SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

WESTERN YUNNAN ROADS DEVELOPMENT PROJECT

IN THE

PEOPLE'S REPUBLIC OF CHINA

December 2002

CURRENCY EQUIVALENTS

(as of 2 December 2002)

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

ABBREVIATIONS

ADB	–	Asian Development Bank
AIDS	–	acquired immune deficiency syndrome
EIA	–	environmental impact assessment
EMAP	–	environmental management action plan
SEPP	–	soil erosion protection plan (based on PRC Law 49 and Regulations 120 & 253)
HIV	–	human immunodeficiency virus
NH	–	national highway
PIU	–	project implementation unit
PRC	–	People's Republic of China
RP	–	resettlement plan
SEIA	–	summary environmental impact assessment
STI	–	sexually transmitted infection
VOC	–	vehicle operating cost
YBEC	–	Yunnan Baolong Expressway Company
YPCD	–	Yunnan Province Communication Department
YPG	–	Yunnan Provincial Government

WEIGHTS AND MEASURES

dB(A)	decibels measured in audible noise bands
ha	hectares
km	kilometer
m	meter
m^2	square meter
m^3	cubic meter
MTE	medium truck equivalent

NOTE

In this report, "$" refers to US dollars

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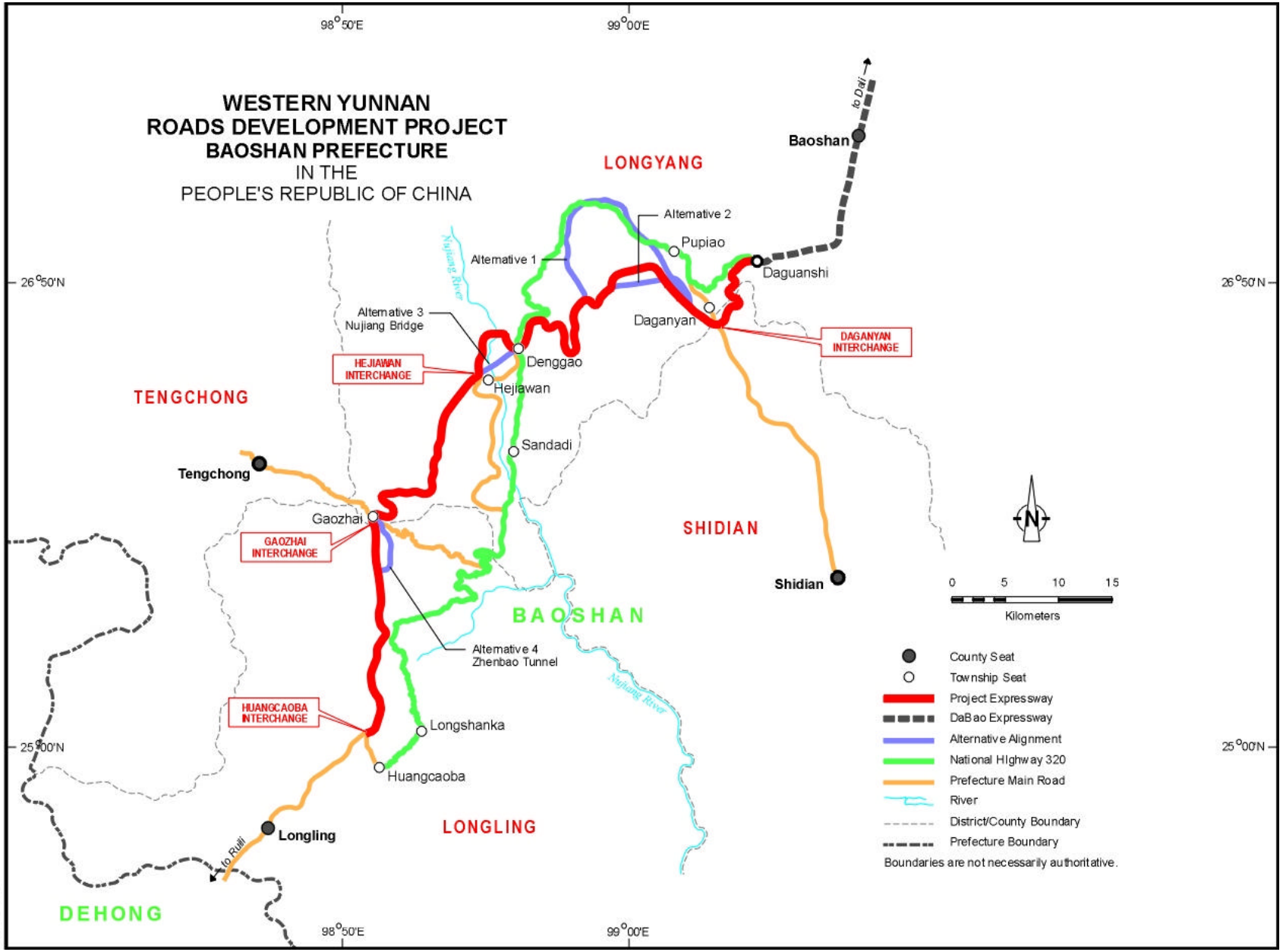
WESTERN YUNNAN
ROADS DEVELOPMENT PROJECT
BAOSHAN PREFECTURE
IN THE
PEOPLE'S REPUBLIC OF CHINA
98°50'E
99°00'E
26°50'N
25°00'N
LONGYANG
TENGCHONG
SHIDIAN
BAOSHAN
LONGLING
DEHONG
Baoshan
to Dali
Pupiao
Alternative 2
Alternative 1
Daguanshi
Nujiang River
Alternative 3
Nujiang Bridge
Daganyan
DAGANYAN INTERCHANGE
HEJIAWAN INTERCHANGE
Denggao
Hejiawan
Sandadi
Tengchong
Gaozhai
GAOZHAI INTERCHANGE
Shidian
Alternative 4
Zhenbao Tunnel
HUANGCAOBA INTERCHANGE
Longshanka
Huangcaoba
Longling
to Ruili
N
0 5 10 15
Kilometers
County Seat
Township Seat
Project Expressway
DaBao Expressway
Alternative Alignment
National Highway 320
Prefecture Main Road
River
District/County Boundary
Prefecture Boundary
Boundaries are not necessarily authoritative.
02-1988 HR

I. INTRODUCTION

1. This summary environmental impact assessment (SEIA) summarizes the findings, benefits, adverse effects, environmental management plan, and recommended mitigation and monitoring measures related to the construction and operation of the Western Yunnan Roads Development Project in Yunnan Province in the People's Republic of China (PRC) (Map). The full environmental impact assessment (EIA) report was prepared by the Highway Research Institute, Ministry of Communications, PRC in February 2002, and is expected to be approved by the State Environmental Protection Administration in December 2002. The Asian Development Bank (ADB) provided technical assistance[1] for project design. The EIA and the present summary are Borrower's documents, which have not been assessed and verified by ADB. The Project has been classified by ADB as a Category A project with potential significant adverse environmental impacts if the appropriate mitigating measures are not properly incorporated in the design and operation stages. This SEIA is being circulated 120 days prior to ADB's Board consideration of the loan in accordance with ADB's environmental assessment requirements.

II. DESCRIPTION OF THE PROJECT

2. The main objectives of the Project are to (i) promote economic growth, (ii) reduce poverty in the western part of Yunnan Province through improved and safer traffic conditions and improved accessibility to poor rural areas, and (iii) contribute to regional development. The Project will (i) alleviate congestion, reduce travel time and vehicle operating costs, and improve road safety; and (ii) improve the access of the poor rural population to market centers. While contributing to poverty reduction, the Project will also support reforms relating to road safety, vehicle emissions, and corporate governance. The project scope includes (i) construction of an 80 kilometer (km), four-lane, access-controlled toll expressway from Baoshan to Longling, including access roads, interchanges, administrative buildings, and service areas; (ii) upgrading of about 300 km of county roads to improve access to areas with poor and minority people; (iii) procurement of equipment for road maintenance, toll collection, surveillance, communications, and vehicle weighing stations; (iv) land acquisition and resettlement; and (v) consulting services for construction supervision, safety audits, and capacity building.

3. The existing road between Baoshan and Longling, in Baoshan Prefecture, is a section of national highway (NH) 320 between Kunming City and the PRC southwest border. It is a combination of expressway, Class I, Class II, and Class III highways, and urban streets. The topography throughout the major part of the road is mountainous. The traffic is congested on many sections, especially during rainy season due mainly to landslides and nighttime fog. The travel time between Baoshan and Longling is currently 4.0-4.5 hours for a passenger car, and up to 6 hours for a heavy truck. Current traffic volume is estimated at about 3,000 medium truck equivalent (MTE) per day. Delays are frequent because of the difficult road conditions, steep grades, small radius curves, and low design speed. The incidence of accidents is high. The project expressway will increase the corridor capacity to about 20,000 MTE per day, and reduce the distance to 80 km and the MTE travel time to about 1.5 hours.

4. The traffic on the expressway is forecast to grow from 4,400 MTE per day at the time of opening the facilities, in 2007, to about 10,500 MTE in 2020. These traffic projections are based on the expected economic growth of Yunnan Province, Baoshan Prefecture, and adjacent Dehong Prefecture. The economy in the project area grew at a rate of about 7% in 2000 and is

[1] ADB. 2001. *Technical Assistance to PRC for the Western Yunnan Roads Development Project.* Manila.

expected to grow at an average rate of 8.5% from 2000 to 2010, and around 7% and 5.5% over 2010–2020 and 2020–2030, respectively. Traffic projections also take into account (i) the additional traffic generated by the Project because of enhanced development and improved investment potential along the new expressway corridor, (ii) increased cross-border trade with Myanmar, and (iii) the impact of toll levels.

5. Of a total of about 970 km of provincial, county, and village roads to be upgraded under provincial government financing over the 10th Five-Year Plan, a set of priority roads was included under the Project based on their anticipated economic performance, poverty reduction impacts, and benefit monitoring and evaluation considerations. Located in Longyang District and Longling County and serving some of the most poor districts in the project area, the selected three road sections totaling 294 km are currently unpaved county roads. Under the Project, they will be upgraded to Class III or IV roads with asphalt and cobbled surface, along their existing alignments, and be linked to the expressway via main county roads and interchanges.

III. DESCRIPTION OF THE ENVIRONMENT

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

A. Physical Environment

1. Climate

7. In the southwest part of Yunnan Province, towards the border with Myanmar and in the low valleys, the climate is subtropical monsoon. Annual average temperatures range from 15.5 to 18.5 degrees centigrade, and annual rainfall from 950 to 2,000 millimeters. There are no frost days in the Nujiang River valley, but Longling County experiences on average 70-90 frost days per year. The province's northern mountainous part experiences a cold climate with up to 120 frost days per year. Of environmental concern are the number of frost days in the mountain areas and the intensive rainfall between May and October, when over 70% of the annual precipitation occurs. Frost and ice shatter rock, induce soil creep, and contribute to surface erosion and rockslides. By holding water, the severity of water-induced soil erosion intensifies when melting occurs. The heavy summer rains restrict construction and increase the risk of landslides, increased erosion, and river siltation.

2. Geology and Soils

8. The geology of the project area is extremely complex, with crossing faults and incomplete folds. The key geological features along the alignment are summarized in Table 1. The geology along the project expressway alignment is very similar to that along the existing road, as it consists of different parts of the same ridges dipping to the south. The terrain is essentially an area of mountains and intermountain basins. The main features are the ridges inclined from the northeast to the southwest and the Longling, Nujiang, Pupiao, and Baoshan flood plains. The rock-substrate is very fractured and highly variable. The geology and slope stability often change considerably over very short distances, and the natural angle of repose varies from 20 to 45 degrees from the horizontal.

9. The strata and lithology are complex, the geology varies widely in composition, including igneous, metamorphic and sedimentary base rock. Surface rock types consist of highly fractured and shattered rock, including basalt, limestone, shale, sandstone, unconsolidated aggregates, clay, gravel, and highly unstable glacial/fluvial sediment. The geomorphology also varies widely from floodplains to solid basalt domes, steep-sided valleys, and large gravel fans. The depth of weathering varies according to the type of base rock and the climate.

Table 1: Geological and Soil Characteristics along Preferred Alignment

Approximate Location	Geological and Soil Characteristics
km 513 to 517	Steep slopes. Limestone mixed with sandstone with some 3–4 m of clay overlay. Rock appears to be stable.
km 517 to 519	Siltstone and shale with some limestone. Fractured rock. Gully erosion.
km 519 to 523	Limestone and dolomite. Fractured rock. Gully erosion.
km 523 to 526	Basalt and limestone. Severe weathering to over 10 m depth. Gully erosion.
km 526 to 529	Pupiao Basin. Limestone (Karst) and lacustrine. Mixed clays.
km 529 to 536	Basalt, limestone, dolomite, mudstone, conglomerate. Except for conglomerate, relatively stable.
km 536 to 545	Limestone, dolomite, sandstone, mudstone, with clay and scree overlay. Unstable on slopes.
km 545 to 554	Bawan Basin and Nujiang River. Essentially all arable farmland and stable.
km 554 to 567	Loose structured clays and gravely soil interspersed with limestone, siltstone, and shale. Sections of fractured rock. Serious washouts.
km 567 to 582	Fractured rock and rockslides. Very unstable.
km 582 to 593	Basalt overlabored by 25–30m of weathered material. Vegetation cover good but small slides apparent.

km = kilometer, m = meter.
Source: *Water Conservation Program Report and Engineering Geology Survey Report*

10. Rockslides, severe slumping, and gully and sheet erosion are apparent on many slopes. Also contributing to the severity of slides are seismological conditions. The Engineering Geological Survey Report indicates that earthquakes have happened once in every 50 years with a Richter magnitude of 6-7. The seismological conditions have been taken into account in the design of the expressway structures.

3. Surface and Groundwater Quality

11. The surface water system in the project area is fully developed and consists of the south-flowing Nujiang and Longchuanjiang rivers and their mountain tributaries. The Gaoligong Mountains comprise the main watershed area of these two river systems. 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 to retain cultivated land. The Nujiang River flow peaks during June through September with an average flow over 2,700 cubic meters (m^3) per second. The surface waters throughout the project area are abundant and of high quality, and, except in some limited spots, meets Class III or better national standards (Appendix 1).

4. Air Quality and Noise

12. Baseline measurements indicate that the air quality is within the upper limit of the national air quality standards for urban residential, mixed-use, and rural areas.[2] Over nearly its entire length, the project expressway will run through quiet rural setting. Measured noise levels are well within national and provincial standards.

B. Biological Environment

1. Flora and Fauna

13. The expressway alignment passes through cut-over forest, agricultural land, and a small natural forest. For its entire length, the alignment does not interfere with important or reserved floral communities. All of the sensitive and restricted habitats are at higher elevations, above and away from the proposed alignment. No known sensitive or endangered fauna exist along the alignment.

14. Forest and plant cover has a marked vertical distribution with abundant variety of vegetation types because of the different temperature and humidity at different altitudes. Natural vegetation types include dry and hot valley monsoon forest, subtropical evergreen coniferous forest, subtropical evergreen broadleaf forest, and temperate and high altitude mountain forest. However, the cut-over forest and the wide distribution of non-native species introduced by humans indicate the breadth of environmental change already imposed on this region.

15. Wildlife has an obvious vertical distribution in concert with the different types of vegetation. There are some 450 bird species and 150 mammal species resident in the area, but no rare or endangered species that might be impacted.

2. Fisheries and Aquatic Biology

16. The native aquatic community, mainly in the Nujiang and Longchuanjiang rivers and the large tributaries, has been somewhat disturbed by decades of aggregate mining in the rivers, siltation, and point discharge of effluent. The water quality is high in the main rivers, but the aquatic habitat continues to be damaged by siltation and turbidity from erosion. The rivers support only a few native fish, primarily catfish and minnows. Smaller tributaries have better physical conditions and probably healthier aquatic ecosystems, but this has not been independently confirmed.

C. Sociocultural Environment

1. Local Economy

17. The main features of the socioeconomic environment are the demography, variety of ethnic minority groups; differences in access to markets, education, and social services; and per

[2] GB 3095 – 1996 Standard for Quality of the Atmospheric Environment (annual daily average concentrations in micrograms per cubic meter)

	Class I	Class II	Class III
Particulates	80	200	300
Sulfur dioxide	20	60	100
Nitrogen oxide	50	50	100
Carbon dioxide	4,000	4,000	6,000

capita incomes (Appendix 1). Agriculture for self-sufficiency in the remote areas, and for sale at markets in the accessible areas, forms the basis of the local economy, with industrial output equal to approximately half of agricultural production. Baoshan City and Longling County have both enjoyed rapid economic growth over the past decade, when average per capita incomes rose at an annual average rate of over 9% to provide an average per capita income in Baoshan City of CNY5,455 per year.

18. In the remote valleys through which the project expressway is to pass, income levels are much lower than in the urban areas, and there are a number of pockets of absolute poverty where high-income crops cannot be grown. The proposed local road component will be an essential element of the Project, as it will improve accessibility to markets, employment opportunities, and education and health facilities. However, improved local roads may also attract tourists, new roadside settlers, and resource users, forcing county and village officials to protect the local environment and ensure that community values and services are not compromised.

2. Land Use

19. The landscape is complex due to highly variable geology and climate. Land use in the proposed expressway corridor is largely cut-over forest (50-60%); agricultural land including paddy, orchards, and small plantations often on steep terraced ridges and valley walls (20%); and non-forested or uncultivated lands. There are also a number of surface mines. The cultivation on terraced hillsides, combined with the lack of protective vegetation, has resulted in significant erosion and soil loss.

3. Sites of Cultural and Historic Importance

20. There are no important cultural or historic sites in the project corridor.

IV. ALTERNATIVES

21. The “no action” alternative was not assessed beyond establishing that NH 320, the existing national highway, is already congested and its alignment is unsuitable for an extension to a four-lane divided expressway. Furthermore, widening the existing highway would result in significant resettlement and high construction costs. The expressway alignment was selected after considering five alternative alignments. The selection process included site inspection; geological and topographical surveys; terrain considerations; discussions with community representatives; and initial assessment of costs, benefits, and relative impacts. Table 2 summarizes the key differences among the five alternatives.

22. Table 2 shows that the selected option is the middle option in terms of length and cost. It will require fewer retaining wall structures, less overall bridge length, and fewer culverts than any other option. It will also require less land acquisition than the other alternatives considered. The proposed alternative alignments are shown on the map.

23. The potential negative impacts from construction and operation of the project expressway along the selected alignment will be minimized and/or reduced to an acceptable level if prescribed mitigation measures, protective works, and planting programs are implemented. To enhance the prospect of compliance with the impact mitigation requirements, monitoring will be conducted throughout and immediately after the construction period.

Table 2: Key Differences among Alternative Alignments

Item	Unit	Selected Alignment (Rank)	Alt 1 Dabanqing	Alt 2 Majiazhai	Alt 3 Gaodeng Upper Bridge	Alt 4 Zhenbao Tunnel
Approximate length	km	80 (3)	88	78	79	85
Subgrade volume	million m^3	19.2 (2)	+ 2.2	- 0.1	+ 1.4	+ 3.0
Retaining wall	m^3	555,861 (1)	+ 432,230	+ 4,712	+ 21,346	+ 90,790
Bridge	m	50,127 (1)	+ 1,592	+ 1,120	+ 186	+ 1,880
Tunnel	m	11,975 (2)	+/- 0	+/- 0	+ 315	- 1,200
Grid sodding	m^2	144,545 (1)	+ 1,955	+ 509	+ 3,833	+ 97,500
Culvert	number	90 (1)	+ 78	+ 3	+ 7	+ 28
House affected	m^2	34,711 (1)	+ 5,625	+ 100	+ 1,300	+ 707
Paddyfield affected	m^2	531,599 (1)	+ 52,800	+ 10,296	+/- 0	+/- 0
Woodland and wasteland	m^2	3,198,265 (1)	+ 21,054	+ 8,580	+214,500	+ 15,576
Damage to water and ecology		Care required in drainage and slope protection (2)	More than preferred alternative	Less than preferred alternative	More than preferred alternative	More than preferred alternative
Cost	million yuan	4,775 (3)	+ 53.7	- 89.4	- 37.9	+ 181.9
Conclusion	**-**	**First selection**	**N.R.**	**Second selection**	**N.R.**	**N.R.**

Alt = alternative, km = kilometer, m = meter, m^2 = square meter, m^3 = cubic meter, N.R. = not recommended.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Physical Environment

1. Land

a. Preconstruction Period

24. The provincial government's Erosion Protection Program covers the area potentially affected by the project expressway. A specific soil erosion protection plan (SEPP) has been prepared for the Project (Appendix 2). The SEPP and EIA include a series of mitigation measures and outline institutional mechanisms to implement them. Given the many debris flows, mud slides, 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.

25. The SEPP is based on the engineering data from the feasibility study. It will be updated and complemented where necessary by the Highway Research Institute as the detailed engineering design progresses, and by the Yunnan Baolong Expressway Company (YBEC), which will prepare the SEPP implementation schedule, to be agreed to by the contractors prior to groundbreaking. Relevant features of the detailed engineering design as well as scheduling of construction activities will be based on the soil erosion prevention program of the EIA and the complementary water conservation program to be implemented as required as design and construction progress. Soil erosion protection will form part of the technical specifications and tender documents, and will be dealt with in a separate section of the civil works contracts.

b. Construction Period

26. The geology, geomorphology, hydrology, and soil conditions vary greatly along the proposed expressway alignment, as do the natural angles of repose, rainfall, and drainage conditions. All these factors influence the stability of natural, cut, and embankment slopes, and necessitates slope stabilization measures.

27. Soil erosion is a major concern of the Yunnan Provincial Government (YPG). The proposed expressway alignment passes through a government-declared soil erosion prevention area. The prevention measures include afforestation in mountainous and hilly areas and land use conversion from agriculture to forests. The EIA and water conservation program detail the anticipated erosion volumes, which may range from 30,000 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.

28. Soil erosion will occur throughout the proposed expressway alignment, particularly during the wet season (May through October). 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 Highway Protection Guidelines (JTJ/T 006-98) and Technical Standards of Highway Projects (JTJ 001-97).

29. Closely related to slope and drainage protection is the disposal of surplus materials left over from earthworks and tunneling works, and the restoration of borrow pits and quarries. If mitigation measures are not implemented, inadequate disposal of surplus materials and lack of quarry and borrow pit restoration may result in significant environmental impacts, especially on agricultural land, rivers, and water quality. All temporary and permanent drains are to be designed and constructed to ensure flowing of surface waters to a water body without eroding natural or built slopes while preventing silt and other material from entering rivers and streams. Catch chambers or settlement ponds should be constructed wherever necessary to prevent material from reaching water bodies.

30. Material extraction and storage sites have not yet been identified; however, a strict borrow-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 Nujiang River and its tributaries will require permits from the Provincial River Management office. As the materials extracted during tunneling may amount to about one million m^3, a disposal plan for the tunnel wastes will be prepared, 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. The disposal plan will include (i) use and management of waste materials, (ii) material transport scheme, (iii) material dumping arrangements, (iv) stabilization of stockpiles against rain and wind (and frost and ice at high elevations), (v) 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.

c. Operation Period

31. During the operation of the project expressway, no significant impacts are predicted other than those resulting from neglected protection works, planting, and revegetation schemes.

2. Water

a. Groundwater

32. 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.

b. Surface Water and Solid Waste

i. Construction Period

33. The project expressway will cross two ridges, the Nujiang River, and a number of tributaries. The Nujiang and its tributaries have Class I or II water quality designation and thus require protection during construction and operation to ensure that good water quality is maintained. Care needs to be maintained to ensure that construction waste does not enter streams and rivers. Surface drainage from bridge construction sites will be intercepted and directed into temporary settling ponds with 48-hour detention capacity, either built by the contractor or rented from local landowners. A geo-textile filter will be provided at the pond outlet to catch suspended sand and mud, should it overflow.

34. Given the very large labor force that will be involved in the construction of this project, very large volumes of sewage effluent will be generated. 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 (GB 8978-1996).

35. During construction, work camp operations will generate several tons of solid waste daily, such as vegetable and other food waste, kitchen waste, paper, plastic, and other solid waste. This waste will be stored correctly, away from water bodies of any kind, and be regularly taken to a suitable landfill site. Suitable 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.

36. 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.

ii. Operation Period

37. Potential impacts resulting from expressway operation will be limited to storm-water runoff from road surfaces and cuts into watercourses, failure of erosion protection works, effluent leakage from solid and liquid waste treatment facilities, 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 will be undertaken:

(i) divert roadway runoff over grassed or pervious areas permitting fine materials to settle, oily water to be detained, and the volume and rate of flow to be reduced, particularly at bridge sites and where the expressway is close to a water body;

(ii) inspect erosion protection, e.g., stabilized slopes and planted areas, at least twice during the first year of road operations 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; and

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

3. Air Quality

a. Construction Period

38. Air quality conditions along the proposed alignment are rated good, as they meet Class II standards. During construction, dust plumes from aggregate plants, concrete plants, and truck traffic may disperse over a large area. Trucks transporting construction materials and heavy equipment will be moving on mostly unpaved rural roads and temporary roads. Much of the construction-related dust will consist of fine particulate matter of less than 10 microns (PM10). During the dry season (from November through April) potential dust problems can be expected. Mitigation measures to overcome dust and vehicle emission impacts include the following:

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

(ii) Construction roads including access roads to the works sites will be carefully

selected to optimize hauling distances and reduce dust pollution and nuisance to public traffic; temporary and rural roads will be maintained and repaired regularly (environmental screening of these roads will be done in compliance with government regulations, and a suitable plan prepared to address and mitigate potential impacts before construction begins),

(iii) Adequate measures will be implemented and dust control equipment installed to contain dust from cement and aggregate storage sites and from concrete batching plants, and protect houses and settlements; construction roads will be watered,

(iv) Trucks transporting sand, cement, aggregates, and waste materials will be covered,

(v) Diesel equipment will be maintained based on an agreed upon maintenance schedule, and engines will be turned off during idle time,

(vi) Air quality at sensitive building locations (e.g., schools and hospitals) will be monitored quarterly during the construction period; all monitoring activities will be coordinated by the project implementation unit with monitors contracted from the certified monitoring stations.

b. Operation Period

39. Air quality conditions during expressway operation were estimated based on traffic forecasts. Air quality conditions prevailing in 2000 were used as the baseline levels. The Project will have only minor negative impacts on the air quality in the expressway corridor. Based on the national regulations and guidelines, YPG is implementing measures to reduce vehicle emissions by requiring all vehicles to have emission control devices, encouraging the use of cleaner fuels (such as compressed natural gas), and reducing traffic congestion. The proposed expressway should contribute to improving air quality. Designed with long curves and comparatively gentle slopes, the proposed alignment will allow fast travel speeds, thus facilitating cleaner combustion, reduction of unburned hydrocarbons and carbon monoxide, and reduction of airborne particles generated by frequent braking. In addition, the diversion of traffic from the existing national highway to the proposed expressway will reduce the emission levels on the existing highway and in the communities it serves.

4. Noise

a. Construction Period

40. Noise impacts resulting from construction activities in general and from the operation of heavy machinery and construction equipment in particular will be severe but temporary and localized. Noise intensity from these activities ranges from 70 to 85 decibels (dB[A]) within 14-150 m of the source. Pile driving produces noise levels exceeding 80 dB(A) at a distance of 150 m from the source. Noise along construction roads may exceed the 70-80 dB(A) range. Therefore, proper equipment maintenance, use of silencers, and restriction of operating times to 06:00–20:00 hours is required to reduce noise level to acceptable standards within 200 m of settlements. Blasting required for cut areas and tunnels will create severe noise peaks (more than 100 dB[A]) affecting areas up to 1 km from the blast site. Blasting operations will be conducted during daytime only.

b. Operation Period

41. Noise levels will affect residents, school pupils, and hospital patients in buildings within 100 m of the proposed road. However, the full potential noise impact on people is difficult to assess, as several of the potentially impacted households are to be moved in the resettlement process. Nevertheless, 116 houses and one school lie within 40 m of the proposed expressway center line. Noise impact mitigation measures are identified in the EIA. Additional measures will include the construction of earth berms and use of solid noise barriers, such as solid walls or noise-reflecting panels near sensitive sites. To ensure that noise does not impact unnecessarily on people resident in the expressway corridor, the following mitigation measures will be implemented:

(i) giving the option to the affected people in noise-sensitive areas to construct permanent noise barriers or relocate the structures;

(ii) restricting new dwellings, schools, and hospitals from locating within a 100 m strip of land on either side of the expressway right-of-way; and

(iii) monitoring ambient noise levels at four special sites (Lengshuiqing primary school, Lengshuiqing; Denggao; Yujiazhai; and Laozhaizi village) four times a year over a period of 20 years; noise levels significantly exceeding the standard levels will require immediate mitigation measures.

B. Biological Environment

42. While intensive agricultural activities in some part of the project area have significantly affected the fauna, the proposed expressway project will not adversely affect the fauna. Aquatic habitats have been somewhat degraded through mining and river siltation, but habitat quality in a number of tributaries has been restored to sustain natural fish populations. Bridges across watercourses will require careful construction methods to prevent flow restrictions or blockages.

43. The selected expressway alignment does not pass through any ecological or forest reserves, or any known archaeological or cultural sites. There are no endangered or precious species resident in the proposed corridor. The selected alignment goes through agricultural lands and natural cut-over forest for which logging restrictions are in place. However, the expressway may facilitate access to the Gaoligong Mountain Natural Reservation Zone as it passes about 4 km away from it. Therefore, there is a need for the protected zone authorities to implement measures to control the access and ensure protection of the natural reserve.

44. Heavy revegetation will be undertaken not only to assist land stability and to reduce erosion but also to assist reestablishing the natural habitat. It will be necessary to monitor plantings and plant growth and to conduct follow-up planting to ensure adequate ground coverage. Tree replacement will be an integral part of each contract package, and to that end the following procedure is suggested:

(i) A vegetation planting layout will be prepared for each construction area (including access roads) indicating the number and species of trees to be removed and replanted, where the replanting will be located, numbers and species of tree to be planted, and maintenance organization,

(ii) Planting and replanting during construction and operations will be supervised by the chief supervision engineer and implemented by contractor-designated staff and local villagers.

C. Sociocultural Environment

45. The Project is not expected to have serious negative social impacts, other than the possible diversion of the local labor force from farming activities to temporary higher paying construction jobs. Given the 3-year construction period, such long absences from farming will put great stress on females to maintain food production levels. The benefits of higher family incomes may be offset by the community disruption and stresses on community services by the many temporary residents. However, because of the government program to discourage agriculture and compensate farmers for ceasing to cultivate slopes of over 25 degrees, the temporary off-farm employment opportunities may promote long-term conservation as cultivated land becomes vacated.

46. In addition to creating construction jobs, the expressway and the 300 km of local roads will provide benefits to communities through improved access to markets, education, health, and social services. However, the expressway passing through previously inaccessible or remote areas will bring with it immigration and increasing levels of land use incompatibility, particularly along the connecting roads to the expressway. In time, pressure to develop and embrace tourism will be felt by local communities but initially the infrastructure to cope with the tourism-related waste, water demand, and increased housing demand will be inadequate. Rising land values will create both positive and negative impacts on villagers, and social change will follow. To cope with these eventualities, preliminary tourism development strategies/plans will be prepared by the affected counties, with active decision-making input from local villagers.

1. Transport of Hazardous Substances

47. The transport of hazardous goods by motor vehicles is governed by standards and related regulations issued by the Ministry of Communications. To assess the accident risk associated with the transportation of hazardous goods, it is estimated that the accident rate for hazardous and toxic goods carriers is 50% less than 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. 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 prepared. 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.

2. Resettlement

48. According to the resettlement plan prepared by the Yunnan Province Communication Department (YPCD), expressway construction will result in loss of land, houses, and other assets affecting an estimated 6,725 people in about 1,508 households (Appendix 3). Those losing land will be compensated, through their economic collectives, in accordance with (i) the 1998 Land Administration Law and provincial guidelines, which set out the procedures,

compensation rates, and resettlement subsidies for acquiring land, and (ii) the approved resettlement action plan. The Project will acquire permanently about 600 hectares (ha) of land, of which about 40% is cultivated. In addition, about 100 ha will be temporarily required for construction purposes. Villagers who lose housing will receive compensation directly and a replacement housing site, with vulnerable households receiving assistance to replace their houses. Those losing other assets such as crops, trees, and other structures will be compensated directly for their losses. People whose land will be borrowed temporarily will be compensated for loss of production. The resettlement impact from the local roads is expected to be limited, as the proposed road widening and paving will be implemented within the existing right-of-way. However, should there be a need to acquire land or compensate the people losing their houses, the compensation framework for the local roads will be the same as for the expressway.

49. The land acquisition and resettlement cost for the project expressway is estimated at about $20 million equivalent. YPCD will fund the resettlement costs according to the standards set out in the resettlement action plan. The resettlement entitlements will be provided to the affected people before ground leveling and demolition commence. The Land Administration Law of 1998 provides for disclosure of information and consultation with affected people. The resettlement information booklet was released to affected people through local government offices in Baoshan Prefecture. The booklet contains sections on resettlement impacts, the resettlement policy, compensation rates and policies, organizational arrangements, consultation and participation, and grievance procedures. The expressway company, acting as the project implementing agency, will be responsible for internally monitoring the resettlement process and for submitting quarterly reports to ADB according to the monitoring and evaluation plan in the resettlement action plan. A regular reporting system will be established to ensure that key resettlement activities are implemented on time. YPCD will engage a local institute to independently monitor the resettlement process and submit semi-annual reports to YPCD and ADB. Further evaluation surveys will be carried out on completion of the resettlement and during the two subsequent years, and the findings will be made available to all concerned agencies.

3. Public Safety

50. In the PRC, the estimated accident rates for expressways in terms of vehicle-km are less than half the rates for Class II highways. However, accident rates on expressways in mountainous terrain are still high by international standards. The Project will therefore include adequate road safety improvement measures to minimize risks to road users and local communities, strengthening the road safety program run by the provincial Traffic Safety Committee. The Ministry of Communication also requires that the Public Security Bureau and the construction industry jointly set up a safe road campaign to publicize safety along the length of all new expressways.

4. Public Health

51. The earliest documented case of HIV/AIDS[3] in the PRC was found in Ruili County, Yunnan Province, along the Myanmar-Yunnan border in 1986. Yunnan is the most HIV/AIDS-affected province in the PRC, with about one third of all reported cases. In 2001, a total of 8,317 HIV/AIDS cases were documented in Yunnan, from which 326 AIDS deaths were reported. The infection pattern is moving from the predominantly minority people living in border areas to urban areas often far from the borders. The 5-year plan (2001-2005) for HIV/AIDS control prepared by the state council includes a series of preventive measures such as ensuring safe

[3] HIV/AIDS = human immunodeficiency virus/acquired immune deficiency syndrome

blood transfusions, and fighting drug use and prostitution. National and provincial surveillance sites have been established at sexually transmitted infection (STI) clinics, and detoxification and female education centers to control and monitor the HIV epidemic. Yunnan Province has 42 surveillance sites, of which two are located in Kunming.

52. The Project will likely increase the risk of HIV infection during construction and operation of the expressway as a result of the following factors:

(i) The project expressway will link Ruili, the epicenter of HIV/AIDS in the PRC, to Kunming, the provincial capital, and then on to the rest of the PRC,

(ii) About 20,000 construction workers are expected to be employed over a 3-year construction period; their interaction with the resident communities may result in the spread of the epidemic,

(iii) Baoshan City has seen a significant increase in STI rates in recent years, and is also in a region with a very low rate of condom use in the sex trade,

(iv) The road will pass through minority villages whose population is vulnerable to STIs and HIV owing mainly to poverty.

a. Construction Period

53. Given the above risk factors, there is a need to implement an HIV/AIDS and STIs prevention program concurrently with the expressway works. This program will consist of an information and education campaign in both Mandarin and the local languages targeting construction workers and the local communities bordering the construction sites.

54. While designing the prevention program, the principal of gender equality will be adhered to, and the specific needs of minority communities will be addressed. Furthermore, to supplement the prevention program, it is planned to develop a training program for the treatment of STIs following World Health Organization guidelines. A benefit monitoring and evaluation system will be implemented under the leadership of the provincial health department.

b. Operation Period

55. During operation, the expressway will be used as a means to disseminate information on HIV/AIDS and STIs. The information campaign targeting primarily the road users will consist of (i) establishing information centers at the expressway service areas and at the main toll stations, (ii) distributing leaflets at the toll stations along with the toll ticket, and (iii) installing billboards along the expressway.

VI. ECONOMIC ASSESSMENT

56. Without the Project, the increasing traffic volumes in the corridor would lead to increased traffic congestion, reduced travel speed, and most likely higher accident rates. These would generate high vehicle operating costs (VOC), increased maintenance costs, and increased health costs. The Project will reduce travel time as a result of shorter distance 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 an economic internal rate of return well above

the accepted 12% threshold. The results of sensitivity analysis confirm the robustness of project economic viability.

57. The environmental benefits will come from reduced noise, and reduced vehicle emissions and particles from repeated braking. The total environmental mitigation cost is estimated at about CNY16.6 million. The investment in environmental training for all involved in the planning, construction, and operation of the road will have a cumulative benefit in raising the environmental management and technical skills of YPCD and Yunnan Baolong Expressway Company (YBEC) staff and local communities.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING

A. Environmental Management Plan

58. The mitigation measures are defined in the EIA. A summary of such measures and the environmental management action plan (EMAP) are in Appendix 4; this also includes an environmental management and monitoring plan recommending organizational, supervisory, impact mitigation, and monitoring requirements. The preconstruction mitigation measures will be incorporated into the final design. This design plus the EMAP will then be passed on to YBEC, which will prepare an EMAP implementation schedule. YBEC will ensure that the contractors comply with the EMAP at all stages of the Project.

59. Four types of specifications will be included in all bidding and contract documents:

(i) a set of environmental prequalification conditions for potential bidders,

(ii) a list of environmental protection and impact mitigation measures to be implemented by successful contractors,

(iii) environmental management clauses to be included in contract terms and conditions and in works specifications, and

(iv) an environmental covenant to be inserted in the loan agreement (specifying borrower responsibility for sound environmental management).

60. Recommendations include several appointments:

(i) an environmental supervision engineer for each contract section,

(ii) several professionals to implement/direct environmental protection works and measures and to check on construction activities unfavorable to the environment, and

(iii) contracts with local environmental monitoring stations to monitor environmental protection works during construction.

B. Institutional Requirements

61. Given the various interests and concerns of the governmental agencies and public entities involved in project implementation and operation, a project steering committee will be formed. The committee will consist of representatives from each major agency and knowledge-

based institution with interest in the biophysical environment of western Yunnan. It will oversee the implementation of works and encourage horizontal management and decision-making approaches to protect the environment while ensuring the long-term stability of the expressway structures.

62. Considerable institutional strengthening and training will be implemented to achieve the required environmental compliance. Protection of the environment during the construction period will be entrusted to the contractors building the road, but they traditionally have little awareness of, or concern for, environmental issues and how to prevent and mitigate impacts. To address this gap the Chinese Research Academy of Environmental Sciences in liaison with the Yunnan Environmental Research Institute will implement an environmental training program (based on the material in the SEIA, the EIA, and the Water Conservation Program report). The cost of such training is included in the EMAP. Additional funding for training in environmental audit and mitigation work will be made available by YPCD. Attendance at environmental training programs will be mandatory for YPCD, YBEC, and contractors' staff. The training will address environmental management, implementation of impact prevention and mitigation measures, and environmental audit and reporting.

63. Monitoring of noise, air, and water quality will be contracted through the Baoshan environmental monitoring station. The contractor will ensure that mitigation measures are implemented and sustained throughout the construction period. YBEC and its government counterparts at all levels will check that contractors have environmental skills and are aware of their environmental protection responsibilities. YBEC will confirm that contract specifications contain environmental mitigation and monitoring responsibilities as defined in the EMAP.

C. Monitoring

64. During the project design phase, YBEC and YPCD will ensure that the required design elements are included to protect slopes, ensure adequate temporary and permanent drainage, and attenuate noise impacts at sensitive locations. YBEC and YPCD will also ensure that bidding documents include environmental management requirements, impact mitigation measures, and criteria for the selection of qualified contractors. During construction, compliance with the EMAP requirements will be monitored on a monthly basis using a monitoring checklist. Over the first 2 years of operation, an independent expert will carry out an environmental audit once every 3 months. Thereafter, provided that impact mitigation measures are satisfactorily complied with, audits will be conducted in every 6 months. Within 6 months of completing the construction work, YBEC will provide a completion report on construction impact mitigation to YPCD and other concerned agencies.

65. Monitoring during the operating period will focus on maintaining mitigation measures, particularly regarding slope protection works, drainage and planting initiated during the construction period, and sampling noise levels at sensitive locations. Soil erosion monitoring will assess the amount of erosion, survival rates of planted trees and grass, and replanting requirements. The monitoring results will assist in improving slope maintenance activities, if necessary, and constructing sound barriers where required. The monitoring of air quality at the end of the first and fifth year of operations will assist in assessing the effectiveness of emission control measures. Annual environmental reports will be prepared by YBEC and submitted to YPCD and other concerned agencies.

VIII. PUBLIC INVOLVEMENT—SOCIOECONOMIC IMPACTS

66. Wide consultations were held with government agencies involved in environmental protection, water resources, forestry, and agriculture, and with the Gaoligong Mountain Conservation Park. Interviews and discussions were held with local community leaders and cross-sections of villagers. The Baoshan Municipal Government and Transportation Bureau were also consulted frequently and participated in the alignment selection and interchange location. Departments of construction, design and environment conducted public surveys and consultations with various groups of affected people.

A. Participatory Process

67. The Baoshan Environmental Monitoring Station conducted a series of consultations in January 2002. Discussion groups were given information about the Project, the expressway alignment, its major design features, and construction quantities. People's understanding of the land acquisition process, their attitudes to the Project, and their suggestions on mitigating potential impacts were solicited. Most participants supported the Project (98%) and the alignment (89%). People interviewed indicated that their greatest concerns about environmental impacts were related to noise, vehicle emissions and dust during construction, and the loss of agricultural land. The most strongly recommended mitigation measures were installation of sound barriers and tree planting. Likewise, there was extensive public involvement during the preparation of the Resettlement Plan. As part of the detailed design phase, further consultations will be held with the affected local communities, in particular regarding relocation/restoration of irrigation ditches, and the location and design of pedestrian underpasses/overpasses and road intersections. Surveys among road users were also conducted in the project area. The results of these surveys complemented the participatory rapid appraisals held in 20 villages to assess the potential project impacts on poverty.

B. Impact on Poverty

68. Since 1994, the central and provincial governments have implemented extensive poverty reduction programs. Further, the Baoshan Prefecture Poverty Alleviation Office has various programs in the prefecture where poverty is pervasive. During the past 6 years, they have invested about CNY350 million in poverty reduction projects. These activities have included developing and improving rural roads; increasing drinking water supply; funding within-county household migration, irrigation, and livestock development; and electricity supply and telephone access to townships and villages. The Project will assist the government's poverty reduction program by providing the rural poor with improved access to basic services and markets. The government is complementing the rural roads program by continuing to rehabilitate and build new rural roads, extending the coverage and quality of public utilities, providing more vocational training and basic education, and developing rural microcredit programs.

69. The Project will reduce poverty in the short, medium, and long terms. In the short term, the expressway will provide about 70,000 person-years of direct employment. In the medium term, this will lead to a ripple effect on the prefecture's economic growth, amounting to 2.0–2.5 times the short-term impact, in addition to the expected pro-poor growth induced by the transport cost savings of the Project. In the long term, the expressway will serve as a main transportation artery between the northeastern region and the southwestern region of the PRC, promoting the development of the central and western regions, and creating new jobs for poor residents in Baoshan Prefecture.

70. In the medium term, the expressway will also reduce road transport bottlenecks in the prefecture, helping farmers shift from subsistence to market-oriented agriculture, and promoting agroprocessing. Designed as an integrated roads development program, the Project will bring the benefits of economic growth to poor households. Improved access will induce poor farmers to shift more to cash crops, increase agroprocessing, and thus create new jobs to lift some people out of poverty. The rural roads development program to be implemented by the provincial government will connect 31 townships with very high concentrations of people having less than CNY1,000 of per capita annual income. By connecting these townships through all-weather roads, poor farmers will shift to growing cash crops, and small processors will be able to get better prices and extend their market areas. The expressway component of the Project will also boost the tourism industry by providing substantial timesavings for tour busses. Benefits accruing to the poor from the rural roads component will even be more significant than those accruing from the expressway component.

IX. CONCLUSIONS

71. 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 longer 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 implementation and payment of compensation to the affected people to ensure that they will be equal or better well-off with the Project.

72. 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 YPCD and YBEC 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, and employment opportunities and a convenient, congestion free travel route for many.

73. 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 EMAP requirements during the construction period, an adequate monitoring and evaluation system will be developed and implemented under the supervision of the Provincial Environmental Protection Bureau. Monitoring of environmental impacts during expressway operation will be the responsibility of the expressway company in liaison with the provincial environmental agencies concerned. The Project will also include special program for HIV/AIDS and STIs prevention in the project area.

Environmental and Socioeconomic Indicators

Table A1.1: Average Ambient Water Quality, Nujiang River
(Sampled at Hongqiqiao, 27 km downstream of Nujiang River Bridge)

	Date	pH	COD_{Mn} (mg/l)	DO (mg/l)	SS (mg/l)
	03/00	7.9-8.1	1.77-3.92	9.2-9.45	20-46
	08/00	7.1-8.2	1.81-3.05	7.78-8.35	323-575
	11/00	7.5-8.2	1.23-2.11	7.25-9.4	36-60
	03/01	8.0-8.5	4.78-5.42	8.9-9	4-25
	08/01	7.5-7.8	3.66-4.86	8.3-9	474-874
	11/01	7.4-7.7	1.31-1.74	9.1-9.9	29-49
GBGHZB1 – 1999 Class I/II/III[1]		**6.5-8.5**	**2/4/6**	**>90%/6/5**	**150**[2]

COD = chemical oxygen demand, DO = dissolved oxygen, mg/l = milligram per liter, pH = acidity, SS = suspended solids
[1] Standard for Irrigation Water Quality (GB 5084-92).
[2] Class III was stated by the Yunnan Environmental Protection Bureau to be the standard for Nujiang River.
Source: Baoshan Environmental Monitoring Station (2000 and 2001).

Table A1.2: Average Ambient Water Quality, Nujiang River
(200 m downstream of Nujiang River Bridge)

	Date	pH	Permanganate Index	DO (mg/l)	SS (mg/l)	Oil (mg/l)
	01/02	8-8.1	1.75-3.72	8.7-9.05	2-30	<0.04
GBGHZB1-199 Class I/II/III		**6.5-8.5**	**2/4/8**	**>90%/6/5**	**150**[1]	**0.05/0.05/0.05**

DO = dissolved oxygen, mg/l = milligram per liter, pH = a scale to measure acidity, SS = suspended solids
[1] Standard for Irrigation Water Quality (GB 5084-92)
Source: Baoshan Environmental Monitoring Station (January 2002).

Table A1.3: Socioeconomic Indicators of Baoshan Prefecture

Year	Population (x 1,000)	GDP (million CNY)	Gross Value of Industrial Output (million CNY)	Gross Value of Agricultural Output (million CNY)	GDP per Capita (CNY)
1990	2,122	1,473	619	1,213	694
1991	2,148	1,680	787	1,392	782
1992	2,168	1,972	912	1,628	909
1993	2,191	2,503	1,171	1,858	1,142
1994	2,213	3,338	1,464	2,428	1,508
1995	2,237	4,133	2,148	2,947	1,848
1996	2,260	5,019	2,246	3,688	2,221
1997	2,283	5,906	2,737	4,228	2,587
1998	2,304	6,374	2,870	4,347	2,766
1999	2,340	6,720	2,798	4,410	2,872
Average Annual Growth Rate (percent)					
1990-1995	1.05	10.51	12.76	5.96	9.36
1995-1999	1.14	9.75	12.93	7.97	8.52
1990-1999	1.09	10.17	12.84	6.85	8.98

GDP = gross domestic product.
Source: Feasibility Study Report (2001).

Erosion Protection Plan Summary
Table A2.1: Suggested Trees for Revegetation Areas

Species	Major Biological Features	Suitable Growing Conditions
Horsetail Pine	Fond of mild humid climate, not demanding with soil, deep rootage up to 5 meters or more, extensive side rootage with fungus	Can resist dry and barren land, can grow in conglomerate area
Arborvitae	Strong adaptability, not demanding with soil, developed rooting, blooming growth	Can resist dry and barren land; can grow in acid, neutral, or alkaline soil; can grow in barren places and dry rock
Cypress (Drooping Cypress)	Sunshine tree, fond of mild and humid climate, strong adaptability to soil	Can resist dry and moisture land, can grow in acid and alkaline soil
Round Cypress	Fond of sunshine but strong shade resistance. resists cold and heat, deep rootage and developed side rooting, grows fast	Not demanding with soil; can grow in acid, neutral, or alkaline soil; can resist dry and moisture conditions
Maple	Fond of sunshine, and mild and humid climate, resists cold, deep rootage and developed side rooting, good sprouting	Not demanding with soil, can grow in acid and alkaline soil
Huaxiang	Fond of sunshine, resists dry and barren land, an important evergreen tree, good sprouting	Good for planting on waste hills, can grow in acid and calcareous soil
Alder	Fond of sunshine, and mild and humid climate, resists moisture, rooting can improve soil, developed rootage, fast growth	Strong adaptability, not demanding with soil, can resist dry and barren land, can grow in acid, neutral or alkaline soil
Shuanpi Oak	Fond of sunshine, adaptable to climate and soil, deep rootage and developed side rootage, resists dryness and wind	Can grow in acid, neutral and calcareous soil with pH of 4-8, underground root grows fast
Sawtooth Oak	Fond of sunshine, and mild and humid climate, resists cold, and dryness, deep rootage	Strong sprouting, not demanding with soil, but not resist saline-alkali soil
Black Oak	Fond of mild and raining climate, resists shade, deep rootage	Fond of calcium soil, grow in limestone mountains
Yunnan Camphor	Fond of sunshine, and mild and humid dimate, fast growth	not demanding with soil
Chinese Maple	Fond of sunshine, and mild and humid climate, resists shade	Can grow in dry and barren lands, but cannot resist moisture. Deep roots
Lebbek Albizzia	Nitrogen fixation, fast growth	Not demanding with soil, can grow in dry and barren lands
Redbud	Shrub, nitrogen fixation, fond of sunshine, resists shade	Some resistance to cold, not demanding with soil
Chinese Clovershrub	Shrub, nitrogen fixation	Hard resistance, beautiful flower, can be used for water conservation
Jinjier	Shrub, nitrogen fixation, fond of sunshine, resists cold, strong adaptability	Can grow in dry and barren lands, and in rock gap, can be used for water conservation
Arrowroot	Shrub, nitrogen fixation	Not demanding with soil, can grow fast and spread widely with thick leaves, good for water conservation
Camellia	Shrub, fond of mild and humid climate, developed and deep rootage	Can grow in barren lands, but not resist saline-alkali soil
Hutuizi	Evergreen shrub, fond of sunshine, and mild climate, does not resist cold	Strong adaptability to soil, can resist dry and moisture land
Yunnan Phoenix Grass		Can be used for water conservation
White Leaf (Baisanye)	Fond of mild and humid climate, nitrogen fixation	Grow in Yun-Gui plateau in southwest China, not resist saline-alkali soil
Alfalfa	Developed side rootage, fast growth, strong budding	Can be used for water conservation
Red Leaf (Hongsanye)	Fond of moisture, developed side rootage	Covering plant
Perennial Rye Grass	Fond of mild and humid climate	Grow well in Yunnan, short dormancy in summer, suitable for water conservation with Baisanye

Table A2.2: Soil Erosion Monitoring Program

Protection Area	Monitoring Content	Monitoring Method	Monitoring Time		Remark
			Construction Stage	Initial Operation Stage	
Waste Areas	Rainfall	Actually measured value at nearby hydrological station			Two points
	Soil erosion volume	Groove method	P=10% after rainfall	P=10% after rainfall	
	Satisfactory rate of arresting facility	Field investigation		One time in flood season	
	Vegetation survival rate and coverage rate	Standard ground method		Twice	
Earth Borrow Pits	Soil erosion volume	Groove method	One time in flood season per year		One point
	Vegetation survival rate and coverage rate	Standard ground method		Once	
Subgrade Slope	Soil erosion volume	Groove method			One section
	Vegetation survival rate and coverage rate	Standard ground method		Twice	
	Satisfactory rate of project measures	Field investigation		One time in flood season per year	
Downstream Rivers from Construction Sites	Soil erosion disaster	Field investigation	After rainstorm		One point

Table A2.3: Cost of Soil Erosion Protection Measures

Name of Works or Cost	Budget Amount (million CNY)	Remark
Subgrade Drainage and Protection Works	155.63	Included in the engineering cost
Landslide Treatment	2.85	
Soil Erosion Fee	1.04	
Soil Erosion Compensation Fee	2.14	

Schedule of Erosion Protection Actions

The program scheduling for soil erosion protection is based on the scheduling of road construction. The various schemes for the main works are:

(i) Embankment and cutting slope protection and drainage works will be executed simultaneously with the main works,

(ii) For waste area, preliminary protection works such as cutoff trench, drainage ditch, and arresting wall will be finished before waste earth disposal,
(iii) Other protection works such as slope protection and revegetation will be finished soon after waste earth disposal,
(iv) Borrow pits will be protected according to actual condition,
(v) Engineering measures and reclaiming measures can precede planting measures. After completion of subgrade works, the soil erosion protection works can be basically finished,
(vi) After completion of the road, other measures can be continued.

SUMMARY RESETTLEMENT PLAN

A. Status of the Resettlement Plan

1. The proposed Western Yunnan Roads Development Project will finance the construction of an expressway between Baoshan City and Longling County, with a length of 80 kilometers (km) and a number of access roads totaling 33 km, as well as 300 km of local roads. The Resettlement Plan (RP) covers all three components. The upgrading of local (township and village) roads is not expected to require much, if any, land acquisition or resettlement. The Yunnan Provincial Government (YPG) has assured the Asian Development Bank (ADB) that if additional farmland will be required, the affected people will receive the same compensation and other assistance provided in the RP.

2. The Yunnan Provincial Communication Department (YPCD) is the Project's Executing Agency. Based on the detailed impact survey completed during project preliminary design, and a socioeconomic survey of affected villages, the RP was prepared by YPCD with the assistance of consultants. The RP is still to be formally approved by YPG; this is expected by December 2002.

B. Scope of Land Acquisition and Resettlement

3. The proposed Baolong Expressway including the access roads will affect 5 townships, 28 administrative villages, and 113 village groups in 2 counties, namely, Longyang District and Longling County of Baoshan Prefecture. According to the detailed impact survey, nearly 600 hectares (ha) of land will be acquired, about 40% of which is farmland, comprising paddy fields (23%), dryland crops (43%), and orchard (34%). The remaining 60% is forestland and wasteland. Approximately 68 ha of land will be occupied temporarily during the construction phase. Land acquisition will directly affect an estimated 1,500 households with 6,700 persons. On average, each affected household would lose 0.16 ha of farmland, which represents 30% loss of their current farmland.

4. Along with land acquisition, about 35,000 square meters (m^2) of houses will be demolished, necessitating relocation of 174 households and 723 persons. Almost 95% of houses are brick-wood on earth-wood structures, with earth-wood accounting for 75% of total demolished houses. The relocation will provide an opportunity to improve current housing conditions for the relocated households. Most households will move a short distance to another site within their original village.

5. Other affected assets include telecommunications and electrical infrastructure, ponds for fish and lotus cultivation, sheds, walls, and economic trees. All land, housing, and other assets will be compensated at replacement value.

C. Policy Framework and Entitlements

6. For people unavoidably affected, the resettlement objective is to achieve equal, or better income and living standards in line with the Land Administration Law (1998) of the People's Republic of China's (PRC) and ADB’s Policy on Involuntary Resettlement. YPCD will ensure that any people losing land, housing, other assets or income source will be assisted to fully restore their income and living standards. YPG in 1999 issued a Land Administration Decree to implement the 1998 Land Administration Law, which stipulates the regulations for land compensation, resettlement subsidies, young crop compensation, house compensation, and

other measures to carry out resettlement. Given the poverty conditions in the region and the compensation standards used on other expressway project, YPCD has proposed higher standards for compensation. Accordingly, the total compensation (land compensation, resettlement subsidy, and young crop) will be set at CNY25,000 per mu[1] for paddy fields; CNY21,000 per mu for dryland fields; and CNY22,000 per mu for vegetable land. Those people losing land temporarily during construction will receive payment equivalent to the production value foregone for the period of loss, which is expected to be 3-4 years. The land used temporarily will be restored by the Project/contractors to the original condition, or else additional funds will be provided to the owner to restore the land. For structures to be demolished, replacement value will be provided to the affected households based on CNY400 per m^2 for brick-wood structures and CNY200 per m^2 for earth-wood structures. Those losing housing will be provided with a free new housing site serviced with road, electricity, and water within the current village group or administrative village. There will be no reduction in house compensation for depreciation, and people will be allowed to salvage materials from their old houses.

D. Resettlement Strategy

7. Efforts to minimize resettlement effects have been made after consultations with local officials during the setting of the alignment in the initial feasibility study. The amount of paddy land to be acquired was kept to only 23% of the total agricultural land lost and the number of relocated houses was kept to only 174. For those unavoidably affected, the resettlement strategy is designed to replace losses of housing, land, other assets, infrastructure, and income.

8. Over 86% of affected people will lose agricultural land. However, the impacts are widely dispersed among villages, so the loses are not significant and can be replaced. Therefore, most of the affected people will remain in agriculture and will be provided replacement land through redistributing village land and, where necessary, developing wasteland so as to ensure that all village members have sufficient land to farm. The village collectives will utilize the compensation funds to improve farm conditions and to develop cash crops and various non-farm activities. From a total of 113 affected village groups, the impact survey has identified 12 village groups that will lose more than 10% of their landholdings. For these seriously affected village groups, economic rehabilitation plans have been developed that include redistributing existing farmland, developing new farmland, converting low yield dryland into paddy, and developing more productive crop varieties and sideline activities. The decision to restore and improve the agricultural economy was based on consultation with and the expressed preferences of the affected people. It was also recognized that new employment and income generating opportunities would arise once the expressway and access roads are constructed. The people generally felt confident that this strategy would lead to faster economic growth, higher incomes, and better living conditions.

9. YPCD will ensure that the resettlement entitlements are provided to the people affected at least 3 months before ground leveling and demolition commence. Land compensation and resettlement subsidies will be paid to the affected village groups. Housing compensation and compensation for young crops and other assets will be provided directly to the people losing these assets. Compensation for infrastructure such as electrical and communication fixtures will be paid to the concerned government departments for restoration.

10. The resettlement regulations have standard provisions for moving allowances to assist the affected people during the transition phase. Also, expressway contractors will be requested

[1] 1 mu = 667 m^2

by YPCD to give priority to resettlement-affected households in the allocation of unskilled jobs during construction. This will be handled through consultation with the township and village leaders.

E. Institutional Arrangements

11. YPG will assume overall responsibility for implementing the resettlement according to the approved RP. A project implementation unit (PIU) within YPCD will be directly responsible for coordinating the planning, implementation, financing, and reporting of land acquisition and resettlement for the expressway, access roads, and local roads. Leading groups for resettlement, each comprising 10-15 staff, will be established in the two affected counties. The county resettlement offices will take the primary responsibility for the resettlement consultation, implementation, and timely delivery of entitlements, with assistance from township officials and village leaders.

F. Minority Population and Vulnerable Groups

12. The potentially vulnerable people affected by the Project can be divided into two groups. One refers to those with ethnic minority background and the other refers to economically vulnerable households – those under the poverty line, elderly living alone, disabled, and households headed by women. There are 161 affected minority households, with 742 persons in six village groups, accounting for 11% of total affected persons. Two ethnic nationalities are involved: 60% Dai and 40% Lishu. Although the compensation and rehabilitation will be the same across 113 village groups, additional measures will be taken for the 6 affected minority village groups to meet their special needs. For example, to maintain their settlement pattern and building style, larger housing plots will be permitted. In addition to ethnic minority township officials being selected to handle resettlement matters, the local minority affairs administration institution (ethnic minority committee) will be involved in different aspects of resettlement implementation, thereby enhancing the participation of ethnic minority households. The ethnic minority committee also provides one more channel to voice any grievances.

13. For economically vulnerable people, including elderly living alone, disabled, households headed by women, and poor households, the Project will provide additional financial and physical support. According to the impact survey, it is estimated that about 307 households and 1,379 persons belong to this group and account for about 20% of total affected persons. Given the extreme poverty conditions among some minority groups, a significant portion of this group includes the minority population. Under the RP, this vulnerable group will receive the following additional assistance: (i) physical help in housing construction and relocation free of charge, and (ii) a special subsidy to enable them to maintain their living standards while constructing their houses. The specific amount for such assistance will be determined according to actual conditions and their needs. For this purpose, the PIU has set aside a special fund with CNY2.44 million or 2% of the total resettlement cost, which will be used to provide direct and needed help for vulnerable people.

G. Consultation and Grievance Redress

14. The 1998 Land Administration Law requires disclosure and consultation with people affected. The people affected have been notified about the key elements of the RP during meetings and interviews. Prior to implementation, there will be further consultations arranged by township and village officials to discuss specific impacts in each village and how they will be addressed. The people losing housing will be offered a choice of housing sites, and those losing

agricultural land will have the opportunity to consider suitable income replacement alternatives. All villagers will also have input to decisions on how to utilize the collective compensation funds.

15. A resettlement information booklet will be distributed to all affected townships, villages, and households through the peasant economic collectives. The information booklet contains the resettlement scope, expected time frame, compensation rates for land and other assets, other assistance to replace assets, relocation and economic rehabilitation strategies, and the grievance redress mechanisms. The county, township, and village officials will ensure that any concerns raised by the people affected are quickly addressed.

16. In case of grievances, the people affected will submit their oral or written complaint first to the village committee or the township resettlement office. If their complaint is not settled in 2 weeks, they have 1 month to seek redress at the county resettlement office. If still unresolved within 2 weeks, the PIU will try to achieve a solution. The final redress would be sought, if necessary, in the civil courts, in accordance with the Civil Procedures Act.

H. Monitoring and Reporting

17. The detailed plan for internal and external monitoring and evaluation is included in the RP. YPCD will engage the service of an independent resettlement monitoring agency to ascertain the extent to which the affected people have (i) received their full entitlements on time, and (ii) fully restored their livelihoods, income levels, and living standards. The independent monitor will conduct a baseline survey prior to resettlement, semiannual investigations during resettlement, and annual survey updates for 2 years after the completion of resettlement. The household survey will include a representative number of those severely affected by loss of land, those losing housing, and those classified as minority and economically vulnerable.

18. A quarterly reporting system is being established in the PIU. The PIU will report to ADB on the progress of land acquisition and resettlement through quarterly progress reports. The PIU will also provide ADB with copies of the semiannual independent monitoring and evaluation reports and a summary of the annual resettlement audit prepared by the Yunnan Audit Bureau.

I. Finance and Implementation Schedule

19. The RP cost is estimated at $20 million equivalent including compensation, resettlement subsidy, payments for other assets such as housing, moving allowances, subsidy for vulnerable groups, fees for resettlement administration, and monitoring and evaluation. Annual adjustments in the cost estimates, including compensation rates, will be made based on the inflation rate for the previous year. YPCD will guarantee to supplement the resettlement budget, as may prove necessary, to meet any shortfall that emerges in achieving the resettlement objectives.

20. The resettlement implementation schedule has been prepared based on the project construction timetable in the feasibility study. It is planned that land acquisition will commence by the middle of 2003 and be completed by the middle of 2004. Housing will be relocated between October 2003 and February 2004. This schedule provides time to develop some new agricultural land during 2003, readjust farmland in 2004, and have full restoration of livelihoods and living conditions by 2005.

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location[1]	Time Frame[2]	Responsibility	
					Implementation	Supervision
PRE-CONSTRUCTION PHASE						
Soil Erosion Protection & Conservation	SEPP has been prepared. This will be updated to match the detailed design.	Legal requirement	Throughout the project corridor	Before construction starts	YPDI and YBEC	YPCD (YBEC) and approval by National or Provincial WRB
Removal of Trees	(i) 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.	Legal requirement	RoW width of ≈ 50 m	Before groundbreaking for construction	Contractors in consultation with local Forestry Department and local communities	YPCD and YBEC
Taking of Land and Property	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 sub-section. Compensation will occur as per the RP.	RP and project requirement	The RoW as defined in the RP	Before construction starts on any contract	County-level communications department.	YPDI and YBEC
Utility Relocation	All utilities will be relocated with prior approval of the concerned agencies.	Contract specifications	Refer utility relocation drawings	Before construction starts	County communications department and contractors	YPDI and YBEC
Removal of Community Utilities	All community utilities such as community water source pipes will be replaced at appropriate and suitable locations.	RP requirements	Any water source within construction zone	Before construction starts	County communications department. and contractors	YPDI, YBEC, and local community committees
Relocation of Ancestral Tombs	Community meetings will be held to pinpoint tombs and identify relocation sites. Relocation should be completed before construction starts.	RP and Contract Specifications	To be defined as part of detailed design surveys	Before construction starts	County communications department and contractors	YBEC and local community committees

SEPP = Soil Erosion Protection Plan, YBEC = Yunnan Baolong Expressway Company, YPDI = Yunnan Provincial Highway Design Institute, WRB = Water Resources Bureau , m = meter, RP = Resettlement Plan, RoW = right-of-way

[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.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
Subterranean Karst Formations	Survey to determine if subterranean karst formations such as caves and subsurface water reservoirs are located in the work area, and if so prepare mitigative actions to conserve these features.	EIA		Before construction begins	YPDI	YPDI
Relocation of Irrigation Systems	Relocation of the canals will be discussed and agreed upon with village committees and county WRBs prior to commencement of the works.	Contract terms and conditions, and RP	Any irrigation system located within construction. zone or affected by the construction	Before construction starts and before the irrigation season gets under way	County communications department and contractors	YPDI in cooperation with Local Community Committees & County WRB
Environmental Protection Training	(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.	Contract terms and conditions, EIA		Before construction starts	(i) SEPA (ii) SEPA/consultants	YPCD/YBEC
Environmental Specifications for contractor prequalification; Technical specifications Environmental Clauses for Contracts; and, Loan covenant	(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 EMAP and monitoring table. (iv) Prepare covenant for loan agreement as defined in the EMAP.	SEIA and EIA	Entire project	Before construction begins	For items (i)-(iii) YPDI in consultation with YBEC For items (iv) YBEC in consultation with BEMS and YEPB	For (i)-(iii) YPCD,YPDI and for (iv) YPCD, YPDI and YBEC
Environmental Screening of New Construction Site Access Roads	(i) Each contractor will complete an 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.	EIA	Construction sites, especially tunnel portals, viaducts, and remote road sections	Before groundbreaking	Contractor working with YEPB	YBEC and YPCD
Access Restriction	Placement of the alignment, pedestrian underpasses will be included into the design every 500m~1000m, with exact locations based on discussion with local village committees.	Contract specifications	Along the entire alignment	Detailed design stage	YPDI	YPDI and YBEC
CONSTRUCTION PHASE						
SOIL						
Disposal of Earthworks (excavation) Materials	(i) Cut and fill, according to detailed design. (ii)Waste will be dumped in preselected areas, approved by the construction chief engineer (CCE). Residual spoils will be used, according to the SEPP.	Design requirement and Contract Specs.	Throughout Project Corridor at all construction sites	During Construction.	Contractor.	CCE, YBEC assisted by the WRB.

BEMS = Baoshan Environmental Monitoring Station, BEPB = Baoshan Environmental Protection Bureau, CCE = construction chief engineer, EIA = environmental impact assessment, EMAP = Environmental Management Action Plan, SEPA = State Environmental Protection Agency, SEIA = summary environmental impact assessment, ToR = Terms of Reference, YEPB = Yunnan Environmental protection Bureau , YPCD = Yunnan Provincial Communications Department.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
Loss of Topsoil	(i) Maintenance of the stockpiles of topsoil will be in accordance with the SEPP and according to Agriculture Department specifications. (ii) Topsoil will be returned to cover the disturbed area and cut slopes. (iii) Topsoil will be handled minimally, avoiding loss.	Soil Erosion Protection Law, No.49-'91 and Reg. No. 120 of PRC	Throughout the project corridor and all borrow and spoil areas	During construction	Contractor	YPCD with assistance of WRB
Compaction of Soil	(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.	Contract specifications Contract specifications	Throughout project corridor and all temporarily used areas; at all cut and fill sites	During construction	Contractor	CCE of YBEC with assistance from WRB
Haphazard Borrowing of Rock	(i) Borrowing within the RoW is prohibited-under this contract. (ii) The Contractor will facilitate inspection of all borrow areas by YEPB and WRB and satisfy YBEC within YPCD of compliance with SEPP and MEMP. (iii) No soil or aggregates will be borrowed from or spoil dumped on Tomb/graveyard sites.	Contract specifications PRC Law: 49-'91 & Reg. No. 120 Contract specifications	Throughout project corridor and all construction sites	During Construction	Contractor Contractor Contractor	YBEC YBEC with assistance from YEPB and WRB YBEC and resident communities
Degradation of Borrow Areas	Borrow pits will be redeveloped as per details found in the Site Operation Plan, the SEIA, & within the SEPP.	FIDIC: 13.1, 26.1 PRC Law: 49-'91 & Reg. No. 120	All borrow areas	During construction	Contractor	YBEC and WRB
Soil Erosion and Siltation	(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.	Design requirement PRC Law: 49-'91 & Reg. No. 120	Within construction corridor and all construction sites; all borrow and spoil areas; service roads and equipment storage sites, etc.	During construction	Contractor	YBEC with assistance from YEPB and WRB

FIDIC = Fédération Internationale des Ingénieurs Conseils, MEMP = mitigation measures execution and monitoring plan, PRC = People's Republic of China.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
Contamination of Soil by Fuel and Lubricants	(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 located at least 300 m from drainage structures and important water bodies. (iii) Fuel storage and refuelling areas, if located 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.	Contract terms and conditions FIDIC: 19.1(iii)	Throughout project corridors, all access roads, sites temporarily acquired, and all borrow areas	During construction	Contractor	YBEC in cooperation with YEPB and BEPB
Contamination of Soil by Construction Material Wastes	(i) All spoils will be disposed of. (ii) All waste material will be completely disposed of as defined, and the site will be fully cleaned before handing over to the operating unit. This will be certified by YBEC after inspection by BEPB.	FIDIC: 32.1	Throughout project corridors, all access roads, sites temporarily acquired, and all borrow and spoil areas	During construction	Contractor with monitoring by EMS	YBEC with assistance from YEPB
WATER QUANTITY AND QUALITY						
Loss of Water Sources	Any source of water (potable or otherwise) for the community such as wells and ponds, incidentally lost, will be replaced immediately.	RP requirement	Throughout project corridors, all access roads, sites temporarily acquired, and all borrow areas	Whenever encountered during construction	Contractor	YBEC and county WRB
Flooding	Prevent temporary or permanent flooding of the site or any adjacent area.	FIDIC: 19.1(iii) FIDIC: 29.1 and contract terms and conditions	Project corridors, access roads, sites temporarily acquired, and borrow areas	During construction and the defects liability period	Contractor	YBEC
Siltation into Water Bodies	Cofferdams will be constructed prior to bridge footings or pile drilling commencing in any major watercourse.	FIDIC:19.1(iii)	See clause 2.1.6	During construction	Contractor	YBEC with assistance from BEPB
Revegetation to Prevent Erosion and Siltation	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.	FIDIC: 19.1 (iii) PRC Law: 49-'91 & Reg. No. 120	Entire project corridors, access roads, & temporary sites	During construction	Construction contractor and local unit retained to do replanting	YBEC assisted by prefecture forestry dept.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
Alteration of Drainage	(i) In sections along watercourses, earth, stone or any other construction materials will be properly disposed of. (ii) Temporary irrigation and drainage systems will be built before permanent systems are blocked or removed.	FIDIC: 19.1 (iii)	Project corridors, access roads, sites temporarily acquired, and borrow areas	During construction	Contractor	YBEC with assistance from YEPB
Depletion of Karst-Groundwater Formations	If groundwater supplies are found, rerouting of the flow by piping or cessation of leakage by sealing the surface area of the cavity with concrete will occur immediately to prevent leakage or contamination.	Contract specifications & using karst survey	Complete during design and implement during construction	During construction	Contractor	YBEC and YEPB
Contamination of Water from Construction Wastes	(i) All measures will be taken to prevent contamination by the wastewater produced in construction, as directed by YBEC. (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, access roads, sites temporarily acquired, and cut/borrow sites	During construction	Contractor with monitoring assistance from the BEMS	YBEC with assistance from YEPB
Contamination from Petro-chemicals	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	During construction	Contractor	YBEC with assistance from BEPB
Sanitation and Waste Disposal in Construction Camps	(i) Laborers' camps will be located at least 200 m away 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	During establishment, operation, and dismantling of such camps	Contractor	YBEC/YPCD and YEPB
AIR QUALITY						
Generation of Dust	(i) Vehicles delivering granular and/or fine materials to the site will be covered. (ii) Materials storage site should be 300 m away from residential area 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/m^3 within 150 m from the work sites. (v) Where practical dust screening vegetation will be planted along perimeter of all existing roadside crushers.	FIDIC 19.1(iii)	Throughout Project Corridors, access roads, sites temporarily acquired and all borrow areas	During Construction.	Contractor with monitoring assistance from BEMS.	YBEC/YPCD with assistance from YEPB and prefecture departments

mg/m^3 = milligram per cubic meter.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
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.	PRC - GB: 14761.7-93	Throughout project corridor, access roads, sites temporarily acquired, and borrow areas	During construction	Contractor, via BEMS	YBEC/YPCD with assistance from YEPB
NOISE POLLUTION						
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.	FIDIC: 19.1 (iii) PRC-GB: 12523-90 FIDIC: 26.1 FIDIC: 19.1 (iii) FIDIC: 45.1	Throughout project corridor, access roads, sites temporarily acquired, and borrow areas	During construction	Contractor with monitoring assistance from BEMS	YBEC/YPCD with assistance from YEPB
Noise from Blasting Operations	(i) Blasting will be carried out only with permission of the CCE of YBEC, using a preestablished schedule. (ii) Blasting mats will be used to reduce noise levels when blasting is carried out.		All blasting sites	During preparation, operation, and closure of such sites	Contractor with monitoring assistance from BEMS	YBEC/YPCD with assistance from YEPB
Erection of Noise Attenuation Structures	Noise attenuation structures will be placed immediately. All such mitigative measures will be inspected by YBEC and BEPB in response to surpassing the 75dB(A) level.	SEIA	At nominated sites as designated in the EIA	Before closure of the construction sites	Contractor with monitoring assistance from BEMS	YBEC/YPCD with assistance from YEPB
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.	Design requirement, SEIA	Entire project site	During construction	Contractor. YBEC & Forestry Department	YBEC/YPCD with assistance from the Forestry Department
IMPACT ON FAUNA						
Loss, Damage to Fauna	Construction workers will be instructed to protect natural resources, fauna, and flora; no harvesting of wild foods will be possible unless by permit from the CCE of YBEC.	FIDIC: 19.1 (iii)	Entire project area	During construction	Contractor	CCE of YBEC & Forestry Department
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.		Project corridor and neighboring villages.	During construction	NGO	Yunnan health Department, YBEC.

AIDS = acquired immune deficiency syndrome, HIV = human immunodeficiency virus, STI = sexually transmitted infection.

Environmental Impact/Issue	Mitigative Measure(s)	References in Law & Contract Documents	Location	Time Frame	Responsibility	
					Implementation	Supervision
DISRUPTION TO USERS						
Loss of Access	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.	As specified in RP documents FIDIC: 29.1	All project corridor and construction sites	During construction	Contractor	YBEC/YPCD Transport & Security Department
INAPPROPRIATE USE OF HAZARDOUS AND TOXIC MATERIALS						
Use of Hazardous and Toxic Materials	(i) Herbicide or other toxic chemicals will be used strictly in accordance with the manufacturer's instructions and according to PRC Regulations.	PRC Regulation: JT3130-88	Entire construction corridor	During construction	Contractor	YBEC/YPCD with assistance from YEPB
OPERATIONAL PHASE						
Management of Storm Water	Storm water should not be drained directly into the tributary rivers classified as Class I and II.		Project corridor, urban stretches	Beginning and end of each monsoon	County departments responsible for drainage	YBEC with input from EPB
Atmospheric Pollution from Vehicles	(i) New afforestation projects adjacent to the project road. (ii) The vehicles on the road will be tested ad hoc for emitting pollutants. (iii) Vehicle emission inspection program will be encouraged by YBEC and a vehicle certification system implemented.	EIA GB 14761.1-14761.7-93	All project corridor and affected villages	Starting Immediately after completion of construction	YBEC with local forestry units YBEC with assistance from BEMS	YBEC, YPCD in cooperation with police
Noise Pollution	(i) Noise pollution will be monitored. (ii) "NO HORN PERMITTED" signs will be set at road sections near schools. (iii) At access points to the expressway, random weighing of vehicles will be done.	EIA- noise section and environmental monitoring plan SEIA	Refer noise pollution monitoring program	Throughout operational phase	YBEC with monitoring by BEMS	YBEC and YPCD
Accidents involving the Handling and Transport of Hazardous & Toxic Materials	(i) YBEC will enforce compliance with PRC regulations. (ii) 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.	PRC Regulation: JT3130-88 Local Transp. Reg. On Haz. Subst. SEIA	Entire project corridor and surroundings			YPCD, YEPB, & police
Sewage and Garbage	(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.	Project EIA	All service areas & toll gates	Throughout operational phase	Rest and toll area operators	YBEC
ENVIRONMENTAL MONITORING						
Environmental Monitoring	Monitoring will be conducted based on relevant specifications or standards issued by SEPA and using the schedule set out in EIA, SEIA, SEPP, EMAP, and MEMP.	Project EIA and SEIA	Monitoring stations selected as defined and verified in field	Throughout operational period as defined	BEMS, plus data technician trainees from YBEC	YBEC with technical input from YEPB