59.8	59.0	58.1
~ Gezidun	night	63.9	60.4	58.7	57.4	56.3	54.1	51.9	50.8	49.9	48.7	47.6	46.7

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-10 Predicted Traffic Noise Value of Middle Plan of H-G Section in 2001

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	67.3	64.8	63.5	62.8	61.9	60.2	58.6	57.7	57.1	56.1	56.2	54.4
~ Yandian	night	60.2	56.7	54.9	53.7	52.5	50.3	48.2	47.1	46.2	44.9	43.8	42.9
Yandian	day	67.7	65.2	63.9	63.2	62.3	60.6	58.9	58.1	57.5	56.5	55.6	54.8
~ Shusanxian	night	60.6	56.2	55.3	54.1	52.9	50.7	48.7	47.5	46.6	45.3	44.3	43.3
Shusanxian ~	day	67.3	64.8	63.5	62.8	61.9	60.2	58.5	57.7	57.0	56.0	55.1	54.4
Changgangtou	night	60.1	56.7	54.8	53.7	52.5	50.3	48.2	47.0	46.1	44.9	43.8	42.8
Changgangtou	day	65.9	63.4	62.1	61.4	60.4	58.8	57.1	56.3	55.6	54.7	53.8	53.0
~ Mayan	night	58.7	55.3	53.4	52.3	51.1	48.9	46.8	45.6	44.7	43.5	42.4	41.5
Mayan ~	day	65.9	63.4	62.1	61.4	60.4	58.8	57.1	56.3	55.6	64.7	53.8	53.0
Tongcheng	night	58.7	55.3	53.4	52.3	51.1	48.9	46.8	45.6	44.7	43.5	42.4	41.5
Tongcheng	day	66.0	63.5	62.2	61.5	60.0	59.0	51.3	56.4	55.7	54.8	53.9	53.1
~ Gezidun	night	58.9	55.4	53.6	52.4	51.2	49.0	47.0	45.8	44.9	43.6	42.6	41.6

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-11 Predicted Traffic Noise Value of Middle Plan of H-G Section in 2010

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	69.8	67.3	65.9	65.2	64.3	62.7	61.0	60.1	59.5	58.5	57.6	56.9
~ Yandian	night	62.6	59.2	57.3	56.1	54.9	53.7	50.7	49.5	48.6	47.4	46.3	45.3
Yandian	day	70.2	67.7	66.4	65.7	64.8	63.1	61.4	60.6	59.9	58.9	58.1	57.3
~ Shusanxian	night	63.0	59.6	58.7	56.6	55.4	53.2	51.1	49.9	49.0	47.8	46.7	45.8
Shusanxian ~	day	69.4	66.9	65.6	64.8	64.0	62.3	60.6	59.8	59.1	58.1	57.3	56.5
Changgangtou	night	62.2	58.8	56.9	55.8	54.5	52.4	50.3	49.1	48.2	47.0	45.9	44.9
Changgangtou	day	68.8	66.3	64.9	64.3	63.4	61.7	60.0	59.2	58.5	57.5	56.7	55.9
~ Mayan	night	61.6	58.2	56.3	55.2	54.0	51.8	49.7	48.5	47.6	46.4	45.3	44.4
Mayan ~	day	68.2	65.7	64.4	63.7	62.8	61.1	59.5	58.6	57.9	56.9	56.1	55.3
Tongcheng	night	61.1	57.6	55.8	54.6	53.4	51.4	49.1	48.0	47.0	45.8	44.7	43.8
Tongcheng	day	68.0	65.5	64.2	67.5	62.6	60.9	59.3	58.5	57.7	56.7	55.9	55.1
~ Gezidun	night	60.9	57.5	55.6	54.4	53.2	51.0	48.9	47.8	46.9	45.6	44.6	43.6

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-12 Predicted Traffic Noise Value of Middle Plan of H-G Section in 2021

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	71.8	69.3	68.0	67.3	66.4	64.7	63.1	62.2	61.6	60.6	59.7	58.9
~ Yandian	night	64.7	61.3	59.4	58.2	57.0	55.0	53.0	51.6	50.7	49.4	48.4	47.5
Yandian	day	72.1	69.5	68.2	67.5	66.6	64.9	63.3	62.4	61.8	60.8	59.9	59.1
~ Shusanxian	night	64.9	61.5	59.5	58.4	57.2	55.5	53.1	51.8	50.9	49.6	48.6	47.6
Shusanxian ~	day	71.5	68.9	67.6	66.9	66.0	64.4	62.7	61.8	61.2	60.2	59.3	58.8
Changgangtou	night	64.3	60.9	59.0	57.8	53.9	54.4	62.3	51.2	50.3	49.1	48.0	47.0
Changgangtou	day	71.1	68.6	67.3	66.5	63.4	63.9	62.3	61.4	60.8	59.8	58.9	58.2
~ Mayan	night	63.9	60.5	58.6	57.5	53.6	54.1	52.0	50.8	49.9	48.7	47.6	46.6
Mayan ~	day	70.5	66.0	66.7	66.0	62.9	63.4	61.8	60.9	60.3	59.3	58.4	57.6
Tongcheng	night	63.4	59.9	58.1	56.9	53.0	53.5	51.5	50.3	49.4	48.1	47.1	46.1
Tongcheng	day	70.3	67.8	66.5	65.8	64.9	63.2	61.6	60.7	60.1	59.1	58.2	57.4
~ Gezidun	night	63.2	59.7	57.9	56.7	55.5	53.3	51.2	50.1	49.2	47.9	46.6	45.9

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-13 Predicted Traffic Noise Value of Low Plan of H-G Section in 2001

Leq: dB(a)

Section	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	67.2	64.7	63.4	62.6	61.7	60.1	58.4	57.6	56.9	55.9	55.0	54.3
~ Yandian	night	60.0	56.6	54.7	53.6	52.3	50.2	48.1	46.9	46.0	44.8	43.7	42.7
Yandian	day	67.6	65.1	63.8	63.0	62.2	60.5	58.8	58.0	57.3	56.3	55.5	54.7
~ Shusanxian	night	60.4	56.1	55.1	54.0	52.7	50.6	48.5	47.3	46.4	45.2	44.1	43.1
Shusanxian ~	day	67.1	64.6	63.3	62.6	61.7	60.0	58.4	57.5	56.9	55.9	55.0	54.2
Changgangtou	night	59.9	56.5	54.7	53.5	52.3	50.1	48.0	46.9	46.0	44.7	43.7	42.7
Changgangtou	day	65.8	63.2	61.9	61.2	60.3	58.7	56.9	56.1	55.5	54.5	53.6	52.8
~ Mayan	night	58.6	55.1	53.3	52.1	50.9	48.7	46.7	45.5	44.6	43.3	42.3	41.3
Mayan ~	day	65.8	63.2	61.9	61.2	60.3	58.7	56.9	56.1	55.5	54.5	53.6	52.8
Tongcheng	night	58.6	55.1	53.3	52.1	50.9	48.7	46.7	45.5	44.6	43.3	42.3	41.3
Tongcheng	day	65.9	63.3	62.0	61.3	60.4	58.8	57.1	56.2	55.65	54.6	53.7	52.9
~ Gezidun	night	58.7	55.3	53.4	52.2	51.	48.8	46.8	45.6	44.7	43.4	42.4	41.4

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-14 Predicted Traffic Noise Value of Low Plan of H-G Section in 2010

Leq: dB(a)

	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	69.2	66.7	65.4	64.7	63.8	62.1	60.4	59.9	58.9	57.9	57.1	56.3
~ Yandian	night	62.0	58.6	56.7	55.6	54.4	52.2	50.1	48.9	48.0	46.8	45.7	44.7
Yandian	day	69.7	67.2	65.9	65.2	64.3	62.6	60.9	60.1	59.5	58.5	57.6	56.8
~ Shusanxian	night	62.6	59.2	57.3	56.1	54.9	52.7	50.7	49.4	48.6	47.3	46.3	45.3
Shusanxian ~	day	68.9	66.4	65.1	64.3	63.4	61.8	60.1	59.2	58.6	47.6	46.7	45.9
Changgangtou	night	61.7	58.3	56.4	55.2	54.0	51.8	49.8	48.6	47.7	46.5	45.4	44.4
Changgangtou	day	68.2	65.7	64.4	63.6	62.7	61.1	59.4	58.6	57.9	56.8	56.0	55.3
~ Mayan	night	61.0	57.6	55.7	54.6	53.3	51.1	49.1	47.9	47.0	45.8	44.9	43.7
Mayan ~	day	67.6	65.1	63.8	63.0	62.0	60.5	58.8	58.0	57.3	56.3	55.5	54.7
Tongcheng	night	60.4	56.0	55.1	54.0	52.7	50.6	48.5	47.3	46.4	45.2	44.1	43.1
Tongcheng	day	67.4	62.9	63.6	62.9	62.0	60.3	58.7	57.8	57.2	56.2	55.3	54.5
~ Gezidun	night	60.3	56.8	55.0	53.8	52.6	50.4	48.3	47.2	46.2	45.0	43.9	43.0

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-15 Predicted Traffic Noise Value of Low Plan of H-G Section in 2021

Leq: dB(a)

Secion	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
Xiaoxichong	day	71.0	68.5	67.2	66.5	65.6	63.9	62.3	61.4	60.8	59.8	58.9	58.1
~ Yandian	night	63.9	60.5	58.6	57.2	56.2	54.0	52.0	50.8	49.9	48.6	47.6	46.6
Yandian	day	71.4	68.9	67.6	66.9	66.0	64.3	62.7	61.8	61.2	60.2	59.3	58.8
~ Shusanxian	night	64.3	60.9	59.0	57.8	56.6	54.4	52.4	51.2	50.3	49.0	48.0	47.0
Shusanxian ~	day	70.9	68.3	67.0	66.3	65.4	63.7	62.1	61.2	60.6	59.6	58.7	57.9
Changgangtou	night	63.7	60.3	58.4	57.2	56.0	53.8	51.8	50.6	49.8	48.4	47.4	46.4
Changgangtou	day	70.3	67.8	66.4	65.7	64.8	63.2	61.5	60.6	60.0	59.0	58.1	57.4
~ Mayan	night	63.1	59.8	57.8	56.7	55.4	53.2	51.2	50.0	49.1	47.9	46.8	45.8
Mayan ~	day	69.7	67.2	65.9	65.2	64.3	62.6	60.9	60.1	59.4	58.4	57.6	56.8
Tongcheng	night	62.5	59.1	57.2	56.1	54.9	52.7	50.6	49.4	48.5	47.3	46.3	45.3
Tongcheng	day	69.5	67.0	65.7	65.1	64.1	62.4	60.8	59.9	59.3	58.3	57.4	56.6
~ Gezidun	night	62.4	58.9	57.1	55.9	54.7	52.5	50.5	49.3	48.4	47.1	46.1	45.1

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-16 Predicted Traffic Noise Value of G-A Section in 2001

Leq: dB(a)

Plan	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
High	day	64.8	62.3	61.0	60.3	59.9	58.7	57.0	55.7	54.0	53.6	52.7	51.9
Plan	night	55.8	52.4	50.5	49.4	48.6	46.9	44.9	43.2	41.8	40.6	39.5	38.5
Middle	day	64.6	62.1	60.8	60.0	59.7	58.5	56.8	55.5	54.3	53.3	52.5	51.7
Plan	night	55.5	52.1	50.3	49.1	48.4	46.7	44.6	43.0	41.5	40.3	39.2	38.3
Low	day	64.4	61.9	60.6	59.9	59.5	58.3	56.7	55.3	54.2	53.2	52.3	50.5
Plan	night	55.4	51.9	50.1	48.9	48.2	46.5	44.5	42.8	41.4	40.2	39.1	38.1

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-17 Predicted Traffic Noise Value of G-A Section in 2010

Leq: dB(a)

Plan	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
High	day	66.9	65.3	63.0	62.3	61.9	60.8	59.1	57.7	56.6	55.6	54.7	53.9
Plan	night	57.8	55.4	52.5	51.4	50.7	49.0	46.9	45.2	43.8	42.6	41.5	40.6
Middle	day	66.5	65.0	62.7	62.0	61.6	60.4	58.7	57.0	56.2	55.2	54.4	53.6
Plan	night	57.4	55.1	52.3	51.0	50.3	48.6	46.6	44.8	43.5	42.2	41.2	40.2
Low	day	66.1	63.6	62.3	61.6	61.2	60.0	58.4	57.0	55.9	54.9	54.0	53.2
Plan	night	57.1	53.7	51.8	50.6	49.9	48.2	46.2	44.5	43.1	41.9	40.8	39.8

Remark: the distance in the table is that away from the central line of the highway.

Table 4-3-18 Predicted Traffic Noise Value of G-A Section in 2021

Leq: dB(a)

Plan	Time	20m	30m	40m	50m	60m	80m	100m	120m	140m	160m	180m	200m
High Plan	day	69.0	66.5	65.2	64.5	64.1	62.9	61.2	59.9	58.7	57.8	56.9	56.1
	night	59.9	56.6	54.7	53.5	52.8	51.1	49.1	47.4	46.0	44.8	43.7	42.7
Middle Plan	day	68.2	65.7	64.4	63.7	63.3	62.1	60.5	59.1	57.9	56.9	56.1	55.3
	night	59.2	55.8	53.4	52.8	52.0	50.3	48.3	46.6	45.2	43.9	42.9	41.9
Low Plan	day	67.5	64.9	63.7	62.9	62.6	61.4	59.7	58.4	57.2	56.2	55.4	54.6
	night	58.5	55.0	53.2	52.0	51.3	49.6	47.5	45.9	44.5	43.2	42.1	41.2

Remark: the distance in the table is that away from the central line of the highway.

4.3.2.2 Assessment of traffic noise environmental impact during operation period

(1) Traffic noise distribution of the proposed highway

According to the traffic noise prediction data, the standard distance distribution of the sections in different phases of the operation period is shown in Tables 4-3-19 and 4-3-20.

Table 4-3-19 Traffic Noise Standard-meeting Distances

Unit: m (environmental standard: day 70dB(A), night 55dB(A))

Plan	Assessment year	2001		2010		2021	
high	Xiaoxichong-Yandian	20	40	25	60	30	80
	Yandian-Shusanxian	20	50	25	65	30	85
	Shusanxian-Changgangtou	20	40	20	60	25	80
	Changgangtou-Mayan	20	30	20	55	25	70
	Mayan-Tongcheng	20	30	20	50	25	70
	Tongcheng-Gezidun	20	30	20	50	25	70
mid.	Xiaoxichong-Yandian	20	40	20	60	25	80
	Yandian-Shusanxian	20	40	20	60	25	80
	Shusanxian-Changgangtou	20	40	20	55	25	70
	Changgangtou-Mayan	20	30	20	50	25	60
	Mayan-Tongcheng	20	30	20	50	25	60
	Tongcheng-Gezidun	20	30	20	50	20	60
low	Xiaoxichong-Yandian	20	35	20	50	25	70
	Yandian-Shusanxian	20	40	20	60	25	70
	Shusanxian-Changgangtou	20	35	20	50	25	70
	Changgangtou-Mayan	20	30	20	50	20	60
	Mayan-Tongcheng	20	30	20	40	20	60
	Tongcheng-Gezidun	20	30	20	40	20	50

Remark: The figures in the table are distances from the central line of the highway.

Table 4-3-20 Traffic Noise Standard-meeting Distances of GAH

Unit: m

Year	2001		2010		2021	
Plan	day 70dB(A)	night 55dB(A)	day 70dB(A)	night 55dB(A)	day 70dB(A)	night 55dB(A)
high	20	25	20	35	20	40
middle	20	25	20	35	20	35
low	20	25	20	30	20	30

From the above tables it can been seen that for the high alternative of HGE, in the distant operation period (2021), the distance between the daytime 70dB equivalent value line and the central line of the highway is 25–30m, and that of the night 55dB is 70-85m. For the middle alternative in 2021 the daytime distance is 20-25m, and the night distance is 60-80m. For the low alternative in 2021, the daytime distance is 20-25m, and the night distance is 50-70m. For the alternatives of GAH in 2021, the daytime distance is 20m, and the night distance is 30-40m.

It is then known that there will be no noise pollution beyond the assessment scope (200m on both sides from the central line of the road) of the two lines in operation period. For HGE in daytime beyond 30m from the central line and at night beyond 85m, and for GAH in daytime beyond 20m and at night beyond 40m, even if the traffic volume reaches the high plan of prediction, the noise will also meet the class-4 standard of GB3096-93.

2) Prediction and assessment of acoustic environment of the representative sensitive spots along the line

Based on the prediction values and considering the revising factors of ground surface covering situation, road composition, height of embankment or cutting and topography of the respective sensitive spots,

$$L_{aeq} = 10Lg\,(10^{0.1(Leq_j - \Delta L)} + 10^{0.1Leq_b})$$

Based on statistics of acoustic environment prediction values of the sensitive spots and the EIA norms relevant, prediction and assessment is made for the representative sensitive spots of residential spots, schools, etc. The results are shown in Tables 4-3-21 and 4-3-22. In the calculation, the embankment of HGE is 3.91m high in average, and that of GAH, 3.8m.

Table 4-3-21 (a) Noise Prediction Results of Representative Sensitive Spots along HGE (high plan) Leq: dB(A)

Year	Stake No.	Sensitive spot	Distance (m)	Noise		Noise standard		Standard-surpassing	
				day	night	day	night	day	night
2001	K4+000	Yandun Mid Sch	200	57.0	45.7	60	50	–	–
	K4+200	Weidianzhuang	90	60.2	50.5	70	55	–	–
	K24+500	Caoguantang	60	62.1	52.4	70	55	–	–
	K54+700	Zhangjialoufang	30	63.7	55.7	70	55	–	0.7
	K94+600	Yuzhuang	edge	63.6	55.6	70	55	–	0.6
	K113+800	Sanbacun	edge	63.8	55.8	70	55	–	0.8
	K125+700	Gezidun	edge	63.8	55.8	70	55	–	0.8
2010	K4+000	Yandun Mid Sch	200	57.9	46.6	60	50	–	–
	K4+200	Weidianzhuang	90	62.5	52.6	70	55	–	–
	K24+500	Caoguantang	60	64.6	54.7	70	55	–	–
	K54+700	Zhangjialoufang	30	66.2	58.2	70	55	–	3.2
	K94+600	Yuzhuang	edge	66.2	58.2	70	55	–	3.2
	K113+800	Sanbacun	edge	66.0	58.0	70	55	–	3.0
	K125+700	Gezidun	edge	66.0	57.9	70	55	–	2.9
2021	K4+000	Yandun Mid Sch	200	59.0	47.6	60	50	–	–
	K4+200	Weidianzhuang	90	64.6	54.7	70	55	–	–
	K24+500	Caoguantang	60	66.6	56.5	70	55	–	1.5
	K54+700	Zhangjialoufang	30	68.7	60.7	70	55	–	5.7
	K94+600	Yuzhuang	edge	68.7	60.0	70	55	–	5.0
	K113+800	Sanbacun	edge	68.6	60.4	70	55	–	5.4
	K125+700	Gezidun	edge	68.6	60.4	70	55	–	5.4

Remarks: 1. The distance in the table is that between the assessment spot and the road central line; usually it is 1.0m before the first row of the village houses, or before the classrooms on school campus.

2."-" is for not surpassing standard, and for surpassing the volume beyond standard is given.

Table 4-3-21(b) Noise Prediction Results of Representative Sensitive Spots along HGE

Leq: dB(A)

Year	Stake No.	Sensitive spot	Distance (m)	Noise		Standard		Surpassing	
				day	night	day	night	day	night
middle plan									
2001	K4+000	Yandun Mid Sch	200	56.9	45.6	60	50	–	–
	K4+200	Weidianzhuang	90	60.0	50.3	70	55	–	–
	K24+500	Caoguantang	60	61.6	52.0	70	55	–	–
	K54+700	Zhangjialoufang	30	63.5	55.5	70	55	–	0.7
	K94+600	Yuzhuang	edge	63.4	55.4	70	55	–	0.4
	K113+800	Sanbacun	edge	63.5	55.5	70	55	–	0.5
	K125+700	Gezidun	edge	63.5	55.5	70	55	–	0.5
2010	K4+000	Yandun Mid Sch	200	57.8	46.4	60	50	–	–
	K4+200	Weidianzhuang	90	62.2	52.6	70	55	–	–
	K24+500	Caoguantang	60	64.1	54.1	70	55	–	–
	K54+700	Zhangjialoufang	30	65.7	57.7	70	55	–	2.7
	K94+600	Yuzhuang	edge	65.7	57.7	70	55	–	2.7
	K113+800	Sanbacun	edge	65.5	57.6	70	55	–	2.6
	K125+700	Gezidun	edge	65.5	57.5	70	55	–	2.5
2021	K4+000	Yandun Mid Sch	200	58.7	47.4	60	50	–	–
	K4+200	Weidianzhuang	90	64.1	54.4	70	55	–	–
	K24+500	Caoguantang	60	65.9	55.8	70	55	–	0.8
	K54+700	Zhangjialoufang	30	66.0	60.0	70	55	–	5.0
	K94+600	Yuzhuang	edge	66.0	59.9	70	55	–	4.9
	K113+800	Sanbacun	edge	67.8	59.7	70	55	–	4.7
	K125+700	Gezidun	edge	67.8	59.7	70	55	–	4.7
low plan									
2001	K4+000	Yandun Mid Sch	200	56.9	45.6	60	50	–	–
	K4+200	Weidianzhuang	90	59.8	50.2	70	55	–	–
	K24+500	Caoguantang	60	61.2	51.5	70	55	–	–
	K54+700	Zhangjialoufang	30	63.3	55.3	70	55	–	0.2
	K94+600	Yuzhuang	edge	63.2	55.2	70	55	–	0.2
	K113+800	Sanbacun	edge	63.3	55.4	70	55	–	0.4
	K125+700	Gezidun	edge	63.3	55.4	70	55	–	0.4
2010	K4+000	Yandun Mid Sch	200	57.5	46.2	60	50	–	–
	K4+200	Weidianzhuang	90	61.6	51.8	70	55	–	–
	K24+500	Caoguantang	60	63.6	53.5	70	55	–	–
	K54+700	Zhangjialoufang	30	65.1	56.2	70	55	–	1.2
	K94+600	Yuzhuang	edge	65.1	56.1	70	55	–	1.1
	K113+800	Sanbacun	edge	64.9	56.9	70	55	–	1.9
	K125+700	Gezidun	edge	64.9	56.8	70	55	–	1.8
2021	K4+000	Yandun Mid Sch	200	58.3	47.0	60	50	–	–
	K4+200	Weidianzhuang	90	62.9	53.5	70	55	–	–
	K24+500	Caoguantang	60	65.1	54.8	70	55	–	–
	K54+700	Zhangjialoufang	30	67.2	59.2	70	55	–	4.2
	K94+600	Yuzhuang	edge	66.0	59.1	70	55	–	4.1
	K113+800	Sanbacun	edge	67.0	58.9	70	55	–	3.9
	K125+700	Gezidun	edge	67.0	58.9	70	55	–	3.9

Table 4-3-22 (a) Statistics of Noise Prediction Results of Representative Sensitive Spots along G-A Section Leq: dB(A)

Year	Stake No.	Sensitive spot	Distance (m)	Noise		Noise standard		Standard-surpassing	
				day	night	day	night	day	night
High	Plan								
2001	K5+100	Renming Pri. Sch.	90	58.1	46.2	60	50	—	—
	K5+200	Pengjiazui	70	59.7	48.0	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	62.4	52.7	70	55	—	—
	K23+100	Lixin Pri. Sch.	90	58.0	45.3	60	50	—	—
	K25+800	Dalongshan Town	edge	62.4	52.6	70	55	—	—
2010	K5+100	Renming Pri. Sch.	90	60.1	48.1	60	50	0.1	—
	K5+200	Pengjiazui	70	61.5	50.0	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	65.3	55.5	70	55	—	0.5
	K23+100	Lixin Pri. Sch.	90	60.0	48.1	60	50	—	—
	K25+800	Dalongshan Town	edge	65.3	55.5	70	55	—	0.5
2021	K5+100	Renming Pri. Sch.	90	62.1	50.2	60	50	2.1	0.2
	K5+200	Pengjiazui	70	63.6	52.0	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	66.5	56.7	70	55	—	1.7
	K23+100	Lixin Pri. Sch.	90	62.1	50.2	60	50	2.1	0.2
	K25+800	Dalongshan Town	edge	66.5	56.7	70	55	—	1.7
Middle	Plan								
2001	K5+100	Renming Pri. Sch.	90	57.9	45.9	60	50	—	—
	K5+200	Pengjiazui	70	59.5	47.8	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	62.2	52.4	70	55	—	—
	K23+100	Lixin Pri. Sch.	90	57.8	45.9	60	50	—	—
	K25+800	Dalongshan Town	edge	62.2	52.3	70	55	—	—
2010	K5+100	Renming Pri. Sch.	90	59.7	47.2	60	50	—	—
	K5+200	Pengjiazui	70	61.2	49.6	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	65.0	55.3	70	55	—	0.3
	K23+100	Lixin Pri. Sch.	90	59.7	47.2	60	50	—	—
	K25+800	Dalongshan Town	edge	65.0	55.2	70	55	—	0.2
2021	K5+100	Renming Pri. Sch.	90	61.4	49.4	60	50	1.4	—
	K5+200	Pengjiazui	70	62.8	51.2	70	55	—	—
	K15+500	Wuheng (Banqiao Vill.)	30	65.7	55.9	70	55	—	0.9
	K23+100	Lixin Pri. Sch.	90	61.4	49.1	60	50	1.4	—
	K25+800	Dalongshan Town	edge	65.7	55.9	70	55	—	0.9

Table 4-3-22 (b) Statistics of Noise Prediction Results of Representative Sensitive Spots along G-A Section Leq: dB(A)

Year	Stake No.	Sensitive spot	Distance (m)	Noise		Noise standard		Standard-surpassing	
				day	night	day	night	day	night
Low	Plan								
2001	K5+100	Renming Pri. Sch.	90	57.8	45.8	60	50	–	–
	K5+200	Pengjiazui	70	59.3	47.7	70	55	–	–
	K15+500	Wuheng (Banqiao Vill.)	30	62.0	52.2	70	55	–	–
	K23+100	Lixin Pri. Sch.	90	57.7	45.8	60	50	–	–
	K25+800	Dalongshan Town	edge	62.0	52.1	70	55	–	–
2010	K5+100	Renming Pri. Sch.	90	59.4	47.4	60	50	–	–
	K5+200	Pengjiazui	70	60.9	49.2	70	55	–	–
	K15+500	Wuheng (Banqiao Vill.)	30	63.7	53.9	70	55	–	–
	K23+100	Lixin Pri. Sch.	90	59.4	47.4	60	50	–	–
	K25+800	Dalongshan Town	edge	64.6	53.9	70	55	–	–
2021	K5+100	Renming Pri. Sch.	90	60.7	48.6	60	50	–	–
	K5+200	Pengjiazui	70	62.2	50.6	70	55	–	–
	K15+500	Wuheng (Banqiao Vill.)	30	64.9	55.2	70	55	–	0.2
	K23+100	Lixin Pri. Sch.	90	60.6	48.6	60	50	0.6	–
	K25+800	Dalongshan Town	edge	64.9	55.1	70	55	–	0.1

Remarks: 1. The distance in the table is that between the assessment spot (village edge or school campus).
2. "-" is for not surpassing standard, and for surpassing the volume beyond standard is given.

Noise pollution interferes with people's normal living, working, resting, and even health when it is above 75dB(A). It is seen from the above tables that at and beyond 50m from the road, for the representative sensitive spots within 50m from the road, there is no standard-surpassing in daytime, while at night the standard surpassing rate is 50% in the near future and 70% in the distant future, when the increase of noise level at these spots is 14.9～27.5dB(A) in daytime and 18.2—28.8dB(A) at night. When the highway is put to operation, the regional function will change with the change of economic and social activities. Within 50—200m from the road, for the sensitive spots like Weidianzhuang and Caoguantang, the standard surpassing rate in daytime and at night is not increased, and in the distant future, the increase of noise level compared with the status quo value is relatively small at these spots. It can be seen therefore that the traffic noise from the proposed highway contributes little to the noise at these sensitive spots, and can be left out of the picture in most cases, except for the Renmin Primary School and Lixin Primary School which are 90m to the right of GAH, generally there is no standard-surpassing according to the low alternative, but according to the high alternative, the standard-surpassing in the distant future is 2.1dB(A) in daytime and 0.2dB(A) at night. The impact of noise is small.

It is seen from the above assessment that in the operation period it has certain impact on the sensitive spots within 50m from the roadside, and the degree of impact is shown in Tables 4-3-23 ~ 4-3-28.

Table 4-3-23 Statistics of Standard-surpassing at Sensitive Spots within 50m from HGE (in 2001)

Stake no.	Spot name	Distance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K18+200	Mogang	40	40	—	0.2	—	—	—	—
K19+100	Liucitang	40	30	—	0.2	—	—	—	—
K31+000	Zhashangdaying	cross	40	—	2.5	—	1.4	—	1.2
K32+350	Huangweinangeng	edge	20	—	2.4	—	1.3	—	1.2
K41+100	Fuyuan M. School	edge	905 p.	6.7	8.4	6.6	8.3	6.4	8.0
K48+200	Wangdawu	30	20	—	2.0	—	1.8	—	1.6
K51+700	Heyuan Pri. School	40	207 p.	4.1	5.0	3.9	4.8	3.7	4.7
K54+700	Zhangjialoufang	30	50	—	2.0	—	1.8	—	1.6
K61+100	Yuemiao M. School	30	546 p.	4.0	5.5	3.8	5.3	3.6	5.1
K88+000	Fangzhuang	edge	22	—	0.6	—	0.4	—	0.2
K94+600	Yuzhuang	edge	20	—	0.6	—	0.4	—	0.2
K109+000	Yuejin Pri. School	cross	120 p.	3.9	5.9	3.6	5.6	3.4	5.3
K113+800	Sanbacun	edge	40	—	0.8	—	0.5	—	0.4
K114+150	Yaoci Pri. School	40 right	215 p.	3.8	4.7	3.6	4.5	3.4	4.4
K119+350	Wufang	20 left	30	—	0.7	—	0.4	—	0.3
K124+700	Jianxin	30 left	30	—	0.7	—	0.4	—	0.3
K125+700	Gezidun	edge	40	—	0.8	—	0.5	—	0.4

Table 4-3-24 Statistics of Standard-surpassing at Sensitive Spots within 50m from HGE (in 2010)

Stake no.	Spot name	Distance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K18+200	Mogang	40	40	—	2.8	—	2.4	—	—
K19+100	Liucitang	40	30	—	2.8	—	2.3	—	—
K31+000	Zhashangdaying	cross	40	—	5.0	—	4.7	—	4.3
K32+350	Huangweinangeng	edge	20	—	4.9	—	4.6	—	4.2
K41+100	Fuyuan M. School	edge	905 p.	8.4	10.1	8.1	6.8	7.5	9.3
K48+200	Wangdawu	30	20	—	4.1	—	3.9	—	3.4
K51+700	Heyuan Pri. School	40	207 p.	6.1	8.2	5.9	6.9	5.2	6.4
K54+700	Zhangjialoufang	30	50	—	4.2	—	3.9	—	3.4
K61+100	Yuemiao M. School	30	546 p.	6.9	8.7	6.5	8.2	5.8	7.6
K88+000	Fangzhuang	edge	22	—	3.2	—	2.7	—	1.1
K94+600	Yuzhuang	edge	20	—	3.0	—	2.6	—	1.9
K109+000	Yuejin Pri. School	cross	120 p.	6.2	8.2	5.6	7.7	4.9	6.9
K113+800	Sanbacun	edge	40	—	3.0	—	2.6	—	1.9
K114+150	Yaoci Pri. School	40 right	215 p.	5.8	6.7	5.6	6.5	5.4	6.4
K119+350	Wufang	20 left	30	—	2.9	—	2.5	—	1.8
K124+700	Jianxin	30 left	30	—	2.4	—	2.0	—	1.4
K125+700	Gezidun	edge	40	—	2.9	—	2.5	—	1.9

Table 4-3-25 Statistics of Standard-surpassing at Sensitive Spots within 50m from HGE (in 2020)

Stake no.	Spot name	Distance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K18+200	Mogang	40	40	—	4.5	—	4.4	—	3.7
K19+100	Liucitang	40	30	—	4.5	—	4.4	—	3.6
K31+000	Zhashangdaying	cross	40	—	7.0	—	6.6	—	6.0
K32+350	Huangweinangeng	edge	20	—	6.9	—	6.5	—	5.9
K41+100	Fuyuan M. School	edge	905 p.	9.9	11.9	9.5	11.4	8.9	10.8
K48+200	Wangdawu	30	20	—	6.4	—	5.9	—	5.3
K51+700	Heyuan Pri. School	40	207 p.	8.3	9.5	7.8	9.0	7.2	8.4
K54+700	Zhangjialoufang	30	50	—	5.7	—	5.0	—	4.2
K61+100	Yuemiao M. School	30	546 p.	9.1	11.2	8.7	10.5	8.0	9.8
K88+000	Fangzhuang	edge	22	—	5.6	—	4.9	—	4.1
K94+600	Yuzhuang	edge	20	—	5.0	—	4.5	—	4.1
K109+000	Yuejin Pri. School	cross	120 p.	8.8	10.5	7.9	9.8	7.1	9.0
K113+800	Sanbacun	edge	40	—	5.4	—	4.7	—	3.9
K114+150	Yaoci Pri. School	40 right	215 p.	7.8	8.7	7.6	8.5	7.0	8.4
K119+350	Wufang	20 left	30	—	5.3	—	4.6	—	3.8
K124+700	Jianxin	30 left	30	—	4.8	—	4.0	—	3.1
K125+700	Gezidun	edge	40	—	5.4	—	4.7	—	3.9

Table 4-3-26 Statistics of Standard-surpassing at Sensitive Spots within 50m from GAH (in 2001)

Stake no.	Spot name	Dis-tance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K1+500	Wangjiachong	40	30	—	—	—	—	—	—
K15+500	Wuheng (Banqiaocun)	30	70	—	—	—	—	—	—
K25+800	Dalongshanzhen	edge	50	—	—	—	—	—	—

Table 4-3-27 Statistics of Standard-surpassing at Sensitive Spots within 50m from GAH (in 2010)

Stake no.	Spot name	Dis-tance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K1+500	Wangjiachong	40	30	—	—	—	—	—	—
K15+500	Wuheng (Banqiaocun)	30	70	—	0.5	—	0.2	—	—
K25+800	Dalongshanzhen	edge	50	—	—	—	—	—	—

Table 4-3-28 Statistics of Standard-surpassing at Sensitive Spots within 50m from GAH (in 2020)

Stake no.	Spot name	Dis-tance (m)	Family no.	Standard surpassing situations					
				high plan		middle plan		low plan	
				day	night	day	night	day	night
K1+500	Wangjiachong	40	30	—	—	—	—	—	—
K15+500	Wuheng (Banqiaocun)	30	70	—	1.7	—	0.9	—	0.2
K25+800	Dalongshanzhen	edge	50	—	1.0	—	0.9	—	0.1

Taking the high alternative as an example, the situation for the 17 sensitive spots within 50m from the roadside of H-G Section in 2001 is like this: in daytime there is standard-surpassing at the five schools of Fuyuan Middle School, Heyuan Primary School, Yuemiao Middle School, Yuejin Primary School and Yaoci Primary School, and the surpassing values are respectively 6.7dB(A), 4.1dB(A), 4.0dB(A), 3.9dB(A), and 3.8dB(A); the percentage in the total number of sensitive spots is 29.4%. At night there are relatively more standard-surpassing cases, but the surpassing values are not high, mostly between 0.2 and 2.5dB(A). The values are high for the five schools mentioned above, which are respectively 8.4dB(A), 5.0dB(A), 5.5dB(A), 5.9dB(A), and 6.7dB(A). The impact of traffic noise upon villages is small, only 0.2 ~ 2.5dB(A).

The Xinnian Primary School is 60m from the road, and the standard-supassing values there are 3.2dB(A) and 4.8dB(A) in daytime and at night respectively.

In the distant future, standard-surpassing is still serious for the five schools, which is 8.3 ~ 9.9dB(A) in daytime and 8.7 ~ 11.9dB(A) at night. For the other sensitive spots, there is no surpassing in daytime, and at night it is 4.5 ~ 7.0dB(A). At the Xinnian Primay School, the values are 7.7dB(A) and 9.2dB(A) in daytime and at night respectively.

The noise impact of GAH in the distant future is not serious, according to the high alternative of traffic volume prediction, the standard-surpassing is slight (1.7dB(A)) at night for two villages, and in daytime there is no surpassing for the three spots.

In sum, the proposed highway has certain noise impact on the sensitive spots within the assessment scope in operation period. It is seen from the prediction assessment that in the distant future, there is basically no standard-surpassing at the spots beyond 50m from HGE, but for the spots within 50m, the impact is larger and the surpassing rate is high. The noise pollution is serious for Fuyuan Middle School, Heyuan Primary School, and Yuemiao Middle School. The noise impact on the sensitive spots within 50m from GAH is not serious in the distant future. So from the perspective of acoustic environment, it is proved that the route selection is reasonable, and the noise impact is small for the whole line. What is more, the construction of the highway will benefit the improvement of the macro-environment of this area.

4.4 Atmospheric Environment Prediction and Assessment

4.4.1 Analysis of atmospheric environment impact during construction period

4.4.1.1 Analysis of pollution source

During the construction of the highway, there is a large quantity of cut and fill transport and of mixing of construction materials. So during the construction period, the main pollutant is TSP, which comes from open or semi-sealed bituminous concrete mixing, the spilling and scattering during transportation, temporary or unpaved road surface, and the on-going operation of construction machinery.

4.1.1.2 TSP impact assessment

(1) TSP pollution caused by earth mixing

There are two ways of mixing of earth: road mixing (refers to on-the-spot mixing) and plant mixing (refers to concentrated mixing, and then transporting the product to the construction spot by vehicles). Plant mixing has a large quantity of dust and a larger range of influence which can reach 150m away in the lower wind. Road mixing has a smaller quantity of dust and smaller range of influence, but the line being polluted is longer and also the lime content in the dust can burn the surface of the plants at the roadside. See Table 4-4-1 for the on-the-spot monitoring results of the Befjing-Tianjin-Tanggu Highway which was being constructed in May, 1990.

Table 4-4-1 TSP Monitoring Results in the Construction

Place	Method	Sampling distance	Monitoring result	Remark
beside ramps of Yangcun Zhenglou interchange	road mixing	50m	0.389 mg/m^3	The monitoring spot is in the lower wind.
		150m	0.271 mg/m^3	
Yangcun mixing plant	plant mixing	50m	8.849-9.078 mg/m^3	
		100m	1.599-1.703 mg/m^3	
		150m	0.483-1.130 mg/m^3	

(2) TSP pollution caused by construction traffic

Flying dust pollution is serious caused by construction traffic on unpaved roads, and the range being influenced by it is also large. Table 4-4-2 shows the on-the-spot monitoring results of flying dust caused by construction traffic on the Bei-Tian-Tang Highway in May, 1990.

Table 4-4-2 Traffic Flying Dust Monitoring Results in Construction

Place	Dust source	Sampling distance	Monitor result	Remark
roadside at Wuqing Yangcun	transport vehicle when paving cement surface	50 m 100 m 150 m	19.652 mg/m^3 11.694 mg/m^3 5.039 mg/m^3	Sampling in lower wind; result is instant value.

Seen from Table 4-4-2, the TSP concentration in the lower wind at 50m from the road surpasses the standard by over 10 times, and still by over 4 times when it is 150m away. The flying dust pollution is serious in the area along the road in construction period.

The project is located in between the Changjiang River and the Huaihe River, where the vegetation is good and the weather is humid and wind speed low. So the TSP pollution is not remarkable, except in dry seasons and windy weather, flying dust may be caused by construction traffic, and protecting measures should be taken for the concentrated residential spots along the line. Dust pollution caused by construction can be reduced to minimum if proper measures like plant mixing, sprinkling water on the temporary roads and covering the transporting vehicles are taken so as to meet the national class-II standard.

4.4.2 Prediction and assessment of atmospheric environment in operation period

4.4.2.1 Meteorological conditions for pollution

(1)Features of climate

The project area belongs to the subtropical northern border zone, which is characterized by humid monsoon climate in transference between northern subtropical and warm temperate zones. The weather is warm and humid, the monsoon is remarkable, the seasons are distinct, the sunshine is adequate, and the frost-free period is long. The annual average precipitation for years is 988.4 ~ 1389.2mm; the rainfall is distributed unevenly within the year, mostly in June ~ August. The annual average temperature is about 15 ℃, and average relative humidity is 76%.

(2) Features of wind field on ground surface

1) wind direction

According to the wind direction data for the past three years (1994 ~ 1996) provided by the meteorological observatories of Hefei, Tongcheng and Anqing, the yearly dominant wind directions of the places are different. In Hefei it is mainly SE (11%) and ENE (10.3%), in Tongcheng, NW (21.3%), and in Anqing, NE (28.7%). The pollution is in a high degree in SE and ENE for Hefei, in NW for Tongcheng, and in NE and SW for Anqing. See Table 4-4-3 for the wind direction frequency and average wind speed for the cities and prefectures through the years. Figures 4-4-1 ~ 4-4-3 are the rosette figures of wind direction frequency of different places for the seasons and years, and Figures 4-4-4 ~ 4-4-6 are those of the pollution coefficients of different places for the seasons and years.

2) wind speed on ground surface

The recent data show that the annual average wind speeds in Hefei, Lujiang, Tongcheng, and Anqing are 2.6m/s, 2.3m/s, 3.2m/s, and 3.2m/s. High wind speed is beneficial for the diffusion of air pollutants, so the conditions for pollutants diffusion in Lujiang County are relatively poor.

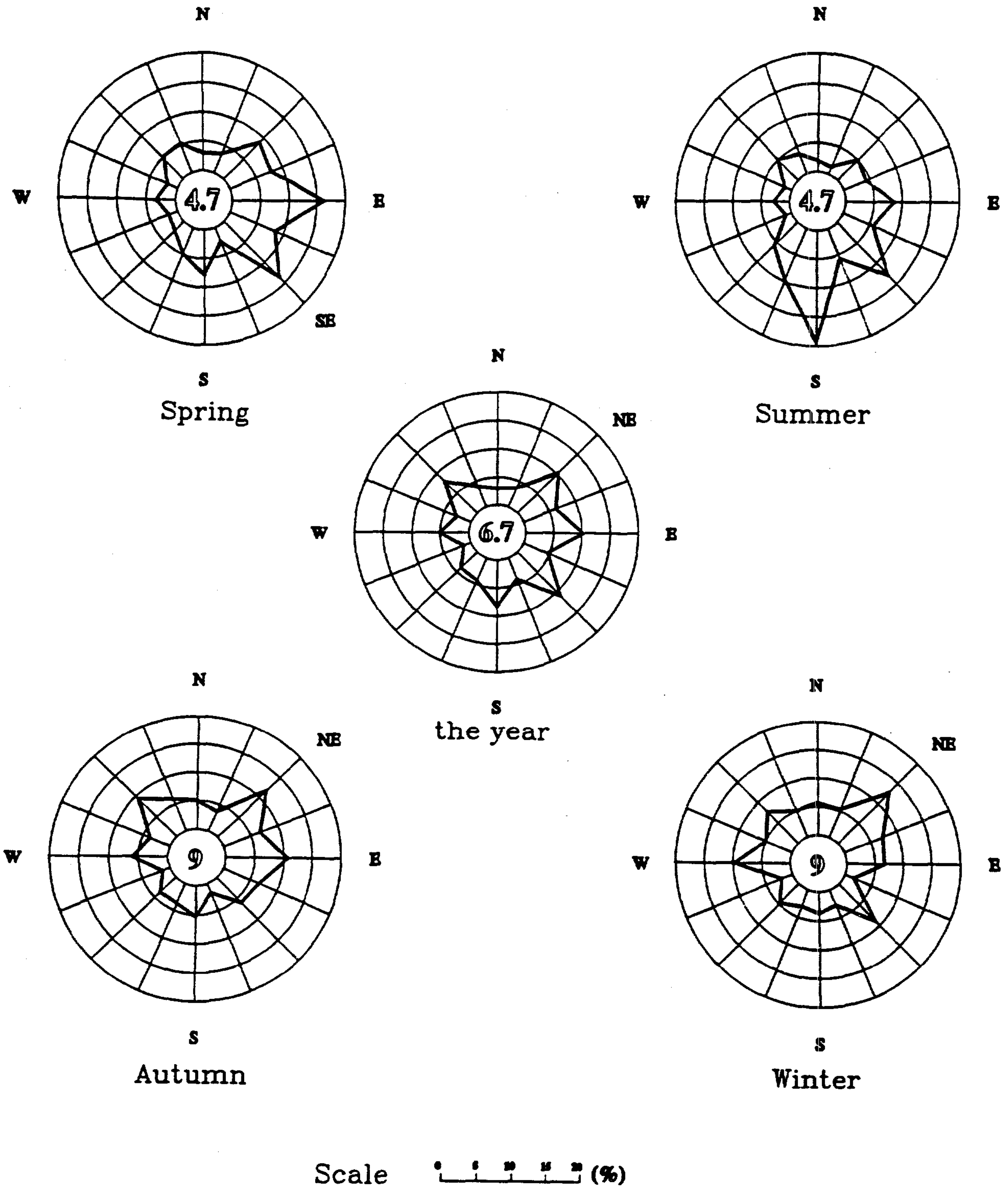
3) atmospheric stability

According to relevant data report in Hefei, Lujiang and Anqing, the appearance frequency of class-D is the highest in the annual atmospheric stability in the region, and those of class-E and class-F are the next. This shows that the atmospheric stability in the assessment area is mainly the medium. See Table 4-4-4 for the details.

Table 4-4-3 Wind Direction Frequency, Average Wind Speeds and Pollution Coefficients of the Cities and Prefectures in Different Directions through the Years

Place	Hefei City			Lujiang City			Anqing City		
Direct	frequency %	average wind speed m/s	pollution index	frequency %	average wind speed m/s	pollution index	frequency %	average wind speed m/s	pollution index
N	3	2.8	1.1	10.3	4.2	2.4	5.3	3.5	1.5
NNE	3.7	3.2	1.2	9	4.2	2.1	11	3.9	2.8
NE	○ 10.3	3.1	3.3	7.3	3.5	2.1	☆ 28.7	4.0	7.2
ENE	6.3	3.2	2.0	3	3.1	1.0	9.7	3.3	2.9
E	○ 10.3	3.0	3.4	3	2.9	1.0	5	2.6	1.9
ESE	4.7	3.1	1.5	1	2.7	0.4	1	2.0	0.5
SE	☆ 11	3.4	3.2	1.7	2.5	0.7	1	1.8	0.6
SSE	4	3.3	1.2	1.3	2.6	0.5	0.7	2.2	0.3
S	8.3	3.4	2.4	7.7	3.8	2.0	2	3.1	0.6
SSW	4.3	3.4	1.3	5.3	4.0	1.3	4.3	3.3	1.3
SW	4	2.7	1.5	8.7	3.5	2.5	○ 12.3	3.6	3.4
WSW	1.3	2.4	0.5	1.3	2.5	0.5	6.3	3.3	1.9
W	5	3.3	1.5	1.3	2.2	0.6	3	2.7	1.1
WNW	2.7	4.0	0.7	1.7	2.5	0.7	1	2.3	0.4
NW	8	4.0	2.0	☆ 21.3	3.3	6.4	1.3	2.0	0.6
NNW	4	3.2	1.2	○ 11.7	4.0	2.9	2.3	2.2	1.0
C	6.7						4.3		

Remark: ☆ is the maximum value, i.e., dominant wind direction for years; ○ is sub-dominant wind direction.



'ig.4—4—1 Hefei City's rosette figure of wind direction frequency of seasons and of the year (1994—1996)

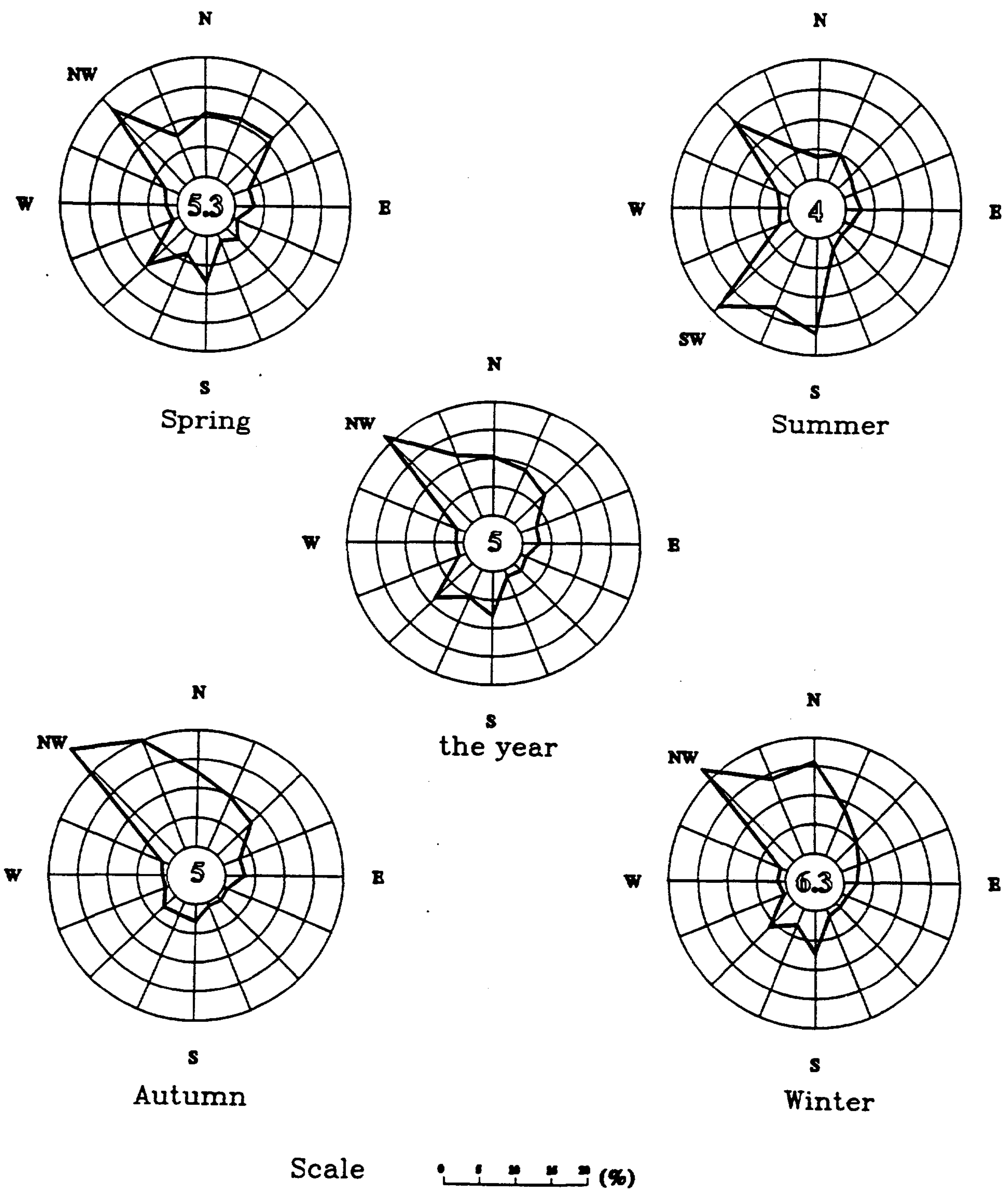


Fig.4–4–2 Tongcheng City's rosette figure of wind direction frequency of seasons and of the year (1994–1996)

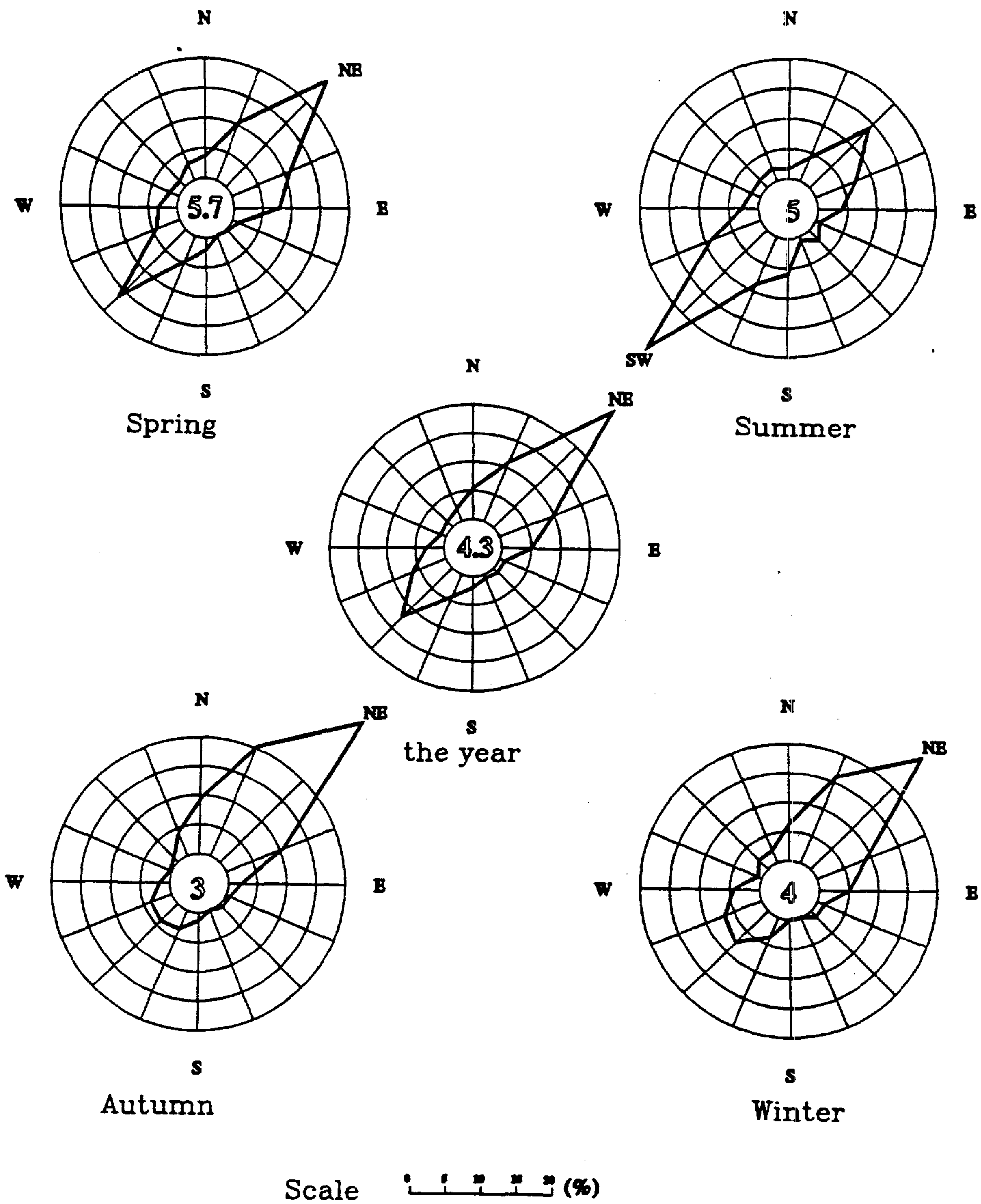


Fig.4−4−3 Anqing City's rosette figure of wind direction frequency of seasons and of the year (1994−1996)

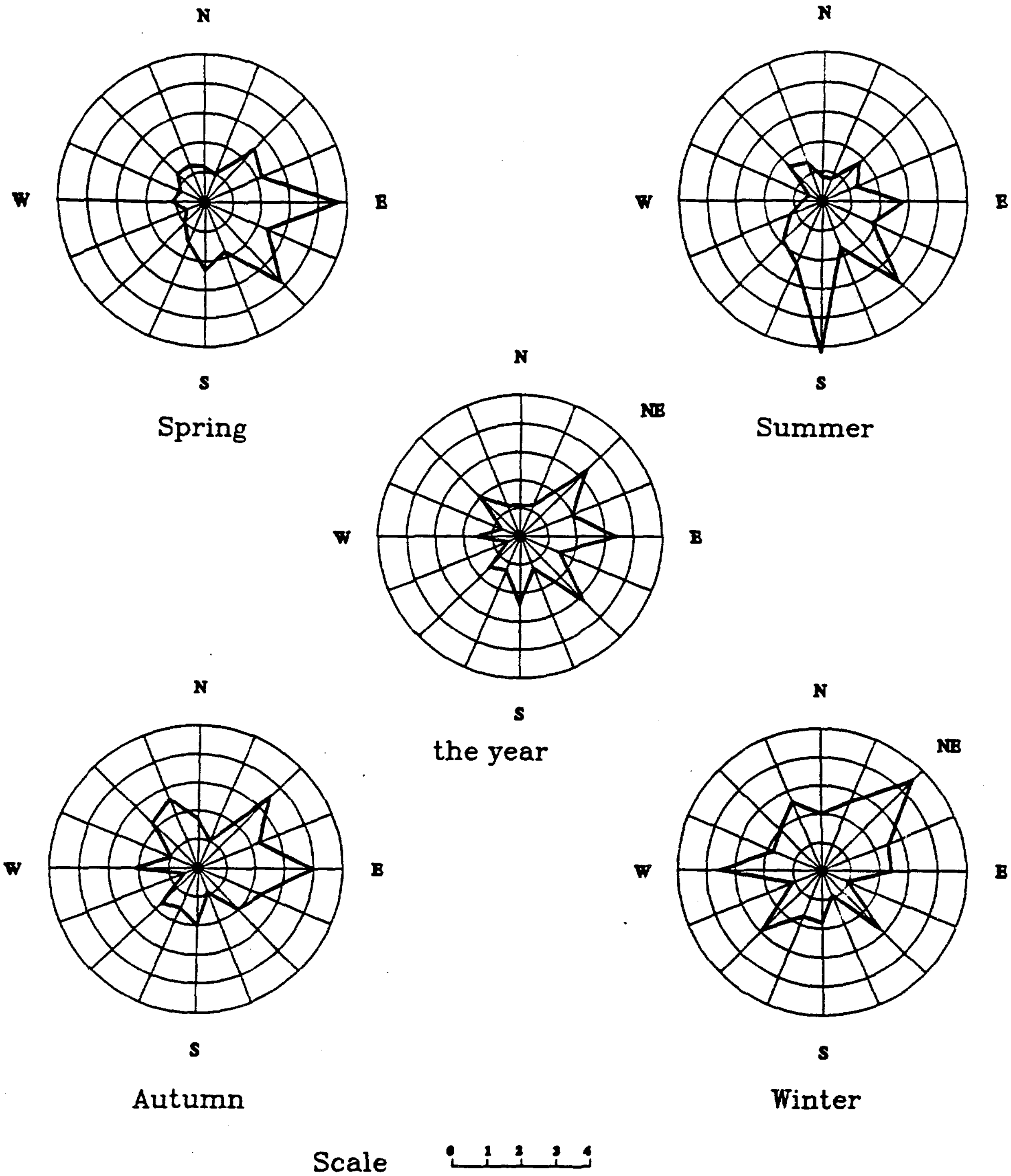


Fig.4−4−4 Hefei City's rosette figure of pollution coefficient of seasons and of the year (1994−1996)

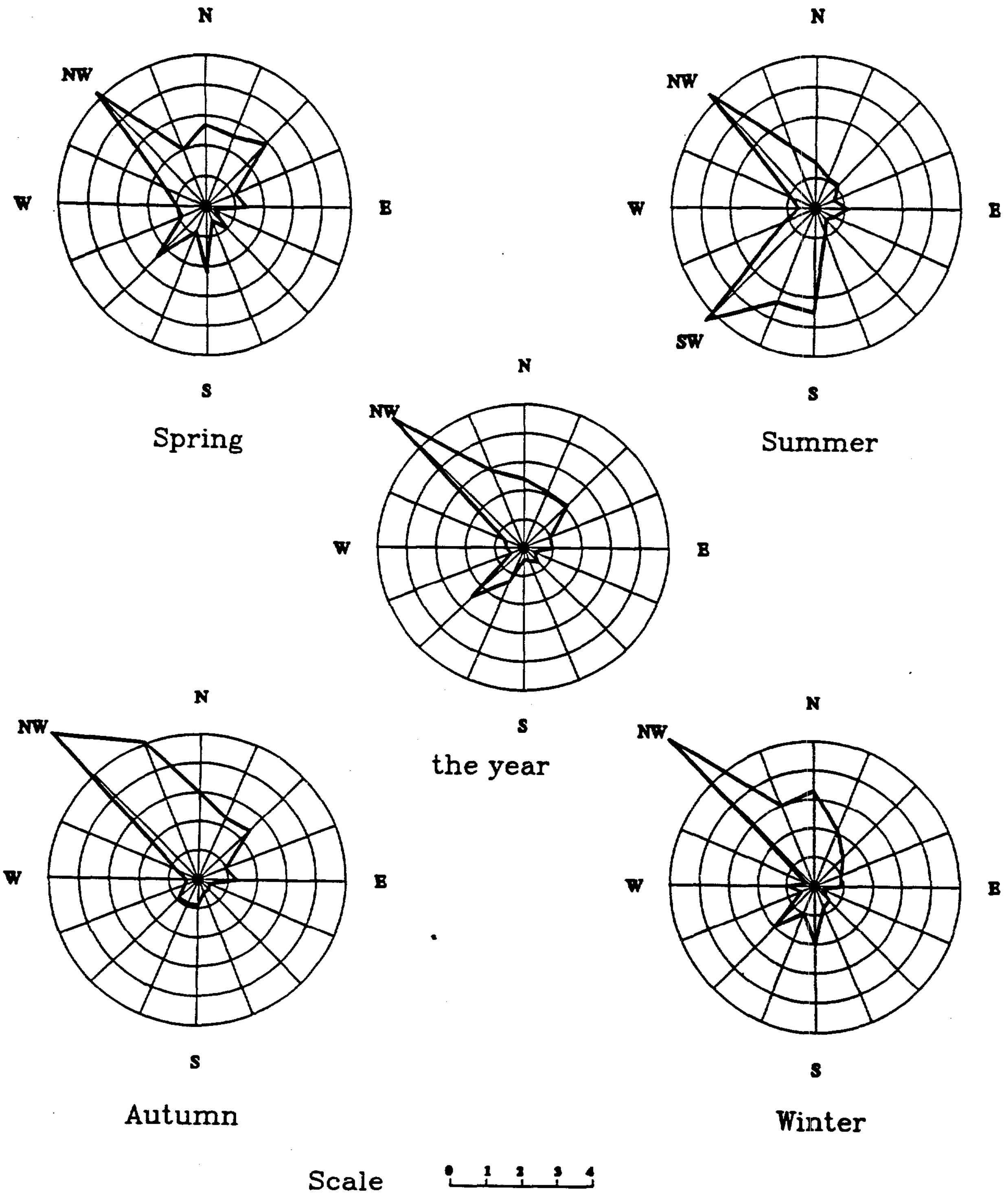


Fig.4−4−5 Tongcheng City's rosette figure of pollution coefficient of seasons and of the year (1994−1996)

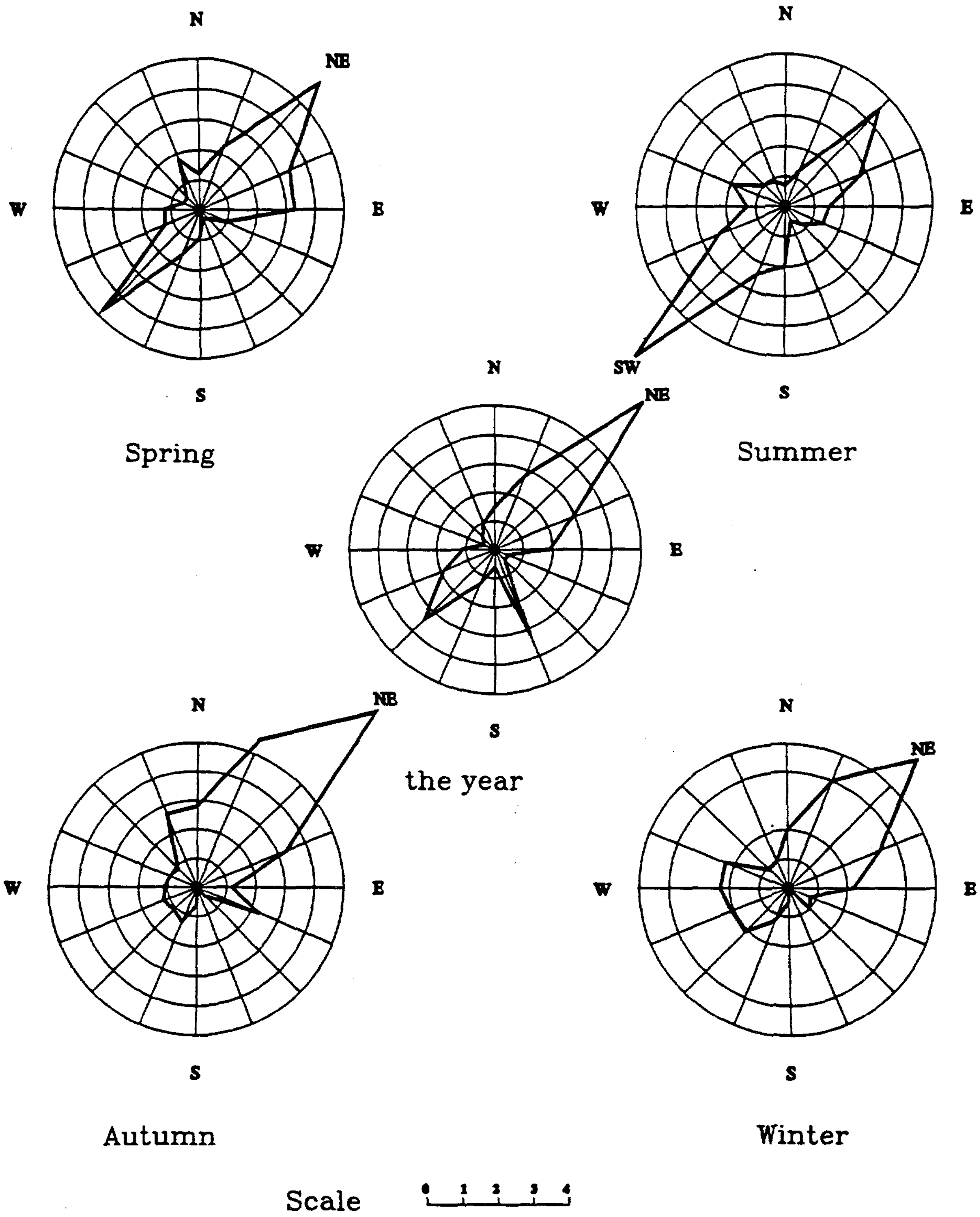


Fig.4–4–6 Anqing City's rosette figure of pollution coefficient of seasons and of the year (1994–1996)

Table 4-4-4 Distribution Percentage of Atmosphere Stability in the Seasons and the Year

Place	Season	Atmos. Stability Classified					
		A	B	C	D	E	F
Hefei	Spring	0.17	4.5	12.8	59.4	14.7	8.4
	Summer	0.17	3.9	10.6	59.7	17.2	8.4
	Autumn	0.17	7.1	10.5	49.9	18.0	14.4
	Winter	0.07	2.3	7.3	53.7	20.8	15.3
	yearly	0.14	4.5	10.3	55.7	17.7	11.6
Lujiang	Spring	1.1	12.6	18.2	34.4	13.0	20.1
	Summer	1.1	10.7	18.1	35.5	10.5	23.8
	Autumn	1.07	12.4	14.4	31.6	13.7	26.9
	Winter	0.01	5.4	11.6	39.1	20.7	23.0
	yearly	0.83	10.3	15.6	35.2	14.5	23.4
Anqing	Spring	0.13	7.1	12.2	56.3	14.3	10.1
	Summer	0.17	6.9	15.5	48.2	17.6	11.5
	Autumn	0.73	8.5	10.6	47.3	17.2	15.7
	Winter	0.07	2.5	7.2	57.9	19.0	13.3
	yearly	0.27	6.3	11.4	52.4	17.0	12.7

4.4.2.2 Calculation of vehicle tail gas emission source strength

The vehicle streams on highways are large and the running speeds are high, so the pollution source of vehicle tail gas emission can be regarded as nearly a linear source of continuous emission, whose strength is related to the single vehicle emission of different types of vehicles, and its impact is mainly controlled by the local meteorological conditions.

(1) Predicted traffic volume

The peak hour traffic volume and daytime average traffic volume per hour of different types of vehicles are calculated on the basis of the predicted annual traffic volumes of the sections provided in the "Engineering Feasibility Studies" (July, 1997 Version) of the project (see Tables 2-3-1 and 2-3-2), the vehicle type ratio (see Table 4-4-5), and traffic investigation data.

(2) Calculation of the strength of the linear source of vehicle pollutant emission

The emission source of running vehicles is calculated as a continuous linear pollution source. The central line of the linear source is the central line of the road, and the single vehicle emission factor adopts the recommended value in the "Norms for EIA of Highway Projects".

The gaseous pollutants' emission source strength is calculated by the following formula:

$$Qj = \sum_{i=1}^{3} Aj * Eij * 3600^{-1}$$ in which,

Qj – emission source strength of class-j gaseous pollutant, mg/s*m;

Aj – traffic volume per hour of class-i vehicle in prediction year, vehicle/h;

Eij – under conditions of running on motorways, the single vehicle emission factor of class-j emitted substance of class-i vehicles in prediction year.

Table 4-4-5 Vehicle Type Composition Ratio of HAE

Year	Large bus	Small bus	L. truck	Mid. truck	S. truck
2001	4.67	35.16	18.65	24.67	16.85
2010	4.84	38.71	19.76	19.19	17.50
2021	4.04	42.37	23.05	12.86	17.69

4.4.2.3 Diffusion model and parameter selection of environmental air pollutants

(1) Diffusion model of air pollutants

The project is located in plain and rolling terrain, and adopting the model recommended in the "Norms", the concentration of pollutants on both sides of the highway is predicted and calculated.

1) when the angle between wind direction and the linear source is $0° < \theta < 90°$, the integral model of calculating linear source in any shape is:

$$C_{PR} = \frac{Q_j}{U} \int_A^B \frac{1}{2\pi \sigma_Y \sigma_z} \exp\left[-\frac{1}{2}\left(\frac{Y}{\sigma_Y}\right)^2\right] \left\{\exp\left[-\frac{1}{2}\left(\frac{z-h}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+h}{\sigma_z}\right)^2\right]\right\} dl$$

in which

C_{PR} - pollutant concentration produced at prediction spot R by section AB of linear source, mg/m^2;

U - average wind speed in height of efficient emission source in predicted section, m/s;

Qj- emission source strength of class-j gaseous pollutant, mg/vehicle* m;

σ_y, σ_z – horizontal and vertical diffusion parameter, m;

Z – height of prediction spot, m;

h – height of effective emission source, m;

A, B – starting and ending points of linear source.

2) when wind direction and linear source meet at right angle (θ = 90 °), the ground surface concentration diffusion model is:

$$Cv = (1/\pi)^{1/2} * Qj/U\sigma_z * \exp[-(h/2\sigma^2_z)^2]$$

The concentration of linear source of unlimited length is irrelevant to the vertical wind direction position.

The references of the signs in the formula are the same as those in the previous formula.

3) when wind direction is in parallel with the linear source (θ = 0 °), the ground surface diffusion model is:

$$Cp = (1/2\pi)^{1/2} * Qj/U\sigma_z(r)$$

$$r = [y^2+(z^2/e^2)^{1/2}$$

$$e = \sigma_z/\sigma_y$$

The concentration of linear source of unlimited length is irrelevant to the horizontal wind direction position. In the formula:

r – equivalent effect distance from micro-unit to prediction spot, m;

e – normal diffusion parameter ratio;

the other signs are the same as those in the previous formula.

(2) Parameter selection and revision

1) revision of source strength. With the development of science and technology, the single vehicle emission of tail gas will be largely reduced in the future, so revision based on technical progress is made to the source strength in this prediction.

2) According to the "Norms for EIA of Highway Construction Projects", the average running speed of vehicles is calculated.

3)he atmospheric stability is mainly class-D.

4)According to "Feasibility Studies" the subgrade width is 28m, and the average fill height of the main line is 3.91m, and that of the linking line is 3.8m. The coefficient in peak hour is 7%.

4.4.2.4 Atmospheric environment prediction and assessment

(1) Prediction of vehicle tail gas concentration diffusion on both sides of the highway

It is calculated and synthesized that with different traffic volumes for different prediction years on the HGE, the predicted diffusion values of emission concentration of NOx and CO increase with the increase of traffic volume, and the concentration of pollutants NOx and CO emitted by tail gas also increase, but the concentration of the two on the HAE does not surpass class-2 standard of atmospheric environmental quality.

Table 4-4-6 shows the sum of maximum and minimum concentrations in the distant future for different traffic volumes.

Table 4-4-6 Predicted Values of Pollutant Concentration Diffusion (35m from the central line of HGE) (Class-D Stability) Unit: mg/m^3

Plan	Pollutant		2001		2010		2021	
		mg/m^3	peak	day aver.	peak	day aver.	peak	day aver.
high	NOx	highest	0.029-0.066	0.017-0.039	0.044-0.099	0.027-0.059	0.055-0.125	0.032-0.074
		lowest	0.016-0.037	0.009-0.023	0.021-0.052	0.013-0.031	0.027-0.066	0.016-0.039
	CO	highest	0.121-0.154	0.071-0.091	0.181 0.230	0.107-0.137	0.226-0.289	0.135-0.171
		lowest	0.066-0.088	0.039-0.052	0.090-0.121	0.054-0.071	0.113-0.151	0.067-0.090
middle	NOx	highest	0.027-0.064	0.016-0.037	0.036-0.092	0.021-0.055	0.052-0.110	0.031-0.066
		lowest	0.013-0.033	0.008-0.020	0.019-0.046	0.011-0.027	0.023-0.054	0.013-0.032
	CO	highest	0.111-0.149	0.066-0.088	0.151-0.214	0.090-0.129	0.216-0.257	0.103-0.153
		lowest	0.058-0.078	0.035-0.046	0.079-0.106	0.047-0.063	0.092-0.125	0.055-0.074
low	NOx	highest	0.027-0.064	0.016-0.037	0.036-0.092	0.021-0.055	0.043-0.110	0.025-0.066
		lowest	0.013-0.032	0.007-0.017	0.017-0.043	0.009-0.024	0.021-0.051	0.012-0.029
	CO	highest	0.111-0.149	0.066-0.088	0.150-0.214	0.090-0.129	0.174-0.257	0.103-0.153
		lowest	0.058-0.078	0.035-0.047	0.078-0.106	0.044-0.060	0.090-0.122	0.054-0.071

It is seen here that in the distant future, if the high plan is adopted, in the Shusan Line-Changgangtou Section (where the concentration is the highest), the once value of NOx concentration varies within 0.055 ~ 0.125mg/m^3, and the daily average is 0.032 ~ 0.074mg/m^3; the once value of CO concentration varies within 0.226 ~ 0.289mg/m^3, and the daily average is 0.135 ~ 0.171mg/m^3. These values are all below the class-2 standard. It can therefore be supposed that the impact of highway operation on atmospheric environmental quality is insignificant. As far as class-2 standard is concerned, the contribution of NOx value is much larger than that of CO. The pollution is the most serious in section of Shusan Line-Changgangtou, and the slightest in section of Tongcheng-Gezidun, which is determined by factors of traffic volume, topography and wind speed.

The pollutant concentration diffusion predicted values of GAH are shown in Table 4-4-7. In the distant future, when the high plan is adopted, at 30m from the central line of the road, the once concentration values of NOx and CO are respectively 0.027-0.068mg/m^3 and 0.143-0.202mg/m^3, and the daily averages of the two are respectively 0.016-0.041mg/m^3 and 0.085-0.120mg/m^3. This shows that even with the high plan in which the traffic volume is the largest, the emission concentration of tail gas diffusion on both sides of the GAH is still small and has no impact on the environment. Since the vehicle speed on the GAH is lower than that on the main line, the pollutant concentration here is smaller as well.

(2) Assessment of atmospheric environmental impact of HAE

According to the principle of " combining the assessment of specific spots and that of the whole line, and viewing the situation of the whole line from those of the representative spots on it", the assessment of three representative spots (areas) is used so as to reflect the pollution of the whole line in the future. The baseline values of the spots are used as the background values of air pollutants of the prediction spots, and thus the results of pollutant concentration distribution prediction is obtained. The representative sections of Shusan Line-Changgangtou (with the most serious pollution) and Tongcheng-Gezidun (with the slightest pollution) are selected in this assessment to generalize the atmospheric environmental quality of HAE. See Table 4-4-8 ~ 4-4-9.

It can be seen in the tables that for the main line, with the high plan in 2021, at 35m from the central line of the road, the average values per hour of NOx concentration are respectively 0.063-0.133mg/m^3 and 0.043-0.082mg/m^3, and the daily averages are 0.040-0.082mg/m^3 and 0.032-0.055mg/m^3; the average values per hour of CO concentration are 0.93-0.99mg/m^3 and 0.74-0.78mg/m^3, and the daily averages are 0.83-0.87mg/m^3 and 0.69-0.71mg/m^3.

Tables 4-4-10 and 4-4-11 show the atmospheric environmental quality of GAH.

As a conclusion of all the above, NOx and CO pollution is slight on the whole highway. Even if in the distant future and the high plan of the largest traffic volume is adopted, the NOx and CO concentration at 35m from the central line of the highway still meets the class-2 standard. The reasons for this are: 1. The terrain along the highway is plain and open, so the diffusing conditions for the pollutants are good; besides, there is no large and stable pollution source, so the background (baseline) values of NOx and CO concentration are low; 2. The tail gas pollutant concentration is low in operation period. Therefore, the impact scope of tail gas pollutants NOx and CO on both sides of the road is limited.

Table 4-4-7 Predicted Values of Pollutant Concentration Diffusion (Class-D Stability) of GAH Unit: mg/m^3

Plan	Away from central line	Pollutant mg/m^3	2001 year		2010 year		2021 year	
			peak	day aver.	peak	day aver.	peak	day aver.
high	30m	NOx	0.017-0.043	0.010-0.026	0.024-0.058	0.014-0.034	0.027-0.068	0.016-0.041
		CO	0.091-0.129	0.054-0.077	0.124-0.172	0.04-0.103	0.143-0.202	0.085-0.120
	110m	NOx	0.009-0.030	0.005-0.018	0.013-0.040	0.007-0.024	0.014-0.047	0.009-0.028
		CO	0.048-0.088	0.029-0.052	0.066-0.117	0.039-0.070	0.076-0.138	0.045-0.134
middle	30m	NOx	0.021-0.053	0.010-0.066	0.021-0.054	0.013-0.032	0.028-0.059	0.017-0.035
		CO	0.112-0.159	0.138-0.195	0.112-0.159	0.067-0.095	0.149-0.176	0.089-0.105
	110m	NOx	0.009-0.028	0.005-0.017	0.011-0.037	0.007-0.022	0.015-0.040	0.009-0.024
		CO	0.046-0.083	0.027-0.050	0.060-0.108	0.036-0.064	0.079-0.120	0.047-0.071
low	30m	NOx	0.016-0.039	0.009-0.023	0.019-0.049	0.012-0.029	0.021-0.052	0.012-0.031
		CO	0.082-0.116	0.049-0.069	0.102-0.144	0.061-0.086	0.108-0.153	0.064-0.091
	110m	NOx	0.008-0.027	0.005-0.016	0.010-0.033	0.006-0.020	0.011-0.035	0.006-0.021
		CO	0.044-0.079	0.026-0.047	0.054-0.098	0.032-0.059	0.057-0.104	0.034-0.062

Table 4-4-8 Atmospheric Environmental Quality of Representative Sections of HGE in the High Plan (NOx)

Section	year	Traffic condition	35m from central line mg/m³	115m from central line mg/m³	Standard-meeting distance	
					1 hr. aver.	day aver.
Shusan -xian ~ Chang-gangtou	2001	peak	0.037-0.074	0.024-0.056	35m	/
		day aver.	0.025-0.047	0.017-0.037	/	35m
	2010	peak	0.052-0.107	0.031-0.082	35m	/
		day aver.	0.035-0.067	0.021-0.051	/	35m
	2021	peak	0.063-0.133	0.037-0.099	35m	/
		day aver.	0.040-0.082	0.025-0.063	/	35m
Tong-cheng ~ Gezidun	2001	peak	0.032-0.053	0.024-0.041	35m	/
		day aver.	0.025-0.039	0.021-0.031	/	35m
	2010	peak	0.037-0.068	0.028-0.053	35m	/
		day aver.	0.029-0.047	0.023-0.039	/	35m
	2021	peak	0.043-0.082	0.031-0.063	35m	/
		day aver.	0.032-0.055	0.025-0.044	/	35m

Table 4-4-9 Atmospheric Environmental Quality of Representative Sections of HGE in the High Plan (CO)

Section	year	Traffic condition	35m from central line mg/m³	115m from central line mg/m³	Standard-meeting distance	
					1 hr. aver.	Day aver.
Shusan -xian ~ Chang-gangtou	2001	peak	0.82-0.85	0.76-0.81	35m	/
		day aver.	0.77-0.79	0.74-0.77	/	35m
	2010	peak	0.88-0.93	0.80-0.87	35m	/
		day aver.	0.81-0.84	0.74-0.80	/	35m
	2021	peak	0.93-0.99	0.82-0.91	35m	/
		day aver.	0.83-0.87	0.77-0.83	/	35m
Tong-cheng ~ Gezidun	2001	peak	0.69-0.71	0.66-0.68	35m	/
		day aver.	0.66-0.68	0.64-0.66	/	35m
	2010	peak	0.71-0.75	0.67-0.71	35m	/
		day aver.	0.68-0.70	0.65-0.68	/	35m
	2021	peak	0.74-0.78	0.69-0.73	35m	/
		day aver.	0.69-0.71	0.66-0.69	/	35m

Table 4-4-10 Atmospheric Environmental Quality of GAH

(NOx)

Plan	Year	Traffic condition	35m from central line	115m from central line	Standard-meeting distance	
			mg/m³	mg/m³	1 hr. aver.	day aver.
high	2001	peak	0.030-0.056	0.022-0.043	30m	/
		day aver.	0.023-0.039	0.018-0.031	/	30m
	2010	peak	0.037-0.071	0.026-0.053	30m	/
		day aver.	0.027-0.047	0.020-0.037	/	30m
	2021	peak	0.040-0.081	0.027-0.060	30m	/
		day aver.	0.029-0.054	0.022-0.041	/	30m
middle	2001	peak	0.034-0.066	0.022-0.041	30m	/
		day aver.	0.023-0.079	0.018-0.030	/	30m
	2010	peak	0.034-0.067	0.024-0.050	30m	/
		day aver.	0.026-0.045	0.020-0.035	/	30m
	2021	peak	0.041-0.072	0.028-0.053	30m	/
		day aver.	0.030-0.048	0.022-0.037	/	30m
low	2001	peak	0.029-0.052	0.021-0.040	30m	/
		day aver.	0.022-0.036	0.018-0.029	/	30m
	2010	peak	0.032-0.062	0.023-0.046	30m	/
		day aver.	0.025-0.042	0.019-0.033	/	30m
	2021	peak	0.034-0.065	0.024-0.048	30m	/
		day aver.	0.025-0.044	0.019-0.034	/	30m

Table 4-4-11 Atmospheric Environmental Quality of GAH

(CO)

Plan	Year	Traffic condition	35m from central line	115m from central line	Standard-meeting distance	
			mg/m^3	mg/m^3	1 hr. aver.	day aver.
high	2001	peak	0.72-0.75	0.67-0.71	30m	/
		day aver.	0.67-0.70	0.65-0.68	/	30m
	2010	peak	0.75-0.80	0.69-0.74	30m	/
		day aver.	0.70-0.73	0.66-0.69	/	30m
	2021	peak	0.77-0.83	0.70-0.76	30m	/
		day aver.	0.71-0.74	0.67-0.66	/	30m
middle	2001	peak	0.72-0.78	0.67-0.71	30m	/
		day aver.	0.76-0.82	0.65-0.67	/	30m
	2010	peak	0.74-0.78	0.68-0.73	30m	/
		day aver.	0.69-0.72	0.66-0.69	/	30m
	2021	peak	0.77-0.80	0.70-0.74	30m	/
		day aver.	0.71-0.73	0.67-0.70	/	30m
low	2001	peak	0.71-0.74	0.67-0.70	30m	/
		day aver.	0.67-0.69	0.65-0.67	/	30m
	2010	peak	0.72-0.76	0.68-0.72	30m	/
		day aver.	0.69-0.71	0.66-0.68	/	30m
	2021	peak	0.73-0.78	0.68-0.73	30m	/
		day aver.	0.69-0.72	0.66-0.69	/	30m

(3) Analysis of environmental impact on sensitive spots

According to prediction calculation and analysis, in all plans and under class-D stability, the NOx and CO concentration of all sensitive spots meet the standard. But under unfavorable meteorological conditions, like temperature inversion, gentle or still wind, and class-E or F stability, etc., on some sections of relatively large traffic volumes, for example, the sections of Xiaoxichong-Mayan and, especially, Shusan Road-Changgangtou, in the distant future, the NOx concentration is likely to surpass the standard. Air pollution monitoring should be strengthened.

CHAPTER FIVE ENVIRONMENTAL MITIGATION MEASURES

5.1 Alternatives Analysis

5.1.1 Alternatives

The Statement of Engineering Feasibility Studies suggested 3 alternatives: Option I (East Route, recommended alignment); Option II (West Route) and Option III (Middle Route).

5.1.2 Environmental discussion and conclusions

5.1.2.1 West Route

This route is 10km longer than the East Route, and brings about more air and noise pollution to Hefei City. The route is mainly passing through mountainous areas and will include more cut and filling works than others, accordingly. From socioeconomic points of view, this route will run through less developed areas and therefore less economic benefits are expected.

5.1.2.2 Middle Route

This is the longest alignment among three options. Since this route runs through southern area of Hefei City, it is likely that it would cause more environmental impacts on Hefei City.

5.1.2.3 East Route

The East Route would cause less impacts on urban air quality in Hefei. Also, less cutting and filling works are envisaged than the West Route.

5.1.2.4 Conclusions

For these reasons, East Route was selected as a recommended alignment.

5.2 Design Period

1 . The H-G-A Expressway is located in the agricultural area of Anhui Province between the Changjiang River and the Huaihe River, and occupy altogether land of 17668.362mu, in which the sum total of paddy fields and dry land is 10,055.5mu, covering 50.3% of all land occupied. In order to reduce land occupation, especially that of basic cultivated fields preservation area, as long as the technical standards of highway construction are satisfied, the contract of double side slopes should be adopted for sections in the agricultural fields. If the foot of each side slope is contracted by 3m, there will be a 9-mu reduction per kilometer in field occupation. Since the total length of field-crossing sections of both HGE and GAH is up to 130km (not incl. cut sections and bridges), it is estimated that there will be a reduction of 1,171mu in field occupation. The economic qualitative and contrastive analysis for this goes as the following:

Advantages:

(1) reduction of field occupation by 1,171mu;

(2) reduction in side slope protection engineering volume;

(3) reduction in side slope planting cost;

(4) reduction in subgrade filling volume.

Disadvantages:

(1) as the stone material has to be transported from other places 15 ~ 60km away from the construction location, there will be more transporting cost;

(2) as cement retaining wall is used, there will be more cement consumption and more labor cost.

It can be seen from the brief comparison above that the advantages of this method are remarkable. Actually it has been adopted in the ADB loan project of Chuxiong-Dali Highway in Yunnan Province and some highways in Sichuan Province. It is suggested here that further comparisons be made in the preliminary design. See Figure 5-1-1.

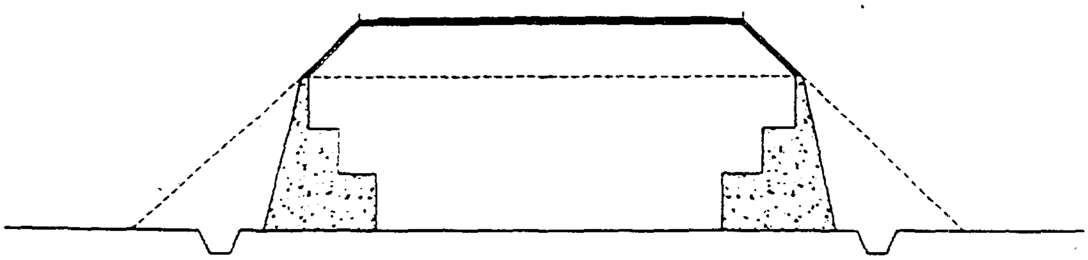


Figure 5-1-1 Contracted Side Slope

2. There are altogether 45 cutting sections in a total length of 15.4km. Protecting walls should be built in order to resist washing to the slope surface by rainfall. Engineering protection at this stage is an effective and necessary measure of water and soul preservation.

3. Emphasis should be laid upon highway planting design. An experienced department should be selected and entrusted with this job, who is not only equipped with basic knowledge in highway communications, but also knows the characteristics and technical difficulties of highway planting. It should also be equipped with techniques of landscaping, turf design and trees and grass planting.

4. There should be waste water treatment facilities in the service areas, which have already been mentioned in the statement of feasibility studies, but which still need detailed design according to the scale, staff number and emission volume.

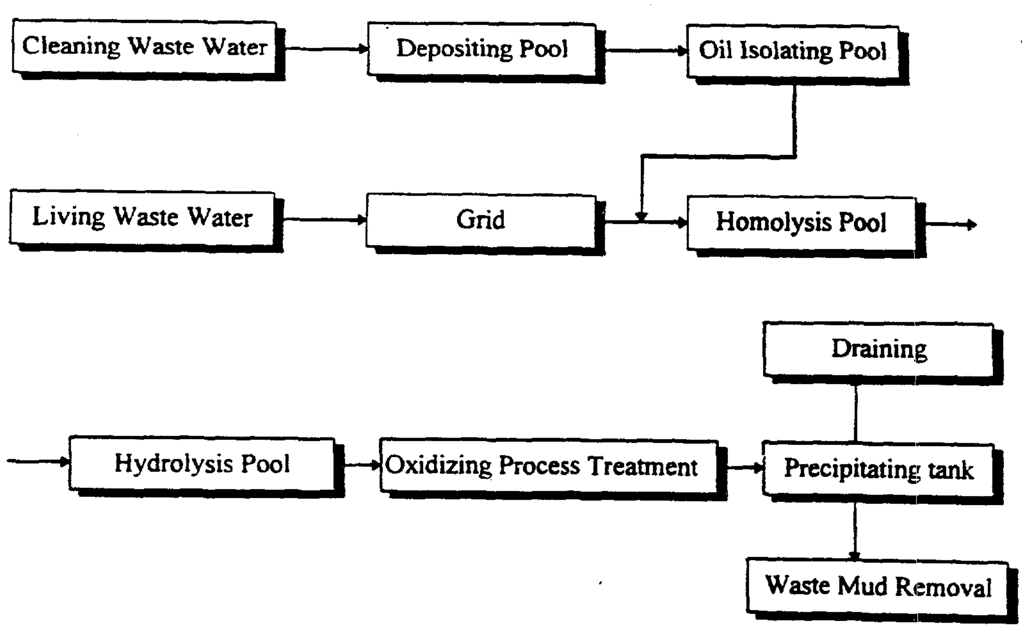


Figure 5-1-2 Flow Chart of Sewage Treatment Techniques

5. There are quite a lot ponds crossed by the highway, among which the Qilitang Pond at K54 is directly crossed through, and there are other smaller ponds some of which are for fish raising. In order to ensure the water quality in these ponds, it should be designed that the road surface runoff is directed out of the ponds, so as to reduce pollution to the water quality.

6. In order to avoid air and noise pollution, the mixing stations of earth, cement or bitumen, the borrowing sites and the waste sites should be away from the environmental sensitive spots; there should be specific design for noise-resisting measures like acoustic barriers, etc.

7. The location of underpasses, bridges and culverts must meet the requirement of the local residents and vehicles and that of flood control and irrigation.

8. Coordination between the highway and the developing of the local towns and cities will bring out the active participation of the local governments and thus benefit the construction itself.

5.3 Construction Period

1. The occupied land should be used appropriately and fully, so as to reduce temporary or borrowing occupation, shorten the temporary occupying time and restore cultivation in time.

2. The woods on the hills along the route should be protected, and the construction staff should be instructed not to cut trees indiscriminately, and safety in fire use should be paid attention to when construction is going on in woods.

3. The low hills with relatively poor vegetation should be chosen first for the borrowing sites. After the borrowing, the ground should be cleared up duly and vegetation be restored according to the requirements in the national "Laws for Water and Soil Reservation" and of the NEPA, so as to reduce soil erosion.

4. The subgrade construction should not be done in the raining season; paving and pressing should be coordinated, i.e., pressing should follow immediately paving so as to reduce soil erosion.

5. The construction of bridge foundation and culvert should be coordinated with navigation and irrigation; clearing-up should be done immediately after the construction is finished. The waste in pier construction must not be thrown into the river so as to avoid deposit in

the course and even impact on the receiver water body, Chaohu Lake and other lakes directing to the Changjiang River.

6. Domestic waste water should be disposed of properly at the shelters of the construction staff. There should be septic tanks for the toilets, and pool for concentrating the waste water which should be kept clean by spraying drug to kill bacteria; waste should be thrown into dustbins, which should be cleaned duly.

7. The construction machines should be maintained carefully in order to be kept in the best working state and the lowest level of noise. If necessary, the protecting measures of earplugs, noise-resisting cotton, etc. should be used to ensure the health of the workers, and they may take turns in different jobs or work in shorter time.

8. If there are residential spots within 150m from the construction site, working hours should be arranged properly; machines with loud noise should be stopped at night (22:00—6:00); the main (temporary) transporting roads should also be away from the residential spots.

9. Earth and bitumen mixing plants should be at the lower wind and over 200m away from the sensitive spots like schools and residential spots; the mixing machines should be well-sealed and facilitated with shock absorber and dust-resisting devices; the workers should be well-protected.

10. Vehicles transporting construction materials should be well-covered so as to reduce scattering. The storehouses and material-piling sites should be covered, especially those containing coal-dust, which should also be wet when being transported.

11. Water should be sprinkled on the transporting roads and the construction sites, especially the dust mixing plants; the roads should be cleaned duly in order to avoid flying dust once more.

12. The laws on cultural relics protection should be well propagated to the working staff; if there are undiscovered cultural relics found during the construction, the relevant departments should be informed immediately and the cutting should be suspended until the appraisal of the cultural relics protection department is completed. Those already discovered before should be taken out and cleared up before the construction begins.

13. The traffic on the existing roads should be kept in good order so as to avoid traffic jams and accidents; the transporting management plan of this project should be developed.

5.4 Operation Period

1. The planting engineering should be reinforced and the vegetation damaged in the construction be restored as soon as possible. Thus not only the soil erosion can be reduced, but the road view can be beautified and the subgrade protected and the ecological balance enhanced. The planting should be coordinated with the urban developing plans.

2. Sample monitoring should be done regularly to the waste water emission of the service areas, so as to find and solve problems if there are and avoid pollution to the receiving water body.

3. The highway administrative departments should strengthen its management of dangerous articles transportation, and establish the system of issuing "transport license", "driver's license", and "transport escort license" for the transport of chemical and dangerous articles; reports should be made as to the transporting vehicles; a small group of firemen should be organized and emergency plans be developed so as to cope with emergencies.

4. The use of lead-free gas should be encouraged in order to reduce air pollution. Exposed transport of coal, cement or roughly packed chemical fertilizer should be forbidden from on the road.

5. Traffic noise which has certain impact on the environment should be dealt with by the following means according to the specific standard-surpassing situations:

(1) Acoustic barriers 3.5m high and 150m long can be built at the road-facing side of the 4 primary schools where standard-surpassing happens.

(2) The walls on the side of the road should be built or heightened to 3.0m high, and two sign boards of "no whistling" should be established respectively on the front and the back of schools and villages at roadside.

(3) For places like Yandunji in HGE and Banqiaocun, Dalongshan Town Government and Wuheng Township government in GAH, walls should be built or heightened on their road-facing side.

6. Examination should be done to the tail gas emission license by the tollhouses, and those vehicles surpassing the standard should be forbidden from the expressway.

7. The environmental monitoring system is to be carried out. Under unfavorable meteorological conditions, the NOx may surpass the

standard at some sensitive spots. Therefore, monitoring should be done regularly from the beginning of the operation; traffic control measures of speed limitation in specific time or no-overtaking should be taken for the NOx standard-surpassing sections so as to reduce NOx pollution and protect the health of the residents and the school students.

8. In order to protect the health of the residents along the highway, apart from the protecting measure taken for the existing residential areas, it is suggested that no schools or hospitals be built within 200m from the new highway, and other kinds of buildings should better be built beyond 50m from the roadside.

The implementation of the above measures is determined by the attention from the authority of the construction department; besides, there should be a professional environmental protection department and a system to ensure the management and supervision of the implementation. Therefore, it is suggested that APCD coordinate with AHHAB in establishing a corresponding environmental protection department for the HAE, which will be in charge of the protection work during construction and operation periods.

5.5 Progress of Major EP Measures Implementation

Table 5-4-1 Implementation of Main EP Measures

Time	1998				1999				2000				2001			
Measure	1st qua.	2nd qua.	3rd qua.	4th qua.	1st qua.	2nd qua.	3rd qua.	4th qua.	1st qua.	2nd qua.	3rd qua.	4th qua.	1st qua.	2nd qua.	3rd qua.	4th qua.
Remove & resettlement			*	*	*											
wall building & heightening													*	*	*	
planting										*	*	*	*	*	*	
acoustic barrier													*	*	*	
sewage disposal facilities in service areas													*	*	*	*
environmental training				*	*			*								

CHAPTER SIX ENVIRONMENTAL MANAGEMENT, PERSONNEL TRAINING AND MONITORING PLAN

6.1 Environment Management Departments and Personnel Requirements

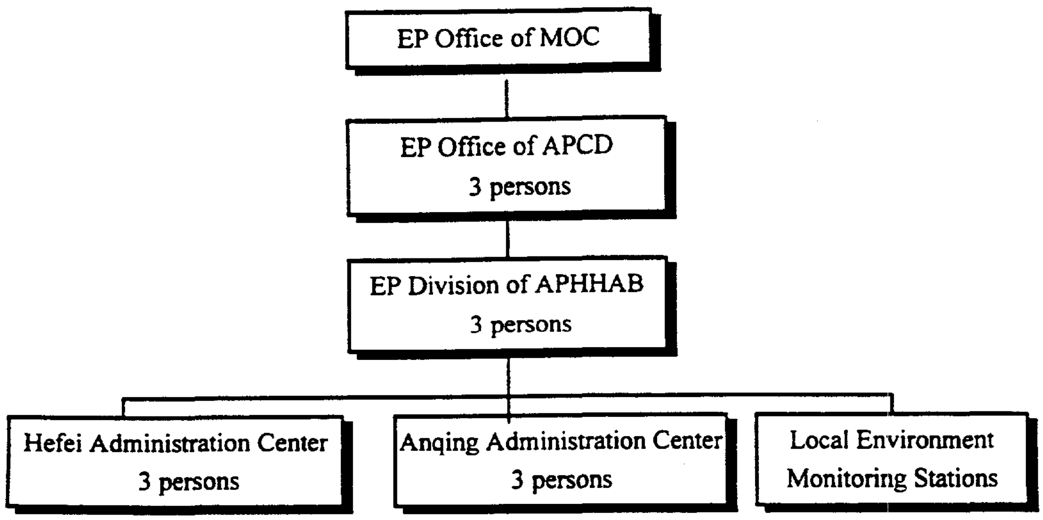


Figure 6-1-1 Environmental Organization Chart During Operation Period

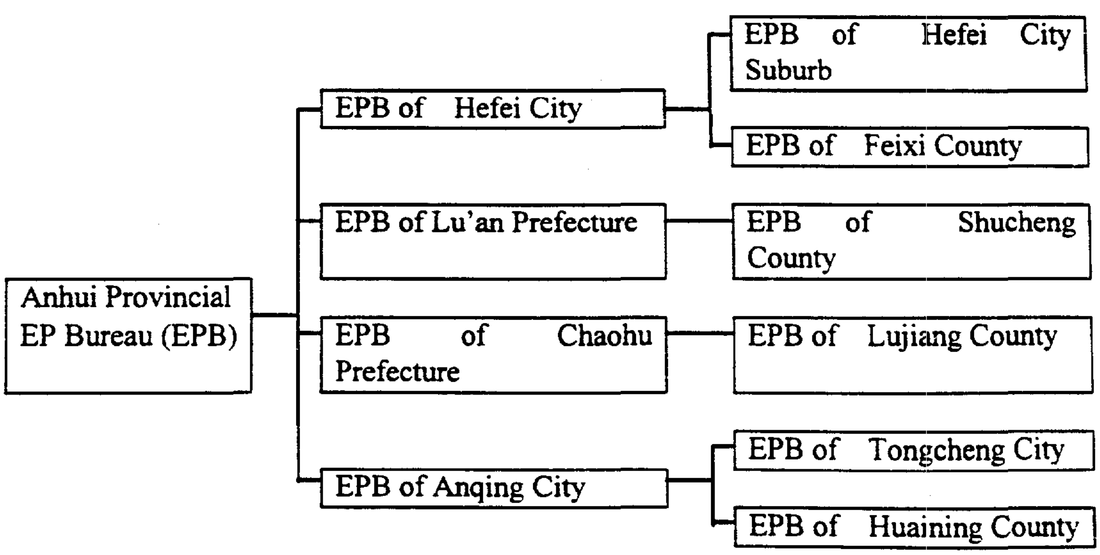
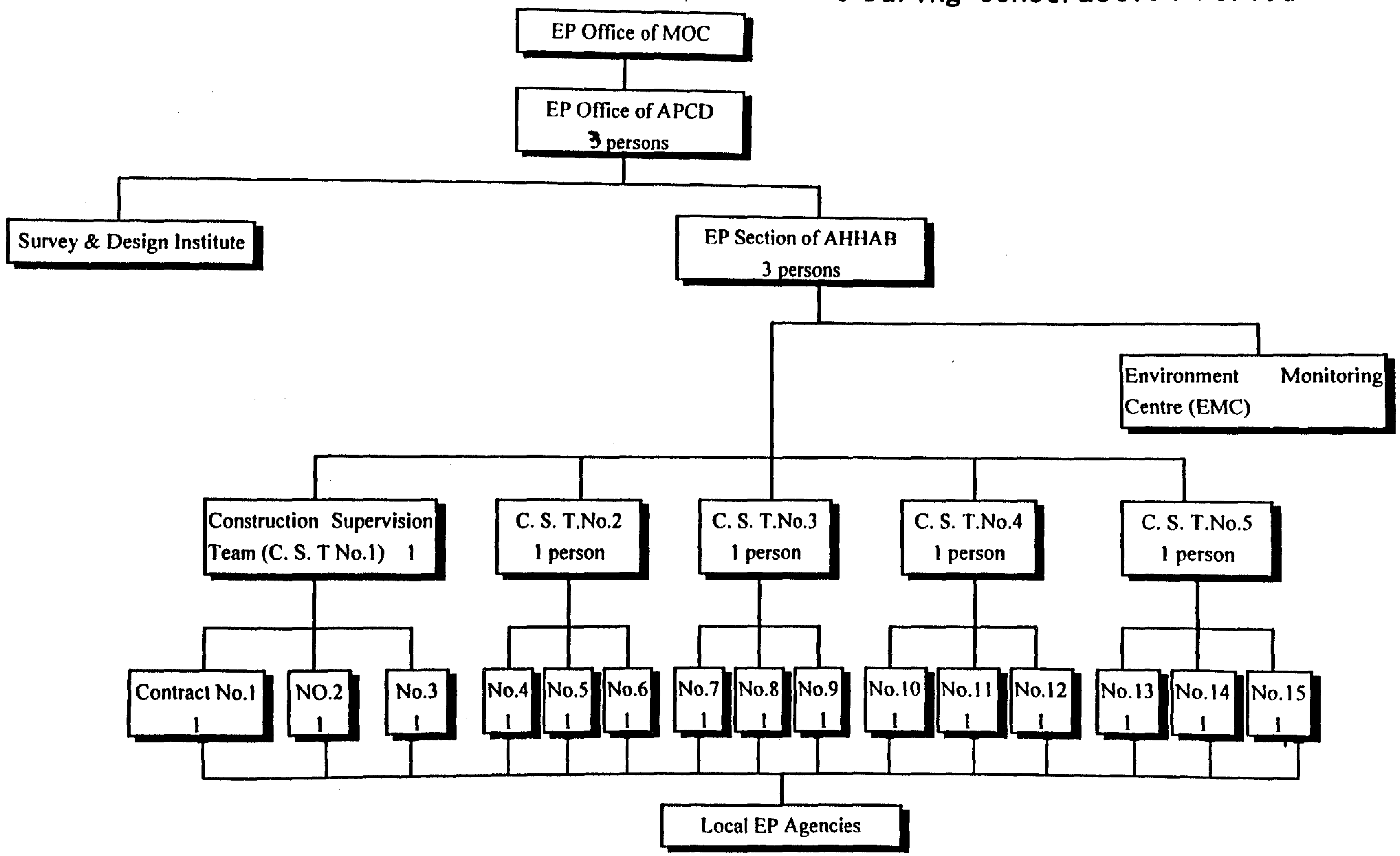


Figure 6-1-2 Regional EAP Supervising Departments

Figure 6-1-3 Environmental Organization Chart During Construction Period



The environment supervision plan and environmental management plan are shown in Table 6-1-1 and table 6-1-2. The following must also be obeyed:

(1). During the design period, the design institution should put the environmental protection measures listed in EIA statement into practice when giving construction design. Environmental protection departments of the construction unit should examine the engineering design schemes of environment protection.

(2). During the public bidding period, contractors should include environmental protection contents when entering a bid. After their winning the bid, they should include terms of environmental protection measures in the contract.

(3). After construction begins, the construction unit should assign at least 5 professionals to carry out environmental engineering supervision, responsible for the environmental administration and supervision during the construction period. The focus of their work is on construction noise, powder dust and flood control and flood discharge.

(4). Every construction team should be assigned an environmental protection worker, supervising and administrating the implementation of environmental protection measures.

(5). During the operation period, the environmental protection section with highway administrating office should be responsible for the supervision and monitoring.

Table 6-1-1 Environmental Supervision Plan

Period	Organization	Contents of Supervision
Study of feasibility & design stage	NEPA,WB, EPO of MOC, PEPB, EPO of APCD	1.Examine the TOR of EIA 2.Examine EIA 3. Examine preliminary design document of EPE (Environmental protection engineering) and EAP 4.Check if the environment protection investment is practicable
Construc-tion stage	PEPB, LEPBs, APHHAB, supervision companies	1.Check if the sites of building material station, asphalt plant and cement mixing station are suitable 2. Check if the dust and noise pollution is controlled, fix the construction time 3. Check the discharge and processing of waste water and other waste materials 4. Check the recovering conditions and processing of borrow and waste sites 5. Ensure the EMP (Environment Monitoring Plan) is taken into action 6. Ensure the implementation of other environment actions matches the requirement of the design; decide the completion deadline of EPEs
Operation stage	EPO of APCD APHHAB and its local divisions, PEPB, LEPBs	1. Check if EMP (Environment Monitoring Plan) is taken into action 2. Check if further step should be taken after execution of EMP to cope with unexpected environment problem 3. Check if the environment quality of sensitive sections meet the corresponding requirement 4. Check the processing of living sewage 5. Ensure the off-road water does not drains to fresh water source 6. Reinforce supervision to remove casual accident risk. Take actions to cope with casual accidents and eliminate the negative impact of leakage of hazardous & toxic goods 7. Ensure implementation of other environment actions

Table 6-1-2 Environment Management Plan

Potential Negative Impact	Mitigating Measure
I Plan and Design Stage	
1. Reduction of flood discharge ability	1. Design carefully
2. Compulsory move and resettlement of residents in the occupied areas	2. Reasonable resettlement plan is made and executed with suitable compensation
3. Loss of land resources	3. Adopt the rational plan with less land acquisition
4. Loss of the beauty of surroundings	4. The project and the geographical feature of landscape should merge in perfect harmony
5. Hindering the way between homes and farmland and increasing the travel time	5. Provide underpasses in suitable places and quantity
6. The erosion on the subgrade soil caused by waste water from ditch	6. Increase the number and adjust the position of water spouts
II Construction Stage	
1. The increased residue in the river and caused by litter and erosion at the construction site and new road	1. The sensitive top soil should be protected and covered by fibre cover, and vegetable should be planted as soon as possible
2. Water and soil pollution caused by oil/ gas/ fuel/ paint in bitumen mixing plants	2. Collect and recycle lubricants agent and avoid the spill and leakage
3. Air pollution by asphalt mixing or cement mixing	3. Install and tune on the equipment to control the pollution and choose the suitable site
4. Dust and noise during construction	4. Regular water sprinkling, isolating high noise equip.
5. Undiscovered under-ground cultural relics found in construction	5. Stop working and inform the relevant management department
6. Destroying landscape by building embankment or filling or quarrying	6. Constructing under design guide, planting in time
7. Interfering the public facilities such as electricity line & communications	7. Consulting with the responsible department, inform firstly and remove secondly
8. Interfering the present transportation conditions	8. Reinforce the management on the traffic jam spot
9. Worsening the hygienic conditions and causing lots of solid waste	9.Install septic tanks in toilets and dustbins at the encampment of workers, reinforce environment management

Table 6-1-2 Environment Management Plan

(continued)

Potential Negative Impact	Elimination measure
10. Possible spreading of infectious disease among workers and local people	10. Regular medical examination of workers and treatment if necessary
11. Producing the surroundings in which mosquitoes, the bacteria carried are reproduced, such as still water ponds	11. Adopt drug to kill bacteria to avoid suitable environment for pests
12. Causing negative impact on soil and landscape with excessive soil acquisition	12. Push away and concentrate the top soil, save it and use it after construction; make efforts to reduce the time of temporary land acquisition
III Operation stage	
1. Air and noise pollution caused by transportation	1. Install sound barrios and take other measures to control noise and reduce the air pollution by controlling vehicle technical condition and reinforce the public transport and traffic management
2. Constant soil erosion	2. Maintenance; planting, add protection devices
3. Waste water and oil containing water in lining service sections	3. Install sewage processing facilities and carry out standard emission
4. The danger such as injury and death caused by spill or leakage of toxic goods during transportation	4. Make and execute a plan to cope with urgent accidents and establish organization and management program to reduce the damage

6. 2 Environment Training

Since there is a lack of experience in environmental protection management of highway projects in China at present, it is recommended that environmental training should be carried out in a timely manner, which comprises (i) overseas study tour/training for environmental management and administration (4.1 person-months) and (ii) domestic training for environmental engineering and techniques (18 person-months) (see Table 6-2-1). Domestic training should include those for contractors of each section.

Table 6-2-1 Environmental Protection Training Plan US $=8.3 Yuan RMB

Trainee(s)	Domestic Training			Overseas Study Tour			Overseas Training			Total Cost			
	persons	man -month	RMB	persons	man-month	US$	persons	man-month	US$	RMB ¥	US$	Total US$	
Project Execution Office	1	1	5,000	1	0.7	5,600							
Highway Administration Bureau (HAB), including the training to the contractor(s)	1	1	5,000	1	0.7	5,600							
Anhui High-grade Highway Administration Bureau (AHHAB) (Induding contractors)	15	15	75,000	1	0.7	5,600							
Highway Survey & Design Institute	1	1	5,000				1	2	16,000				
Total	18	18	90,000	3	2.1	16,800	1	2	16,000	9,000	32,800	43,640	

6.3 Environmental Monitoring Plan

6.3.1 Purpose and principle of Planning

The purpose is to supervise the implementation of various EP measures and to make a timely adjustment on the basis of monitoring results. The principle is to take various sensitive areas as critical points.

Depending on the future traffic volume, the monitoring plan would be reconsidered during the initial operation phase.

6.3.2 Monitoring targets and items during various periods

(1). The monitoring items during the construction period are: TSP, construction noise, and the water quality (SS and petroleum oil) of the lower reaches of Fengle River and Renxing River.

(2). The items during the operation period are NOx and traffic noise, and the petroleum oil, CODcr and BOD_5 in the water sampled from the spouts of domestic sewage emission in the service areas.

6.3.3 Environmental monitoring agencies

The environmental monitoring plan falls on the atmosphere, water quality and noise monitoring, see Table 6-3-1, Table 6-3-2 and Table 6-3-3. It is suggested that the routine monitoring work should be entrusted to the local environmental protection departments. According to the administrative division along the highway, the HAE has its longest section within the governing territory of Anqing City, and the next in the order comes Lujiang County in Chaohu Prefecture, then the Feixi County in Hefei City, and the Shucheng County in Liuan Prefecture. Based on investigation of the environmental monitoring stations of the above prefectures and cities, it is suggested that the monitoring job is given to the Provincial Environmental Monitoring Center as the chief to be entrusted, which will in charge of the job division. The construction department (the owner) of the project may sign the implementation plan or contract of environmental monitoring with the Center, and the monitoring is implemented according to the contract.

Table 6-3-1 Water Quality Monitoring Plan

Period	Place	Items	Frequency	Duration	Sampling hour
con-struction period	50m from Fengle River Bridge & Renxing River Bridge in lower reaches	SS, petroleum oil	once/ y. in dry & rainy seasons resp. in pier/ volu. Construction	2 days	once in am & once in pm., 0-50cm in surface, mixed sample
opera-tion period	sewage emitting spouts in service areas	CODcr BOD_5 petroleum oil	twice / year in Jan. & Oct.	1 day	once in am. & once in pm.

Table 6-3-2 Noise Monitoring Plan

Period	Place	Frequency	Time
construction period	worksites within 100m from which there are sensitive spots	once/ week	1 day, 10:00-11:00 23:00-24:00
primary period of operation	Xin`nian Primary School Mogang Primary School Long`an Primary School Tugang Primary School Nanxin Primary School Dawang Primary School Yuejin Primary School Yaoci Primary School Shuanghe Primary School	4 times/ year	1 day, 10:00-11:00 23:00-24:00
middle period of operation	the spots of primary period of operation, and those villages of Yandunji, Chenlaowu, Wuheng Town	4 times/ year	1 day, 10:00-11:00 23:00-24:00
future period of operation	the residential spots to be protected, with more than 40 families, 100m from roadside	4 times/ year	1 day, 10:00-11:00 23:00-24:00

Remark: The monitoring frequency and spots may be rearranged according to actual situations and representative spots will be screened according to the increase of traffic volumes.

Table 6-3-3 Atmospheric Environment Monitoring Plan

Period	Place	Items	Frequency	Duration	Sampling hour
construction period	residential areas, near mixing plants and unpaved roads	TSP	once/ month	5 days	worktime once in am, once in pm
further stages of operation period	Yandunji, Chenlaowu, Wuheng Town, Long`an Pri. Sch. and Tugang Pri. Sch.	NOx	twice/ year	5 days	7:00, 10:00, 14:00, 19:00

Remark: The monitoring frequency and spots may be rearranged according to actual situations and representative spots will be screened according to the increase of traffic volumes.

6.3.4 Monitoring reporting system

The monitoring reporting system of this project is shown in Figure 6-3-4. After each monitoring, the monitoring agencies should submit the statement and report it to the higher authorities.

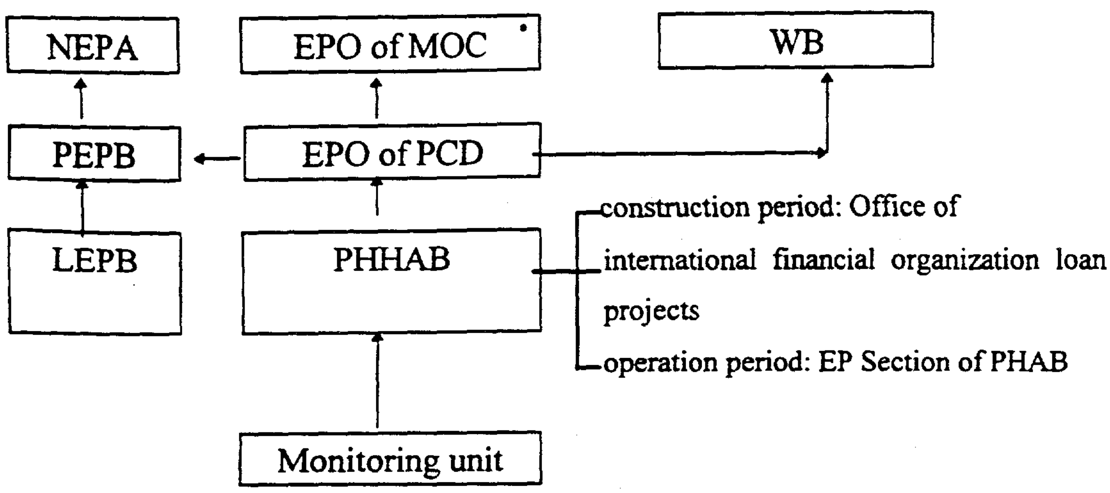


Figure 6-3-4 Submit Program of Environmental Monitoring Report

6.3.5 Monitoring Expenses

The monitoring expenses for carrying out monitoring plans of this project total as high as RMB 1.3524 million yuan.

(1) Atmosphere: the monitoring expense is RMB 0.28 million yuan during construction period, routine monitoring expense is RMB 0.36 million yuan during future stage of operation period.

(2) Noise: RMB 0.3744 million yuan during construction period; RMB 0.2 million yuan during operation period (10,000 yuan a year, counted as 20 years); the total amounts to 0.5744 million yuan.

(3) Water quality: 18,000 yuan during construction period; 120,000 yuan during operation period (6,000 yuan per year, counted as 20 years). The total is 0.138 million yuan.

The actual monitoring expenses are settled according to the formal monitoring contract signed by execution agencies and local environmental monitoring stations.

CHAPTER VII BRIEF ANALYSIS OF ENVIRONMENTAL ECONOMIC COST AND BENEFIT

7.1 Economic Assessment of the Project

7.1.1 Results of national economic assessment

The results show that the highway has very good national economic benefits. See Table 7-1-1.

Table 7-1-1 Results of National Economic Assessment

		ENPV (10000 y.)	EBCR (%)	EIRR (%)	FYEIRR (%)	economic investment return period (years)
HAE	High plan	414727.59	3.14	26.11	14.11	10
	Middle plan	307407.57	2.59	23.26	13.16	11
	Low plan	213147.17	2.10	20.55	12.21	13
GAH	High plan	60945.16	3.26	25.75	16.24	10.2
	Middle plan	51441.02	2.90	23.94	15.39	11.0
	Low plan	41977.63	2.55	22.27	14.44	11.9

Remarks: ENPV — economic net present value; EBCR — economic benefit-cost ratio;

EIRR — economic internal return rate; FYEIRR — first year internal rate of return;

7.1.2 Analysis of national economic sensitivity

See Table 7-1-2 for the analysis results under the most unfavorable conditions that the construction cost is increased by 20% and the benefit is decreased by 20%.

It is shown here that the highway has a strong national economic anti-risk ability.

Table 7-1-2 Analysis of National Economic Sensitivity under the Most Unfavorable Conditions

	HGE			GAH		
	High plan	Middle plan	Low plan	High plan	Middle plan	Low plan
EIRR (%)	20.32	17.88	15.53	20.23	18.74	17.31

7.1.3 Results of financial assessment

It shows here that the highway has very good financial benefits. See Table 7-1-3. (The basic financial discount rate is 3.2%.)

Table 7-1-3 Financial Assessment Results

		ENPV (10000 y.)	EBCR (%)	EIRR (%)	FYEIRR (%)	economic investment return period (years)
HGE	High plan	590809.13	2.94	13.12	8.06	14
	Middle plan	501332.57	2.65	12.14	7.68	14
	Low plan	399606.65	2.31	10.90	7.32	15
GAH	High plan	87245.63	3.10	17.36	13.32	11.3
	Middle plan	73644.03	2.77	16.22	12.61	11.0
	Low plan	62964.84	2.52	15.19	12.07	12.3

7.1.4 Analysis of financial sensitivity

See Table 7-1-4 for the analysis results of financial sensitivity of the project under the most unfavorable conditions that the construction cost increases by 20% and the benefit decreases by 20%.

It shows here that the highway has a strong financial anti-risk ability.

Table 7-1-4 Analysis of Financial Sensitivity under the Most Unfavorable Conditions

	HGE			GAH		
	High plan	Middle plan	Low plan	High plan	Middle plan	Low plan
EIRR (%)	9.06	8.14	6.97	12.59	11.53	10.57

7.1.5 Analysis of loan-repaying ability

The primitive loan-repaying plan of this project is: the income from toll, deducting the costs in major repairs, maintenance and management, will all be used in loan-repaying. It is calculated that the WB loans in HGE can be repaid completely in the year 2021, and the remained fund after the repaying is 11591 million yuan for the high plan, 10071 million yuan for the middle plan, and 8289 million yuan for the low plan. The WB loans in GAH can be repaid completely in 2021, and the domestic loans, in 2004; the remained fund after the repaying is RMB 2370 million yuan for the high plan, 2010 million yuan for the middle plan, and 1740 million yuan for the low plan.

7.2 Estimates on Environmental Protection Investment

7.2.1 Estimates on lump-sum investment in environmental protection

Based on the environmental situation along the line and the various environmental protection measures and suggestions adopted in the design period, construction period and operation period listed in this assessment statement, the lump-sum investment estimates is shown in Table 7-2-1. The total sum will be 30.889 million yuan, covering 0.69% of the construction sum total.

Table 7-2-1 Estimates on Lump-sum Investment in Environmental Protection

No.	Item	Description	Quantity	Investment	Time
1	landscaping, grass, trees and bushes planting	on cutting and filling side slopes, the central reserves, & intersection areas	$2.8km^2$	23,000,000 yuan	construction period, & around 2001
2	Beautification of service area	near K71	1	300,000 yuan	construction period, & around 2001
3	sewage disposal in service area	near K71	1	300,000 yuan	construction period
4	acoustic barriers	Xin'nian, Mogang, Long`an and Tugang Pri. Schs.	4 places	50,000 yuan /place 200,000 yuan	around 2001
5	wall building	Nanxin, Dawang, Yuejin, Yaoci and Shuanghe Pri. Schs.	5 places	30,000 yuan/place, 150,000 yuan	around 2001
6	wall building, wall heightening and/or other measures to be determined in the design	Yandunji, Dali, Hengbu, Huxiaoying/ Sunxiaoying, Zuotangkan/Caoxiaoying, Sanligang, Guzhangwan, Zhashangdaying, Huang-weinangeng, Dingjiafenfang, Zhangwan, Yangyuan, Caizhuang, Chenzhuang, Chenlaowu, Shiwan, Dalengshan, and Gezidun	Walls heightened to 3m of houses in the 1st roll at village edge	18 places, 10,000 yuan/place for the time being, 180,000 yuan	around 2021

Table 7-2-1 Estimates on Lump-sum Investment in Environmental Protection (continued)

No.	Item	Description	Quantity	Investment	Time
8	sign board building	no whistling around schools and big villages	30 blocks for the time being	1500 yuan/block, 45,000 yuan	around 2001
9	staff training	environmental managers, designers and supervisors, engineering construction staff	once abroad, twice domestic	362,000 yuan	
10	environ. monit.	in both construction & operation periods		1,352,000 yuan	
	sum total			30889 thousand yuan	

Remarks: 1. The cost in land re-cultivation, pond restoration & pond building has been included in that in remove and resettlement and is not listed here. 2.The cost in water sprinkler purchase and operation is paid by contractors and is not listed here. 3. The cost in intercepting ditches, slope protection and underpasses is listed in engineering cost.

7.2.2 Environmental protection annual cost

The annual environmental protection cost after the construction of the highway is shown in Table 7-2-2. If the operation period lasts 20 years, the total cost is 0.6072 million yuan.

Table 7-2-2 Environmental Protection Annual Cost (10,000 yuan)

No	Item of cost	Envir. protect. annual cost	Remarks
1	equipment maintenance	3.0	sewage treatment facilities
2	equipment depreciation	6.0	sewage treatment facilities, at 10% discount
3	road planting management	/	already included in road maintenance cost
4	technical improvement	10.0	for enhancing EP levels
5	EP workers' salary	12.0	20 persons, 6,000 y/person*year
6	office expenses	8.0	20 persons, 4,000 y/person*year
7	envir. sanitation	5.0	for septic tanks atmanag. offices & tollhouses
8	monitoring	6.72	according to the yearly average
9	unpredictable	10.0	for temporary envir. engineering
	sun total	60.72	

7.3 Analysis of Environmental Economic Profits

7.3.1 Analysis of the environmental profits of the proposed highway

(1) Reducing the tail gas pollution of the existing roads of low grades

As far as the natural environmental quality is concerned, the proposed highway will reduce the tail gas pollution of the National No. 206 Highway and those roads of low grades, because when vehicles are running on the highway, the tail gas emission in unit running distance will be reduced, and thus the air pollution related to this and the pollution to ground surface water, soil and crops will also be reduced.

According to results of the comparative experiment done by Dr. Carl (American EP expert) of the PBI Company on the Shenyang-Dalian Highway, with the same running distance (the total distance being 750km in the experiment), compared with that on grade-2 roads, the tail gas emitted on the highway has 47% less CO, 48% less HC, and 35% less NOx (see Tables 7-3-1 and 7-3-2). This may help to justify the remarkable environmental profits of the highway.

Table 7-3-1 Tail Gas Emitted Volume on Highway

Unit: g

Pollutant emission	CO	HC	NOx	Remark
80% when 100km/h	17100	1710	3810	The highway is Shenyang-Dalian expressway located in Liaoning Province.
10% when speeding up	282975	56775	15900	
10% when lowering down	104250	26475	3075	
Total	404325	84960	22785	

Table 7-3-2 Tail Gas Emitted Volume on Grade-2 Roads

Unit: g

Pollutant emission	CO	HC	NOx	Remark
40% when 100km/h	8550	855	1905	The location is on the grade-2 relief road of Shenyang-Dalian expressway
30% when 50km/h	6754	675	450	
15% when speeding up	422800	84784	23774	
15% when lowering down	156375	39536	4612	
Total	594479	125850	30741	

(2) Reducing noise pollution

The existing grade-2 and grade-3 roads here are seriously being turned into streets: because people have not been enough conscious of the importance of environmental protection, the buildings are right along the roadsides, and are suffering more and more from the pollution of noise and tail gas with the continuous increase of traffic volume. The proposed highway will be operated with scientific and reasonable planning and EP measures, so it will not be turned into a street; besides, it will attract traffic from the existing roads and thus mitigate the pollution from which the residents along the roads are suffering.

7.3.2 Analysis of the profits of environment protection investment

(1) Direct profits

Since the large-scaled construction and the waste gas emission and traffic noise in the operation of the highway cause impact on the environment and the living standard of the residents, and cause damage to the local ecological environment, the environmental problems brought about will be complicated and three-dimensional ones. It follows that the economic losses avoided each year by taking feasible EP measures, i.e., the direct economic profits of EP investment, are remarkable but difficult to be calculated precisely and embodied in the form of money. We can only roughly estimate or qualitatively analyze the losses in people's health, agricultural production and other aspects caused by waste gases, coal dust and noise if no EP measures are taken, so as to reflect the direct economic profits of EP investment.

(2) Indirect profits

The following indirect profits can be made if effective EP measures are taken on the proposed highway: the educational quality of the schools along the line and the normal social contacts and entertainment of the residents here can be assured; the psychological agitation of the residents and thus the incentives for social instability can be reduced, etc. Such profits are great and last long, but even more difficult to be embodied in the form of money. However, they are surely an important part of the socioeconomic profits of EP investment.

7.4 Brief Analysis on Environmental Benefit and Cost

Based on the above analyses, and adopting the methods like compensation acceptance and scoring, quantitative estimates or qualitative analysis is made on the environmental economic benefit and cost of the project (see Table 7-4-1). The results show that the environmental positive benefits are 2.29 times larger than the negative ones, and so the highway has remarkable social profits, and the environmental economic benefits are much larger than environmental losses. The project is thus feasible.

Table 7-4-1 Brief Analysis on Environmental Economic Benefit and Cost

Environment factors	Impact and measures taken	Benefit (+) cost (--)	Remarks
atmosph. & acoust. Environments	quality of those along proposed highway reduced (-2) that of those along existing roads improved (+1)	-1	
people's health	no distinct adverse impact. The convenient traffic is conducive for going to hospitals	+1	
soil and water conservation	causes local increase in soil erosion; measures of protection & drainage engineering, & EP measures	-2	
wild animals and plants	no distinct adverse influence	0	
mineral resources	no distinct adverse influence; good for exploration	+3	
tourism resources	no distinct adverse influence; good for exploration	+3	
agriculture	impact of land-occupation on production	-1	
planting and beautification	money invested to protect side slopes and reduce soil erosion, improve environment	+2	
relocation and resettlement	compensation for relocation	-2	
land value	price of residential land along the road is lowered; that of productive land rises	+1	
direct social benefit	shortening mileage, saving time, improving safety – altogether 6 benefits	+3	
indirect social benefit	improving investment environment, promoting economic development, strengthening people's consciousness of the environment	+3	
EP measures	increase in EP engineering investment	-1	
Total	Benefit : +16 Cost: -7 Benefit/Cost: 2.29		

CHAPTER EIGHT PUBLIC PARTICIPATION

8.1 Approach and Methods of Public Participation

During the project preparation, local people and concerned bodies have been extensively consulted. In order to ensure two-way communication with the public, a series of actions have been taken in a comprehensive manner. Public consultation activities include: (i) distribution of handout; (ii) organizing meetings/workshop with local people, experts and concerned bodies; (iii) interviews with local people and concerned bodies; (iv) public opinion survey. Also, EA documents of the project such as EIA, EAP and Summary were made public at APCD Office in May 1998.

8.2 Distribution of Handout

The first task of the project office for public consultation is to provide local people and concerned bodies with project-related information. In this context, a handout of the project, which concisely describes the project components and alignment, was prepared. In total, 5,000 copies of the handout were distributed among local people and concerned bodies.

8.3 Organizing Meetings/Workshop

APCD organized a meeting with the heads of local agencies along the route on October 1997. At the meeting, the proposed project components and alignment were introduced and discussed. Also, during the field survey, a series of meetings were organized to learn comments and/or concerns on the project. (See the paragraph 8.4 below.)

8.4 Field Survey and Interviews

In order to collect first-hand information along the alignment, the assessment team with participation of the design team carried out the field survey in Sept. 1996 and Jan./Feb. 1997.

During the field survey, the team visited local governments along the alignment and environmentally sensitive sites (schools), which are listed in Table 8-1-1. Also, in order to learn comments/suggestions on EA work and environmental mitigation measures, a series of meetings were organized with local experts, villagers, and local governmental officials.

Table 8-1-1 List of Local Governments Visited

No.	Local Government
1	Yandun Village Government
2	Yandian Village Government
3	Jinniu Town Government
4	Ketan Town Government
5	Changgang Village Government
6	Changbu Village Government
7	Chenbu Village Government
8	Gaoqiao Town Government
9	Dalongshan Town Government
10	Wuheng Village Government

8.5 Public Opinion Survey

The public opinion survey was carried out in January and February 1996. In total, 114 copies of responses have been received. Among these 114 persons, their occupation is as follows: 61 directors of villages/towns; 13 leaders of farmers; 33 farmers and 7 teachers. 8 of those are female. The results of this survey is summarized in Table 8-1-2. Based on the survey, it is concluded that the project is supported by the local community and that no outstanding environment-related concerns have been raised.

8.6 Environmental Assessment Documents

Pursuant to the World Bank Policy, the environmental assessment reports such as EIA, EAP and Summary was made public at APCD Office in May 1998. In order to enhance accessibility of the public to the documents, advertisements were put in a local newspaper.

8.7 Major Environment-related Feedback

The local people are expecting positive impacts of the project on local socioeconomic conditions and support the project. Major environment-related feedback to the project includes: (i) proper implementation of tree planting and (ii) adequate handling of waste soil. These comments have been reflected in the engineering design and drawings.

Table 8-1-2 Results of Public Opinion Survey

Question	Answer	Per-sons	% in the total	Remarks
Are you in favor of the construction of the highway?	yes	114	100	
	no	0	0	
	no comment	0	0	
Are you in favor of the route selection?	yes	97	85	
	no	9	8	
	no comment	8	7	
Do you think the highway will benefit the development of this area?	yes	100	87.7	
	no	9	7.9	
	no comment	5	4.4	
Do you have any complaint about the land-occupation and house-removing in the project?	no	95	83.3	
	yes	16	14	
	no comment	3	2.7	
Do you know about the policies of compensation for land-occupation and house-removing?	yes	58	50.9	
	yes but just a little	47	41.2	
	no	9	7.9	
Are you going to submit to the land-occupation, removing and resettling if you are involved in them?	yes	71	62.3	
	yes but with conditions	43	37.7	
	no comment	0	0	
What in the construction may have relatively big impact on you?	noise	70	61.4	some have multiple choices, total?t100%
	tail gas	26	22.8	
	dust	27	23.7	
	others	18	15.8	
Which of the measures do you prefer to reduce the impact?	planting	88	77.2	some have multiple choices, total?t100%
	acoustic barrier	16	14	
	away from villages	21	18.4	
	others	2	1.8	

CHAPTER IX ASSESSMENT CONCLUSIONS

9.1 Conclusions of Environmental Baseline Assessment

9.1.1 Ecological environment

(1) HAE is located in the middle of Anhui Province between the Changjiang River and the Huaihe River. HGE is 126.02km long, and GAH, 27.47km. The topography along HAE includes two major types of hilly terrain and river valley plain or undulating plain terrain. The environment within the assessment scope is mainly an agricultural ecological one with little vegetation of protophytes because of long history of human exploration. There are no protected plants or animals found in the investigation.

(2) The monitoring of representative soil samples along the line shows that the PH value is 5.00-6.94, primarily slight acid; the organic content is 0.05-2.95%, slightly low; the lead content is 15.48-24.60mg/kg, and according to "Soil Environmental Quality Standards" GB15618-95, the environmental quality indices of lead in the soil of the whole line are lower than 0.08, within the non-polluted scope.

(3) The situations for ground surface water environment: as far as the five items of PH, SS, CODcr, petroleum oil and Pb in the monitoring are concerned, and according to the class-2 standard in "Ground Surface Water Environmental Quality Standards" GB3838-88, except that the petroleum oil in Renxing River surpasses the standard ($\leqslant$ 0.05mg/L) by 1.6 times, all the other items are within the standards; the baseline of water quality is generally good.

(4) The project is located between the Changjiang River and the Huaihe River, and the areas passed are mainly agricultural ones dominated by paddy fields; the soil erosion is insignificant, and the soil is within the unremarkably eroded scope.

9.1.2 Social environment

(1) The major places passes by HAE are Hefei City, Feixi County, Shucheng County, Lujiang County, Tongcheng City, and Huaining

County. The total area directly influenced is 50,416km^2, taking up 36.2% of the provincial total; up to the end of the year 1995, the total population here reached 20.747 million, covering 34.5% of the provincial total.

(2) The directly influenced area has a good developing environment. Up to the end of 1995, the GNP had reached as high as RMB 4410 million yuan, and the gross output value of industry and agriculture 113150 million yuan; the two values cover respectively 35.9% and 36.7% of the provincial totals.

(3) Within the directly influenced area, the fundamental facilities are in good conditions: there are highways like the National No. 206 Highway, and 8 provincial trunk roads and several county roads; there is the Hefei-Jiujiang Railway; and some rivers here have navigable courses which reach Level-3 or Level-6; the Anqing City is on the Changjiang River and has the Anqing Harbor, and Hefei and Anqing have airports, too.

(4) The counties and cities here have relatively complete water conservancy facilities; the effective irrigation areas of them all take up above 90% of the total areas of cultivated fields in the counties and cities.

(5) The directly influenced area is rich in mineral resources and tourism resources; the construction of the highway will create better transporting conditions for the exploration and utilization of these resources.

9.1.3 Acoustic environment

There are 36 acoustic sensitive spots within the assessment scope of HGE and GAH. The monitoring results of the acoustic environmental baseline of the representative sensitive spots are: for schools, 45.2-55.5dB(A) in daytime and 33.6-44.3dB(A) at night; for villages and residential spots, 41.5-51.1dB(A) in daytime and 36.6-43.8dB(A) at night. According to class-1 standards in "Urban Environmental Noise Standards", except that the daytime acoustic environment of the Yandun Middle School surpasses the standard by 0.5dB(A), the data obtained at all the other sensitive spots are within the standard scope. It follows that the acoustic environmental quality within the assessment scope along the highway is good.

9.1.4 Baseline of atmospheric environmental quality

According to investigation, the sensitive spots of atmospheric environment within the assessment scope of HGE are mainly villages, towns and schools, among which there are 1 county government office, 27 villages with over 30 families in each, and 9 primary schools; those within the assessment scope of GAH are 6, including 2 primary schools, 2 county and township government offices, and 4 villages. There are no large pollution sources along the two section.

The results of baseline monitoring show that, according to class-2 standards in "Atmospheric Environment Quality Standards", the average values of single pollution indices are all below 1.0 (except the TSP of one or two spots). It is proved that the atmospheric environmental quality along HAE is good, and the NOx and CO have large environmental capacity. This provides favorable conditions for the construction of the highway.

9.2 Conclusions of Environmental Impact Prediction and Assessment

9.2.1 Ecological environment

(1) The total land-acquisition by HGE covers 15160.502mu, and that by GAH is 2507.86mu; the two figures altogether take up 0.52% of the total area of cultivated fields along the two lines (3845.5 thousand mu). Generally speaking, the land-acquisition of the project has little impact on the agricultural production here. However, since the land are now contracted by families, some farmers may be influenced adversely. As long as the local governments coordinate reasonably, the living standard of the farmers will not be lowered.

(2) During the construction period, the vegetation within the occupied scope will be damaged, and the small animals living in it will either die or migrate to other places. Besides, the cutting and material

transportation will cause enormous flying dust in the dry season and thus influence adversely the growth of crops around. Therefore, water should be sprinkled so as to reduce pollution of flying dust.

(3) HGE goes across 56 rivers, streams or irrigation canals, while GAH crosses 6 streams. There are bridges or culverts designed for all these cases. As long as the relevant technical norms issued by MOC are followed strictly in the construction, and no waste is to be disposed of into the water, there will be no pollution to the water body in the lower reaches. The alignment of the highway is at least about 8km away from the Chaohu Lake; in the construction of the bridges over the Fengle River and the Hangbu River, as long as the norms are followed, there will be no impact on the water quality of the lake.

(4) The results of soil erosion impact prediction are: there are 22 cut sections which are totally 8.15km long in HGE, and 23 cut sections in GAH, 7.25km long. Calculated with the local soil erosion model 500t/km*y, and assuming that all the 45 cut sections have two cutting side slopes, the total volume of soil erosion each year will be 231.75 tons; it sums up to 463.5 tons for the first two years of construction, and in the third year, thanks to the completion of protection engineering, the soil erosion will come under control.

It is reported in the statement of feasibility studies that the average fill height is 3.91m; calculated with the side slope ratio 1:1.5, it is predicted that an area of 1.4km^2 of side slope will be produced. If all is built with earth, there will be altogether 2100 tons of soil erosion in the 1st year of construction. In the third year of construction, the erosion will be controlled as well because of the completion of protection engineering.

(5) It is predicted that the lead in the soil of the fields along the highway will not surpass the class-2 standard in "Soil Environmental Quality Standards" even if the maximum baseline value of 24.60mg/kg is increased by 10 times. Besides, lead-free gas will have been used all over the country by the year 2000. The lead pollution on the roadsides will eventually vanish.

9.2.2 Social environment

The proposed highway links Anhui Province with Nanjing and Shanghai in the east, and Jiujiang, Huangshi, Wuhan, Chongqing, and Chengdu in the southwest; the socioeconomic profits it will bring about are enormous. It plays an important role in promoting the development of southwest Anhui and the exploration of mineral and touring resources, and in improving the investment conditions of this area; meanwhile it has remarkable effects in reducing the traffic jams on the existing National No. 206 Highway and the impact of traffic noise and waste gas on the environment along it.

It is reported in the statement of engineering feasibility studies that there are altogether 119,560m^2 of buildings to be removed for the construction of HGE and GAH, in which there are 34,454m^2 of buildings, 48,186m^2 of brick houses and 36,920m^2 of simplified houses. As long as the relevant policies are put to practice carefully, and the involved families are well-informed of those policies, the removing and resettling problems can be solved properly. As the resettlement is digested just within the neighborhood, there will not be a large population migrated from rural areas to towns and cities.

9.2.3 Acoustic environment

During the construction period, the noise will affect to a certain degree the environment, but it can be controlled as long as the construction work is done in due time, and the machines with large noise stop working during 22:00-6:00 if there are sensitive spots within 100m.

The predicted traffic noise value in operation period in the distant future will not surpass the class-4 standard in "Urban Environmental Noise Standards" at the sensitive spots beyond 50m away from HGE; but among the spots within 50m, there are Mogang Primary School, Longwan Primary School, Xinnian Primary School, and Tugang Primary School at which the standard-surpassing rate is high and the noise pollution is serious, so necessary measures must be taken to reduce noise. As long as the suggested measures are really taken, the acoustic environmental quality can still meet the assessment standards.

9.2.4 Atmospheric environment

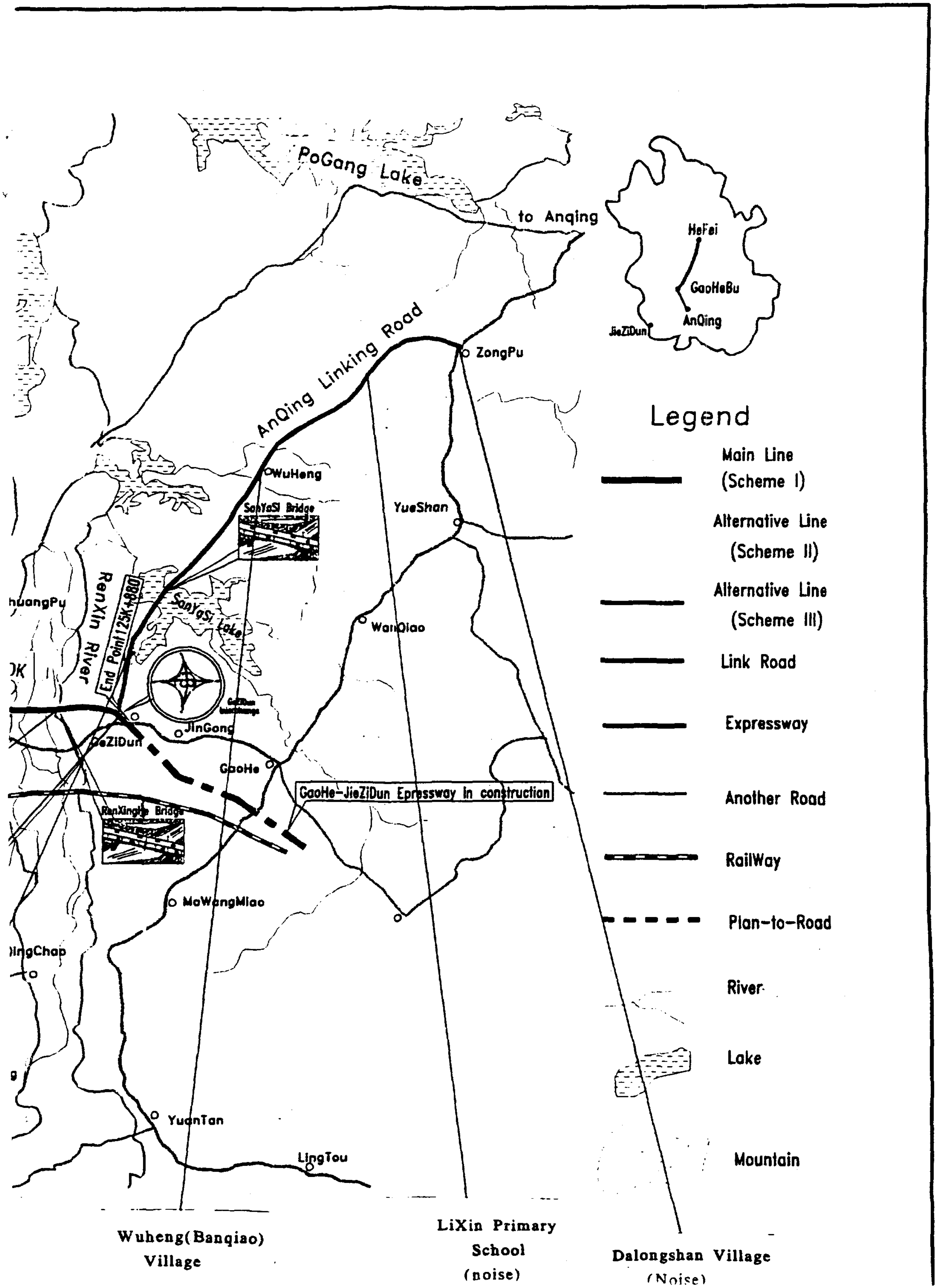
According to the prediction results of the different plans of traffic volume on HGE and GAH, and referring to the assessment standards relevant, the NOx and CO pollution on both lines is insignificant, and the air quality is good. Even if in the distant future of operation period and the high plan with the largest traffic volume is adopted, the concentration of NOx and CO 35m away from the central line of the road can still meet the class-2 standard in "Atmospheric Environmental Quality Standards".

However, under unfavorable meteorological conditions, such as temperature inversion, gentle wind or still wind, and E and F stability, and on sections of large traffic volumes like Xiaoxichong-Mayan Section and Shusan Line-Changgangtou Section, the concentration of NOx is likely to surpass the standard in the distant future; but the impact is still relatively small.

9.3 Synthesized Assessment Conclusion

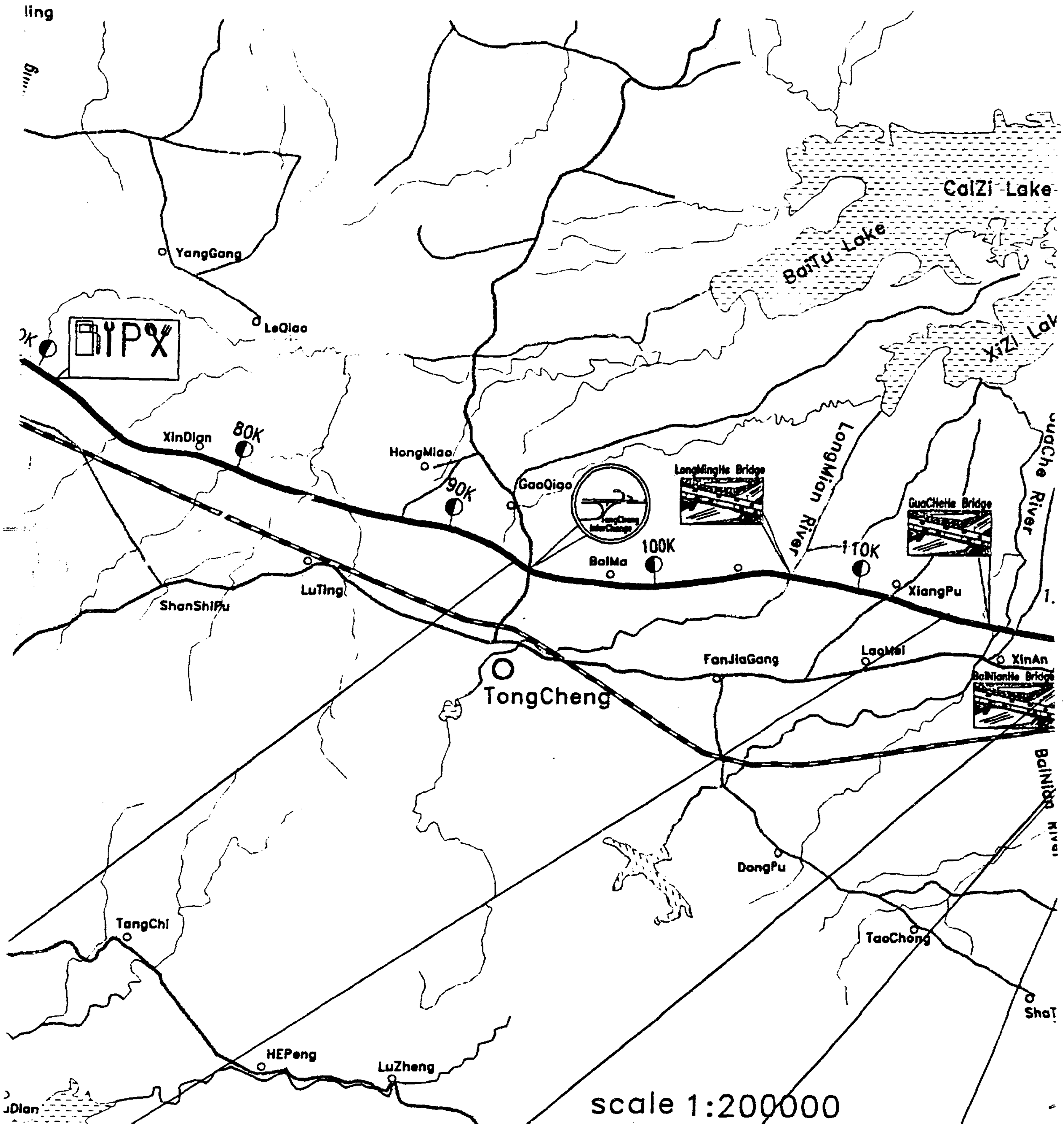
The environmental protection investment estimated on the basis of the conclusion of the impact prediction and assessment of the project amounts to RMB26.9574 million yuan, covering 0.69% of the project sum total. The positive environmental profits of the project is much larger than its adverse impact by the ratio of 2.29:1.

In sum of all the above, the construction and operation of the Hefei-Gaohebu Highway and its linking line will exercise great promoting functions on the socioeconomic development of this area and even the areas of Shanghai, Jiangsu, Hubei, Chongqing, and Chengdu; its influence is far-reaching. Meanwhile, it will bring some adverse impact to bear upon the environment along it; but as long as all the environmental protection measures are carefully put to practice, and the principle that "the construction and the EP engineering are designed, completed, and checked and accepted at the same time" is followed, the environmental protection goals can be achieved, and the adverse impact of the project can be absorbed by the environment. Therefore, the development of this project demonstrated in the perspective of environmental protection is feasible.



PoGang Lake
to Anqing
HeFei
GaoHeBu
AnQing
JieZiDun
ZongPu
AnQing Linking Road
WuHeng
SanYaSi Bridge
YueShan
RenXin River
End Point125K+880
SanYaSi Lake
WanQiao
JinGong
GaoHe
GaoHe-JieZiDun Epressway in construction
RenXinghe Bridge
MoWangMiao
YuanTan
LingTou
Legend
Main Line (Scheme I)
Alternative Line (Scheme II)
Alternative Line (Scheme III)
Link Road
Expressway
Another Road
RailWay
Plan-to-Road
River
Lake
Mountain
Wuheng(Banqiao) Village
LiXin Primary School (noise)
Dalongshan Village (Noise)

s Quo Monitoring Spots



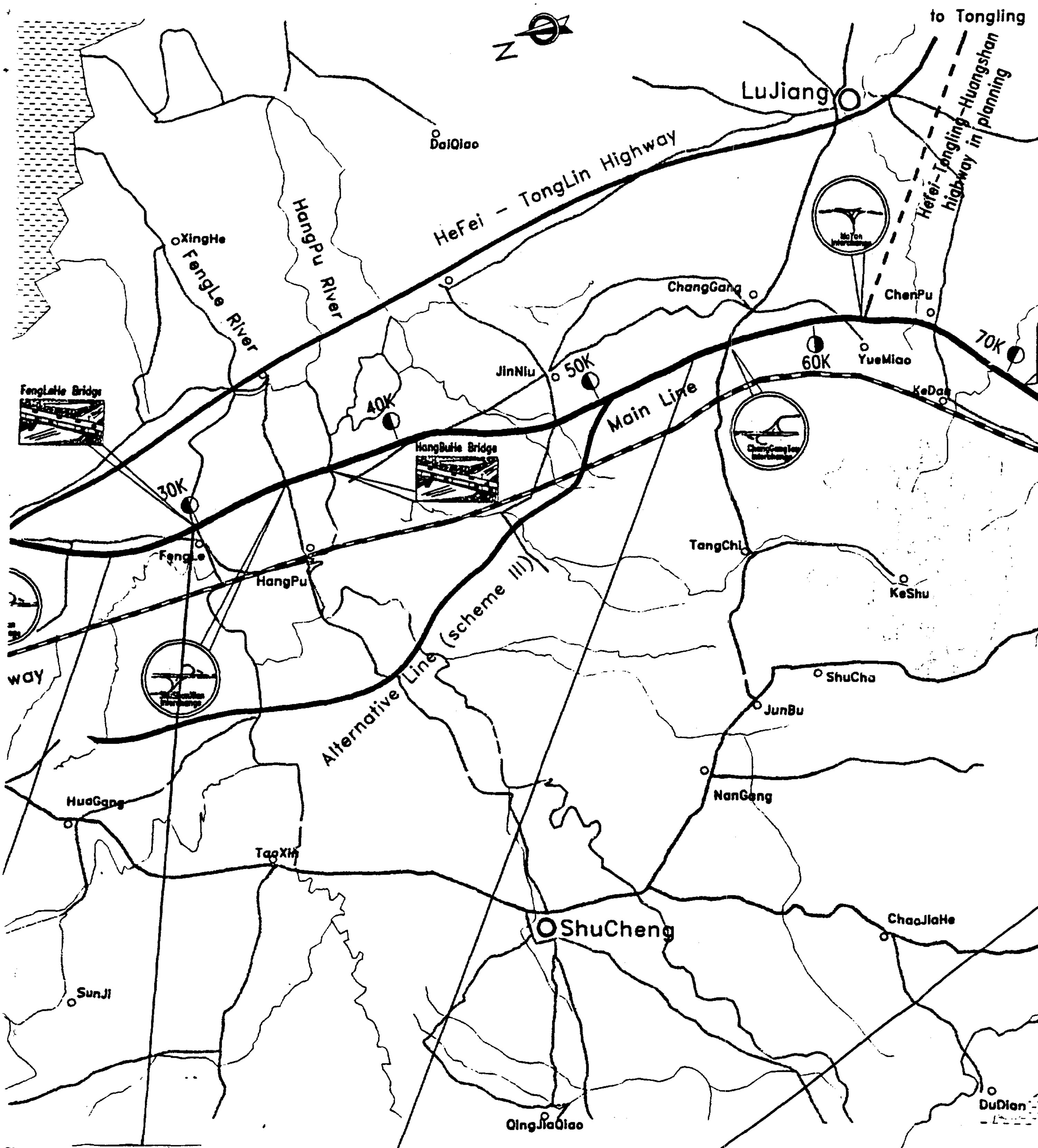
nba Village

Renxing River

Gezidun

Pengjiazui Village and Renmin Primary School

Distribution of Status

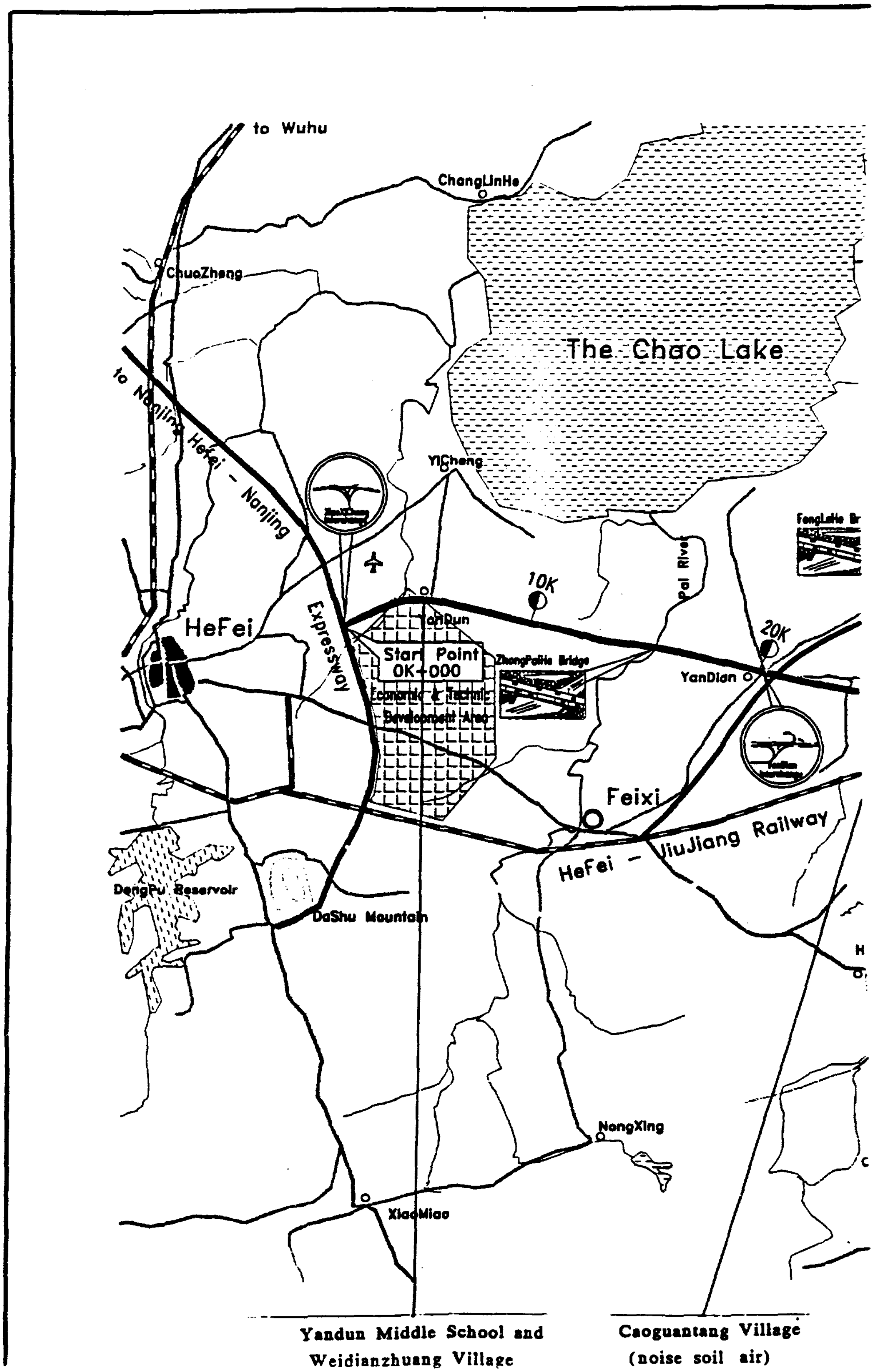


Fengle River
(Water)

Zhangjialoufang Village
(noise, soil)

Yuzhuang Village
(noise, soil, air)

Sanba V
(wate



Yandun Middle School and Weidianzhuang Village

Caoguantang Village (noise soil air)