ENVIRONMENTAL ACTION PLAN (EAP) of the XIAOSHANGYUAN - LANTIAN CLASS II MOTOR VEHICLE HIGHWAY
SHAANXI II HIGHWAY PROJECT
SHAANXI PROVINCE, PEOPLE'S REPUBLIC OF CHINA

Shaanxi Provincial Transportation Department

May 1995
5. IMPLEMENTATION SCHEDULE AND COSTS

5.1 Implementation Schedule

5.2 Summary of Costs

APPENDIX  Key Elements of the EAP/EMP for the Proposed)
Xiaoshangyuan-Lantian Class II Auto-only Highway

MAP I  Locations of Sensitive Sites, Excavation Sites and Monitoring Sites

This document was prepared in English by ERM-Environomics, Beijing, under supervision of the Shaanxi Provincial Highway Survey and Design Institute, Xi'an, Shaanxi Province.
ENVIRONMENTAL ACTION PLAN (EAP)  
XIAOSHANGYUAN - LANTIAN CLASS II MOTOR VEHICLE HIGHWAY

1. INTRODUCTION

1.1 General Description

1. The proposed Xiaoshangyuan - Lantian Highway project (XLH) is an integral component of National Highway No. 312 from Shanghai to Yining. It is also a key section of the Shaanxi province highway network. The highway links Shangzhou city in Shangluo district to Luolicun in Lantian county (see Figure 1.1a).

2. The objective of the proposed XLH project is to provide a connecting link between the existing Shangzhou-Xiaoshangyuan and Lantian-Xi'an Class II roads, increase transport capacity and promote the economic development of Shangluo district. It is anticipated that the project will strengthen economic ties in the region, by facilitating transport of commodities and the transfer of technology.

3. The physical components of the project include construction of a 48.28km long Class II motor vehicle highway, including: six tunnels with a total length of 2470m, the longest of which will be 1,670m; 7 large bridges, 22 medium bridges and 12 small bridges. The project will entail acquiring 1575 mu (105 ha) of land, 880.3 mu (58.7 ha) of which is agricultural, and demolishing 8923.3 m² of building area.

1.2 Significant Environmental impacts

4. Significant environmental impacts during project construction include temporary agricultural land disruption, soil erosion, and impacts on water and air quality. Major anticipated operational impacts include air quality degradation, increase in background noise-levels and lead pollution to crops along the proposed alignment.

1.3 Consideration of Project Alternatives

5. The proposed alignment was selected from four alternatives (See Figure 1.3a) on the basis of minimizing both socio-economic and environmental impacts. The proposed alignment minimizes land acquisition, population displacement and ecological disturbance through, where possible, avoiding large land cuts.
XIAOSHANGYUAN-LANTIAN HIGHWAY PROJECT

LEGEND

- Village or Town
- Proposed Route
- Alternative Route
- Tunnel (1.67 km)
- Main Rivers
- Existing Highway Link in Shanghai

ENVIRONOMICS

ERM

Figure 1.1b
Location of Alternative Routes Considered
2. ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

2.1 Significant Environmental Impacts

6. The major environmental impacts of the proposed XLH project are summarized below.

2.1.1 Location Issues

i. Relocation, Cultivated Land Acquisition and Social Disruption

7. The total cultivated area impacted by construction of the highway is 58.7 ha. A total of 16 villages will be affected as a result of agricultural land acquisition or resident displacement. Agricultural land acquisition will affect 361 families (a total of 1771 people) who will need to be compensated with land of similar or superior quality. In addition, 18.9 ha of agricultural land will be temporarily disrupted where the topsoil will be removed and subsurface soil excavated to provide construction materials. The topsoil will then be replaced and the land restored to its original use.

8. The road construction activities and operation may also impact access between communities and farmland for pedestrians and vehicles. The locations of sensitive sites and residential areas are shown in Map I appended to this report.

9. Details of resettlement and land acquisition compensation issues are provided in a separate Resettlement Action Plan (RAP).

ii. Cultural and Historic Sites

10. Two historic sites were identified along the alignment during a survey of cultural and historic locations undertaken during the EIA (see Map I). Neither of these are listed as protected and they will not be directly impacted by the proposed highway.

2.1.2 Construction Phase

11. Potential construction phase impacts include disruption of areas adjacent to construction locations and excavation sites, soil erosion, potential air quality degradation, and noise and vibration disturbance resulting from construction activities, blasting and transportation of construction materials. Impacts on water course and water quality may also arise where bridges are constructed across water courses or sand is excavated from flood courses. Map I shows the locations of water course along the alignment.

12. Soil erosion is of major concern during the construction phase. It is anticipated that uncontrolled soil erosion due to construction activities will be approximately 8 to 12
times current erosion levels. Prevention measures will be adopted especially at excavation and fill sites to minimize erosion potential.

13. An estimated, 135,107 m³ of earth and 2,270,117 m³ of stone will be excavated with estimated utilization ratios of 88 and 41.4 percent respectively. Therefore significant volumes of surplus will be generated and stockpiled at various locations along the alignment which may contribute to soil erosion and disruption of vegetation cover. Improper disposal of debris and earth may also lead to obstruction of water courses during flood periods. Adequate and secure disposal of the anticipated excavation debris is a significant concern and shall be managed as discussed below.

2.1.3 Operation Phase

14. Operation of the road may lead to air quality degradation and an increase in background noise levels. Background air quality monitoring indicates that current pollution levels are within Class II National Ambient Air Quality Standards. No significant impacts on atmospheric quality are anticipated during the operation phase. In the proposed tunnels, air quality is expected to meet Design Standards for Tunnels (JTJ026-90) which stipulates a maximum CO level of 150ppm under normal operating conditions.

15. Since the road is to restrict access to all but motor vehicles, the risk from mixed vehicle type accidents will be eliminated. Although industrial development along the alignment is minimal, the road’s importance as a link between Xi’an and Shangzhou municipality and as a component of the national highway network will increase the risk of traffic accidents resulting in chemical and other hazardous materials spills. Emergency response measures and surveillance facilities along the propose highway and in the 1.67 km tunnel are planned to respond to spill incidents, and mitigate impacts on the ecological environment and human health.

16. An additional potential impact is a slight increase in lead content of green leaf vegetables grown along the alignment which is anticipated to exceed National Food Hygiene Criteria after 20 years of highway operation.

2.2 Proposed Mitigation Concepts and Measures

17. Environmental protection strategies for the project area are as follows:

a. Project design includes elements which optimize opportunities for environmental improvement and avoids or minimizes adverse environmental impacts. Where avoidance or minimization is not possible, economically and technically feasible mitigation measures have been formulated and shall be implemented within a reasonable time frame;
b. Environmental protection measures include mitigation of impacts during design, construction and operation phases of the project.

18. Environmental improvement measures include upgrading existing dirt roads along routes used for transport of materials. This reduces fugitive dust and improves rural traffic movement. In addition, diversion of through traffic from the center of villages will have a net positive impact on air quality and noise levels within settlements. It will also serve to reduce congestion and the risk of accidents which may involve loss of human life or release of hazardous materials.

2.2.1 Design Phase

i. Environmental Consideration

19. The project was formulated and authorized in accordance with the "Three Synchronization" rule, which requires that all development and construction projects incorporate environmental protection measures in planning, design, construction and operation phases.

20. Environmental factors have been taken into consideration in order to minimize visual impacts and the need for physical alteration of the landscape, as well as impacts to natural resources, sensitive ecosystems, cultural resources, agricultural lands and populated areas.

ii. Route Selection

21. The alignment of the proposed Xiaoshangyuan-Lantian highway was selected from among four alternatives on the basis of minimizing land acquisition, adverse air quality and noise impacts on sensitive sites and residential areas, as well as avoiding cultural relics and unfavorable geological conditions.

22. In comparison with the other three alternatives, the proposed alignment is environmentally preferable on the following points:

1. Ninety percent of the alignment is located in Qinling mountain area, making use of favorable natural terrain along Qipanhe and Lanqiaohe river valley. As a result, agricultural land acquisition, land excavation and land fill, and impacts on natural scenery are minimized.

2. The route is shorter than the other alternatives and makes use of the existing Class II road in some sections. Road construction is therefore shorter and disruption to the natural and socio-economic environment is minimized.
3. Six tunnels with a total length of 2470m, including one, 1,670m long, are designed at the sections with unfavorable topography which reduce destruction of natural vegetation, topography and potential soil erosion induced by large amount of land cut and land fill.

4. There are few residential areas along the alignment and the alignment detours around populated areas. This reduces resident displacement, relocation and noise disturbance.

iii. Social Disruption

23. Provisions have been made in the project design for residential areas affected by the proposed development. These include reducing right-of-way land requirements and minimizing severance of local access roads in selecting transportation routes.

24. Seven large bridges, 22 medium bridges and 12 small bridges have been incorporated in the project design as well as 16 crossings to facilitate access to farmland, avoid community separation and meet requirements of vehicle access.

iv. Soil Erosion

25. Topographical and geological characteristics of the alignment require that both engineering solutions and stabilization through afforestation be adopted to reduce surface erosion and prevent land subsidence.

26. A total of 3130m of slope protection, 20643m of retaining walls (height range from 3-8m), and 119 culverts have been incorporated in the engineering design so as to avoid soil erosion, slope failure and facilitate natural drainage. Drainage courses and silt traps will also be installed on slopes and embankments where appropriate to prevent slope collapse and sedimentation impacts on water courses or fields. Temporary and permanent drainage systems were designed to minimize soil erosion and alteration of hydrological regimes, including impacts on irrigation and artificial ponds. Drainage channels will be properly lined where necessary and directed to discharge ponds so as to avoid direct discharge to farmland.

27. An extensive landscaping program has been integrated into the engineering design, taking into account topographical and geological characteristics along the alignment, to prevent potential soil erosion due to construction activities and during operation. This program will be initiated from the very beginning of road construction. Where appropriate, grading and revegetation of cut slopes, embankments, median dividers, shoulders, closed borrow sites and waste soil mounds will be undertaken. Following the completion of activities at each site, grading will be undertaken and trees and grasses will be planted.
v. Dust/Air Pollution

28. Quarries, borrow areas and transportation routes, as well as waste disposal sites have been identified, taking into account the transportation distance from the material borrow sites to construction sites (see Map 1). Dust and atmospheric pollution impacts from these areas were evaluated with particular emphasis to protection of environmentally sensitive locations such as residential areas.

29. Ventilation measures have been incorporated in the design of the longest tunnel to ensure adequate ventilation in order to avoid accumulation of pollutants such as CO and NOx. Eighteen extractor fans shall be installed at regular intervals within the tunnel to facilitate ventilation. Details are provided in the project engineering report.

vi. Water Pollution

30. Permanent and temporary drainage systems are incorporated in the project design to minimize surface water pollution and disturbance to irrigation channels and drainage systems.

31. Sanitary waste water facilities (septic systems) have been incorporated in the service station design proposed at Muhuguan. This station includes re-fueling facilities. In order to prevent direct discharge to surface water bodies, contaminated runoff shall be collected into settling tanks prior to discharge.

32. Underground storage tanks for gasoline and other hazardous materials shall be installed in a crypt with adequate monitoring facilities to detect leakage and prevent groundwater contamination.

vi. Waste Construction Material Disposal

33. Twelve debris disposal sites have been included in the project design to stockpile surplus construction materials. These will be covered with soil and restored for cultivation. One of the largest debris sites, located in Putao Valley, will be restored for agricultural use.

34. Debris from tunnel excavation and quarry activities will be used to upgrade existing access road surfaces especially those affected by transportation of construction materials or shall be used for other local construction projects.
vii. Noise

35. Other than consideration of alternative alignments, noise screening measures such as forest belts have been integrated in the design and bid documents. The proposed alignment selected has minimal noise impacts on sensitive sites and residential areas.

viii. Flooding

36. Bridges and culverts were adequately designed to meet safe flood discharge requirements.

ix. Cultural Relics

37. In addition to route selection, the design phase included initial studies and relic site surveys undertaken by SPAI to identify existing cultural sites and appropriate protection measures where necessary.

2.2.2 Construction Phase

i. Dust/Air Pollution

38. Road surfaces, excavation areas and construction sites will be sprayed regularly and kept moist as necessary particularly near towns, water resources and sensitive locations in order to control fugitive dust. Existing dirt roads used for transportation of construction materials will be upgraded and widened, and where necessary paved to accommodate two way truck traffic and reduce fugitive dust emission. Dirt road affected by construction traffic will be sprayed regularly to minimize dust.

39. Stockpiles and storage areas will be covered or sprayed to prevent fugitive dust. Construction materials will be covered during hauling to prevent undue dust or debris on roads.

40. Asphalt and concrete mixing equipment shall be fitted with dust collection facilities and located 500 meters down wind of residential areas. Workers will be provided with dust masks.

ii. Soil Erosion/Water Pollution

41. During the construction phase, reasonable actions will be taken to incorporate good construction practices into the project implementation and avoid undue or long term disturbance of farmland and water courses.
42. Trees, shrubs and grasses will be planted along the roadside and on side slopes as soon as the road bed is constructed. Afforested areas that have been disrupted during road construction will be recovered. Quarries and disposal sites will be afforested after site closure.

43. Construction of bridge piers and material excavation from water courses will be avoided during the rainy season. Excavation and debris disposal sites will be graded and re-vegetated where applicable to avoid slope failure and soil erosion.

44. In areas adjacent to surface water bodies, rivers and drainage systems, surplus excavated material disposal shall be appropriately controlled so as to prevent sedimentation and adverse water quality impacts. Excess stone and gravel will be removed to disposal sites to avoid obstruction to river courses. Temporary channels or conduits shall be constructed where necessary to facilitate irrigation and drainage, during the construction of permanent drainage systems. If the existing irrigation or drainage systems and artificial ponds are damaged, appropriate measures including either rehabilitation or reconstruction, shall be undertaken.

45. Reasonable measures shall be undertaken to prevent direct discharge of polluted water from construction activities into rivers and irrigation channels. Temporary ponds shall be placed where appropriate within construction areas to collect waste water and run-off from construction sites and settle out eroded soils before discharge to avoid sedimentation of water courses.

46. Storage areas for gasoline and other hazardous materials will be enclosed and shall include concrete slabs and brims to control potential spillage.

iii. Construction Camps

47. Septic tanks will be installed at construction camp sites to prevent direct discharge of sewage to surface water bodies. Sewage sludge and domestic waste from construction sites will be collected, used as fertilizer or appropriately disposed of following recovery of recyclable components. Disposal sites shall be approved and secured to avoid environmental contamination or site failures. Septic tanks will be regularly emptied.

48. Camp domestic solid wastes will be collected in containers and/or at designated areas and disposed of regularly to safeguard sanitary conditions.

49. Drinking water at construction sites shall meet China’s national drinking water standards.
iv. Noise and Vibration

50. Hearing protection for construction workers will be provided and construction activities will be prohibited between 10pm and 6am where residential areas are within 200m of the site to avoid disturbance to local residents.

51. Construction machinery and trucks will be properly operated and maintained. Devices for the control of noise will be properly equipped so as to control noise in compliance with Chinese Class IV noise standards for urban areas and with class II standards in sensitive areas including schools and hospitals.

52. Vibration monitoring will be undertaken by environmental supervisors at each contract lot and mitigation measures will be properly adopted to rectify any detected damage as a result of vibration of construction machinery. Heavy machines will not be operated at the same time.

v. Conservation of Ecological Resources

53. Forested areas will not be used for material borrow sites. As far as possible use of arable land for borrow sites has been minimized. In arable lands selected for material borrow sites, fertile topsoil layers (30cm) will be removed and stockpiled and sub-soil shall be excavated for construction materials. Following completion of the excavation, topsoil will be replaced and the area will be reverted to original uses.

54. Education of construction workers will be strengthened to protect natural resources, wild plants and animals. Poaching will be strictly prohibited. Construction trucks will be restricted to approved or designated roads so as to avoid damage to the farmland and pasture land.

vi. Cultural Relics

55. Construction work will be stopped immediately if fossils, coins, artifacts of value or antiquity, structures or other remains of geological or archaeological interest are discovered during construction. The Shaanxi Provincial Archaeological Bureau and Shaanxi Provincial Archaeological Research Institute, will be duly informed in case of such discovery. A survey of the site will be undertaken by authorized personnel and necessary mitigation measures will be identified and implemented under the supervision of the Shaanxi Provincial Archaeological Bureau. Detailed action plans will be formulated for sites discovered where excavation is required.

56. A separate action plan for cultural relics preservation has been developed incorporating protection measures to avoid any adverse impacts during construction on the
two historic sites located near the alignment and establish procedures in the case of discovery of new sites.

vii. Risk Management

57. Good construction practice is the most efficient way to reduce risks of accident and fatalities. Relevant government regulations and standards regarding construction procedures shall be followed strictly to guarantee construction safety. Construction vehicles shall have effective lights; lighting and safety signs will be installed on roads and intersections used during construction. Traffic control measures will be implemented at intersections, especially at access roads used for material transportation. Adequate traffic regulations will be adopted and enforced for all construction routes.

58. During the construction, effective safety and warning measures shall be adopted to reduce accidents. Blasting times, signals and guards shall be stipulated according to Chinese regulations. People and vehicles in danger areas shall be evacuated in time. Careful and thorough checks shall be made before blasting. Safety lookout posts shall be set up so that people and vehicles do not pass through until blasting is completed.

59. Management and usage of blasting materials shall strictly follow safety requirement of the Public Security Department.

viii. Traffic and Transportation

60. Local construction materials will be used as much as possible to avoid long distance transportation. A total of twelve borrow sites have been selected at various locations along the alignment each serving a localized segment of the highway construction.

61. Where sections of existing roads are used for transportation of construction materials, temporary service roads will be constructed as appropriate to alleviate congestion on existing roads. Identified access roads which are generally existing dirt roads will be upgraded by paving or widened where necessary to accommodate two way truck traffic. Improvement and upgrading of existing dirt roads along routes used for transport of materials can improve rural traffic movement and reduce fugitive dust.

62. Adequate traffic control measures will be implemented in consultation with Communications and Public Security Departments to avoid traffic congestion and accident risks where trucks use existing highway. The contractor is required to provide adequate diversions and signs where the construction crosses existing alignments.

63. A construction materials transportation plan and schedule will be formulated to avoid hauling activities during peak hours especially on existing roads.
2.2.3 Operation Phase

i. Transportation Management and Road Safety

64. The Public Security Department shall be informed prior to transportation of hazardous materials on the roadway, especially with regard to the nature of the hazard, and the time, routes and parking places of vehicles transporting such materials. The vehicles and drivers will be checked by the Public Security Department. Pertinent danger signs will be posted on the vehicles indicating the nature of the hazard. Transport of hazardous material will be restricted to a limited number of off-peak hours. Hazardous material may not be transported together with passengers, or other goods.

65. The local Fire Department will responsible for responding to hazardous materials spills, fires or major accidents. Signs will be posted in environmentally sensitive locations such as residential areas and water courses in order to alert and warn drivers.

66. To minimize the risk of accidents from operation of the highway, adequate signing and signals will be maintained indicating speed restrictions, location of entrances and exit ramps. Signs shall be set up in residential areas, at river crossings and tunnels to alert drivers.

67. Within the 1.67km tunnel, in addition to ventilation measures, a surveillance system and safety facilities will be installed including lighting, electronic message boards, traffic signals, CO detectors and fire extinguishers.

68. Xiaoshangyuan-Lantian Administrative Division will be responsible for managing and maintaining safety and service facilities along the highway.

ii. Vehicle Management

69. Vehicles speeds on the highway shall not exceed 80 km/h in flat areas and 40 km/h in mountainous areas.

iii. Noise

70. Sound barriers will be installed or other mitigation measures implemented at sensitive sites and impacted residential areas as included in the project design. Additional noise barriers shall be installed at locations where noise impacts are found to exceed standards based on the results of monitoring. Noise impacts along Qinglingpu Primary School, Qingfeng Primary School and Heilongkou Hospital are within Class II standards and thus do not require mitigation.
71. Blowing of vehicle horns in posted sensitive sites shall be prohibited at night. Speed restriction shall be imposed on vehicles passing these sensitive areas at night time. The maximum enforced speed for large and medium sized vehicles shall be 30 Km/h at night. Small sized vehicles will be restricted to speeds below 60 Km/h at night.

iv. Other

72. Land use planning controls will be implemented to prohibit construction of new residential areas and other permanent buildings within 50 meters from the edge of the alignment. Migration to the area near the roadside will be strictly controlled.

3. ENVIRONMENTAL MONITORING PLAN

3.1 Introduction

73. The Environmental Monitoring Plan of the project has been formulated in consultation with the Shaanxi Provincial Highway Survey and Design Institute and the Shaanxi Provincial Institute of Environmental Science.

74. As detailed in the EIA report, the overall project impacts will be minimized due to sound planning and implementation strategies on the part of the project proponents. An overall monitoring program has been formulated in order to (i) ensure early detection of conditions that necessitate particular mitigation measures, and (ii) provide information on the progress and consequences of mitigation measures.

75. The purpose of monitoring activities during highway construction and operation is to determine the influence on air, noise and vibration, and water quality so that appropriate mitigation measures can be undertaken to alleviate any identified impact. Monitoring parameters, network distribution and frequency have been determined according to the nature and locations of potentially significant impacts as well as results of the baseline monitoring program.

3.2 Monitoring Plan: Schedule, Parameters and Locations

76. Baseline environmental monitoring along the alignment was performed by the Shaanxi Provincial Environmental Monitoring Center (SP EMC) between 1993 and 1994, which included air quality monitoring, background noise levels, surface water quality, and soil and crop lead content monitoring.

77. In addition, a survey of habitat and wildlife along the alignment was undertaken. No ecologically sensitive locations were identified.
A systematic monitoring plan is presented in Table 3.1. The detailed locations of monitoring sites are shown in Map 1.

### 3.2.1 Construction Phase

#### i. Air Quality Monitoring

TSP will be monitored four times per year for 3 consecutive days, once in the morning and once in the afternoon, by the environmental monitoring group of the Central Supervision Laboratory. Monitoring will be undertaken around the construction sites, quarry areas, material borrow sites and major roads used for transportation of construction materials. Monitoring results will be assessed in relation to Class II National Air Quality Standards (GB 3095-82).

Fugitive dust monitoring will be undertaken by environmental supervisors at each contract lot every 5-10 days. Dustpans will be placed in at least 6 sampling locations at construction sites, quarries and material borrow sites and major access roads. More frequent monitoring will be undertaken during the beginning stages of construction.

#### ii. Noise and Vibration Monitoring

Noise and vibration monitoring will be undertaken by environmental supervisors on a weekly basis, two-three times per day (once in the morning, afternoon and at night) at construction sites and major access roads for transportation of construction materials. Ad hoc noise monitoring will also be undertaken as appropriate. Noise monitoring data will be assessed on the basis of National Urban Noise Standards (GB 3096-93) Class II for sensitive sites and Class IV for residential areas. Vibration monitoring results will be analyzed based on National Standards of Environmental Vibration in Urban Area (GB 10070-88). Noise monitoring at construction sites will comply with Noise Standards at Construction Boundary (GB 12523-90).

#### iii. Water Quality Monitoring

Water quality monitoring will be undertaken by the environmental monitoring group of the Central Supervision Laboratory at rivers near construction sites and where bridges are being constructed. COD, SS, DO, oil, temperature and pH will be monitored one month before construction starts and after this three times each year for two consecutive days.
3.2.2 Operation Phase

i. Air Quality Monitoring

83. Monitoring of TSP, NO\textsubscript{x}, and CO will be undertaken at Luolicun, semi-annually for a period of five consecutive days, four times per day.

ii. Noise Monitoring

84. Regular monitoring will be undertaken to establish noise levels and trends and enable the need for additional noise mitigation measures to be assessed. Monitoring of noise levels at Luolicun will be undertaken four times a year over a period of three consecutive days, at daytime and night time as well as ad hoc monitoring where appropriate. Resulting data will be assessed for compliance with National Standards for Noise in Urban Areas (GB 3096-93 - standards for sensitive sites and areas bordering trunk roads).

iii. Water Quality Monitoring

85. COD, SS, DO, oil, temperature and pH will be monitored three times per year at Lanqiao and Muhuguan, semi-annually for a period of two consecutive days.

86. Following accidents involving spills of chemicals or other hazardous substances, monitoring of water quality impacts will be undertaken as appropriate. Parameters, frequency and location will be determined according to the nature of the incident.

3.3 Monitoring Organizations and Personnel

87. An environmental monitoring office comprising five to ten monitoring specialists in the Central Supervision Laboratory under SPTD will be established for the purpose of implementing the environmental monitoring plan during construction and operation of the expressway.

88. All the monitoring activities will be undertaken by certified experts as appropriate in compliance with monitoring technical criteria issued by the National Environmental Protection Agency (NEPA). With the exception of fugitive dust and noise, sampling and analysis of monitoring data will be undertaken by the Central Supervision Laboratory. Fugitive dust, noise and vibration monitoring will be undertaken by environmental supervisors at each contract lot who will be trained in the use of the monitoring equipment.
Table 3.1
Environmental Monitoring Plan

<table>
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<th>AIR</th>
<th>CONSTRUCTION PHASE</th>
<th>OPERATION PHASE</th>
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<tbody>
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<td></td>
<td><strong>TSP:</strong></td>
<td>- frequency: semi-annually, once in January and July, over a period of 5 consecutive days and 4 times per day;</td>
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<tr>
<td></td>
<td>- frequency: four times per year for 3-consecutive days; once in the morning and afternoon;</td>
<td>- monitoring items: TSP, CO, NO, as well as meteorological data;</td>
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<td></td>
<td>- monitoring sites: around construction sites, quarry areas and access roads;</td>
<td>- monitoring sites: Luolicun</td>
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<td></td>
<td><strong>Fugitive dust:</strong></td>
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<td></td>
<td>- at least 6 pans at each site;</td>
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<td>- every 5-10 days, more frequent at the beginning stage of construction activities</td>
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<table>
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<tr>
<th>NOISE</th>
<th>CONSTRUCTION PHASE</th>
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<td>- Monitoring items: noise levels and vibration;</td>
<td>- frequency: 4 times a year, at daytime and night;</td>
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<td>- monitoring sites: at construction sites, quarry areas, and major access roads;</td>
<td>- monitoring sites: Luolicun</td>
</tr>
<tr>
<td></td>
<td>- frequency: weekly, 2-3 times (morning, afternoon and night)</td>
<td>- ad hoc monitoring</td>
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<th>WATER QUALITY</th>
<th>CONSTRUCTION PHASE</th>
<th>OPERATION PHASE</th>
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<td>- monitoring items: COD, SS, DO, oil, pH, temperature;</td>
<td>- monitoring items: COD, SS, DO, oil, pH, temperature;</td>
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<tr>
<td></td>
<td>- monitoring sites: major water bodies and where bridges are being constructed;</td>
<td>- monitoring sites: 2</td>
</tr>
<tr>
<td></td>
<td>- frequency: three times per year for a period of two consecutive days; monitor one month before the start of construction.</td>
<td>- frequency: two times each year for a period of two consecutive days.</td>
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4. INSTITUTIONAL ARRANGEMENTS

4.1 Project Environmental Management and Supervision

89. In order to ensure the implementation of environmental measures as stipulated in the Environmental Action Plan (EAP), the following agencies have been assigned responsibility for environmental issues during the construction and operation phases.

90. Shaanxi Provincial Transportation Department (SPTD) has overall authority within the project. A Deputy Director of SPTD shall be responsible for the overall project administration. The Director of Shaanxi Highway Bureau (SHB) shall be responsible for the management of the construction and operation phases of the proposed project. The project headquarters located in Xi'an will have project responsibility during both construction and operation phases. Within this overall framework an institutional structure for management of environmental issues has been formulated as described below.

i. Construction Stage

a. An Engineer's Office will be established within SPTD, with the chief supervision engineer and three assistant engineers. One of the three assistant engineers will be assigned clear responsibility for environmental issues related to the project.

b. Under the Engineer’s Office at the project Headquarters (HQ), in addition to three divisions and one central supervision laboratory, an Environmental Supervision Unit (ESU) will be established. One senior environmental officer and one environmental expert will be assigned in this Unit on a full time basis to develop appropriate environmental policies for the highway construction, to guide environmental staff at district offices and environmental supervisors at contract lots where necessary, and to liaise with the Provincial Environmental Protection Bureau (EPB) and the World Bank.

c. At the Xiaoshangyuan-Lantian District Office, one well trained full time environmental staff will be assigned to coordinate environmental supervisors at contract lots, to review project environmental monitoring data, report the environmental supervision results to the HQ and to liaise with local EPBs on project environmental protection issues.

d. At each of the two contract lots, one environmental supervisor will be assigned to carry out the environmental supervision of the construction activities, ensure that all protection measures stated in the construction bid documents or addressed in the Environmental Action Plan (EAP) are implemented, undertake
noise, vibration and fugitive dust monitoring and to report the results of the environmental supervision to the district environmental staff.

91. Figure 4.1a presents the organizational structure for environmental management of the Xiaooshangyuan - Lantian Highway during construction and Figure 4.1b presents the roles and responsibilities of each organization involved.

ii. Operation Stage

a. The Environmental Protection Office of SPTD consisting of three environmental staff will be responsible for overall environmental management of the Shaanxi II Highway Project.

b. Shaanxi Highway Bureau (SHB) will be responsible for environmental management of the Xiaooshangyuan-Lantian Expressway project. At SHB Headquarters, one Deputy Director will be responsible for the environmental issues related to the Highway. One staff at deputy chief level in the Maintenance Division under SHB will be assigned responsibility for environmental protection of the highway.

c. Within the Xiaooshangyuan-Lantian Highway Administrative Division, one staff will be responsible for environmental protection of the highway.

92. Figure 4.2a presents the organizational structure for environmental management of the Xiaooshangyuan - Lantian Highway during operation and Figure 4.2b presents the roles and responsibilities of each organization involved.

4.2 Environmental Training

93. A comprehensive training program for the Shaanxi II Highway Project has been formulated within the overall project budget, part of which will be assigned to improving the expertise of environmental staff and ensure the implementation of the Environmental Action Plan for the Xiaooshangyuan - Lantian Highway Project. The level of training will be determined by the qualification of the staff. Appropriate forms of training will be selected to optimize the effects taking into consideration financial feasibility and duration of the training.

94. The overall training plan and schedule for the Shaanxi II Highway Project is proposed as follows:

a. The senior environmental officer at HQ who will head the ESU shall be sent abroad for two or three weeks, if necessary, to attend a seminar on
Figure 4.1a  Institutional Arrangement of the Lantian - Xiaoshangyuan Highway During Construction Phase
FIGURE 4.18
TASK ORGANISATION DIAGRAM
ENVIRONMENTAL MANAGEMENT TASKS
DURING CONSTRUCTION
XIAOSHANGYUAN—LANTIAN HIGHWAY
SHAANXI PROVINCE, PEOPLE’S REPUBLIC OF CHINA

Shaanxi Provincial Transportation Department
Staff: 1 Assistant Engineer
Tasks:
- Overall Responsibility for Environmental Issues
  related to Shaanxi 2 Highway Project

Central Laboratory
Environmental Monitoring Office
Staff: 5—10 technical staff
Tasks:
- Implementation of TSP and Water quality monitoring
- Data Tabulation and reporting to district office

Environmental Supervision Unit
Staff: Senior Environmental Officer (1)
      Environmental Expert (1)
Tasks:
- develop appropriate environmental policies for highway construction
- provide guidance to environmental staff at district offices and contract lots
- liaise with Environmental Protection Bureau and World Bank

District Office
Staff: Environmental officer (1)
Tasks:
- guide environmental supervisors at contract lots
- review of environmental monitoring data
- reporting results of environmental monitoring data to Environmental Supervision Unit
- liaise with local EPBs on environmental protection regarding the project

Contract Lots (2)
Staff: Environmental Supervisor (1 for each contract lot)
Tasks:
- environmental supervision of construction activities
- ensure implementation of protection measures outlined in bid document and EAP
- undertake noise and fugitive dust monitoring
- periodic reporting to district environmental staff on results of environmental supervision
Figure 4.2a  Institutional Arrangement of the Lantian - Xiaoshangyuan Highway During Operation Phase
FIGURE 4.28

TASK ORGANISATION DIAGRAM
ENVIRONMENTAL MANAGEMENT TASKS
DURING OPERATION
XIAOSHANGYUAN—LANTIAN HIGHWAY
SHAAEXI PROVINCE, PEOPLE’S REPUBLIC OF CHINA

Saanxi Provincial Transportation Department
Deputy Director

Central Laboratory
Environmental Monitoring Office
Staff: 5-10 technical staff
Tasks:
- Monitoring of air quality
- Water quality and noise
- Data Tabulation and reporting

SPTD Environmental Protection Office
Staff: Environmental Staff (3)
Tasks:
- Responsible for overall environmental management of the Shaanxi 2 Highway project

Shaanxi Highway Bureau SHB
SHB Maintenance Office
Staff: SHB Deputy Director (1)
- Environmental Staff (1) at Deputy Chief Level from maintenance office
Task:
- Deputy Director responsible for environmental issues related to Xiaoshangyuan—Lantian Highway
- Environmental Staff at maintenance office assigned to deal with environmental issues

Xiaoshangyuan — Lantian Highway
Administration Division
Environmental staff (1) at Deputy Chief level responsible for environmental protection of the highway
environmental management of highway projects and to learn about environmental management practices from administrations of various highways.

b. The environmental expert in the ESU, environmental staff at the district office and several highway designers and planners will be sent for environmental training within China for two to three months, if necessary. In addition, the two highest achieving experts during training in China will be sent abroad for two to three months' to receive extensive and advanced training on environmental management of highway projects, if such training courses are not available in China.

c. Environmental training courses of approximately one month's duration will be undertaken in Xi'an to train engineers responsible for environmental supervision related to the construction of highways included under Shaanxi II Highway Project. The resource persons may be invited from Xi'an, other parts of China or from abroad.

4.3 Environmental Equipment

i. Central Supervision Laboratory

95. The Central Supervision Laboratory will play a key role in environmental monitoring during both construction and operation, including air quality, water quality and operational noise. In order to carry out this monitoring program the list of priority equipment shown in Table 4.3a was identified and will be purchased as part of the project. The cost of procuring equipment will be shared between the various components of the Shaanxi II Highway project.

ii. District-level Supervision

96. Equipment to measure local meteorological conditions along the proposed alignment will be procured such as atmospheric temperature gauge, hydrometer and wind gauge, and provided to environmental staff at the district office.

iii. Contract Section Supervision

97. Fugitive dust, noise and vibration monitoring will be undertaken by environmental supervisors and the following package listed in Table 4.3b will be provided to each contract lot.
Table 4.3a
Equipment Procurement List for Central Supervision Laboratory

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Equipment</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COD detector</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Ultra-violet spectro-photometer</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>TSP sampler</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>atmospheric sampler</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>CO detector</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>atomic absorption photometer</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>high-grade noise detector</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>analytical balance</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>vibration analyzer</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>monitoring vehicle</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>computer and related equipment for data analysis</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>vehicle exhaust monitoring equipment</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>other equipment and apparatus for chemical analysis</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3b
Equipment Procurement List for Each Contract Section Laboratory

<table>
<thead>
<tr>
<th>Name of Equipment</th>
<th>Set</th>
<th>Unit Price (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise level detector</td>
<td>1</td>
<td>5,000</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>1</td>
<td>15,000</td>
</tr>
<tr>
<td>Fugitive dust collection equipment</td>
<td>1</td>
<td>500</td>
</tr>
</tbody>
</table>
5. IMPLEMENTATION SCHEDULE AND COSTS

5.1 Implementation Schedule

98. Environmental issues that require appropriate addressing prior to inception of project construction and operation have been taken into consideration during the design phase by Shaanxi Highway Survey and Design Institute and Shaanxi Highway Bureau in close coordination with Shaanxi Provincial Research Institute of Environmental Sciences, Shaanxi Provincial Transportation Department and various local authorities.

99. Mitigation measures proposed for the construction period will be implemented by contractors during construction of the expressway. During the operation phase the Environmental Protection Office of SPTD will be responsible for implementation of mitigation measures through the Shaanxi Highway Bureau Maintenance Office as appropriate.

5.2 Summary of Costs

100. A total of 1.76 million RMB will be provided for implementation of the EAP, including engineering measures, direct mitigation measures, environmental personnel training and equipment purchase. This does not include environmental training, equipment procurement for the Central Supervision Laboratory and Cultural relics protection which has been assigned an overall budget shared between the six components of the Shaanxi II Highway Project. A summary detail of proposed expenditures is presented in Table 5.2.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Actions</th>
<th>Quantity</th>
<th>Cost ('000RMB)</th>
<th>Resource</th>
<th>Implementation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mitigation</td>
<td>Measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Phase</td>
<td>1. Environmental protection design</td>
<td>80</td>
<td></td>
<td>Project pre-construction</td>
<td>SHDSI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Environmental design of the expressway</td>
<td></td>
<td></td>
<td>budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Soil erosion</td>
<td>50</td>
<td></td>
<td>Project engineering</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Spray trucks</td>
<td>2</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Domestic waste water treatment</td>
<td>10</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(septic tanks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Covering of construction material stockpiles and storage areas</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Construction material transportation</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>covering (tarpaulin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Subsoil removal, land reclamation and afforestation</td>
<td>265 mu</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation Phase</td>
<td>9. Comprehensive landscape engineering</td>
<td>2 km</td>
<td>100</td>
<td>Project Management and</td>
<td>SHB Maintenance Division</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maintenance Budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Environmental Monitoring</td>
<td>13. Construction period</td>
<td>160</td>
<td>Project supervision budget</td>
<td>Environmental Monitoring Office/ Environmental Supervisors at contract lots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>-----</td>
<td>---------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1757</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Actions for the overall Shaanxi II Highway Project</td>
<td>15. Environmental training</td>
<td>400</td>
<td>Project training budget</td>
<td>SPTD 5 people will be trained abroad</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16. Equipment procurement</td>
<td>1466.5</td>
<td>Project equipment budget</td>
<td>SPTD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17. Cultural relics protection</td>
<td>5000</td>
<td>Pre-construction budget</td>
<td>SPAI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix I   Key Elements of the EAP/EMP for the Proposed Xiaoshangyuan-Lantian Highway

<table>
<thead>
<tr>
<th>Environmental Issues</th>
<th>Action Taken/To be Taken</th>
<th>Responsible Entity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Design Phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Environmental Considerations</td>
<td>The project was formulated and authorized in accordance with the &quot;Three Synchronization&quot; rule which requires all development and construction projects incorporate environmental protection measures in planning, design, construction and operation phases.</td>
<td>Shaanxi Provincial Transportation Department (SPTD)</td>
<td></td>
</tr>
<tr>
<td>2. Route Selection</td>
<td>The alignment was selected from among four proposed alternatives so as to minimize land acquisition, impacts of air pollution and noise on residential areas, as well as to avoid cultural relics and unfavorable geological conditions.</td>
<td>SPTD</td>
<td></td>
</tr>
<tr>
<td>3. Social Disruption</td>
<td>2 large bridge, 22 medium bridges, 12 small bridges and 16 crossings have been incorporated into the project design in order to minimize separation and isolation of communities due to the project construction and meet local population and vehicle access requirements.</td>
<td>Shaanxi Highway Survey and Design Institute (SHSDI)</td>
<td></td>
</tr>
<tr>
<td>4. Soil Erosion</td>
<td>3,130m of slope protection, 20,643m of retaining walls and 119 culverts were incorporated in the engineering design in order to facilitate natural drainage and avoid soil erosion and slope failures. 6 tunnels will also be constructed to reduce disturbance to the Qinling mountains. Trees and grasses were designed to be planted on median divider, side slopes and along the roadside, where appropriate. Temporary and permanent drainage systems were designed to minimize soil erosion and alteration of hydrological regimes, including impacts on irrigation and artificial ponds.</td>
<td>SHSDI</td>
<td></td>
</tr>
<tr>
<td>Environmental Issues</td>
<td>Action Taken/To be Taken</td>
<td>Responsible Entity</td>
<td>Remarks</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>5. Dust/Air Pollution</td>
<td>In addition to actions regarding route selection, quarries, borrow areas and transportation routes, as well as waste disposal sites were identified. Dust and atmospheric pollution impacts from these areas were evaluated with particular emphasis to protection of environmentally sensitive locations such as residential areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Water Pollution</td>
<td>Sanitary waste water facilities (septic systems) were designed for service stations in order to prevent direct discharge to surface water bodies. Underground storage tanks have been designed to be installed in a crypt to prevent groundwater contamination.</td>
<td>SHSDI</td>
<td></td>
</tr>
<tr>
<td>7. Flooding</td>
<td>Bridges and culverts were adequately designed to meet requirements of safe discharge of flood.</td>
<td>SHSDI</td>
<td></td>
</tr>
<tr>
<td>8. Cultural Relics</td>
<td>In addition to actions regarding route selection, the design phase included initial studies and relic site surveys, identification, avoidance and excavation planning where necessary.</td>
<td>Shaanxi Province Archaeological Institute</td>
<td></td>
</tr>
<tr>
<td>9. Tunnels</td>
<td>Ventilation systems were adequately designed at the 1670km long tunnel to avoid accumulation of pollutants in the tunnel.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Construction Phase

1. Dust/Air Pollution   | Road surfaces, excavation areas and construction sites will be sprayed regularly and kept moist as necessary for dust control particularly near towns, water resources and sensitive locations. Dirt access roads will be upgraded and where necessary paved, those affected by construction traffic will be sprayed regularly. Asphalt and concrete mixing equipment will be fitted with dust collection facilities and located 500m down wind of residential areas. Workers will be provided with dust masks. | Contractors         |               |
<table>
<thead>
<tr>
<th>Environmental Issues</th>
<th>Action Taken/To be Taken</th>
<th>Responsible Entity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Soil Erosion/ Water Pollution</td>
<td>Erosion control will be achieved by minimizing vegetation removal and exposed surfaces until required by construction and by other erosion prevention measures. Excavation sites will be reclaimed, stabilized and re-vegetated following cessation of activities. Temporary ponds shall be placed where appropriate within construction and excavation areas to capture surface drainage and settle out eroded soils. In areas adjacent to surface water bodies, rivers, and drainage systems surplus excavated material disposal shall be appropriately controlled so as to prevent sedimentation and adverse water quality impacts. Temporary channels or conduits shall be constructed where necessary to facilitate irrigation and drainage, during the construction of permanent drainage systems. All reasonable measures shall be taken to prevent direct discharge of polluted water from construction activities into rivers and irrigation channels. Waste water and run-off from construction sites will be collected and settled before discharge to water courses. Construction of bridge piers and material excavation from water courses will be avoided during the rainy season. Drainage interception facilities will be installed at bridges to prevent polluted run-off from entering water courses. Storage areas for gasoline and other hazardous materials will be enclosed and shall include concrete slabs and brims.</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td>3. Construction Camps</td>
<td>Adequate measures, such as provision of septic tanks shall be undertaken at construction camp sites to prevent direct discharge of sanitary sewage to surface water bodies.</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td>Environmental Issues</td>
<td>Action Taken/To be Taken</td>
<td>Responsible Entity</td>
<td>Remarks</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Environmental Issues</td>
<td>Sewage sludge and domestic waste from construction sites will be collected to be used as fertilizer or disposed of following recovering of recyclable components. Disposal sites shall be approved and secured to avoid environmental contamination or site failures. Septic tanks shall be regularly emptied.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drinking water at construction sites shall meet China's national drinking water standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hearing protection for construction workers will be provided and construction activities will be prohibited between 10pm and 6am. Construction machinery and trucks will be properly operated and maintained.</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forests will not be used for material borrow sites. Where arable land is occupied by the alignment, topsoil shall be moved and used for reclamation. Where arable land is selected for material borrow sites, fertile topsoil will be removed and stockpiled and sub-soil excavated for construction materials. Following completion of excavation, topsoil will be replaced and the area will be reverted to original uses.</td>
<td>Contractors</td>
<td></td>
</tr>
<tr>
<td>Ecological Resources</td>
<td>Education of construction workers will be strengthened to protect natural resources, wild plants and animals. Poaching will be strictly prohibited.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction trucks will be restricted to approved or designated roads so as to avoid damage to the farms and pasture lands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Work will be stopped if new relics are discovered during construction. A survey of the site will be undertaken by authorized personnel and necessary mitigation measures will be identified and implemented under the supervision of the provincial Archaeological Bureau. Detailed action plans will be formulated for sites newly discovered sites where excavation is required.</td>
<td>Contractors, Shaanxi Archaeological Bureau, Shaanxi Archaeological Institute</td>
<td></td>
</tr>
</tbody>
</table>
Environmental Issues | Action Taken/To be Taken | Responsible Entity | Remarks
--- | --- | --- | ---
7. Risk Management | In order to guarantee construction safety, construction vehicles shall have effective lights, and safety signs and lighting shall be installed on roads and intersections used during construction. | Construction unit | 
| During the construction, effective safety and warning measures shall be adopted to reduce accidents. Blasting times, signals and guards shall be stipulated according to Chinese regulations. People and vehicles in dangerous areas shall be evacuated in time. Careful and thorough checks shall be made before blasting. Management and blasting materials usage protocols shall strictly observe Public Security Department requirements. | 
8. Traffic and Transportation | Local sources will be used as much as possible to avoid long distance transportation of construction materials, particularly soil and rock. | Contractors | 
| Adequate traffic control measures will be implemented when roads are congested during the construction period. The contractor is required to provide adequate diversions and signs where the construction crosses existing alignments. | 

C. Operational Phase

1. Transportation Management | The Public Security Department shall be informed prior to transportation of hazardous materials on the roadway, especially with regard to the nature of the hazard, and the time, routes and parking places of vehicles transporting such materials. The vehicles and drivers will be checked by the Public Security Department. Pertinent danger sign will be posted on the vehicles indicating the nature of the hazard. Transport of hazardous material will be restricted to a limited number of off-peak hours. Hazardous material may not be transported together with passengers, or other good. | Shaanxi Highway Bureau (SHB) | 
<p>| The local Fire Department will be responsible for responding to emergencies involving hazardous materials spills, fires or major accidents. Signs will be posted in environmentally sensitive locations in order to alert and warn drivers. |</p>
<table>
<thead>
<tr>
<th>Environmental Issues</th>
<th>Action Taken/To be Taken</th>
<th>Responsible Entity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Noise</td>
<td>Sound barriers will be installed or other mitigation measures implemented at sensitive sites and impacted residential areas as included in the project design. Additional noise barriers shall be installed as appropriate. Speed and horn restrictions will be enforced in residential areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Others</td>
<td>Land use planning controls will be implemented to prohibit construction of new residential areas and other permanent buildings within 50 meters from the edge of the alignment. Migration to the area near the roadside will be strictly controlled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Service Stations</td>
<td>Solid waste and waste water from service stations will be collected and treated. Septic tanks shall be installed for sanitary sewage, solid waste will be disposed of at secure landfills.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Environmental Monitoring

1. Atmosphere

   (1) Construction period:
   (a) monitoring items: TSP, fugitive dust
   (b) monitoring frequency: 4 times a year, 3 days/term
   (c) monitoring sites: construction sites, quarry areas and access roads

   (2) Operation period:
   (a) monitoring items: TSP, CO, NOx
   (b) monitoring frequency: 4 times a year, 5 days/term
   (c) monitoring site: 7

   TSP: Environmental Monitoring Office (EMO)
   Fugitive dust: Environmental supervisors
   EMO
<table>
<thead>
<tr>
<th>Environmental Issues</th>
<th>Action Taken/To be Taken</th>
<th>Responsible Entity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Noise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) monitoring items: noise levels and vibration</td>
<td>Environmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequency: every two days and ad hoc noise and vibration</td>
<td>supervisors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) monitoring sites: sensitive sites within 100m of construction sites, along access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>roads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Operation period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) monitoring</td>
<td></td>
<td>EMO</td>
<td></td>
</tr>
<tr>
<td>frequency: twice a year for a period of 3 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) monitoring site: Luolicun</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Water Quality</td>
<td></td>
<td>EMO</td>
<td></td>
</tr>
<tr>
<td>(1) Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) monitoring items: COD, SS, pH, oil, temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequency: 3 times a year, 2 days/term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) monitoring sites: Lanqiaoxiang, Muhuguan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Operation period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) monitoring items: COD, SS, pH, oil, temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequency: 2 times a year, 2 days/term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) monitoring sites: Lanqiaoxiang, Muhuguan</td>
<td></td>
<td></td>
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</tbody>
</table>
Map I
Locations of Sensitive Sites, Excavation Sites and Monitoring Sites