SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

HUNAN ROADS DEVELOPMENT II PROJECT

IN THE

PEOPLE’S REPUBLIC OF CHINA

March 2004
CURRENCY EQUIVALENTS
(as of 28 February 2004)

Currency Unit – yuan (CNY)
CNY1.00 = $0.1208
$1.00 = CNY8.2772

ABBREVIATIONS

ADB – Asian Development Bank
CECC – Hunan Chang-Ji Expressway Construction Company Limited
EIA – environmental impact assessment
EMP – environmental management plan
EPB – Environment Protection Bureau
GDP – gross domestic product
HECC – Hunan Expressway Construction and Development Co. Ltd.
HPCD – Hunan Provincial Communication Department
HPDI – Hunan Provincial Highway Design Institute
LAR – land acquisition and resettlement
NO₂ – nitrogen dioxides
NR – national road
PRC – People’s Republic of China
RP – resettlement plan
SEIA – summary environmental impact assessment
SEPP – soil erosion protection plan
VOC – vehicle operating cost

WEIGHTS AND MEASURES

m³ – cubic meter
dB(A) – decibel measured in audible noise bands
°C – degrees centigrade
ha – hectare
km – kilometer
l – liter
pH – measure of acidity/alkalinity
m – meter
MTE – medium truck equivalent
mg – milligram
Nm³ – normal cubic meter
m² – square meter

NOTE

In this report, "$" refers to US dollars
# CONTENTS

## MAPS

I. INTRODUCTION 1

II. DESCRIPTION OF THE PROJECT 1

III. DESCRIPTION OF THE ENVIRONMENT 2  
   A. Physical Environment 2  
   B. Ecological Environment 4  
   C. Sociocultural Environment 5

IV. ALTERNATIVES 6

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES 8  
   A. Physical Environment 8  
   B. Ecological Environment 15  
   C. Sociocultural Environment 15

VI. ECONOMIC ASSESSMENT 17

VII. ENVIRONMENTAL MANAGEMENT PLAN 18  
    A. Institutional Requirements 18  
    B. Monitoring 19

VIII. PUBLIC INVOLVEMENT AND DISCLOSURE 19

IX. CONCLUSIONS 20

## APPENDIXES

1. Summary Erosion Protection Plan 22  
2. Environmental Costs 24  
3. Summary Resettlement Plan 25  
4. Environmental Management Action Plan 28
I. INTRODUCTION

1. The environmental impact assessment (EIA) for the Hunan Roads Development II Project (the Project) was undertaken by the Highway Research Institute of the Ministry of Communications in July 2003. The consultant engaged under the technical assistance review the report and visited locations that could experience environmental impacts. This summary environmental impact assessment (SEIA) was based on the EIA report, with some modifications, following Asian Development Bank (ADB) policy and guidelines as indicated in Environmental Policy of the Asian Development Bank, November 2002, and Environmental Assessment Requirements of the Asian Development Bank, March 1998. The EIA and this SEIA are documents of the project proponent and have not been evaluated by ADB. ADB’s assessment of these reports and evaluation of the environmental impacts will be included in the documentation presented to the Board of Directors separately.

2. The environmental assessment was conducted in accordance with relevant laws, regulations, and standards applicable in the People’s Republic of China (PRC), including in particular (i) Technical Guidelines on Environmental Impact Assessment and Environmental Protection Standards of the PRC, September 1993, and (ii) Standards for Environmental Impact Assessment of Highway Construction Project, MOC January 1996.

II. DESCRIPTION OF THE PROJECT

3. The Project is located in Hunan Province in the central-western region of the PRC (Map 1). The project area, the western part of Hunan, is characterized as hilly and mountainous terrain, which has limited accessibility and widespread, severe poverty. In 2002, while Hunan’s per capita gross domestic product (GDP) was CNY6,549, the project area’s per capita GDP was merely CNY1,660 with 56% of the population with an annual income of below CNY900.

4. The principal objective of the Project is to spur economic growth and reduce poverty in Hunan. The Project will (i) improve economic efficiency, foster trade, and facilitate interregional integration by alleviating congestion, reducing vehicle operating costs (VOCs), and improving traffic safety; (ii) supply a missing link in the Changsha-Chongqing western corridor; (iii) spread economic and social benefits over a wider cross-section of local communities by improving accessibility for the rural poor in the corridor; and (iv) catalyze economic growth in Hunan, which will, in turn, improve poor people’s incomes and well-being.

5. The Project comprises (i) constructing a 173 kilometer (km), four-lane access-controlled, toll expressway from Changde to Huaihua, including tunnels and bridges, interchanges and toll stations, and service areas; (ii) upgrading or improving 517 km of local roads, thereby providing improved access to 404 villages; (iii) procuring equipment for road maintenance and safety, toll collection, surveillance and communications, tunnel ventilation and lighting, vehicle axle road testing, and environmental protection; (iv) land acquisition and resettlement; and (v) consulting services for construction supervision, safety audits, monitoring and evaluation, and capacity building.

6. The proposed expressway starts from Doumuhu in the Dingcheng District of Changde City at km4, connecting with Xujiaqiao Interchange on the Changde to Zhangjiajie Expressway (under construction), going through Xujiaqiao, Taohuayuan, Zhengjiayi, Yangxiqiao, and entering Yuanling County in Huaihua City at Taipingpu at km75. It follows the bank of Yuanjiang River when it arrives at Shuxikou, passes through Guanzhang, Nanmupu, Madiyi, Liangshuijing, Maxipu, and finishes at km165 at the border of Yuanling and Luxi counties. Map 2 shows the alignment of the Project.

7. A set of nine priority local road projects that targeted the poorest areas has been selected from Hunan’s approved road development plans in the 10th Five-Year Plan. An estimated 440,000 people are served by the selected local roads; about 65% or 286,000 of these are poor residing in 77 poverty villages and townships in mountainous areas. The local roads are currently mostly unpaved and in poor condition. These will be upgraded to Class III or IV roads\(^2\) with asphalt surface, using the existing alignment, and linked to the expressway. Improvements were estimated at a total cost of CNY692 million. As the local roads will be upgraded mostly on the existing alignment, land acquisition and resettlement impacts will be limited.

III. DESCRIPTION OF THE ENVIRONMENT

8. For purposes of the assessment, the following boundaries were considered: (i) terrestrial environment—300 meters (m) from the center line of carriageway, but will be extended to borrow and materials stockpile sites; (ii) aquatic environment—200 m from the center line of carriageway, extending 500 m downstream at large water crossing sites; (iii) air quality—200 m from the center line of carriageway; and (iv) acoustic environment—200 m from the center line of carriageway, and extended in sensitive areas such as schools, hospitals, and residential areas.

A. Physical Environment

1. Meteorology and Climate

9. The project area is in subtropic humid climatic zone with four distinct seasons. In spring, skies vary quickly from sunny to overcast. The annual average temperature is 16.5 degrees centigrade (°C) with the lowest and highest temperatures recorded at -13.2°C and 40.6°C, respectively. Of environmental concern is the intensive precipitation between April and August when 70% of the annual rainfall (1,450 millimeters) occurs, restricting construction activities and increasing the risks of siltation, erosion, and slope slippage.

2. Topography, Geology and Soils

10. The line recommended for the Changde-Jishou Highway is in a northeast-southwest direction, in the southeast edge of Yuanma basin and northwest edge of Xuefeng Mountain. The overall landform is low in the northeast and high in the southwest. The first 10 km of the road from Changde to Taoyuan are in the Xiang-Gan hills with relief types being mostly plain on open alluvial valley and gentle hills with elevations below 50 m above mean sea level. From km10 to km62 in Yangxiqiao to Chaanpu, the alignment is in a denuded hilly area with elevations of 100–300 m. The road section from Chaanpu to Shuxikou (km62 to km150) is characterized by

\(^2\) Class I road has four or more lanes and estimated daily traffic volume of at least 15,000 vehicles, Class II road has daily volume of 3,000 to 7,500 vehicles, Class III road from 1,000 to 4,000 vehicles per day, and Class IV road less than 1,000 vehicles.
denuded low hills 100–300 m high with large landform undulation, slopes of 30–40° and V-shaped valleys. The remaining section is also found in denuded low hills with slopes of 15–25° at elevations of 160–400 m.

11. The strata and lithology in the project area are complex. The geology varies widely in composition, including Quaternary through Cambrian age rocks. In some places, Jurassic and Devonian strata are exposed. The road corridor along km0 to km60 in Changde is in a geologically active area that necessitates adoption of antiseismic measures.

12. The project area is dominated by well-developed hilly soil with terrace fields or dry lands. Hilly areas have numerous stone gulches with thin soil covering and exposed based rock.

3. Surface and Groundwater Quality

13. The surface water drainage consists of numerous tributaries draining into the Yuanshui River, which crosses the proposed alignment. The Yuanshui River originates from the southeast part of Guizhou province and enters the project area in Yuanling County. The river then flows northeast to Dongting Lake in Changde. Along the road corridor, the Donghe, Wanrong, and Sima rivers drain into the Wushui River, which then flows to the Yuanshui River at Wutan Township in Luxi County. The Yuanshui River flow peaks during March through August with an average flow over 1,133 cubic meters (m$^3$) per second. The Xuefeng Mountains comprise the main watershed area of this river system. Several large tributaries flowing through the steep mountain slopes drain large volumes of rapid runoff; soil erosion is exacerbated in some places due to deforestation and lack of terraces in cultivated areas.

14. Chemical oxygen demand, pH,$^3$suspended solids and oil in the sampling stations located along Yuanshi River at km170 and km173 conformed with surface water quality national standards for Class III (functional zones).$^4$ The pH ranged from 8.2 to 8.3 and was within the prescribed range of 6–9, while chemical oxygen demand recorded from 2.3 milligrams (mg) per liter (l) to 2.8 mg/l was below the 6 mg/l standard. Suspended solids measured from 4.7 mg/l to 16.4 mg/l, well below the maximum allowable concentration of 150 mg/l. Oil was below the detection level of 0.05 mg/l. Results indicate that the waters of Yuanshui River are of good quality.

4. Air Quality

15. The alignment of the proposed expressway avoids large critical receptors such as cities and towns. Much of the road runs along rural areas and open fields where there are no significant sources of air pollution. Primary sources of emissions are fumes from passing vehicles and ground dust.

16. Ambient levels of nitrogen dioxides (NO$_2$) and total suspended particulates (TSPs) were measured for three consecutive days in stations located in km32 at Zhenjiayi School, km111 in Yanjiachun, and km123 in Wujia. TSP concentrations ranged from 0.01 mg/normal cubic meter (Nm$^3$) to 0.16 mg/Nm$^3$ and are below the prescribed national air quality standard (GB3095-96 Class II)$^5$ of 0.30 mg/Nm$^3$. The NO$_2$ concentrations were below the maximum allowable level of

$^3$ Measure of acidity/alkalinity.
$^4$ National standards GB08492 and GB3838-2002 apply to water quality classification.
$^5$ National standards GB3095-96 applies to air quality classification.
0.24 mg/Nm$^3$ except in Zhenjiayi School where an hourly average concentration of about 0.34 mg/Nm$^3$ was recorded. The high NO$_2$ concentrations measured at certain periods during the 3-day sampling may be attributed to burning of domestic refuse and yard waste by local residents.

5. **Noise**

17. Daytime and nighttime noise measurements were conducted in 16 stations in the project area. Sampling points were about 1 m in front of classrooms, dormitories, or houses. All locations yielded low noise levels ranging from 42 decibel measured in audible noise bands (dB[A]) to 50 dB(A), except at Zhuantian Village (km147), where daytime noise level was recorded at 57 dB(A) thereby exceeding the 55 dB(A) standard. Noise levels during nighttime generally exceeded the 45 dB(A) standard, with measurements reaching 55 dB(A). The primary source of noise at night is passing vehicles along the existing national road national road (NR) 319 and local roads and the high-pitched, ear-piercing sound produced by cicadas. Other sources of noise in the area are community noise from schoolchildren and residents. There are no large industrial establishments along the alignment that could be significant sources of noise.

B. **Ecological Environment**

1. **Flora and Fauna**

18. There are no known sensitive or endangered species in the project area, or any old growth forest or protected ecological sites. The proposed alignment does not cross or encroach on any protected areas.

19. The main alignment passes largely through elevated areas along hillsides to minimize impacts to agricultural areas on level land. At km75 of the proposed expressway, the alignment has been diverted to avoid a jujube, or Chinese date tree (Ziziphus jujube), believed to be more than 400 years old. Vegetation cover in the counties to be traversed by the project road is mostly of the middle subtropical evergreen broadleaf forest type.

2. **Fisheries and Aquatic Biology**

20. The native aquatic community, mainly in the Yuanshui River and its large tributaries, has been severely disturbed by decades of unmanaged aggregate mining in the rivers, and discharge of sewage, solid waste, blast fishing, and electrofishing. The rivers support only a few native fish, primarily snakehead mullet, shad fish, grass carp, chub, and herring.

3. **Land Resources, Land Use, and Crops**

21. Land use in the proposed expressway corridor is about 60.0% largely cut-over forest consisting of very little old growth and is dominated by secondary evergreen broadleaf forest; shrubs; grasses; and tree species such as tea, fur, and pine. The agricultural land (16.0%) includes rice fields, orchards, and small plantations often on steep terraced ridges and valley walls. Of the remaining land, 10.4% is nonforested or uncultivated and 6.6% is watershed.

22. Agriculture provides livelihood to over 69% of the population in Hunan. Crops cultivated in Changde include rice, rapeseed, green manure cotton, bean, wheat, corn, peanut, and sesame. In the Yuan Valley, through which the proposed expressway will pass, crops grown include ramie, wheat, rice, corn, tea, sorghum, rapeseed, citrus fruits, and soybeans. Huaihua
Prefecture was designated an agricultural experimental zone under the Eighth Five-Year Plan of the State Council. Consistent with the plan, large areas of waste hills and mountainous areas were converted to orange and chestnut plantations.

4. Mineral Resources

23. The project area has abundant mineral resources, such as realgar (a rare soft orange mineral consisting of arsenic sulfide), diamonds, phosphor, coal, salt, nitrate, and lime in Changde City. The diamond reserve in Changde makes up 98% of the total provincial reserves while nitrate and lime reserves accounting for 10% and about 82%, respectively. The gold mines along the tributaries of Yuanshi River and the petroleum and natural gas reserves in Dongting Lake are also very rich.

24. Huaihua Prefecture contributes 80% of the barite produced by the province, 24% of the phosphor, and 20% of the gold. Other minerals found in the area are copper, antimony, barite, calcium carbide, limestone, clay, and cement limestone.

C. Sociocultural Environment

1. Cultural and Historical Sites

25. Some of the tourist spots in Changde City are the Liuyehu Lake and the Huangshantou and Hupingshan mountains. The more famous tourist destinations in the project area are the Taohuayuan Park in Taoyuan County; Lingxing Lecture Temple, Huxi Academia, Phoenix Mountain, and Lotus Pavilion in Qianyang; and Nanzheng Street and Queen Palace in Zhijiang. Numerous temples offer a potential for tourism development, including the Danshan, Songyun, and Longquan temples.

2. Social Profile

26. The Project is in western of Hunan—one of the poorest areas in the PRC. The area has limited accessibility and widespread, severe poverty. It has a total population of 2.8 million. The project area covers eight counties, of which four are key poverty counties (i.e., counties eligible for government poverty reduction funds). Of 2,518 villages in the project area, 715 villages are classified as key poverty village. The area’s per capita annual income was $201 (CNY1,660) in 2001 and 56% of the rural population has annual income of below $109 (CNY900). The national highway (NR319), which runs parallel to the project expressway, has a combination of class II and below roads with pavement in poor condition with over 60% of its length and frequent flooding and congestion. The poor are concentrated in the western mountainous regions of the project area. Due to geographical isolation and the high costs of motorized transport, the poor have limited mobility. Geographical remoteness limits their access to markets, income generation activities, social infrastructure, and information from outside. Food security is also a primary problem in the mountainous areas (over 70% of the project area).

27. Socioeconomically, the project area can be divided into two subareas: Changde City subarea in the eastern section is plain and hilly with good infrastructure and social services. In 2002, agricultural and industry output in Changde City ranked third and second, respectively, among the cities in Hunan. The western section of the Project in Huaihua subarea is mainly of mountainous terrain. It is a national level poverty county. Although the GDP increased on average at a rate of 8.4% per year since 1980, per capita GDP in 2002 is only $533 (CNY 4,415).
28. The minority population in the project area, estimated at 1.3 million, is distributed among 56 ethnic groups and accounts for 41% of the total population in the project area. The main minority groups are the Bai, Miao, Tujia, and Yao. The diversity in composition of minority groups along with their rich cultures provides a wealth of resource for tourism. The provincial authority plans to develop and integrate the tourism resources in western Hunan to form a tourism triangle, which will include Zhangjiajie (north of the project area); Yuanling (a project county, on the road alignment); and Fenghuang (a project county).

29. The local road component will expand the road network in poor minority villages and to meet the needs of the beneficiaries, and thereby will maximize the spread of the expressway benefits to the poor. Rural farmers, particularly those in the area of the local road program and near the expressway interchanges, will be in a position to increase their agricultural incomes through better access to markets, more competitive prices for their products, and cheaper transport costs. Tourism is also expected to pick up in the Golden Tourism Development Triangle Area, so that the rural residents in the areas will benefit from increased employment opportunities.

IV. ALTERNATIVES

30. **No Action Alternative.** In 2001, traffic volume on the existing road (NR101) reached around 3,200 medium truck equivalent per day between Changde and Huaihua, and is growing at 6.6% per annum. Without the Project, the traffic on NR101 will exceed its capacity at several points by 2008. This will result in traffic congestion, further road deterioration, and increased vehicular accidents. The existing road will become a bottleneck that will adversely affect trade and living conditions in the area.

31. **Alternate Transport Modes.** Transportation by water is not a viable option because the Wuqiang Brook Dam in Yuanling prevents navigation along Yuanshui River. The rail option was also not considered since benefits would largely accrue only to urban areas at the loading centers in the towns of Taoyuan and Yuanling. While there is an airport in Changde (Taohuayuan Airport), there is none in Jishou. Building a new airport would be limited by topographic conditions and the expansion of air transportation to service regional passengers does not appear feasible. Air transit would still be confined to its niche of lightweight, high-value freight.

32. **Alternative Alignments.** Alternative alignments were investigated, and the recommended alignment was selected based on (i) construction costs, (ii) acquisition of productive agricultural lands, (iii) loss of existing infrastructures, (iv) need for resettlement, and (v) loss of natural vegetation.

33. The recommended alignment is called “K Line” in the Feasibility Study. During the preliminary design, 11 alternatives (Table 1) were examined in detail. Other alternatives were abandoned after field investigations proved them unsatisfactory.
## Table 1: Alternative Alignments

<table>
<thead>
<tr>
<th>Section</th>
<th>Location (km)</th>
<th>Alternatives</th>
<th>Reason for Rejecting Alternative Line</th>
<th>Selected Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changde Section</td>
<td>13.555-23.560</td>
<td>A B</td>
<td>A: would create longer route length, more difficult interchange lay-out and longer connecting road</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>23.560-31.422</td>
<td>F</td>
<td>F: would require greater excavation and waste material, hence, greater impact on the local environment</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>43.078-71.565</td>
<td>C D</td>
<td>C: would have poorer geological conditions and has greater volume of excavation spoils</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D: is longer and would have greater impact on housing and existing power supplies, hence, higher cost</td>
<td></td>
</tr>
<tr>
<td>Huaihua Section</td>
<td>70.518-74.628</td>
<td>H</td>
<td>K: would be difficult to construct because of deep cuts and high fills</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>78.713-82.526</td>
<td>I</td>
<td>K: would not integrate well with the local planning</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>82.526-87.345</td>
<td>M1 M2</td>
<td>M1: would have too much impact on arable land and require more demolition</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M2: would have higher earthworks quantity and costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>101.987-105-398</td>
<td>N</td>
<td>N: would have much greater earthworks, more impact on arable land, and be more costly</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>122.059-127.854</td>
<td>J</td>
<td>K: would be longer and more costly, have more impact and the geological condition is not as good as that of line J</td>
<td>J</td>
</tr>
<tr>
<td></td>
<td>132.069-146.853</td>
<td>P</td>
<td>P: would have more impact on land and housing; has a number of karst caves with some evidence of collapsed ground and unstable conditions</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>155.837-164-482</td>
<td>O Q</td>
<td>Q: would run along the foot of a hill where the rock angle makes it likely to collapse during excavation</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>164.482-167.565</td>
<td>R</td>
<td>K: would be longer, have greater impact on structures, and be more costly, geological condition not as good as line R</td>
<td>R</td>
</tr>
</tbody>
</table>

34. During preliminary design, the selection of recommended alignments has fully taken into account the environmental impacts and cost, route length, geological conditions, construction conditions, migration, and resettlement, and took into consideration minimum disturbance to the existing NR319, reservoirs, rivers and high-voltage power transmission lines. The EIA report and the soil erosion protection plan (SEPP) report indicate that the selected alignment for all sections of the road corridor is the preferred route. If adequate mitigation actions, especially resettlement, compensation, and compliance monitoring, are undertaken and maintained during the 3-year construction period and throughout the operating phase, and disturbed land is revegetated immediately after work is completed, the adverse impacts of the main alignment could be minimized. The SEIA, thus, concurs with the EIA's conclusion, which suggests that the "k" alignment be selected as the basis of the preliminary design.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Physical Environment

1. Topography, Geology, and Soils

a. Construction Period

35. General Construction Activities and Access Roads. The Project will require excavation of over 30 million m$^3$ of earth and rocks. Excavated earth will be used as much as possible as fill for highway subgrade. A large portion of excavated materials, together with about 4.5 million m$^3$ of borrow materials, will be used as fill. The estimated amount of waste earth and rock that will be disposed is 6.3 million m$^3$. A disposal plan will be prepared for excavated materials. The plan will include (i) use and management of waste materials, (ii) a material transport scheme, (iii) material dumping arrangements, (iv) stabilization of stockpiles against rain and wind (and frost and ice at high elevations), (v) a drainage system, and (vi) rehabilitation of exposed areas. This plan, to be a contractual requirement, will be carefully monitored by the project Executing Agency. Ongoing maintenance, revegetation, and rehabilitation measures for all spoil sites should be documented while updating the SEPP. The transport of excavated materials will require use of trucks and other heavy equipment. Damage to access roads, elevated emission of dust and noise levels, and increased vehicular flow are expected. Access roads will be maintained to minimize disruption to residents and other road users. Proper scheduling of trucks for hauling operations so that peak hours do not coincide with school hours and during night time will help minimize disturbance to sensitive receptors such as schools and residential areas.

36. Rock Quarries, Sand and Gravel Sites, and Borrow Sites. The EIA identified 31 rock quarries and 6 sand and gravel sites along the 173 km road corridor. These areas are mostly less than 5 km from the alignment except for the site in Changde, which is more than 100 km away. A strict borrow-site and storage site rehabilitation and restoration program will be implemented and included in the construction contracts. The contractors will prepare a detailed work program and plans indicating the construction activity sequences, topsoil storage areas, and borrow pit and quarry restoration measures. According to the PRC regulations, the work sites along the Yuanshui River tributaries will require permits from the Provincial River Management office.

37. Tunnel Excavation Waste and Portal Access Roads. As the materials extracted during tunnelling may amount to about 1 million m$^3$, a disposal plan will be prepared for the
wastes from the 15 tunnels to be constructed, with most materials being incorporated into the works or disposed in nearby depressions to be agreed upon among the executing agency, contractors, and concerned environmental agencies. Some high cuts will present similar problems, and therefore cuts over 200 m long and more than 10 m high will be included in the disposal plan for excavation materials.

b. Operating Period

38. During the operation of the project expressway, no significant impacts are predicted other than those resulting from neglected protection works in waste disposal areas and erosion prone areas and failure to maintain revegetated areas along the alignment, borrow sites, and spoils sites. To prevent these, regular monitoring inspections should be undertaken to ensure that drainage and revegetation measures are maintained.

2. Water Quality

a. Construction Period

39. No significant impacts on groundwater quantity and quality are expected, as most work sites will be on rocky terrain and away from aquifers. The operation of the expressway will not affect the groundwater system.

40. Bridge and Road Construction Waste. The project expressway passes over the tributaries of Yuanshui River (Chengxi, Dayangxi, Gaopaiqu, Huilonghe, Jinganghe, Lujiaxi, Muwangxi, Shuixi, Tongxi, Xiajiaxi, and Xixi), which require protection during construction and operation. Cast-in-place concrete pile will be used in bridge construction. During boring, cofferdams will be installed to prevent silt arising from boring operations from mixing with river water. When large amounts of boring slag are produced, these will be hauled to spoils disposal areas, which will be provided with retaining walls and vegetation cover.

41. Surface drainage from bridge construction sites should be intercepted and directed into temporary settling ponds (with 48-hour detention capacity), either built by the contractor or rented from local landowners. A geotextile filter should be provided at pond outlets to catch suspended sand and mud, should overflows occur.

42. Soil Erosion. Soil erosion is a major concern of the Hunan Provincial Government. The proposed expressway alignment passes through a government-declared soil erosion prevention area. Measures include afforestation in mountainous and hilly areas and land-use conversion from agriculture to forests. The SEPP details the anticipated erosion volumes, which may range from 4,000 to 65,000 tons of eroded material per square kilometer per year during the construction period; resulting from construction activities, borrow pit operations, and disposal of surplus material. Soil erosion leads to river siltation, flooding, damage to agricultural lands, and destruction of vegetation, all of which generates high repair and rehabilitation costs.

43. The provincial government's erosion protection program covers the area potentially affected by the project expressway. A specific SEPP has been prepared for the Project (appendixes 1 and 2). The SEPP and EIA include a series of mitigation measures and outline institutional mechanisms on implementation. Given the many debris flows, mudslides, and unstable soil conditions, protection measures against soil erosion are of particular importance.
The SEPP and specific engineering solutions described in the EIA will be implemented to mitigate soil erosion.

44. Soil may erode along the proposed expressway alignment, particularly during the wet season (March through August). To ensure maximum slope protection at all times, the construction of slope-protection works, and grass and tree planting in the right-of-way in each subsection will proceed concurrently with the construction works. As earthworks progress along sections with large volumes of cut and fill, the contractors will stabilize slopes through retaining structures to be designed and implemented based on the PRC’s Highway Protection Guidelines and Technical Standards of Highway Projects.

45. Closely related to slope and drainage protection is the disposal of surplus materials left over from earthworks and tunnelling works, and the restoration of borrow pits and quarries. All temporary and permanent drains are to be designed and constructed to prevent surface runoff from eroding natural and built slopes. This will minimize siltation of rivers and streams. Catch chambers or settlement ponds should be constructed wherever necessary to prevent material from reaching water bodies.

46. **Sewage Generation.** Sewage will be generated by people who will be working on the project road. To protect local water quality, sewage pits and/or temporary primary sewage treatment plants, including at least settlement and oxidation ponds, will be set up. Sewage wastes will be managed according to PRC discharge standards.

47. **Solid Waste Generation.** During construction, work camp operations will generate solid waste. The contractor will ensure proper storage and disposal of wastes and will encourage reuse and recycling to minimize residual waste. Wastes will be stored away from water bodies and will be regularly hauled to a suitable landfill site. Appropriate waste storage containers will be provided by the contractors, and agreements will be signed with local villages for waste disposal through village facilities. These arrangements are to be made prior to the commencement of works.

48. A handling protocol, e.g., waste storage away from watercourses, and provision of retention areas to contain accidental spills of toxic, hazardous, and harmful construction materials such as caustic and acidic substances, oil, waste oil, diesel, and bitumen, will be prepared and implemented by the contractors. Irrigation channel diversions and reconstruction must be completed prior to construction, before the irrigation season starts, and based on consultation with stakeholders at all levels.

**b. Operating Period**

49. Operating period impacts will likely be limited to direct stormwater runoff from road-surfaces into watercourses, failed erosion protection works, effluent leakage from solid and liquid waste treatment facilities provided for the permanent offices and service centers along the highway, and accidental spills. Under normal circumstances, and with good housekeeping practices, there will be very little impact on water quality from the operation of the road. Nevertheless, the following mitigation measures are recommended:

(i) Divert roadway runoff waters over grassed or pervious areas permitting fine materials to settle, oily water to be retained, and the volume and rate of flow to be reduced. These measures will be necessary at the bridges that cross the
Yuanshui River tributaries or where the expressway is beside the river.

(ii) Inspect erosion protection works such as grassed or stabilized slopes at least twice during the first year the road is in operation to be sure that they are maintained and function as designed.

(iii) Monitor sewage treatment works at the expressway offices and service centers, particularly septic tanks and holding tanks, to ensure that wastewater is properly treated, meets discharge standards before leaving the site, and is properly disposed of.

(iv) Monitor solid waste management to ensure proper storage, timely pickup, reuse, recycling, and disposal.

3. **Air Quality**

   a. **Construction Period**

50. The current ambient air quality along the alignment meets Class II standards (designated standards for mixed-use [urban and industrial] areas).\(^6\) Sources of air pollution during construction are (i) dust emission from aggregate preparation, concrete mixing plants, and hauling activities; (ii) odor emissions from asphalt melting and mixing; and (iii) emissions from trucks and heavy equipment at the construction site and on the roads to and from the borrow and spoils areas. Based on the August 1999 monitoring conducted by the Highway Research Institute of the Ministry of Communications on the Bazhou mixing plant for the Jin-Bao highway in Hebei province, the TSP level 50 m downwind of the mixing plant was 1.34 mg/Nm\(^3\) while at 100 m, a lower concentration of 0.62 mg/Nm\(^3\) was obtained. Both exceed the 0.30 mg/Nm\(^3\) Class II standard. Compared to Jin-Bao, the project area is in a zone that has higher humidity and moisture content; hence, the TSP levels are likely to be less than the values recorded at the Bazhou mixing plant.

51. On other projects, PRC authorities have recorded vehicle-related dust (TSP) levels above PRC Class III standard,\(^7\) 150–200 m from the source, and truck traffic at unpaved construction sites and on materials haul roads generating TSP levels in the 400 m wide impact zone nearly 20 times higher than background levels.

52. Dust particulates of less than 25 microns, about 8% of which is less than 5 microns, will generally characterize construction site dust. Such emissions pose considerable health impact since particles less than 10 microns are known to irritate the lungs, which could eventually lead to lung disease, if inhaled over a few months. Hunan’s climate is quite humid within up to 6 months with daily rainfalls; however, the rest of the year is dry enough to permit serious dust problems. Mitigation measures to overcome these localized, potentially adverse dust impacts over the 3-year construction period include the following:

   (i) Site storage areas, concrete mixing stations, and asphalt plants will be more than 300 m downwind from the nearest settlement.

---

\(^6\) As defined by national standard GB3095-96.

\(^7\) Class III applies to industrial zones.
(ii) Dust suppression equipment will be installed on the cement aggregate and concrete batch plants. Construction roads will be watered, based on a set daily schedule (considering weather conditions), using water trucks. Two watering trucks will be provided for each 20–30 km long section. All truck loads of aggregates and spoil will be covered during haulage.

(iii) Diesel equipment will be properly maintain, based on a published maintenance schedule and curtailment of unnecessary idling.

(iv) Sensitive locations will be monitored quarterly during the construction period. Monitoring will be coordinated by the construction management office, with the contractors retaining the Hunan Provincial Environmental Monitoring Station to undertake the work. Any TSP readings above Class II limits will require immediate remedial action by the contractors. Fines will be imposed and remedial action costs charged to the contractor if the contractor defaults on its duties to implement the environmental management plan (EMP).

b. Operating Period

53. Future air quality conditions were estimated based on traffic forecasts from the preliminary design report. The parameter modelled was NO₂ along the proposed road corridor in seven sections for the years 2008, 2014, and 2022. This will mainly come from vehicle emissions with volume related to the vehicle type and condition.

54. For all six sections and the three forecast years, NO₂ will meet Class II standards 20 m from the edge of the pavement. Beyond 20 m from the pavement, the air quality was predicted to be suitable for residential areas. The Project will have only minor negative effects on the air quality of the project corridor. Apart from the ongoing vehicle emission testing, no other monitoring is required.

4. Noise

a. Construction Period

55. A significant increase in noise levels is expected during construction. Primary sources are the various construction activities, which will involve operation of heavy machinery such as excavators, bulldozers, graders, stabilizers, concrete mixing plants, drills, stone crushing and screening plants, and rollers. While noise levels may be severe, these are considered temporary and localized. Noise intensity from these activities ranges from 70–85 dB(A) within 14–150 m of the source during the day and 80–532 m during the night. Pile driving will produce daytime noise levels exceeding 80 dB(A) at 150 m from the source. Blasting, particularly for cut areas and tunnels will occur often, creating periods of severe noise peaks of more than 100 dB(A) a number of times per day up to 1 km from the blast site.

56. Reduction of noise levels can be achieved with proper equipment maintenance and restriction of operating period to between 0600–2000 hours. Other measures that can be implemented are siting of rock crushing, concrete, and materials shipment yards at least 2 km from sensitive receptors such as residential areas, schools, and hospitals. Sound suppression
methods will be applied where piling equipment is operating within 500 m of sensitive features such as schools.

57. Extremely large amounts of borrow and waste materials will be transported to and from the construction sites. This is likely to take place frequently during the 12–13 hours/day work schedule for the 300-days/year construction season over 3 years. As a result, haul roads passing near or through villages will experience frequent noise in the 70-80 dB(A) range. To mitigate noise impacts, the following mitigation measures should be implemented:

(i) To reduce night noise, work hours within 1 km of any settlement area will be restricted to between 0600 to 2000 hours and, if possible, the movement of heavy vehicles along urban and village roads will also be restricted during this period.

(ii) Construction sites near residential areas will be monitored by the Changde and Huaihua environmental monitoring stations for 24 hours quarterly and random monitoring when necessary. If noise standards are exceeded, equipment and construction conditions will be checked under the supervision of the chief construction engineer, and measures put in place immediately to rectify the situation. Fines and payment of costs by the contractors for mitigation done by others will be the final option.

b. Operational Period

58. During the operating phase, noise will be generated by passing vehicles. In open areas, traffic noise will be linearly dispersed, and will only have a minor impact. During the field investigation for the EIA, day and night time background noise levels at sensitive sites, such as schools and residential areas, were determined. By using a calibrated analogue model specified by the Ministry of Communications to simulate the traffic noise at sensitive rural areas, total equivalent noise levels were calculated. Most of the sensitive sites meet the national standards and no mitigation measure is needed.

59. By the year 2008, of the 43 specific noise sensitive sites, daytime and nighttime noise levels in 41 sites will be acceptable. At two sites (Yangpu Village and Nanmupu Primary School) noise will exceed the standard by 3 dB(A) and 7.3 dB(A), respectively. By 2022, seven sites will exceed the PRC's standard and as such, will require monitoring.

60. The following mitigation measures are proposed, consistent with noise attenuation measures specified in the relevant Government guidelines and as recommended in the EIA:

(i) Relocate one dormitory of Nanmupu Primary School. Provide options of relocation or noise barriers to 10 residential houses in Yangpu Village.

(ii) Restrict new dwellings of any kind from locating within 100 m from either side of the carriageway.

(iii) Plant trees and shrubs within the 50 m wide right-of-way as soon as construction of a particular road section is completed.

(iv) Monitor ambient noise levels at the five residential sites (Nanmupu, Ningxiangpu, Zhangshuwan, and Zhengjiayi villages and the dormitory of Jinshi Mining Company) and six schools (Guangzhuang middle school, Lihuxi primary school,
Nanmupu middle school, Nanmupu primary school, and Zhengjiayi primary school), twice per year for 2 days each, for 10–20 years during the operating period. Modifications in sampling frequency and location may be adopted depending on annual reviews. Mitigate immediately when significant exceedance occurs.

5. Transport of Hazardous and Toxic Materials

61. The transport of hazardous goods by motor vehicles is governed by standards and related regulations issued by the Ministry of Communications.

62. The annual accident rate for NR319 between km1520 and km1608 within Yuanling County is 0.868 accidents per million vehicle-kilometer. Of the total cargo transported along the existing NR319, 7.2% is considered to involve hazardous cargo. To assess the accident risk associated with the transport of hazardous goods, it is estimated that the accident rate for hazardous and toxic goods carriers is 50% less than for other goods carriers, as the drivers tend to be better trained, and more alert and cautious. Also, with limited access and divided traffic flows, the probability of an accident involving hazardous materials on the proposed expressway will be less than on the existing road.

63. Even with a low probability of a hazardous spill, the expressway operator will be prepared for such an eventuality. A spill contingency plan for cleaning up hazardous and toxic materials will be formulated. In particular, attention will be paid to the possibility of hazardous spills in the long tunnels. Prepared in a manual form, the contingency plan will be kept at all tollbooths and tunnel traffic monitoring stations. The manual will indicate (i) the acting authority, (ii) actions and sequence of actions required, (iii) materials and equipment needed and their deployment actions (equipment to be parked and materials to be stored at toll stations and large tunnel sites), and (iv) reporting responsibility. Fire fighting and spill control equipment will be strategically stored along the highway and specific training of personnel on emergency response will be provided.

64. The Project will involve establishment of an interdepartmental framework to enhance road safety in the project area. The Hunan Provincial Communication Department (HPCD) will concentrate on the engineering, road safety audit, blackspot improvement, and operational issues of the expressway while the Hunan Public Safety Bureau will deal with traffic law enforcement to create safer expressways. According to government standards, the Hunan Public Safety Bureau will establish a highly qualified team to manage traffic operations for the expressway, with 1 police person for every 2 km. Road safety for the local roads will be the responsibility of the local traffic police.

65. HPCD will develop a comprehensive road safety strategy in the project area, with the assistance of an international safety specialist. The strategy will aim to promote innovative ways to improve road safety through the following approaches: (i) institutional strengthening: by strengthening the provincial road safety committee by establishing an interdepartmental executive group, developing comprehensive action programs, promoting awareness, setting effective targets, and monitoring; (ii) capacity building and human resources development: by setting up an efficient and uniform database, and upgrade skills and knowledge; (iii) coordination: by developing a blackspot program, undertaking accident prevention measures, fostering knowledge, disseminating knowledge of the best practices, and setting common targets and timeframe; and (iv) cooperation: by instituting a creative effective cooperation approach through government and nongovernment organizations, the private sector, and community groups.
6. Vehicle Emissions

66. HPCD and Hunan Environmental Protection Bureau will prepare a vehicle emissions control implementation plan. This will be implemented through cooperative effort among a number of agencies, jurisdictions, and communities, as well as government commitment and leadership. Fuel companies, the private sector, and nongovernment offices can be involved. Current programs of the environmental bureau must be modified and use optimized resources to enhance emission reduction in the project area. The plan will include (i) identification of vehicle type; (ii) establishment of vehicle inspection sites; (iii) building of compressed natural gas filling stations; (iv) a public awareness campaign regarding the inspection timetable for vehicles, based on license plate numbers and widely indicate economic incentives such as toll reduction for certified vehicles; (v) an intensive training program and capacity building focusing on emission testing, data analysis, and reporting; (vi) an annual air quality monitoring program; (vii) media, nongovernment office, and community involvement; and (vii) establishment of an emission council for the province.

B. Ecological Environment

67. The proposed alignment does not cross or impinge on any protected areas or old growth forests. There are also no known endangered and/or rare species of flora or fauna in the project area. The Phoenix Hill and Wuqiang Brook at Yuanling, and the Taohuayuan Park near Changde City are more than 5 km from the alignment and will not be adversely affected by the Project.

68. In compliance with the PRC’s forestry law and ADB’s forestry policy, HPCD agreed to undertake compensatory planting of an equivalent or larger area for affected forest tree plantations. The program, which will be implemented in coordination with the Hunan Provincial Forestry Department, will be an integral part of each contract package and will have the following components (i) an inventory of the trees to be removed and approximate location with reference to the alignment; (ii) preparation of a vegetation replanting lay-out using a topographic map of the site indicating the approximate number of trees to be removed together with the planting location and number and species of trees to be replanted; this will be prepared for each construction area including access road; and a maintenance program detailing timeframe, logistical requirements and human resources support along, with specific responsibilities should also be provided. The revegetation work should be contracted out to local villages under the supervision of the chief construction engineer or each contractor’s designated staff.

69. Plantings must be maintained during the operating period. This will be done through regular watering, protection from grazing animals, and disease control. Trees outside the right-of-way but within the corridor of impact, including those replanted in erosion prone areas, will also need to be tended for at least 3 years, until they are mature enough to withstand seasonal climatic conditions.

C. Sociocultural Environment

70. Cultural Relics. To determine the presence of potential cultural relic sites, preliminary surveys will be conducted by the cultural relic authorities before any construction-related activities are implemented. Site clearing, excavations, and other earthworks will be closely monitored by local cultural bureaus. If an important site is unearthed, work will stop immediately and the matter will be promptly referred to the provincial and state level agencies for evaluation and decision on appropriate actions.
71. **Socioeconomic Environment.** The Project is not expected to have significant negative socioeconomic impacts as long as commitments made in the EIA and the resettlement plan are fully implemented in terms of relocation of affected people, reconstruction of homes removed, rehabilitation of degraded areas, and reestablishment of livelihood.

72. The anticipated economic impacts from the Project are increases in (i) profitability of cash crops and fruits, due to improved marketing opportunities; (ii) crops and livestock production, due to improved inputs of supply and technical services; and (iii) non-farm incomes, due to improved information service and travelling convenience. Other benefits as a result of the Project will be (i) improved access to social and production services, (ii) increased employment opportunities, and (iii) enhanced safety and reduced traffic congestions.

73. **Resettlement.** The Project will permanently occupy about 1,122 hectares of land. The temporary use of land will amount to 290 hectares. Nearly half (48.7%) of the land to be permanently acquired is currently under cultivation. Approximately 13,192 people will be affected. About 6,630 people who will lose all their land over which they now have a usufruct right. About 4,950 rural people in 1,275 households, will have their houses demolished with the floor space of their house/building totalling 341,424 square meters; and another 1,600 people in five schools and a forestry farm will also require relocation. (See Appendix 2).

74. Those losing land and assets will be compensated. The resettlement budget estimate of $51.6 million (CNY427 million) is included in the project cost estimates. The resettlement impact from the local road component is expected to be small. The compensation framework for local roads will be the same as that for the expressway. HPCD will fund the resettlement costs according to the standards set out in the draft resettlement plan. The Hunan Chang-Ji Expressway Construction Company Limited (CECC) will be the implementation agency in charge of the execution and coordination of land acquisition and resettlement. A land acquisition and resettlement coordination division will be established at each of the affected districts and counties.

75. Compensation will be paid for housing, and new housing will be made available before relocation takes place. The resettlement information booklet, together with provincial compensation rates, will be released to affected people through local government offices. The booklet contains sections on resettlement impacts, the resettlement policy, compensation rates and policies, organizational arrangements, consultation and participation, and grievance procedures. HPCD and CECC will be responsible for internally monitoring the resettlement process and for submitting reports to ADB according to the monitoring and evaluation plan in the resettlement plan. A regular reporting system will be established to ensure key resettlement activities are implemented on time. HPCD will engage a local institute to independently monitor the resettlement process. Further surveys will be done on completion of the resettlement and 1 year later, and the findings reported to HPCD and ADB.

76. **Environmental Impacts of Local Roads.** No realignment or significant reconstruction is planned for any of the local roads. The proposed widening and paving, from 6.5 m to a 8 m carriageway (class IV road), will all be done within the existing right-of-way and will not have any significant impact on the natural environment. The work will improve environmental conditions since sealing the roads will greatly reduce dust levels. These roads should provide poor remote communities in the townships of Taoyuan and Yuanling counties with reliable all weather access routes to markets and savings in travel time.
77. **Socioeconomic Impacts of Local Roads.** Local communities will benefit from employment opportunities during road construction. It has been assumed that all unskilled labor will come from villages close to the roads and that the construction will be labor intensive. During operation, there is a great potential for tourism development in the project area. With the completion of the local road upgrading, and through various promotion activities, an estimated 10–20% of the tourists who go to neighbouring Zhangjiajie will extend their trip to Yuanling in the project area. The local population is also expected to receive a large proportion of the benefits from tourism by providing local produce and unskilled staff to the service establishments, selling traditional handicrafts, and demonstrating local customs. Some of the indirect benefits that will accrue to residents in the project area due to better access from local road improvements are increased farming knowledge, better and cheaper farm implements and supplies, reduced risk of illness, better education, reliable access to medical and market facilities, and greater food security.

### VI. ECONOMIC ASSESSMENT

78. **Benefits.** Without the Project, the increasing traffic volumes in the corridor will lead to increased traffic congestion, reduced travel speed, and (most likely) higher accident rates. These will generate high vehicle operating costs (VOCs), increased maintenance costs, and increased health costs. The Project will reduce travel time because of shorter distances and higher speeds, reduce VOCs, and improve road safety and driving conditions. Through traffic diversion, the traffic conditions on the existing road will improve, thus generating additional VOC savings. The Project is economically viable, with a 17.6% economic internal rate of return. The results of sensitivity analysis confirm the robustness of project economic viability.

79. **Costs.** The total environmental costs (both capital and recurrent costs) are estimated at $59.8 million (CNY495 million), of which $51.1 million (CNY423 million) are engineering cost (mostly for erosion protection) and resettlement plan costs, and are included in the project cost estimate. Environmental capital and operating costs of the mitigation measures during construction are $58.5 million (CNY484 million), and the nonrecurring costs are estimated at $57.7 million (CNY478 million). The recurrent operating-period costs for 20 years are about $1.3 million (CNY11.1 million).

80. **Economic Analysis of Environmental Impacts.** The environmental benefits will come from lower dust levels due to sealing of local roads and reduced emission of vehicle fumes. Net vehicle emissions will be reduced and the air quality in the NR319 corridor will improve due to improved traffic flow and overall reduction in traffic volume on this road. Noise levels along NR319 will abate somewhat during operation of the Project. However, due to diversion of some road traffic to the expressway from NR319, noise levels will increase at some of the sensitive sites along the project road. To mitigate this impact, sound barriers will be installed or affected structures moved, which will require funding. The investment in environmental training for all people who are involved in the planning, construction, and operation of the Project will have a cumulative benefit in raising the environmental management and technical skills of HPCD and CECC staff and local communities. The benefits to be gained from implementing environmental controls $59.8 million (CNY495 million) during construction and operation, while these will have significant costs, will far outweigh the biophysical and economic implications arising from degradation of the environment if such expenditures are not allocated at all.
VII. ENVIRONMENTAL MANAGEMENT PLAN

81. The mitigation measures defined in the EIA and enhanced in the SEIA's EMP (Appendix 3) have been passed to the Hunan Provincial Highway Design Institute (HPDI), which is responsible for the detailed design work. HPDI must incorporate the preconstruction mitigation measures into the final design. This design plus the EMP will then be passed to CECC, which will prepare an EMP execution schedule. CECC will ensure that the contractors and the expressway operator comply with the EMP at all stages of the Project. CECC will include environmental specifications in the bidding documents and the contract documents for the successful contractors.

82. To ensure that contractors will comply with the provisions of the EMP, the following specifications should be incorporated in all construction bidding procedures: (i) a set of environmental prequalification conditions for potential bidders; (ii) a list of environmental items to be budgeted by the bidders in their proposal, and environmental evaluation factors for bid reviewers; (iii) environmental clauses for contract terms and conditions and specifications, which could be the EMP attached as an executable item in the contract; and (iv) an environmental covenant for insertion in the loan agreement, specifying the borrower's environmental responsibility based on the EMP.

A. Institutional Requirements

83. To undertake a credible environmental compliance monitoring program, the following four elements must be present within HPDI, CECC, their contractors, and local partners:

(i) administrative and managerial commitment to mitigation and monitoring;

(ii) a clear chain of command to deal with mitigation implementation and the application of fines in noncompliance situations;

(iii) skilled environmental monitors and analysts within CECC (could be contracted through the two environmental monitoring stations); and

(iv) a systematic and credible data collection, organization, and reporting system.

84. HPDI has at least one or two environmental specialists, while CECC has none. Training within these units will be implemented by HPCD. Training of CECC staff in environmental mitigation, monitoring, interpretation, and reporting methods will be essential and is budgeted for in the EMP. Additional funding is suggested for training and retaining staff to oversee and audit all mitigation work.

85. Monitoring of noise, air, and water quality should be contracted through the Hunan Provincial Environmental Monitoring Station. The contractor must ensure that mitigation measures are implemented and sustained throughout the construction period. In turn, CECC and its government counterparts at all levels must check that contractors have environmental skills and are aware of their environmental protection responsibilities. Therefore, CECC must confirm that the contractors' contract specifications contain environmental mitigation and monitoring responsibilities as defined in the EMP.
B. Monitoring

86. During the project design period, monitoring will ensure that design measures such as noise attenuation materials and facilities are specified for sensitive areas, bidding documents contain environmental requirements, and criteria for the selection of qualified contractors are clearly defined and followed. HPDI will submit a preconstruction mitigation completion report to ADB before the end of the design period.

87. During construction, compliance monitoring should be completed as the work is carried out. During the first 2 years of construction, monitoring should be monthly (using a monitoring checklist) and an independent expert should complete audits once every 3 months. Thereafter, and if all has gone well, monitoring should occur every 4 months and audits will be completed semiannually. Reporting to ADB should be done at least twice a year.

88. Within 6 months of completing the construction work, CECC’s Technical Department must provide a construction mitigation completion report to CECC’s chief construction engineer and to ADB. The report should indicate the extent and success of mitigation completed and the maintenance and monitoring needs during operations.

89. Operating period monitoring will focus on maintaining mitigation measures initiated during the construction period, sampling noise, and testing vehicle emissions. These results will be used to enhance future mitigation measures. Annual operating-period environmental reports will be discussed with CECC and local environmental protection bureaus.

VIII. PUBLIC INVOLVEMENT AND DISCLOSURE

90. Various public meetings have been held in the course of the feasibility study and EIA preparation. From January 2000 to April 2001, about 80 individuals, consisting of farmers and local government and factory representatives, were consulted by HPCD, HPDI, and officials at the prefecture and county levels to gather inputs for the project engineering feasibility study. The focus was on collection of socioeconomic information; estimation of project impact on villages, structures, and farmlands and how these can be minimized; assessment of the level of awareness on the proposed project; and determination of future development plans in the project area. For the project preliminary design, more than 150 people from affected villages were interviewed by HPDI and the Highway Design Institute, with assistance from the local government and village committees. The interviews were conducted from November 2001 to November 2002 to identify and quantify impacts on land, structures, and trees; discuss design issues; raise local awareness of the project and its likely impacts; and discuss frequency and suitability of underpasses and overpasses. The socioeconomic survey for the preparation of the resettlement plan was conducted by the project preparatory technical assistance consultants and Hunan University from May to July 2003. A total of 1,120 respondents were interviewed regarding compensation and relocation issues as well as on their attitudes toward the proposed expressway. Findings indicated overwhelming support for the project. In August 2003, consultations were again conducted, involving 160 people, including village leaders, local residents, and school heads. Inputs were gathered for rehabilitation/relocation plans for affected villages.

91. The perception survey was conducted from September to August 2003. About 200 individuals (selected from all administrative levels, and including peasants, workers, government
offices, teachers, etc.) were given forms and 175 people responded. The major opinions and concerns of the respondents are summarized as follows:

(i) all indicated support for the Project and considered it a necessity;
(ii) 92% of the respondents agreed with the location of the alignment;
(iii) 92% of the respondents considered the road would be economically beneficial;
(iv) 90% of the respondents agreed to give up their land or remove house if needed, however 56% of respondents did not know the land acquisition and compensation policy of highway construction; about 70% of the respondents would agree to the government arrangements and the rest 30% would agree with added preconditions;
(v) 66% of the respondents consider the main pollution impacts will be noise (66%), dust (30%), vehicle emission (19%), and others (4%); and
(vi) 75% of the respondents considered tree planting as the main environmental mitigation action to reduce the impact of road construction.

About 20% of the respondents made suggestions, including

(i) reduction of the land taken to the minimum and readjusting the farmland to compensate for areas acquired for the road right-of-way,
(ii) the compensation policy should be open to the public, and
(iii) the local labour force should be used as much as possible for the road construction.

93. While the respondents expressed full support to the Project, the survey results show that they have little knowledge about land acquisition and resettlement compensation policies. The EIA recommended that the proponent, through local governments, properly inform the local residents of pertinent resettlement policies and compensation criteria to alleviate their concerns and to promote awareness on the Project. More extensive public involvement was implemented during the preparation of the resettlement plan. During the detailed design period, consultation concerning the siting of pedestrian underpasses and relocation/restoration of irrigation ditches should be discussed with local communities.

94. After approval, the EIA will be made available for public review at the Hunan Province Communications Bureau, the Hunan Environmental Protection Bureau (EPB), and public libraries. Changde EPB maintains a 24-hour telephone “hotline” for complaints about environmental problems. Huaihua and Yuanling EPBs also maintain hotlines.

IX. CONCLUSIONS

95. The predicted adverse effects of the proposed expressway alignment will be minimized and reduced to an acceptable level when the prescribed mitigation and monitoring actions are implemented. There will be minor residual effects, but they will be offset by the long-term economic benefits in the project area and the province. The required land acquisition and resettlement have been minimized through a careful selection of the expressway alignment. A resettlement plan has been prepared and will serve as the guiding document for resettlement.

---

8 The total percentage is more than 100% because some people select more than one option.
implementation and payment of compensation to the affected people, to ensure that they will maintain their status or will be better off with the Project.

96. The environmental gains from the Project include (i) reduction in vehicle emissions, particularly dust, sulfur dioxide, carbon monoxide, and nitrogen oxides; (ii) reduction in dust levels through paving of local roads; and (iii) greatly improved environmental technical skills at the operating levels and reinforced environmental awareness among HPCD and CECC staff, thus bringing long-term benefits and a more environmentally responsible provincial communications department. The Project will also have a positive economic impact on the project area, providing better access to markets; social services; employment opportunities; and a convenient, congestion-free travel route for many.

97. Given the potential risks of erosion and landslides, slope protection and stabilization measures will be implemented to minimize erosion, protect the neighboring population and road users, and eliminate risks of damage to the expressway structures and to private and public property. The rehabilitation of borrow pits and quarries, maintenance of access roads to the work sites, restoration of temporary construction roads and tracks, and disposal of surplus materials and debris will be the responsibility of the civil works contractors. Local knowledge of the water and soil conditions and vegetative cover will enable local communities to participate in revegetation design, planting, and maintenance. The required environmental protection measures and structures as well as implementation requirements will be included in the contractual documents. To ensure compliance with EIA and EMP requirements during the construction period, an adequate monitoring and evaluation system will be developed and implemented under the supervision of the provincial EPB. The expressway company, in liaison with the provincial environmental agencies concerned, will be responsible for monitoring environmental impacts during expressway operation.
SUMMARY EROSION PROTECTION PLAN

1. The alignment of the proposed Changde-Jishou expressway will pass through a government-declared soil erosion prevention area. To minimize soil erosion due to project implementation, a soil erosion protection plan (SEPP) specific to the project was prepared by the Highway Scientific Research Institute of the Ministry of Communications. The SEPP recommends engineering solutions and vegetative measures to mitigate soil erosion in the following areas.

2. **Pavement Works.** Soil erosion on pavement mainly occurs prior to placement of base layer. To prevent soil erosion during this stage, drainage will be provided to divert surface run-off. When excavation or fill of highway subgrade is rolled to the design elevation and asphaltic concrete has been laid, soil erosion will no longer occur.

3. **Tunnel Works.** Before tunnels are excavated, a drainage system will be installed at the tunnel portal. Temporary spoil stockpiles will be adequately protected with gravel layer and sand bags.

4. **Borrow Sites and Waste Sites.** Protective works for borrow and waste sites were considered during preliminary design. Soil erosion at borrow sites will be prevented mainly by revegetation using grasses and trees after the area has been leveled. Waste sites will be initially protected by installing retaining walls and drainage ditches. Vegetation cover will be provided during rehabilitation phase when slopes of disposal sites have been finalized to a stable angle.

5. **Construction Site and Construction Access Road.** Temporary access roads will mostly be in mountainous areas. These will be provided with 50 centimeters wide by 50 centimeters deep drainage ditches to divert run-off. Upon completion of construction works, temporary roads will be provided with vegetative cover. Drainage facilities will be installed in construction sites before these are used. Sand bags will be placed around stockpiles. For large construction sites, settling ponds will be installed to reduce sediment levels of surface run-off.

6. The proposed monitoring program, costs and implementation schedule of the SEPP are presented in the following tables.
<table>
<thead>
<tr>
<th>Protective Zone</th>
<th>Monitoring Content</th>
<th>Monitoring Method</th>
<th>Time and Frequency</th>
<th>Monitoring Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Site</td>
<td>Amount of waste soil and rocks</td>
<td>Site investigation</td>
<td>Once after completion of soil waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change in soil erosion area</td>
<td>Site investigation</td>
<td>Once in rainy season per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change in soil erosion amount</td>
<td>Location survey</td>
<td>Once in rainy season per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change in soil erosion degree</td>
<td>Location survey</td>
<td>Once in rainy season per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damage to surrounding area and its trend</td>
<td>Site investigation</td>
<td>Once in rainy season per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number and quality of preventive measures</td>
<td>Site investigation</td>
<td>Once after completion of construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Survival rate, growth situation, and coverage degree of planting measures</td>
<td>Site investigation and location survey</td>
<td>Once per year after implementation of planting measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stability and appropriateness of protective works</td>
<td>Site investigation</td>
<td>Once per year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil retarding effect</td>
<td>Site investigation</td>
<td>Once per year</td>
<td></td>
</tr>
</tbody>
</table>

|                  | Borrow Site                                                                          | Site investigation                 | Once after completion of earth borrow |                     |
| Subgrade Side Slope | Change of soil erosion area                                                          | Site investigation                 | Once in rainy season per year     |                     |
|                  | Change of soil erosion amount                                                        | Site investigation                 | Once in rainy season per year     |                     |
|                  | Change of soil erosion degree                                                        | Site investigation                 | Once in rainy season per year     |                     |
|                  | Damage to surrounding area and its trend                                             | Site investigation                 | Once in rainy season per year     |                     |
|                  | Survival rate, growth situation, and coverage degree of planting measures           | Site investigation and location survey | Once per year after implementation of planting measures |                   |

|                  | Subgrade Side Slope                                                                  | Site investigation                 | Once in rainy season per year     |                     |
|                  | Change of soil erosion area                                                          | Site investigation                 | Once in rainy season per year     | km98.000 to km99.000 is selected as typically representative of high side slope excavation section |
|                  | Change of soil erosion amount                                                        | Location survey                    | Once in rainy season per year     |                     |
|                  | Change of soil erosion degree                                                        | Location survey                    | Once in rainy season per year     |                     |
|                  | Damage to surrounding area and its trend                                             | Site investigation                 | Once in rainy season per year     | km4.500 to km5.500 is selected as typically representative of fill section |
|                  | Survival rate, growth situation, and coverage degree of planting measures           | Site investigation and location survey | Once per year after implementation of planting measures |                   |
|                  | Stability and appropriateness of protective works                                     | Site investigation                 | Once per year                   |                     |

Waste sites at km58.550, right 550 m; km179.500 left 400 m; and km89.200.
## ENVIRONMENTAL COSTS

<table>
<thead>
<tr>
<th>Phase</th>
<th>Environmental Protection Measures</th>
<th>Unit Cost (CNY)</th>
<th>Total Cost (CNY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preconstruction</td>
<td>1. Preparation of soil erosion protection plan</td>
<td>400,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Construction</td>
<td>2. Preparation of implementation plan for mitigation measures and monitoring</td>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>3. Provision of one environmental technician per contractor</td>
<td></td>
<td>210,000</td>
</tr>
<tr>
<td></td>
<td>4. Planting of trees and grasses on road side, slope and median along 173 km corridor</td>
<td>200,000/km</td>
<td>34,600,000</td>
</tr>
<tr>
<td></td>
<td>5. Greening at 7 interchanges</td>
<td>1,000,000</td>
<td>7,000,000</td>
</tr>
<tr>
<td></td>
<td>6. Provision of cover for haul trucks and material storage sites</td>
<td></td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td>7. Relocation of 10 farmhouses due to high noise levels</td>
<td>30,000/home</td>
<td>300,000</td>
</tr>
<tr>
<td></td>
<td>8. Relocation of 1 school dormitory due to high noise levels</td>
<td>200,000/dormitory</td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td>9. Erosion protection measures and water conservation engineering</td>
<td></td>
<td>379,639,460</td>
</tr>
<tr>
<td></td>
<td>10. Rehabilitation of borrow and spoil storage sites</td>
<td></td>
<td>46,714,360</td>
</tr>
<tr>
<td></td>
<td>11. Sewage treatment facilities and provision of rubbish storage bins at work camps</td>
<td>100,000/civil contract package</td>
<td>2,100,000</td>
</tr>
<tr>
<td></td>
<td>12. Personnel training for highway construction units, management units, emergency units</td>
<td></td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>13. Personnel training for environmental protection units</td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>Operation</td>
<td>14. Environmental monitoring during construction</td>
<td>100,000/yr for 3 years</td>
<td>300,000</td>
</tr>
<tr>
<td></td>
<td>15. Preparation of implementation plan for mitigation measures and monitoring</td>
<td>85,000</td>
<td>85,000</td>
</tr>
<tr>
<td></td>
<td>16. Sewage treatment facilities at toll gates, service areas, management station, and parking areas</td>
<td>400,000/station</td>
<td>3,600,000</td>
</tr>
<tr>
<td></td>
<td>17. Rubbish storage bins at toll gates, service areas, management station, and parking areas</td>
<td>15,000/station</td>
<td>270,000</td>
</tr>
<tr>
<td></td>
<td>18. Preparation of toxic and hazardous materials spill prevention plan</td>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>19. Environmental monitoring during operation</td>
<td>100,000/yr for 20 years</td>
<td>2,000,000</td>
</tr>
<tr>
<td></td>
<td>20. Noise reduction measures that may be needed by 2014</td>
<td></td>
<td>2,000,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>480,418,820</strong></td>
</tr>
</tbody>
</table>
SUMMARY RESETTLEMENT PLAN

A. Project Area and Impact

1. Land acquisition and resettlement impacts were minimized by aligning the expressway away from dense populated areas and avoiding irrigated land and facilities, where possible. Consultations were held with local officials. Efforts to minimize resettlement impacts resulted from consultations with local officials.

B. The Resettlement Plan

2. The resettlement plan has been prepared by the Hunan Expressway Construction and Development Co. Ltd. (HECC) under the assistance of the project preparatory technical assistance consultants. This resettlement plan relates almost entirely to the Chande-Yuanling Section of Changde-Jishou Expressway component and 12 kilometers of interconnector roads of the project. The project preliminary study formed the core base for the resettlement plan, and the impact data used was the survey data from Hunan Design Institute, which has a high reliability. The resettlement socioeconomic survey covering 657 households and 56 villager-level interviews provided robust base for the formulation of the resettlement plan. The draft resettlement plan has been reviewed by the affected district and counties and by the Asian Development Bank (ADB), and these comments have been incorporated into the resettlement plan by HECC. The detailed measurement survey has been carried out to determine the precise number of affected people. The results are being tabulated and any changes will be incorporated in the final resettlement plan, including cost implications. Consultations were conducted with the affected people, and their comments and suggestions were reviewed by HECC to ensure that any concerns are addressed.

C. Policy Framework and Compensation

3. For people unavoidably affected by the Project, the resettlement objective is to ensure attainment of equal or better livelihoods and living standards in line with the Land Administration Law (1998) of the People’s Republic of China (PRC) and ADB’s Policy on Involuntary Resettlement (1995) and Indigenous People’s Policy (1998). The resettlement plan is also based on the Implementation Measures for the Land Administration Law of PRC in Hunan Province (2000) and the Management Measures on Temporary Land Occupation, Hunan People’s Government, order no. 140 (2001). HECC will ensure that any people losing land, housing, other assets, or other means of production will be assisted in restoring their incomes and living standards to at least the levels without the Project’s intervention. Lost assets will either be replaced or their owners compensated at replacement cost.

4. The current resettlement plan draft also stipulates generic eligibility/entitlement provisions for project-affected people losing land, houses, and income and provides rehabilitation subsidies. Permanent land losses are compensated either through land reallocation within the villagers’ group or through cash payments to the collective at rates of 8 times the average annual output value. Temporary land losses will be directly paid to the affected people at a rate stipulated as per the resettlement plan. House losses will be directly paid to the affected people in cash at replacement cost free of demolition expenses and salvaged materials. Crops and tree losses will be directly paid to the affected people in cash at rates stipulated in the resettlement plan. Each resettled household will also receive allowances for transport costs, work loss, transfer costs, medical expenses, and temporary housing.
D. Relocation Site Development and Rehabilitation Assistance

5. The relocation site selection should be planned comprehensively with the income restoration plan and the township rural overall planning. Generally, there are three options for residential resettlement site selection: (i) for villages where less than 10 households are involved in house relocation (light impact), the new housing sites will be selected within the same village/land-owning group; (ii) if more households are involved in relocation, but there is enough land for their livelihood (intermediate impact), a site suitable for clustered buildings will be selected with the consideration of farmers convenience; (iii) villages with a serious relocation impact will be replanned by both the township government and villages. Along the Chang-ji Expressway alignment, no enterprise structures will be lost because few enterprises are near the alignment. Five schools and one forestry farm will be affected, and general relocation plans have been prepared.

6. Proposed income rehabilitation measures are to (i) incorporate the resettlement into a local village economic development program, such as land redistribution and irrigation system improvement and expansion; (ii) establish small businesses and enterprises based on local resource endowment; (iii) raise cash crops, animals, and fish; and (iv) invest in social infrastructure. Under the above categories, detailed needs for farmers to promote their working skills have been analyzed through the social economic survey and relevant training will be planned. For the vulnerable groups, a special social assistance fund will be provided by the Project to secure their livelihood.

E. Implementation Framework and Budget

7. The Hunan Provincial Communication Department will be responsible on behalf of the Hunan Provincial Government for the general administration of project implementation and monitoring of the work to complete the project. The Changde-Jishou Expressway Construction and Development Co. Ltd. (CECC) will be in charge of implementing the project and of land acquisition and resettlement (LAR) to resolve problems vital for the implementation. A LAR division will be set up within CECC. LAR coordination offices will be established in each affected district and county. The office will headed by a district leader and consist of 5–8 members from different government departments, particularly the land administration, municipal construction, environment protection department, and usually one from each department. Each affected township will have a LAR office consisting of four people, and each village committee will appoint at least one person to join and provide assistance to the LAR work and to carry out the economic rehabilitation plan together with the township government and village committee. HECC has already established a leading group for project implementation. So far the leading group has started coordination and internal policy circulation work for the project LAR.

8. LAR costs for section covered by the ADB loan (Changde-Shuxikou) are estimated at $51.6 million (CNY427 million), including compensation for land and buildings, income restoration assistance, repair of infrastructure, management costs, monitoring, taxes, and contingencies.

F. Stakeholder Participation, Disclosure of Resettlement Plan, and Grievances

9. At various stages of the project planning, affected people have been informed and consulted about the likely impacts of the project. Stakeholders consulted include (i) heads of households to be affected, (ii) village heads and villagers’ representatives, (iii) local government
agencies and departments, and (iv) women and other vulnerable groups. The consultation will continue through the project implementation period.

10. The draft resettlement plan prepared by HECC has been discussed with local governments and stakeholders for their input on the policy in general and adequacy of the mitigation measures in particular. Further, HECC organized public consultation meetings in each affected district and county. Key findings of the consultation indicate significant support for the Project. Some of the concerns raised will be addressed by adjusting the road design and improved compensation and resettlement policy measures and entitlements. The final resettlement plan will be summarized as a booklet and disclosed after approval from ADB and local government. A working organization for resettlement consisting of officials from the Land Administration Bureau and related departments, will implement the resettlement plan, and claims will be reviewed and resolved within 3 weeks.

G. Project Monitoring and Evaluation

11. The resettlement plan will have both internal and external monitoring. HECC will take overall responsibility for project monitoring during the implementation phase. CECC will carry out internal monitoring of land acquisition and resettlement so as to guarantee timely and well-done land acquisition and resettlement works following the resettlement plan and to protect the interest of the affected people. The following activities will be monitored: (i) compensation payments, (ii) house rebuilding and relocation of affected people, (iii) land redistribution, and (iv) grievance redress. Progress reports will be prepared by CECC and submitted to ADB on a quarterly basis until resettlement is completed. CECC will then prepare a resettlement completion report for submission to ADB.

12. An institute or organization, independent of the Hunan Provincial Communication Department and the local governments along the alignment, will be contracted to carry out the external monitoring and evaluation work under this resettlement plan. A preferred candidate for this task is an organization with experience in monitoring work for international agencies. The tasks include (i) review and verification of the compensation payments; (ii) status of land acquisition and payments on land compensation; (iii) assessment of the disbursement of compensation procedure; (iv) appraisal of the grievance procedure; (v) Affected people’s reaction/satisfaction with the entitlements and compensation; (vi) assessment of the restoration of livelihoods of affected persons; and (vii) determination of lessons for future policy implementation, formulation, and planning. The external monitoring will be carried out every 6 months in the first 2 years, and then annually for 2 years or until resettlement is deemed successful. The monitoring findings will be presented in reports to CECC in Chinese and to ADB in English.
## ENVIRONMENTAL MANAGEMENT ACTION PLAN

<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preconstruction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Erosion Protection and Conservation</td>
<td>The SEPP has been prepared. This will be updated to match the detailed design.</td>
<td>Legal requirement</td>
<td>Throughout the project corridor</td>
<td>HPDI and CECC $48,326 (CNY400,000)</td>
<td>Before construction starts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of Trees</td>
<td>Before any ground is broken, a vegetation replanting layout will be developed for the site on a topographic map, showing replanting areas, type of plantings, and maintenance program to be undertaken. Use the SEPP as a guide.</td>
<td>Legal requirement</td>
<td>ROW width of ≈ 50 m</td>
<td>Contractors in consultation with local forestry department and local communities</td>
<td>Before ground breaking for construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking of Land and Property</td>
<td>Information dissemination and community consultation about the entitlements will be based on the Land Administration Law. All relocation and resettlement activities must be completed before construction starts in any road subsection. Compensation will occur as per the RP.</td>
<td>RP and project requirement</td>
<td>The ROW as defined in the RP</td>
<td>County-level communications department $51.6 million (CNY427 million)</td>
<td>Before construction starts on any contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility Relocation</td>
<td>All utilities will be relocated with prior approval of the agencies concerned.</td>
<td>Contract specifications</td>
<td>Refer utility relocation drawings</td>
<td>County communications department and contractors</td>
<td>Before construction starts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of Community Utilities</td>
<td>All community utilities such as community water source pipes will be replaced at appropriate and suitable locations.</td>
<td>RP requirement</td>
<td>Any water within construction zone</td>
<td>County communications department and contractors</td>
<td>Before construction starts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relocation of Ancestral Tombs</td>
<td>Community meetings will be held to pinpoint tombs and identify relocation sites. Relocation should be completed before construction starts.</td>
<td>RP and contract specifications</td>
<td>To be defined as part of detailed design surveys</td>
<td>County communications department and contractors</td>
<td>Before construction starts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relocation of Irrigation Systems</td>
<td>Relocation of the canals will be discussed and agreed upon with village.</td>
<td>Contract terms and conditions,</td>
<td>Any irrigation system located within</td>
<td>County communications department and contractors</td>
<td>Before construction starts and</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CECC = Chang-Ji Expressway Construction Company, EIA = environmental impact assessment, HPDI = Hunan Provincial Highway Design Institute, m = meter, RP = resettlement plan, ROW = right-of-way, SEPP = soil erosion protection plan, WRB = Water Resources Bureau.

1. The project site covers areas beyond the right of way such as borrow areas, access roads, service roads, and equipment storage sites.
2. Time frame refers to the duration or instant of time when the mitigation measures will be taken.
<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Protection Training</td>
<td>(i) Before construction starts, training in environmental mitigation management protection will take place. (ii) On-the-job training of monitoring technicians and specialists will occur for air, noise, and water quality monitoring.</td>
<td>Contract terms and conditions, EIA</td>
<td>and RP construction zone or affected by the construction</td>
<td>contractors</td>
<td>before the irrigation season gets under way</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Specifications for Contractor Prequalification; Technical Specifications; Environmental Clauses for Contracts; and Loan Covenants</td>
<td>(i) To assure environmental credibility among contractors, prepare environmental prequalification specifications to be included in the prequalification package to contractors. (ii) Prepare an environment section in the TOR for bidders. (iii) Prepare environmental contract clauses for contractors, namely the special conditions and terms and conditions, e.g., reference EMP and monitoring table. (iv) Prepare covenants for loan agreement as defined in the EMP.</td>
<td>SEIA and EIA</td>
<td>Entire project</td>
<td>For items (i)-(iii) HPDI in consultation with CECC For items (iv) CECC in consultation with HEMS and HEPB</td>
<td>Before construction begins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Screening of New Construction Site Access Roads</td>
<td>(i) Each contractor will complete environmental screening of any new access road and provide a list of mitigative measures to be completed. (ii) Prepare a sketch map of all existing roads to be used as access routes to construction sites.</td>
<td>EIA</td>
<td>Construction sites, especially tunnel portals, viaducts, and remote road sections</td>
<td>Contractor working with HEPB</td>
<td>Before ground breaking</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Topsoil</td>
<td>(i) Stockpiles of topsoil will be maintained in accordance with the SEPP and Agriculture Department specifications.</td>
<td>Soil Erosion Protection Law, No. 49-‘91 and Reg. No. 120 of PRC</td>
<td>Throughout the project corridor and all borrow and spoil areas</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Ensure that the method of stockpiling materials, use of plants, and siting of temporary buildings or structures do not adversely affect the stability of excavation or fills.</td>
<td>Contract specifications</td>
<td></td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction of Soil</td>
<td>(i) Construction vehicles, machinery, and equipment will move or be stationed in designated areas. (ii) Ensure that the method of stockpiling materials, use of plants, and siting of temporary buildings or structures do not adversely affect the stability of excavation or fills.</td>
<td>Contract specifications</td>
<td>Throughout project corridor and all temporarily used areas; at all cut and fill sites</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haphazard Borrowing of Rock</td>
<td>(i) Borrowing within the ROW is prohibited under this contract. (ii) The contractor will facilitate inspection of all borrow areas by HEPB and WRB and satisfy CECC within HPCD of compliance with SEPP and MEMP. (iii) No soil or aggregates will be borrowed from or spoil dumped on tomb or graveyard sites.</td>
<td>Contract specifications</td>
<td>Throughout project corridor and all construction sites</td>
<td>Contractor</td>
<td>During Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) The contractor will facilitate inspection of all borrow areas by HEPB and WRB and satisfy CECC within HPCD of compliance with SEPP and MEMP.</td>
<td>Contract specifications</td>
<td></td>
<td>Contractor</td>
<td>During Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degradation of Borrow Areas</td>
<td>Borrow pits will be redeveloped as per details found in the site operation plan, the SEIA, and within the SEPP.</td>
<td>FIDIC: 13.1, 26.1 PRC Law: 49-‘91 and Reg. No. 120</td>
<td>All borrow areas</td>
<td>Contractor</td>
<td>During construction</td>
<td>$5,643,739 (CNY46,714,360), inclusive of costs for site survey and design, supervision, monitoring, construction</td>
<td></td>
</tr>
</tbody>
</table>

CECC = Chang-Ji Expressway Construction Company, FIDIC = Fédération Internationale des Ingénieurs Conseils, HEPB = Hunan Environmental Protection Bureau, HPCD = Hunan Provincial Communication Department, MEMP = mitigation measures execution and monitoring plan, PRC = People’s Republic of China, ROW = right-of-way, SEPP = soil erosion protection plan, SEIA = summary environmental impact assessment, WRB = Water Resources Bureau.
<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Erosion and Siltation</td>
<td>(i) On road embankment slopes, slopes of all cuts, etc., shrubs and grass will be planted according to the SEPP. (ii) To control soil erosion and siltation stemming from earthwork operations, the following well-known measures should be applied: berms, dikes, sediment basins, fiber mats, mulches, grasses, and slope drains.</td>
<td>Design requirement PRC Law: 49-'91 and Reg. No. 120</td>
<td>Within construction corridor and all construction sites; all borrow and spoil areas; service roads and equipment storage sites, etc.</td>
<td>Contractor $45.9 million (CNY379.6 million) for construction of drainage, subgrade protection, side slope protection, retaining wall and water conservation engineering</td>
<td>During construction</td>
<td>Design requirement PRC Law: 49-'91 and Reg. No. 120</td>
<td>During construction</td>
</tr>
<tr>
<td>Contamination of Soil by Fuel and Lubricants</td>
<td>(i) Vehicle, machinery, and equipment maintenance and refuelling will be carried out such that spilled materials do not seep into the soil. (ii) Fuel storage and refilling areas will be at least 300 m from drainage structures and important water bodies. (iii) Fuel storage and refuelling areas, if in agricultural land or areas supporting vegetation, will have topsoil stripped, stockpiled, and returned after completion of refuelling activities. (iv) Oil traps will be provided for service areas, toll station areas, parking areas, and within drainage systems for bridges.</td>
<td>Contract terms and conditions FIDIC: 19.1(iii)</td>
<td>Throughout project corridors, all access roads, sites temporarily acquired, and all borrow areas</td>
<td>Contractor</td>
<td>During construction</td>
<td>FIDIC: 19.1(iii)</td>
<td></td>
</tr>
<tr>
<td>Contamination of Soil by Construction Material Wastes</td>
<td>(i) All spoils will be disposed of. (ii) All waste material will be completely disposed.</td>
<td>FIDIC: 32.1</td>
<td>Throughout project corridors, all access roads, sites temporarily acquired, and all borrow areas</td>
<td>Contractor with monitoring by HEMS</td>
<td>During construction</td>
<td>FIDIC: 32.1</td>
<td></td>
</tr>
</tbody>
</table>

FIDIC = Fédération Internationale des Ingénieurs Conseils, HEMS = Hunan Environmental Monitoring Station, m = meter, PRC = People’s Republic of China, SEPP = soil erosion protection plan, SEIA = summary environmental impact assessment.
### Environmental Impact/Issue Mitigative Measure(s)

<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/ Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Water Sources</td>
<td>Any source of water (potable or otherwise) for the community such as wells and ponds, incidentally lost, will be replaced immediately.</td>
<td>RP requirement</td>
<td>Throughout project corridors, all access roads, sites temporarily acquired, and all borrow areas</td>
<td>Contractor</td>
<td>Whenever encountered during construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flooding</td>
<td>Prevent temporary or permanent flooding of the site or any adjacent area.</td>
<td>FIDIC: 19.1 (iii) FIDIC: 29.1 and contract terms and conditions</td>
<td>Project corridors, access roads, sites temporarily acquired, and borrow areas</td>
<td>Contractor</td>
<td>During construction and the defects liability period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siltation into Water Bodies</td>
<td>Cofferdams will be constructed prior to bridge footings or pile drilling commencing in any major watercourse.</td>
<td>FIDIC:19.1 (iii)</td>
<td>See clause 2.1.6</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revegetation to Prevent Erosion and Siltation</td>
<td>Revegetation will be done immediately after construction ceases at a site, and no tree or vegetation other than those approved for removal by the provincial forestry department will be cut.</td>
<td>FIDIC: 19.1 (iii) PRC Law: 49-'91 and Reg. No. 120</td>
<td>Entire project corridors, access roads, and temporary sites</td>
<td>Construction contractor and local unit retained to do replanting $4.2 million (CNY34.6 million) for planting of trees and grass for 173 km $0.8 million (CNY7 million) for greening at 7 interchanges</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alteration of Drainage</td>
<td>(i) In sections along watercourses, earth, stone or any other construction materials will</td>
<td>FIDIC: 19.1 (iii)</td>
<td>Project corridors, access roads, sites</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CECC = Chang-Ji Expressway Construction Company, FIDIC = Fédération Internationale des Ingénieurs Conseils, HEMS = Hunan Environmental Monitoring Station, HEPB = Hunan Environmental Protection Bureau, km = kilometre, PRC = People’s Republic of China, RP = resettlement plan.
<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
</table>
| Depletion of Karst-Groundwater Formations | (i) All measures will be taken to prevent contamination by the wastewater produced in construction, as directed by CECC.  
(ii) Construction work close to the streams or water bodies will be avoided during rainy periods.  
(iii) The discharge standards promulgated under PRC regulation GB: 8978–1996 will be strictly adhered to. | FIDIC: 19.1 (iii)  
FIDIC: 26.1  
GB: 8978-1996 | Throughout project corridors and at associated worksites | Contractor with monitoring assistance from the HEMS | During construction |
| Contamination of Water from Construction Wastes | (i) All measures will be taken to prevent contamination by the wastewater produced in construction, as directed by CECC.  
(ii) Construction work close to the streams or water bodies will be avoided during rainy periods.  
(iii) The discharge standards promulgated under PRC regulation GB: 8978–1996 will be strictly adhered to. | FIDIC: 19.1 (iii)  
FIDIC: 26.1 | Throughout project corridors and at associated worksites | Contractor | During construction |
| Contamination from Petrochemicals | Waste petrochemicals must be collected, stored, and taken to approved disposal sites in compliance with PRC guidelines. | FIDIC: 19.1 (iii)  
FIDIC: 26.1 | Throughout project corridors and at associated worksites | Contractor | During construction |
| Sanitation and Waste Disposal in Construction Camps | (i) Laborers’ camps will be at least 200 m from the nearest habitation.  
(ii) The sewage system for the construction laborers’ camps will be properly designed, built, and operated.  
(iii) Arrangements for proper disposal of excreta must be made. | FIDIC: 19.1(iii)  
See FIDIC: 26.1 | All construction workers’ camps | Contractor  
$0.2 million (CNY2.1 million) or (CNY100,000)/civil contract package | During establishment, operation, and dismantling of such camps |
| Generation of Dust | (i) Vehicles delivering granular and/or fine materials to the site will be covered. | FIDIC 19.1(iii)  
See FIDIC: 26.1 | Throughout project corridors, access roads,  
Contractor with monitoring assistance from HEMS. | During Construction. | 

<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/ Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) Materials storage site should be 300 m from residential areas and covered with canvas or sprayed with water. (iii) Water will be sprayed on construction sites and major feeder roads twice a day during dry season. (iv) Dust from work sites, machinery (rock crushing), and equipment will not exceed 2.0 mg/m³ within 150 m from the work sites. (v) Where practical, dust screening vegetation will be planted along perimeter of all existing roadside crushers.</td>
<td>PRC - GB: 14761.7-93 Throughout project corridor, access roads, sites temporarily acquired, and borrow areas</td>
<td>Contractor, via HEMS</td>
<td>During construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission from Construction Vehicles, Equipment, and Machinery (i) The discharge standards under the Environment Protection Law, 1989 will be strictly adhered to in compliance with PRC-GB:14761.7-93. (ii) An inspection certification will be initiated.</td>
<td>PRC-GB: 12523-90 FIDIC: 26.1 FIDIC: 19.1 FIDIC: 45.1</td>
<td>Contractor with monitoring assistance from HEMS</td>
<td>During construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Pollution</td>
<td>Noise from Vehicles, Plants, and Equipment (i) The equipment and machinery used in construction will strictly conform to PRC and local noise standards, i.e. GB 12523-90. (ii) At construction sites within 150 m of the nearest habitation, noisy construction work will be stopped between 2200 hours and 0600 hours.</td>
<td>FIDIC: 19.1 FIDIC: 45.1</td>
<td>Throughout project corridor, access roads, sites temporarily acquired, and borrow areas</td>
<td>Contractor with monitoring assistance from HEMS</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise from Blasting Operations (i) Blasting will be carried out only with permission of the CCE of CECC, using a preestablished schedule. (ii) Blasting mats will be used to reduce noise levels when blasting is carried out.</td>
<td></td>
<td>All blasting sites</td>
<td>Contractor with monitoring assistance from HEMS</td>
<td>During preparation, operation, and closure of such sites</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CECC = Chang-Ji Expressway Construction Company, CCE = construction chief engineer, m³ = cubic meter, FIDIC = Fédération Internationale des Ingénieurs Conseils, HEMS = Hunan Environmental Monitoring Station, m = meter, mg = milligram, PRC = People’s Republic of China.
<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erection of Noise Attenuation Structures</td>
<td>Noise attenuation structures will be placed immediately. All such mitigative measures will be inspected by CECC and Local EPBs in response to surpassing the 75 dB(A) level.</td>
<td>SEIA</td>
<td>At nominated sites as designated in the EIA</td>
<td>Contractor with monitoring assistance from HEMS</td>
<td>Before closure of the construction sites</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Impact on Flora**

- Loss of or Damage to Vegetation
  - (i) All works will be carried out in such a fashion that damage or disruption to flora is minimized.
  - (ii) It is prohibited to borrow soil from or dump spoil outside those sites nominated in the construction design and SEPP.

<table>
<thead>
<tr>
<th>Impact on Fauna</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss, Damage to Fauna</td>
<td>Construction workers will be instructed to protect natural resources, fauna, and flora; no harvesting of wild food will be possible unless by permit from the CCE of CECC.</td>
<td>FIDIC: 19.1 (iii)</td>
<td>Entire project area</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Health and Safety Aspects**

- Spread of HIV/AIDS and STIs
  A prevention/education program will be implemented concurrently with the project implementation. Information centers will be established at each construction site.

<table>
<thead>
<tr>
<th>Health and Safety Aspects</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Access</td>
<td>At all times, the contractor will provide safe and convenient passage for vehicles, pedestrians, and livestock to and from side roads, and property access connecting the project road.</td>
<td>As specified in RP documents FIDIC: 29.1</td>
<td>All project corridor and construction sites</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Inappropriate Use of Hazardous and Toxic Materials

<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Hazardous and Toxic Materials</td>
<td>Herbicide or other toxic chemicals will be used strictly in accordance with the manufacturer's instructions and according to PRC regulations.</td>
<td>PRC Regulation: JT3130-88</td>
<td>Entire construction corridor</td>
<td>Contractor</td>
<td>During construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operational Phase

#### Mitigation and Monitoring
- **Preparation of mitigation and monitoring implementation plan and maintenance timetable for operational phase**
  - **Location**: All project corridor and affected villages
  - **Responsible Party and Budget**: CECC $10,269 (CNY85,000)
  - **Time Frame**: Prior to operation

#### Management of Storm Water
- **Storm water should not be drained directly into the tributary rivers classified as Class I and II.**
  - **Location**: Project corridor, urban stretches
  - **Responsible Party and Budget**: County departments responsible for drainage
  - **Time Frame**: Beginning and end of each monsoon

#### Atmospheric Pollution from Vehicles
1. **New afforestation projects adjacent to the project road.**
2. **The vehicles on the road will be tested ad hoc for emitting pollutants.**
3. **Vehicle emission inspection program will be encouraged by CECC and a vehicle certification system implemented.**
   - **Location**: All project corridor and affected villages
   - **Responsible Party and Budget**: CECC with local forestry units, CECC with assistance from HEMS
   - **Time Frame**: Starting immediately after completion of construction

#### Noise Pollution
1. **Noise pollution will be monitored.**
2. **"NO HORN PERMITTED" signs will be set at road sections near schools.**
3. **At access points to the expressway, random weighing of vehicles will be done.**
   - **Location**: Refer to noise pollution monitoring program
   - **Responsible Party and Budget**: CECC
   - **Time Frame**: Throughout operations phase

#### Accidents Involving the Handling and Transport of Hazardous and Toxic Materials
1. **CECC will enforce compliance with PRC regulations.**
2. **In case of an accident involving hazardous substances, the relevant emergency procedures team (as specified in the expressway operating process) will be called. A spill management plan will be prepared.**
   - **Location**: Entire project corridor and surroundings
   - **Responsible Party and Budget**: CECC
   - **Time Frame**: Throughout operations phase

---

**CECC** = Chang-Ji Expressway Construction Company, **EIA** = environmental impact assessment, **HEMS** = Hunan Environmental Monitoring Station, **PRC** = People's Republic of China, **SEIA** = summary environmental impact assessment.
<table>
<thead>
<tr>
<th>Environmental Impact/Issue</th>
<th>Mitigative Measure(s)</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Monitoring: Responsible Party and Budget</th>
<th>Time Frame/ Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewage and Garbage</td>
<td>(i) Domestic sewage at toll stations will be treated by the use of septic tanks, and then used as fertilizer. (ii) Solid waste will be sorted using multicompartment collection bins and recycled wherever possible. (iii) Oil traps will be maintained and monitored regularly.</td>
<td>Project EIA</td>
<td>All service areas and toll gates</td>
<td>Rest and toll area operators</td>
<td>Throughout operations phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Environmental Monitoring**

<table>
<thead>
<tr>
<th>Environmental Aspects</th>
<th>References in Law and Contract Documents</th>
<th>Location</th>
<th>Responsible Party and Budget</th>
<th>Time Frame</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality, Water Quality, Noise</td>
<td>Monitoring will be conducted based on relevant specifications or standards issued by SEPA and using the schedule set out in EIA, SEIA, SEPP, EMP, and MEMP.</td>
<td>Monitoring stations selected as defined and verified in field</td>
<td>HEMS, plus data technician trainees from CECC</td>
<td>Throughout construction period</td>
<td>Quarterly (TSP only for air)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction: $12,081 (CNY100,000)/yr for 3 years</td>
<td>Throughout operations period</td>
<td>Semiannual (noise and water) Annual (NO$_2$ only for air)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operation: $12,081 (CNY 100,000)/yr for 20 years</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CECC = Chang-Ji Expressway Construction Company, EIA = environmental impact assessment, EMP = environmental management plan, HEMS = Hunan Environmental Monitoring Station, MEMP = mitigation measures execution and monitoring plan, NO$_2$ = nitrogen dioxides, SEPP = soil erosion protection plan, SEPA = State Environmental Protection Administration, SEIA = summary environmental impact assessment, TSP = total suspended particulates, yr = year.