

**SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT**

**OF THE**

**JIANGXI EXPRESSWAY PROJECT**

**IN THE**

**PEOPLE'S REPUBLIC OF CHINA**

**July 1996**

**CURRENCY EQUIVALENTS**

(as of 15 June 1996)

Currency Unit – Yuan (Y)

Y 1.00 = \$0.120

\$1.00 = Y 8.322

On 1 January 1994, the PRC's dual exchange rate system was unified. The exchange rate of the yuan is now determined under a managed floating exchange rate system.

**ABBREVIATIONS**

BOD	-	Biochemical Oxygen Demand
CO	-	Carbon Monoxides
DO	-	Dissolved Oxygen
EIA	-	Environmental Impact Assessment
EPB	-	Environmental Protection Bureau
JPCD	-	Jiangxi Provincial Communications Department
JPCDI	-	Jiangxi Provincial Communications Design Institute
JPHAB	-	Jiangxi Provincial High Class Highway Administration Bureau
JJGAM	-	Jiangxi-Jingdezhen Grade A Motorway
MOC	-	Ministry of Communications
NEPA	-	National Environmental Protection Agency
NOx	-	Nitrogen Oxides
Pb	-	Lead
PRC	-	People's Republic of China
RAP	-	Resettlement Action Plan
RoW	-	Right-of-Way
SS	-	Suspended Solids
TSP	-	Total Suspended Particulates

**WEIGHTS AND MEASURES**

°C	-	Degree Centigrade
db(a)	-	Decibels (A)
km	-	Kilometer
km <sup>2</sup>	-	Square Kilometer
ha	-	Hectare
m	-	Meter
m <sup>3</sup>	-	Cubic Meter
mg	-	Milligram

**NOTES**

- (i) The fiscal year of the Government coincides with the calendar year.
- (ii) In this Report, "\$" refers to US dollars.
- (iii) Data in all the tables were provided by the Jiangxi Provincial Communications Design Institute.

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## **A. Introduction**

1. The Jiangxi Provincial Communications Department (JPCD) has proposed construction of the Jiangxi Expressway Project (the Project), a 134-kilometer (km) expressway section from Jiujiang City to Jingdezhen City. An environmental impact assessment (EIA) for the Project was prepared by Jiangxi Environmental Protection Research Institute under contract from JPCD. The EIA, required by the Government of the People's Republic of PRC (PRC) in order to receive project approval, will be submitted to the Government in July 1996. The summary SEIA was prepared by an association of Chodai Co., Ltd. and Jiangxi Provincial Communications Design Institute for the Asian Development Bank based on the feasibility study and the preliminary design which was completed in February 1996. The preliminary design modified several technical aspects of the Project shown in the feasibility study.

2. The screening process has not identified any environmental impact of major significance. If additional assessment related to the relocated road sections is properly conducted and appropriate mitigation measures are taken, the environmental impacts of the Project will be within acceptable levels.

## **B. Description of the Project**

3. Jiangxi Province is an important hub for north-south and east-west traffic in the PRC. The economic structure of the province has been evolving from a predominantly agricultural base to one with a strong industrial growth in both light and heavy industries. Between 1987 and 1994, the value of gross industrial output increased by about 23 percent per year. This rapid economic development has led to a significant increase in road transport demand in the province. The modal share of highways for freight and passenger traffic has been increasing rapidly to 24 percent of total freight and 45 percent of passenger traffic in 1994.

4. The Project constitutes a 134-km expressway linking the important river port of Jiujiang City on the Changjiang and the porcelain center of the PRC, Jingdezhen City, and will connect with the 113-km Jiujiang-Nanchang expressway completed in 1993 with World Bank assistance. The proposed route is midway between the Shanghai Economic Development Region and the Wuhan Economic Development Region.

5. The existing 145-km road between Jiujiang City and Jingdezhen City is a two-lane road categorized as a lower class road by the National Road Standards. Because ferry boats are used to take traffic across Poyang Lake, the road's traffic capacity is restricted at that point. The Project includes construction of a 3,210 meter (m) bridge crossing with two main spans of 240 m over Poyang Lake. The construction period is anticipated to be from 1997 through 2000.

6. According to the feasibility study, the Project route will include 1 extra-sized bridge, 3 large-sized bridges, 66 medium- and small-sized bridges, a 900-m tunnel, 5 interchanges, 11 grade separations, and 261 culverts. However, according to the preliminary design, the route will have 2 extra-large bridges, 7 large-sized bridges, 38 medium- and small-sized bridges, a 1,200 m tunnel (dual 2-lane), 6 interchanges, 70 grade separations, and 415 culverts. Thus, there are many changes between the two reports.

## C. Description of the Environment

### 1. Physical Resources

#### a. Geology, Topography and Soils

7. The Project expressway is at the north of Poyang Lake, running along the south bank of the lower reaches of the Changjiang. Its topography is mainly an alluvial lake plain. The areas in the east of the Hukou Bridge and from Tianbanjie to Jingdezhen are low hilly land. Some of the surface soils along the route are erodible.

#### b. Climate

8. The Project area has a subtropical climate with four distinctive seasons. It is warm and moist with much rainfall. The rainy season is between March and June. The annual mean temperature is 16.8 degrees centigrade ( $^{\circ}\text{C}$ ). The maximum monthly mean temperature is  $28.7^{\circ}\text{C}$  in July, and the minimum monthly mean temperature is  $4.2^{\circ}\text{C}$  in January. The annual precipitation in the area along the route is 1,394 to 1,412 millimeters (mm). The maximum daily precipitation is 178 mm. The annual mean wind velocity is 3.1m/second. The prevailing wind direction is northeast.

#### c. Air Quality

9. Ambient air quality along the route is generally good because most of the route is in the rural area. The major potential air pollution sources along the route are factories and automobiles in Jiujiang City, automobiles along the existing road, and brick and ceramic kilns in Jingdezhen City.

10. Ambient air quality monitoring was carried out as part of the EIA study. The results are shown in Table 1. The concentration of carbon monoxides (CO), nitrogen oxides (NO), total suspended particulates (TSP) and lead (Pb) were monitored at six locations along the route. The monitoring was conducted for five consecutive days in December 1995 and showed that national ambient air quality standards for CO and NO concentrations were not exceeded.

**Table 1: Air Quality Monitoring Results (daily mean, unit: milligram/m<sup>3</sup>)**

No.	Monitoring Location	CO Standard: 4.0	NO <sub>x</sub> Standard: 0.10	TPS Standard: 0.30	Pb Standard: 0.0015
1	Shanlijie	3.1-3.2	0.03-0.08	0.04-0.14	0.0009-0.0028
2	Caoyanjie	2.8-3.0	0.03-0.05	0.08-0.20	0.0009-0.0016
3	Mingshan Xiang	2.5-3.1	0.02-0.05	0.03-0.08	0.0009-0.0014
4	Tandou Village	2.9-3.1	0.02-0.03	0.11-0.25	0.0002-0.0004
5	Jingpanling Primary School	2.8-2.9	0.02-0.04	0.06-0.13	0.0001-0.0004
6	Luojiatan	2.8-3.0	0.02-0.04	0.20-0.38	0.0002-0.0004

Source: EIA Report, prepared by Jiangxi Provincial Communication Design Institute, PRC, 1996.

11. There are excesses of daily mean TSP over the standards at one location (Luojiatan), which is affected by brick and ceramic kiln emissions in Jingdezhen City. The daily mean Pb concentrations also show some excesses at two locations (Shanlijie and Caoyanjie) near the existing road.

#### d. Noise Environment

12. Ambient noise levels were monitored in November 1995 at 14 locations, including 10 residential areas and 4 schools. The results are shown in Table 2. Based on the monitoring results, the existing ambient noise levels are good along the route.

13. Grade IV national noise standard was applied for noise within 100 m of the roadside, and Grade II national noise standard was applied for noise over 100 m of the roadside. Grade IV standards are 70 dB(A) in daytime and 55 dB(A) at night. Grade II standards are 60 dB(A) in daytime and 50 dB(A) at night.

14. The ambient noises monitored at residential areas along the route range between 39 to 60 dB(A) during the day and 32 to 56 dB(A) at night. The ambient noise at the monitored schools was measured at 42 to 53 dB(A) during the day and 35 to 40 dB(A) at night. Except for Shanlijie residential area, which is affected by the existing highway noise [60 dB(A) during the day and 56 dB(A) at night], no locations had ambient noise over Grade II national standards.

**Table 2: Noise Monitoring Results**

Monitoring Location		dB(A) <sup>a</sup>	
		Daytime	Night
(Grade II Standard)		60	50
Residential	Mejiashow	55	44
	Shanlijie	60	56
	Caojijiang Village	50	35
	Wenqiao Town	53	39
	Caoyanjie	46	36
	Anleban	53	32
	Mingshan Town	39	35
	Yangjiaun	31	35
	Hongyan Town	46	35
	Luojiatan	45	35
School	Guanrong Primary	53	40
	Bishan Primary	43	35
	Tankou Primary	42	36
	Jingpanling Primary	48	35

<sup>a</sup> A-weighted decibels, a measure of sound weighted for frequencies heard by human beings

Source: EIA Report, prepared by Jiangxi Provincial Communication Design Institute, PRC, 1996.

### e. Surface Water and Groundwater

15. The Project expressway runs through the plain zones of the lower reaches of the Changjiang, which flows through the northern Project area, and Poyang Lake which lies in the northwest. The Poyang Lake plain lies in the south, where waterways crisscross, and lakes and branch streams are numerous. The hydrographic network is woven around the Changjiang and Poyang Lake, and floods are formed by runoff from torrential rains. The Hukou section of Poyang Lake is the watercourse through which the lake flows into the Changjiang .

16. Grade III environmental water quality standards were applied to the Changjiang and Poyang Lake. Water quality monitoring results at Poyang Lake are shown in Table 3. Sampling data show that suspended solids (SS) exceed the standard. The average SS concentration of six samplings in 1995 was 31.1 milligrams (mg)/liter and the standard is 15 mg/liter. This high SS concentration is mainly derived from soil in the lake. The other items monitored, including pH, BOD, DO and Pb meet the requirements of the standards.

**TABLE 3: Water Quality Monitoring Results At Poyang Lake**

Unit	pH	SS mg/l	BOD mg/l	DO mg/l	Pb mg/l
Standard					
Grade III	6.5-8.5	15	4.0	5>	0.05
Minimum	7.6	12	0.3	6.8	–
Maximum	8.3	58	1.4	9.3	0.007
Mean	8.0	31	1.0	7.8	0.004

pH - hydrogen/hydroxyl ions in water; BOD - biochemical oxygen demand; DO - dissolved oxygen;  
Source: EIA Report, Jiangxi Provincial Communication Design Institute, PRC, 1996

17. Drinking water in rural areas is taken primarily from wells, although some comes from rivers. Jiujiang City's municipal water supply comes from the Changjiang. Hukou County takes its water from Poyang Lake. One water intake point for Hukou county is 1,700 m downstream from the proposed extra-large bridge on Poyang Lake. Another water intake is under construction and will be 860 m downstream from the bridge.

## 2. Ecological Resources

18. Natural flora and fauna along the route have been reduced by centuries of human activities such as agriculture and other land use, so that there are essentially no natural areas of habitat remaining.

19. There are plenty of bushes and grass along the route from Jiujiang to Hukou. Along the route through Hukou, Duchang, Poyang, and the entry of Jingdezhen, the vegetation consists of crops such as rice and cotton, and trees such as masson pine.

20. There is no ecology protected area along the highway. The closest protected area is the national deer protection area, which is 40 km north of the route. The second closest protection area is the crane protection area, which is by Poyang Lake, 70 km southwest from the route.

### **3. Human and Economic Development**

#### **a. Population and Communities**

21. The areas to be influenced by the proposed expressway route include Jiujiang City (Jiujiang Urban Area, Jiujiang County, Hukou County, Pengze County, and Duchang County); Poyang County of Shangrao Prefecture; and Jingdezhen City (Jingdezhen Urban Area, Leping City, and Fuliang County). These areas together cover 15,171 square kilometers (km<sup>2</sup>), accounting for 9 percent of the total area of Jiangxi Province (166,900 km<sup>2</sup>).

22. The population of these counties in 1994 was 4,519,100 which is about one-tenth of the total population of Jiangxi Province. The Han are the predominant ethnic group in the province and account for 99 percent of the population; other national minorities (for example, Hui, Yi, Miao, and Yao) are less than 1 percent. The population density is 298 persons/km<sup>2</sup>. About 76 percent of the population is agricultural.

#### **b. Industry and Economy**

23. The volume of gross domestic product of the counties in 1994 was Y12,643 million at current prices, which is over 12 percent of the provincial total (Y103,199 million). The sectoral composition is as follows: (i) primary sector, 24.5 percent; (ii) secondary sector, 44.0 percent; and (iii) tertiary sector, 31.5 percent.

24. The value of industrial and agricultural production in 1994 was Y21,588 million at 1990 constant prices; this represents about 12 percent of Jiangxi Province's total.

25. Jiujiang City has developed an industrial system of remarkable variety, including oil refinery, power, textile, machinery, chemistry, construction material, and food industries, mainly distributed in the urban areas and towns. The industrial system of Poyang County is beginning to take form, and includes coal, ceramic, brewery, construction material, and fish product processing. Jingdezhen city also has a variety of industries, such as ceramic, tools and machinery, electronic, coal, power, medicine, construction material, navigation, light industry and food industry manufacturing. The city is the largest production and export base of ceramic products, which are sold in 110 countries in 5 continents.

#### **c. Infrastructure Facilities**

26. The urbanized areas of Jiujiang City (including Hukou Town) and Jingdezhen City have their own water supply systems. In the other rural areas, water is usually taken from wells. There is no centralized waste water treatment facility in either of these cities. Jiujiang, Hukou, and Jingdezhen have their own sewage systems. Most areas have access to electric power services. There are 225 post offices and about 90,200 telephone sets in use in the counties under the direct influence of the proposed expressway.

#### **d. Transportation**

27. Currently, there is a 145-km two-lane (Grade III/IV) road from Jiujiang to Jingdezhen. In spite of periodic upgradings, the technical standards of the road are still low. The route is cut into two halves by Poyang Lake, and its traffic capacity is limited severely by the Hukou ferry. Jiujiang is connected to Nanchang, the capital of Jiangxi Province, by the Nanchang-Jiujiang Class I Highway, which was opened to traffic in January 1993; the city is also connected to Hubei

and Anhui provinces by the newly constructed Jiujiang Changjiang Bridge. National Highway No. 206 (Yantai-Shantou) passes through Jingdezhen, which connects the city with Yingtan City, located to the east of Nanchang City.

28. There is no railway through the counties covered by the proposed expressway. From Jiujiang City, the Nanchang-Jiujiang Railway runs to the south and connects with the Zhejiang-Jiangxi, Beijing-Guangzhou, Yingtan-Xiamen, and Anhui-Jiangxi Railways. The Wuhan-Jiujiang Railway connects the city directly with Wuhan City. The Beijing-Kowloon Railway (under construction) will greatly increase the transport capacity of Jiujiang City and strengthen its regional and national transport networks. The Anhui-Jiangxi Railway runs through Jingdezhen City and connects the city northwards to Nanjing and southwards to Guixi, joining with the Zhejiang-Jiangxi Railway and Yingtan-Xiamen Railway. There is also a local railway, the Jingdezhen-Yongshan Railway.

29. Water transport plays an important role not only in local daily life and traffic but also in interregional and international traffic to and from this area. All counties and districts within the direct influence of the proposed expressway are connected to one another by waterways from the local rivers such as the Chang River, which flows through Jingdezhen City and Poyang County into Poyang Lake. Jiujiang City has 133 km of the Changjiang and 82 km of navigation lanes in Poyang Lake. Jiujiang Port is an important port in the middle and lower reaches of the Changjiang, and is the only foreign trade port of Jiangxi Province. In addition, there are Hukou, Penze, Wucheng, Xingzi, Duchang, and Hamashi ports.

30. There are two airports in Jiujiang City and two in Jingdezhen City. Regular flights operate between Jiujiang Airport and Beijing-Jiujiang-Shenzhen and Jiujiang-Nanjing-Shanghai. The other airports are used for local passenger and freight transport, as well as for aerial surveys and spraying of pesticides.

#### **e. Land Utilization and Agricultural Production**

31. The counties cover 15,171 km<sup>2</sup> of land. Farmland covers 2,503 km<sup>2</sup> (250,346 ha), which is 16.5 percent of the total area. The rest consists of forest, waste land, water surface, urbanized areas, and others. Of the farmland, 94 percent (235,607 ha) is cultivated, of which 150,039 ha is used for rice cultivation.

32. Because the areas along the route are largely plain and delta at the mouth of Poyang Lake, the intensity of cultivation is relatively high. Agricultural production includes a combination of rice, cotton, oil-bearing crops, and fishery, and the reclaimed areas are usually specialized in production of grain and cotton. The area is also considered as the supply base of commercial grains in the country. In sum, the agricultural economy in the region is well developed. Table 4 shows the agricultural production for the region in 1994.

**Table 4: Agricultural Outputs of the Project Area (1994)**

<b>Products</b>	<b>Output (tons)</b>
Rice	1,352,400
Oil-bearing Crops	38,585
Cotton	81,468
Vegetables	787,500
Fruit	5,831
Pork	135,261
Eggs	23,703
Fish	141,413

Source: EIA Report, prepared by Jiangxi Provincial Communication Design Institute, PRC, 1996.

#### **f. Quality of Life**

33. The average annual income of the employees of Jiujiang Urban Area was Y3,120 in 1994, 1.94 times that in 1990; the average annual income of the rural residents was Y1,271, 2.24 times that in 1990. The average annual income of the urban employees of Jingdezheng increased by 1.88 times, to Y3,107, from 1990 to 1994; rural residents gained 1.89 times, to Y1,313, during the same period.

34. Despite the general increase in income, there are pockets of poverty, particularly in two counties (Poyang and Duchang) affected by the highway. The State Council Leading Group Office of Poverty Alleviation has identified these counties as poor by nationally set standards (per capita income Y500 at 1992 prices).

35. Other aspects of quality of life factors (e.g., education, health, sanitation, and recreational facilities) have grown significantly in recent years. Clinics and hospitals are available in rural areas and can basically meet the medical needs of the local people. However, serious illness has to be treated in the central hospitals.

### **D. Anticipated Environmental Impacts and Mitigation Measures**

#### **1. Socioeconomic Considerations**

##### **a. Social and Resettlement Impacts**

##### **i. Relocation of Population**

36. According to preliminary estimates, a total of 361 families (1,332 persons) will be displaced by the Project; this means that 46,238 square meters (m<sup>2</sup>) of residential area and some 30 business and commercial units (8,246 m<sup>2</sup>) will be demolished. A resettlement action plan is in the early stage of preparation by JPCD. Resettlement consultants have reviewed existing Government policies concerning land acquisition, compensation policies, and resettlement activities, including organization and monitoring.

37. The Provincial Regulation for Land Requisition and Resettlement can be summarized as follows:

- (i) Resettlement will be conducted within the same village as much as possible.
- (ii) For each family, the land for reconstruction of houses will be the same size as, or larger than, the existing area.
- (iii) The families affected will be given new farmland by redividing the existing farmland within the production group to which they belong. If the average area of farmland becomes less than 200 m<sup>2</sup>/per person, one person of the family will be awarded a township title and the local government will guarantee that person industrial employment. A detailed resettlement action plan is provided in a separate report available upon request.

## **ii. Effect on Housing Quality**

38. Replacement houses will be of better quality and larger than those lost to the Project. Further, new houses will be served by water and electricity, and resettled families will be given cash payments to aid in the relocation and resettlement process. In the PRC, resettlement projects are viewed as economic development programs for improved living standards.

## **iii. Division of Extended Families**

39. The displacement will have some positive as well as negative impacts on traditional extended families in the rural areas. A positive impact is provision of additional housing for younger members of extended families to establish separate households in relocated sites. Many families view this as desirable. The negative impacts may include a communication lapse between generations because of family division and a decrease in mutual assistance of family members, especially for the aged.

## **iv. Community Separation**

40. Negative impacts include separation of communities by the expressway, from access to schools, health facilities and other community facilities, similar social impacts may result from separation of kin groups and neighbors and disruption in patterns of social interaction.

## **v. Disruption of Functioning of Institutions**

41. Some temporary disruption will occur to schools, hospitals, and cultural facilities during construction. Institutions may experience continuing impacts from noise and air pollution. The preliminary design indicates that one school will need to be relocated.

## **vi. Social Impact from Construction Workers**

42. The construction work crew will be housed temporarily at various sites during the construction phase. The presence of large numbers of workers from outside will have some impact (both positive and negative) on the local villages as the villagers interact with the construction work force.

**b. Economic Impacts****i. Regional Economy**

43. The Project will directly promote the economic development of Jiujiang and Jingdezhen cities and the region; it will also influence the development of the capital city of Nanchang and of the Nanchang-Jiujiang-Jingdezhen triangle. Further, it will improve the investment environment of the triangle area and provide a necessary condition for further investment and economic activities. There are already reports of the positive impact on economic growth in the region from the newly opened Nanchang-Jiujiang highway.

**ii. Access**

44. Because the Project expressway is of high class, its construction will greatly improve the road's condition and increase the traffic capacity in the region, particularly between the two cities. When the Project is completed and local traffic conditions are greatly improved, construction and development of the areas along the route will be promoted; this will enhance prosperity and the local population will be able to share the benefits of development.

**iii. Local Economy**

45. The improvement of road conditions will encourage industrial enterprises to move from large-and medium-sized cities to suburban areas. It will speed up the development of commerce, tourism, the construction industry, the transport industry, the processing industry, and so on along the route. As a result, more diversified employment opportunities will be available and the income of local residents is expected to rise. During the construction period, there will be temporary benefits to local residents in the form of new business (e.g., supply of food, water) and services to the construction workers. The local economy will also benefit from purchases by construction contractors and workers.

46. The construction of the Project expressway will require about 5,000 unskilled workers per day over a four-year period. The poor and those presently living under the poverty line in the counties affected by the Project will receive priority in work and employment opportunities during the construction period. Construction materials, including sand, gravel, and limestone, can be supplied by existing quarries and plants of local communities, which will bring local residents additional income. After construction is completed, there will be opportunities for operation and maintenance work. Also, additional employment opportunities will arise in the service sector, including vehicle service stations, restaurants, and hotels.

**iv. Production Impacts**

47. The area of productive agricultural land that will be requisitioned for the Project is about 730 ha, of which 490 ha will be used permanently. Table 5 shows the areas by type of productive lands to be lost to expressway construction:

**Table 5: Productive Lands to be Acquired by the Project**

Existing use	Permanent Use (ha)	Temporary Use (ha)	Total (ha)
Rice Fields	292.94	60.04	352.98
Dry Fields	194.51	176.15	370.66
Vegetable and Fruit Fields	4.96	0.70	5.66
Total	492.41	236.89	729.30

48. Some cultivated fields and other production areas will be separated from farmer's houses by the expressway.

49. Because the Project may block the original water channels, existing irrigation systems will have to be adjusted. The number of nonfarm establishments to be removed is 31, including one primary school in Hukou Town. During construction, there may be some accidental or temporary disruption of electric power, water supply, or access.

**c. Transportation Impacts**

**i. Disruption of Traffic Flow**

50. During construction, there will be temporary diversions of traffic along the existing road network where the new expressway crosses existing roads, as well as temporary blockage of access to structures and roadside areas.

**ii. Congestion on the Existing Road**

51. Congestion along the existing Jiujiang-Jindezhen Road will be decreased significantly, especially along the two sections at the terminals of the present ferry. This will (i) provide savings in vehicle operating costs and in travel time costs, (ii) decrease stress on drivers and passengers, (iii) decrease noise, and (iv) improve air quality along the existing road.

**iii. Road Safety**

52. Improved operating conditions on the existing road and high design standards on the new expressway will improve road safety and decrease the accident rate in the area.

**iv. Public Transport**

53. Reduction of congestion on the existing road will facilitate the operation of buses and other public transport used for short and medium distance travel, decreasing travel time and improving the comfort level of passengers.

**v. Mitigation of Socioeconomic Impacts**

54. The necessity for removal of houses, relocation of population and loss of productive land will be minimized by careful final route selection and sensitive design. The provisions of the Principles for Implementation of Land Acquisition, Demolition and Resettlement for Jiujiang-

Jingdezhen Highway will be followed with respect to compensation, relocation, and reallocation of land. The impact of separating communities and separating farmers from fields and places of production will be mitigated by providing an adequate number of underpasses at reasonable distances. The road design has 201 passageways to facilitate movement between the sides of the expressway and farming communities. Schemes for economic rehabilitation of Project-affected persons will be implemented by providing various options, including work in off-farm enterprises. Special efforts will be taken to target the poor as beneficiary groups (through work and employment) of the expressway Project. The executing body will try to minimize the changes by providing culverts, bypasses, wells, and other infrastructure. Overall, the existing irrigation system will not be affected significantly.

## 2. Air Quality Impacts

### a. Construction Period

55. If appropriate mitigation measures are not taken, the following may affect air quality: fugitive dust from aggregate production, concrete mixing, and vehicle movements; emissions from asphalt plants; and emissions from the operation of heavy diesel equipment.

### b. Operation Period

56. The air dispersion modeling performed under various scenarios shows that CO concentrations are below the national standard in any scenario, and NO is estimated to increase according to the future traffic volume increase. Distances needed for NO to meet the national standard are 10 m for all sections of the route in the year 2001, 50 m for the section from Jiujiang to Hukou and 10 m in other sections in 2010; and 160 m for the section from Jiujiang to Hukou and 30 to 40 m for other sections in 2020. The predicted values are shown in Table 6.

**Table 6: Distances Needed for NO Concentration to Meet the Standard (meters)**

Year	Jiujiang to Hukou	Hukou to Chailing	Tianbarjie to Chailing	Tianbarjie to Jingdezhen
1999	10	-	-	-
2001	10	10	10	10
2010	50	10	10	10
2020	160	40	30	40

57. Soil contamination by lead from vehicle emissions was assessed. The lead concentration in the soil along the route remains below the standard. Nevertheless, lead contamination in soil may be a significant potential hazard, especially for agricultural land use.

### c. Mitigation

58. Additional air pollution impact analysis is required for sensitive locations along the modified alignment section of the route. Appropriate mitigation measures may be provided if necessary. Mixing stations for construction materials will be more than 200 m downwind of the nearest settlement areas. The centralized approach will be adopted as much as possible for mixing

construction materials. The material storage area will be 150 m from the residential areas, and will be covered to prevent dispersion and spreading. Construction material will be enclosed or covered during transport to prevent leaking and dispersing. Asphalt plants will be more than 300 m downwind.

#### d. Noise Impacts

59. The main noise impacts during construction are related to the construction plant and equipment noise. Significant noise generating activities are the pavement, concrete mixing, stone crushing and screening, construction material transport, pile driving for the bridge, and tunnel construction activities. Based on the results of noise propagation modeling performed, the required distance from each noise source is 30 m to meet the noise standards in daytime, and 200 m at night.

#### e. Operation Period

60. Impacts during operation come from vehicular noise in general. The expected expressway traffic noise will not cause significant impacts in the open areas along the route. However, it may influence residential areas and schools along the route.

61. Noise modeling predicted that night time levels will exceed the standards at three locations by 2.4 dB(A) in 2020. Predicted noise levels at other locations in 2010 and 2020 will meet the standard. If Grade II standards are applied for all locations, the predicted noise levels will exceed the standards at five receptor locations in 2010 and at seven locations in 2020 (see Table 7).

**Table 7: Predicted Noise Level at the Sensitive Receptor Locations**

Location		Distance from the Center Line of the Road	in 2010 [dB(A)]		in 2020 [(dB(A)]	
			Day-Time	Night Time	Day-Time	Night-Time
Residential	Shanlijie	100	59	45	61	47
	Caowaxiang Village	50	61	51	62	55
	Wenqiao Town	50	65	54	66	56
	Caoyanjie	40	65	55	67	57
	Anlepan <sup>a</sup>	50	63	52	65	54
	Mingshan Town	40	65	55	67	57
	Zouling Village	30	64	54	66	56
	Raoshanduanjia	30	65	55	67	57
	Jiangjia Village	110	59	47	61	49
	Hongyan Town	100	55	44	57	47
	Luojiatan	60	55	44	57	47
School	Hubing Primary	50	64	53	66	55
	Bishan Primary	150	55	42	56	44
	Tankou Primary	50	59	48	60	48
	Jingpanling Primary	200	55	41	57	44

Note:(i) Grade IV national noise standard applied for noise within 100 m of the roadside is 70 dB(A) in daytime and 55 dB(A) at night.

(ii) Grade II national noise standards applied for noise over 100 m of the roadside is 60dB(A) in daytime and 50 dB(A) at night.

<sup>a</sup> A sensitive receptor location in Final Design, which was not included in the Preliminary Design

#### f. Mitigation

62. Additional noise impact analysis is required for the sensitive locations along the modified alignment section of the route. Appropriate mitigation measures will be provided if necessary. Noise impact from tunnel construction will be analyzed. Construction work near sensitive locations will be prohibited at night between 10 pm and 6 am, according to the predicted noise levels. Because the noise produced by the mixers may affect a large area, mixing sections will be 300 m from sensitive locations. The construction machinery and transport vehicles will be well maintained to keep them in good order and reduce noise generation. New hospitals, schools, or other residential buildings will not be sited within 50 m of the edge of the expressway. In areas such as Chaowa Village, which will be severely affected by long-term noise, 1-m high protective apron rails will be built as a noise buffer, on the grade separation bridge. Double glazing will be installed at Hubin Secondary school building, where noise is estimated to exceed the standards. The design will incorporate appropriate mitigation measures, including noise barrier walls for noise sensitive receptors identified in the EIA or by subsequent surveys.

### **3. Soil Impacts**

#### **a. Construction Period**

63. Some erosion may result from runoff in areas of construction activities, including excavation, filling, and other earth disturbance, and some of the soils along the route are erodible. Suitable remedial measures are required to minimize erosion. A number of sections will have large cuts and fills. Based on the preliminary geometric design, about 14 sections will have cuts 15-20 m deep, and 11 sections will have cuts 20-33 m deep. In embankment areas, 8 sections will have fill 15-21 m deep. The volumes of cut and fill are not balanced, with fill volume being almost twice that of cut areas. The deficit will have to be obtained by widening side cuts or from borrow pits. These large earthworks could have environmental impacts, including soil erosion and loss of vegetation.

#### **b. Operation Period**

64. If slopes of roadway cuts or embankments are not properly resurfaced or revegetated, the potential impacts of erosion will be high.

#### **c. Mitigation**

65. The Project alignment and profile will be modified so as to result in less earthwork volume and more balanced cuts and fills to the extent feasible.

66. Cut slopes, embankments, and other potential erosion areas will be stabilized to the extent feasible while work is going on. All earth disturbance areas will be stabilized within several days after earth movement is completed at the site.

67. During construction, retaining walls will be constructed at the foot of the slopes prior to slope cutting and filling. Slope protection will be provided with mortar, mixed with rubble.

68. Appropriate measures will be taken to prevent or reduce soil erosion of unfinished earthworks during the rainy seasons.

69. In order to prevent road bed slopes from erosion, mortar, mixed with rubbles, will be laid on the slopes to allow immediate rainwater drainage.

70. During excavation of steep slopes, water catchment or detention ponds will be installed on the tops of the slopes to prevent erosion. If the road bed passes through extremely wet sections, longitudinal and latitudinal blind drains of spall will be laid, or drainage systems composed of plastic pipes used, to drain the water from the road bed. Deep excavated pits will be revegetated or converted into ponds within 60 days of excavation.

71. During operation, expressway slopes, cuts, and embankments will be maintained to prevent soil erosion. The maintenance will include watering, fertilizing, pest control, and replanting. This type of maintenance cost will be budgeted as part of the regular Project maintenance cost.

#### **4. Water Quality Impacts**

##### **a. Construction Period**

72. Any interruption of irrigation to rice fields during construction or any permanent flow alteration would adversely impact the crops and farmers. Improper handling of hazardous construction materials could cause surface water and groundwater contamination. If wastewater from construction work camps is discharged directly, it would have negative impacts on the quality of the receiving water body.

##### **b. Operation Period**

73. The main water quality impact during operation will result from surface runoff on the expressway. The risk of hazardous materials spill that may affect water quality is discussed in para. 80.

##### **c. Mitigation**

74. Hazardous construction materials, including chemicals and petroleum products, will be handled, stored, and disposed of in an environmentally satisfactory manner. Drainage from construction areas will be treated in settling basins or vegetated runoff areas before flowing into waterbodies. Wastewater from construction work camps will be treated properly prior to being discharged.

75. To maintain adequate flow in the irrigation system, the route will be designed to avoid the main channels as much as possible or to provide crossings for irrigation channels. The drainage installations (culverts, side drains, bridges) will be based on hydrological studies and evaluation of irrigation flows. Contaminated expressway runoff will be separated from irrigation water.

#### **5. Ecological Impacts**

76. The impact on the vegetation along the route will come from construction activities such as earth excavation and material storage. As part of the overall environmental management measures, construction works will be planned and implemented to minimize exposed land surfaces. To provide sufficient protection from erosion, plants and grasses will be planted and adequately maintained. Because the route has been influenced by human activities for long time, no major impacts are expected during operation.

#### **6. Historic and Cultural Impacts**

77. 1,257 tombs along the right of way (RoW) will be relocated because of the expressway construction. The Government has specific regulations and rules for compensating tomb relocation. Although the families will be compensated for removal and reburial, this may be a religiously and culturally sensitive matter for some of them. Consideration will therefore be given in the final design to reducing the number of the relocations, if possible.

78. There are no known historic or cultural sites within the Project area, and there is no apparent need for further surveys prior to construction. If unexpected historic sites are found during construction, a report will be submitted to the authorities and proper procedures will be followed in compliance with the relevant laws. During operation of the expressway, no impact on historic or cultural resources are expected from the Project.

## **7. Aesthetic Considerations**

79. The proposed Hukou Bridge will be visible from the Stone Bell Hill, a national historic site in Hukou County. The design will be enhanced aesthetically, taking into consideration the national historical site.

## **8. Hazardous Materials Impacts**

80. Because hazardous materials such as fuel oil, lubricant, and paint are used during construction, there is some risk of spills at hazardous storage areas, handling areas, or along the expressway. After construction is finished, major freight transported on the road will be coal, metals, timber, grain, and fertilizer. Although hazardous materials are not expected to be transported frequently, appropriate mitigation measures will be provided for spills.

81. Transportation, storage, and handling of hazardous material will be supervised closely by the Project office to confirm proper handling during construction. All bridges will be provided with guardrails to prevent trucks carrying hazardous materials from going off the road and spilling the contents into the water body. Emergency telephones will be placed on both sides of the expressway. An oil and hazardous material spill contingency plan will be developed and implemented as a part of the emergency action plan. The plan will include identification of responsible people, spill response procedures, and spill control kits. Training will be provided to relevant staff in proper timing. . Poisonous and hazardous materials are listed in the "PRC Chemical Hazardous Material Safety Control Regulation." Vehicles carrying toxic or hazardous materials will be posted with regulated signs, and will be required to notify the expressway management and to obtain permission to enter the expressway. Use of the expressway by such vehicles will be prohibited during rainy, snowy or foggy weather.

## **9. Bridge Construction and Operation Impacts**

### **a. Construction Period**

82. The Hukou bridge construction activities include transport and use of construction materials in and over water, operation of construction equipment in riverbeds, drilling for pilings, and some river diversions. Drilling for bridge pilings or piers will raise suspended solids in the water. Therefore, considering the purification ability of the existing facilities, adequate measures will be taken to decrease the concentration of suspended solids in the waterbody and the volume of the dredged mud. The bridge construction activities will temporarily block or disrupt navigation in navigable waterways.

### **b. Operation Period**

83. Because of its design, the bridge will not have a significant impact on the diversion of floods and navigation.

84. The impact on the water quality of Poyang Lake of lead from vehicle emissions on the bridge was analyzed, and was predicted to be within the allowable standard.

### **c. Mitigation**

85. Bridge construction work in riverbeds will be conducted during low water conditions as much as possible. Dredged waste materials will not be disposed of within the river or within the floodplain of the river, but will be disposed of on in-land areas.

86. Hukou Town has intake points for its water supply downstream of the bridge, and the water quality (especially its lead content) will be closely monitored. Bridge and tunnel construction will inevitably produce a considerable amount of suspended solids in the water; therefore, adequate measures will be taken to decrease suspended solids and to treat water from intake points near the construction sites.

87. When an open caisson is built for the construction of the piers under water, fallen pieces of rock and sand will be pumped out and shipped to the assigned disposal area. Underwater demolition activities will be avoided as much as possible; however, if they are required, guidance will be sought from aquatic biologists in order to minimize the damage to aquatic creatures.

## **E. Alternatives**

88. The "without" Project alternative is the continued use of the existing road. Because the existing road is a lower class highway and cannot carry enough traffic to serve the demand, this would continue to restrict economic development in the region. The alternative would continue adverse environmental impacts such as noise and air pollution, which would become even more significant as the volume of traffic increase. Thus, the "without" Project option is not feasible and was not reviewed in the EIA.

### **1. Alternatives for Alignment**

89. The EIA evaluated alternatives for alignment. Two alternatives are basically the same except along a minor part of the route. The EIA stated that the second alternative would have less impact on the environment because of less land acquisition and resettlement, and fewer sensitive sites for noise and air pollution. In the third alternative, a more significant alignment change was made than in the first two alternatives.

90. The third alternative would entail more earthwork and a greater imbalance in the volumes of cut and fill material than the other two alternatives, and increased adverse environmental impacts from the Project. However, the route of the third alternative requires relocating fewer households, passes by fewer sensitive locations, and stays further from such locations. Thus, alternative three would have the least adverse environmental impacts.

### **2. Alternatives for the Bridge Site**

91. The EIA evaluated three alternative sites for the bridge across Poyang Lake. The selected alternative has better geological conditions, the lowest impact on the environment, and is farthest from the residential area of Hukou County and historic Stone Bell Hill.

## **F. Cost-Benefit Analyses**

### **1. Costs and Benefits of the Project**

92. The feasibility study estimated economic and financial costs and benefits of the Project. Calculations were made of transport cost savings, vehicle operating cost savings, and value of passenger and freight time savings. The economic investment costs and financial costs were estimated. A supplementary feasibility study report made adjustments to the original study, and the consultants reviewed and adjusted the financial and economic analyses. The results, representing the adjusted financial and economic values based on current estimates are given in Table 8.

**Table 8: Cost Estimates, Financial and Economic Analyses**

Financial Cost	Y3,026.5 million
Net Present Value	1,860
Benefit Cost-Ratio	1.67%
Internal Rate of Return	7.63%
Investment Recovery Period	17.9 Years
Economic Costs	Y2,706.69 million
Net Present Value	1,162.3 million
Benefit Cost Ratio	1.72%
Internal Rate of Return	18.44%
Investment Recovery Period	14.3 years

Source: EIA Report, Jiangxi Provincial Communication Design Institute, PRC, 1996.

### **2. Environmental Protection Cost**

93. The cost of implementing the resettlement program is estimated at Y65.6 million, equivalent to 2.7 percent of the base Project cost. The environmental protection cost is about Y50 million, equivalent to 2 percent of the base Project cost. Such costs include slope protection, prevention of soil erosion, and tree planting. Monitoring costs are not included in the cost estimate, but will be included in the final Project cost as an additional cost, amounting to Y6.6 million.

## **G. Institutional Requirements and Environmental Monitoring Plan**

94. In the PRC, the National Environmental Protection Agency (NEPA) and its subordinate offices in the provinces, cities, and counties have the principal responsibility to monitor environmental quality and manage the overall environment.

95. In addition to NEPA's system, the Ministry of Communications (MOC) and its offices in the provinces have their own requirements for the protection of environment relating to expressway construction and operation.

96. Jiangxi Provincial High Class Highway Administration Bureau (JPHAB), under JPCD, will be responsible for the monitoring. JPHAB will submit reports to the Bank, NEPA, and MOC once every quarter during construction and once every year after completion.

97. A detailed environmental management plan will be prepared based on the proposed plan in the EIA and mitigation measures summarized in the summary EIA.

98. JPHAB will set up environmental stations to conduct regular periodic air and noise monitoring during Project operation. The stations will have 3-4 environmental monitoring staff and an environmental monitoring vehicle with monitoring equipment.

99. Qualified professionals certified by provincial environmental protection institutions will be assigned to the staff positions. MOC offices will supervise the environmental management of the Project expressway. NEPA offices will check on the compliance with the plan.

100. Table 9 summarizes the institutional management for environmental protection such as noise and air pollution along the route.

101. Two types of environmental monitoring are required: (i) monitoring the contractors' compliance with the environmental aspects of the operational and design requirements, and (ii) environmental impacts from project implementation.

102. A detailed environmental monitoring plan will be prepared prior to Project implementation. The detailed monitoring plan will be based on the plan proposed in the EIA, the mitigation measures summarized in the summary EIA, and results of additional environmental reviews of the final engineering design. The plan will include sampling design (sampling locations, monitoring schedule, monitoring methodology for sampling, and sample handling); nature of output expected in the monitoring report; and reporting schedule.

103. Tables 9, 10 and, 11 outline the environmental management and monitoring plan for construction and operation periods.

## **H. Public Participation**

104. Jiangxi Provincial Communication Design Institute held full consultation with local governments in the affected regions during preliminary design and route selection. During the field reconnaissance, the EIA team also made opinion polls, from various government agencies, the People's Congress, consultative conference, interest groups, communities and, above all, the local residents and experts. The general opinion is strongly in favor of construction of the Project.

Table 9: Plan of Environmental Management

Stage	Institutions of Management	Items of Management	Objectives of Management
Feasibility Study	The National Environmental Protection Agency, Environmental Protection Office of the Ministry of Traffic, Provincial Environmental Protection Bureau, Asian Development Bank	Review and examine the EIA outline and EIA report. Review and examine the chapters concerning environment protection in the Feasibility Study Report	Define and set the objectives of Environmental Protection management in the preparation, construction and operation periods.
Design and Construction	Asian Development Bank, National Environment Protection Agency, Provincial EPB	Review and examine the initial design of environmental protection and the design of working drawings.	Strictly carry out the "Three Synchronization". <sup>a</sup>
	Asian Development Bank, NEPA	Inspect whether the Environmental Protection funds are available.	Guarantee the Environmental Protection funds.
	Provincial EPB; city and county EPBs	<ol style="list-style-type: none"> <li>1. Inspect the appropriateness of the storing rounds of construction materials and the position of mixing station</li> <li>2. Inspect for the pollution from construction dust and noise during construction stage.</li> <li>3. Inspect the discharge and treatment of wastewater from construction and service quarters.</li> <li>4. Inspect the handling and restoration of earth borrowing and deposit sites.</li> <li>5. Inspect the cleaning of the river and lake channels.</li> <li>6. Inspect the progress and quality of the construction of Environmental Protection facilities.</li> </ol>	Ensure the prevention and control of the environmental pollution derived from the process of construction. Check and accept the Environmental Protection construction. Guarantee the "Three Synchronization". <sup>a</sup>
Operation	Provincial EPB, City and County EPB's, Provincial Traffic Department	Implement the monitoring plan: <ol style="list-style-type: none"> <li>1. Inspect the environment quality of the sensitive areas.</li> <li>2. Inspect the treatment of wastewater from the service quarter.</li> </ol>	Ensure conformity to the national standard of Environmental Protection during the Operation Period.
	Provincial EPB, Public Security and Fire Department	Enhance inspection; prevent contingency; remove the potential risks; inspect the capability for handling emergencies.	Remove potential sources of accidents Prevent severe accidents that would pollute the environment.

<sup>a</sup> "Three sychronization" is a national environmental policy of enforcing pollution control and prevention (to be synchronized) with the three stages of design, construction, and operation of development projects.

105. Table 12 summarizes the investigation conducted between 2 and 8 December 1995, among 250 people along the route, 202 of whom responded.

106. The opinions collected from the local agencies concerned are summarized as follows:

- (i) County and township officials insist that adequate numbers of overpasses, underpasses or interchanges be built in their own areas of the expressway to facilitate communications between the two sides of the motorway and for farming activities.
- (ii) Employment opportunities created by the Project will be given to those affected and surplus local laborers.
- (iii) Compensation for land acquisition and resettlement will be made promptly in accordance with policies, especially for the construction of new houses for resettlers.
- (iv) The irrigation canals that are misused or damaged because of the construction of the expressway will be restored to their original states.
- (v) Consultations will be made with the owners before buildings are demolished.

**Table 10: Environment Monitoring Plan, for Construction Period  
(Supervised by the Provincial High-Grade Highway Administration Local EPBs)**

Environmental Factor	Place	Item	Time and Frequency
Atmosphere	Mixing stations; sensitive spots on the transport route; construction sites	TSP	Twice a year at each spot; 3 days per time, sampling once in the morning, once in the afternoon
Noise	Sensitive spots within 150-m radius of construction sites, sensitive spots on the transport route	Noise	Twice per year at each spot; 20 minutes per time, sampling once in daytime, once at night
Ground water	During bridge construction (500 m downstream or upstream from the water intake at Hukou)	pH, Pb, CO <sub>2</sub> , BOD, DO, SS, Oil	Once every year winter
Surface water	During bridge construction (500 m downstream or upstream from the water intake at Hukou)	pH, Pb, CO <sub>2</sub> , BOD, DO, SS, Oil	Once every year winter

107. The ground work for consultation and public participation has been carried out, and will continue through the planning and implementation process of the Resettlement Action Plan.

Resettlement offices at city, county, and township levels involve the affected people in planning and implementing land acquisition schedules, relocation, and rehabilitation. A participatory institutional structure will be outlined in the Resettlement Action Plan.

**Table 11: Environmental Monitoring Plan for Operation Period  
(Supervised by the Environmental Protection Bureau and Provincial Traffic Department)**

Environment Factor	Place	Item	Time and Frequency
Atmosphere	1. Shanlijie 2. Wanpo Village of Beiyan Township 3. Dingjia Village of Mingshan Township 4. Tankou Village 5. Jingpanling Primary School 6. Loujiatan	NO, CO TSP	Twice per year; once in January, once in July; five consecutive days per time.
Noise	1. Shanlijie 2. Liuqiao Township 3. Zhang Ling Town 4. Jipai Village 5. Chengjia Village 6. Zouling Village 7. Tankou Primary School 8. JingpanLing 9. Hong Yuan Township 10. Luojiatan	Noise	Twice per year; 3 consecutive days per time; once in daytime and once at night
Soil	1. Shanlijie 2. Xiadeahen Village 3. Jiepai Village 4. Tankou Village 5. Loujiatan Village	Soil (lead)	Once every winter
Traffic Noise and Exhaust Gas of Vehicle	At the tolling spots	Noise and exhaust gas of vehicles	Sampling check on vehicles entering Jiujiang-Jingdezhen Grade A Motorway

## I. Conclusions

108. The Project will improve the traffic flow and the economy in the north part of Jiangxi Province, including Jiujiang City and Jingdezhen City. These areas are growing and are expected to have further economic development.

109. The existing road has adverse environmental impacts, including air pollution and noise. The Project will lessen the adverse impacts by diverting the traffic from the existing road.

110. Major potential environmental impacts from the Project are soil erosion related to the massive earthworks, air pollution, and noise along the route. Soil erosion will be minimized by modifying the alignment and profile to the extent possible, appropriate remedial measures during construction, and revegetation of slopes and embankments. Air and noise impacts will be reduced by requiring new buildings to be set back from the road, and by installing noise barriers at some locations.

111. A comprehensive monitoring and reporting plan will be established and implemented. This will cover construction and operation as well as resettlement and compensation.

**Table 12: Public Responses to the Project**

Items	Responses	Percentage (%)
Knowledge about the Project	Very much	12
	Somewhat	60
	Little	28
Preference for resettlement	To the same village	78
	To another village	22
Effect of Project on development of the village	Beneficial	77
	Adverse	6
	No idea	17
Adverse effects on environment	Very much	25
	Slight	55
	No knowledge	20
Attitude regarding the construction of highway	The earlier, the Better	92
	Better to start later	7
	Better never to start	1

112. The Project is not expected to have any environmental impact of major significance. The environmental impact will be within acceptable levels if mitigative measures are adequately taken.