

SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

RURAL ACCESS ROADS PROJECT

IN THE

LAO PEOPLE'S DEMOCRATIC REPUBLIC

August 2000

CURRENCY EQUIVALENT

(as of 4 August 2000)

Currency Unit – US Dollar (\$)

ABBREVIATIONS

ADB	–	Asian Development Bank
DOR	–	Department of Roads
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
ESU	–	Environment and Social Unit
LAO PDR	–	Lao People's Democratic Republic
MCTPC	–	Ministry of Communications, Transport, Post, and Construction
NBCA	–	National Biodiversity Conservation Area
NTFP	–	nontimber forest products
PKK	–	Phou Khao Khoay
REMDP	–	resettlement and ethnic minorities development plan
SEIA	–	summary environmental impact assessment
UXO	–	unexploded ordnance

WEIGHTS AND MEASURES

°C	–	degree Celsius
km	–	kilometer
km ²	–	square kilometer
m	–	meter
mm	–	millimeter

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I. INTRODUCTION

1. The Government of the Lao People's Democratic Republic (Lao PDR), with assistance from the Asian Development Bank (ADB), intends to implement a project to improve rural access roads in four provinces: Attapeu, Houaphan, Vientiane, and Xaisomboun Special Region. The principal objective of the Rural Access Roads Project (the Project) is to improve about 225 kilometers (km) of rural roads to all-weather standards to provide affected districts with better access to markets and social infrastructure. An additional component of the Project is to provide for the rehabilitation of about 100 km of feeder roads in Houaphan Province to improve access to market and other social services and reduce local dependence on opium cultivation.

2. The Project, for road improvement, does not involve construction of any new alignment and as such, was originally classified as Category B. Since at least two of the project roads will traverse ecologically sensitive areas, the initial environmental examination, prepared as part of the feasibility studies,¹ recommended that an environmental impact assessment (EIA) be prepared. The Project was then reclassified as Category A. The EIA study was therefore prepared at the same time as the engineering design study.²

3. This summary environmental impact assessment (SEIA) was prepared based on information in the EIA, initial environmental examination, resettlement and ethnic minorities development plan (REMDP), and findings by the design consultants working on the Project, including a comprehensive village survey.

II. DESCRIPTION OF THE PROJECT

4. The Government has set a high priority on completing all-weather national and provincial road links from the capital, Vientiane, to all provincial centers. Parallel to the development of these national roads, there has emerged a need for rural roads to provide farmers access to markets, thereby reducing poverty and developing human resources. The Project will improve beneficiary access to available services and improve the service providers' access to the targeted areas.

A. Attapeu-Senamnoy (22 km)

5. This 4-5-meter (m) wide road section in Attapeu connects two sections that were improved under previous ADB funding.³ The Project will upgrade the existing earth and/or gravel road, which becomes muddy in the wet season, traverses the flood plain of Sekong River, and forms a barrier for runoff from the escarpment (which rises about 1000 m above the river valley) on the west side of the road to the river on the east. The Project will support the improvement of the existing surface that is currently part earth and part gravel, to 6-m wide bitumen surface road. In many locations, the road is low and subject to flooding in the rainy season. Accordingly, the road is to be raised with several sections being on an embankment.

¹ Feasibility studies for the Project were completed in April 1999 under Technical Assistance (TA) 2889-LAO: *Rural Access Roads Improvement*, for \$600,000, approved on 7 October 1997.

² The engineering design study was funded under Loan 1533-LAO: *Xieng Khouang Road Improvement Project*, for \$46 million, approved on 9 September 1997.

³ Loan 1234-LAO: *Sixth Road Improvement Project*, for \$26 million, approved on 1 June 1993.

B. Na Sack- Khock Khao Do (48 km)

6. This road in Vientiane Province is an integral part of National Road No. 11, forming a shorter route from Vientiane Municipality to southern Sayaburi than the road that is more frequently used. The original road was built in the mid-1980s. Villagers have kept the road passable (for two-wheel tractor type vehicles) from their villages at the ends of the road to their rice fields. The 23 km in the center of the road have, however, been overgrown with thick scrub and secondary growth forest, with a narrow track for walking, which is only passable in the dry season. The road is essentially flat for the first 12 km, rises steeply to cross the mountain range to the west between km 12 and 35, and then falls steeply to a flat alignment over the final 13 km to the western end of the road at Khock Khao Do on the Mekong River. Khock Khao Do is accessible only via a 2.5 hour trip by boat from Xanakhon. The Project will improve the present track to 3.5-m gravel surface road with bitumen surface in some steep road segments.

C. Thong Khoun-Long Xan (76 km)

7. This road is located in Xaisomboun Special Region, links to National Road no. 13 and was first constructed in the 1980s. The road is 3-6 m wide. A section of the route that was originally considered passes through the Phou Khao Khoay (PKK) National Biodiversity Conservation Area (NBCA) and is very steep and virtually impassable in the wet season. However, a recently constructed access road to the Nam Leuk hydropower project bypasses the NBCA and links Long Xan with Thabok. This access road offers a better alternative route and was therefore selected. The project will involve upgrading the existing earth surface, to gravel and bitumen surface road for all roads crossing the villages.

D. Huay Hung-Xam Tai (72 km)

8. Most of this road in Houaphan Province was built in the mid-1970s. At present, the road is passable in the dry season, with private buses providing public transport between Xam Tai and Xam Nua (one trip each way daily, see Map 2). The road is 3-4 m wide, an earth surface and no shoulders. The road traverses the Nan Xam NBCA⁴ and essentially bisects the NBCA into eastern and western halves from approximately km 16 to 32. The Project will improve the road to gravel and bitumen surface in some steep road segments, and involve simple rehabilitation works with light equipment.

E. Feeder Roads

9. About 100 km of feeder roads in Xam Tai and Xiengkhor districts of Houaphan Province will be rehabilitated to improve access to markets and social services. These areas are mountainous and at altitudes of 1000-2000 m. Forests in the proposed areas have been logged or degraded through shifting cultivation and slash-and-burn activities. No feeder track will be widened to more than 3.5 m. A modified gravel surface will be provided. The alignment will be selected by the community with technical assistance from district and provincial engineers of the Department of Roads (DOR). Contractors will be hired under the Project but as far as possible, the workers will be hired from local communities.

⁴ Nam Xam NBCA was established in 1993.

F. Implementation Plan

10. As proposed, project implementation will commence in 2001, and continue over a three-year period by the DOR of the Ministry of Communications, Transport, Post, and Construction (MCTPC). At the provincial level, the Department of Communication, Transport, Post, and Construction will manage the provincial road network. The responsibility for periodic maintenance has also been delegated to them. The World Bank is currently assisting DOR to establish the Road Maintenance Program with the potential involvement of the community and private sector. This is expected to provide a sustainable mechanism to manage and finance road maintenance throughout the Lao PDR.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

11. Northern Lao PDR consists of a deeply dissected high plateau, with the rugged Annamite Chain (Annam Trung Son) occupying the eastern portions, and the rest of the country dominated by low hills or flatlands. The country has been divided into four biogeographical areas, the Annam Trung Son mountain chain (Annam), tropical lowland plain (Central Indo-China), subtropical hills (North Indo-China), and temperate montane (Indo-China transition).

12. Attapeu is in extreme southeastern Lao PDR, and forms a triangle with Viet Nam to the east, Cambodia to the south, and the rest of the Lao PDR to the north. Attapeu is southeast of the fertile Bolovens Plateau, and is drained by the Sekong River, which cuts through the province from southwest to northeast. It lies primarily in the tropical lowland plain portion of the country. Houaphan Province is in the northeastern part of the country. It is split between the Annam Trung Son mountain range to the east and the subtropical hills to the west. Vientiane Province lies almost entirely in the tropical lowland plain. It is bound on the south and west by the Mekong River. Xaisomboun Special Region is in north central Lao PDR. It is bound by Vientiane on the west and Borikhamxai on the east and south. It also lies within the tropical lowland plain area.

13. The northern half of the Lao PDR contains karst limestone outcrops that are cut by narrow river valleys. The northern portion of the country has mostly shallow lateritic soils. The southern part of the Lao PDR, particularly the Bolovens Plateau, has good soil condition.

14. The Lao PDR is a tropical country with two principal seasons. The wet season is from May to October. Precipitation varies from about 1,200 millimeters (mm) per year in the lowlands to over 3,000 mm in the mountainous areas. Temperatures average between 20°C and 30°C.

B. Ecological Resources

15. The Lao PDR is among the most important countries in Southeast Asia for biological diversity. The Senamnoy-Attapeu project road is in Attapeu Province, which has the richest variety and number of wildlife among the project provinces and at least 15 endangered species have been reported as present. Three endangered species of large animals may still be found (i.e., Malayan tapir, Sumatran rhinoceros, and wild elephant) in Attapeu. Most of the faunal and floral diversity is contained within Dong Ampham NBCA, which covers at 1,975 square kilometers (km²), or most of the eastern one fifth of Attapeu. However, the project road is about 100 km from the NBCA and will not have direct or indirect impacts on it.

16. Vegetation in the vicinity of the Senamnoy-Attapeu project road alignment has been significantly degraded by swidden fields. Although one side of the road was classified as a production forest area, there is currently no commercial logging along this project road due to the lack of merchantable timber. Tree-cutting is only done by villagers for house construction (5 cubic meters per house). Nontimber forest products (NTFP) and wildlife have also diminished due to the increase in human population.

17. The Huay Hung-Xam Tai project road bisects the Nam Xam NBCA into eastern and western halves. The NBCA covers 580 km², and is predominantly hilly to mountainous. It is about 85 percent forested, and 31 percent of the forest is dense. The NBCA has approximately nine vulnerable and protected species. However, the Nam Xam NBCA does not rank particularly high in the national context in terms of its biodiversity conservation value. No staff have been assigned for protected area management for this NBCA. Logging that took place before the ban in 1993, and the subsequent movement of shifting cultivators into the logged areas, has left primarily fallow fields and bamboo growth along the project road. Outside the NBCA, one company currently has a logging concession within the vicinity of Xam Tai. Wildlife has diminished in all villages along the Project road, except for Ban Say. Guns are not allowed in Ban Say, and hunters from outside the area are barred from entering. Portions of land within the NBCA are allotted to the villagers for practical uses (e.g., housing, agriculture, and logging), although other protected area laws still apply.

18. Trees along the Na Sack-Khock Khao Do project road in Vientiane Province have been largely logged out. However, due to limited access, from km 23, the road has overgrown with secondary growth forests with bamboo and shrub. As a result, the area attracts some wildlife species that use secondary growth as their habitat. Villagers report elephants and tigers in the area. However, as of 1999, no biodiversity assessment had been carried out for this area. The *Lao Wildlife*⁶ book indicates that this project area maybe part of the home range of several large wildlife species (e.g., tiger and elephant) but no such species were found during the preparation of the publication. Na Sack villagers report that the abundance of NTFP in local forests is increasing due to reduced market demand. In Khock Khao Do, on the other hand, NTFP and wildlife have significantly declined due to swidden farming and the influx of local and Thai merchants.

19. The Thong Khoun-Long Xan project road in Xaisomboun Special Region, particularly the Thong Khoun-Phou Ngom section, is largely settled. Former forests have been largely logged out and converted to agricultural lands. NTFP plants have declined, together with wildlife diversity. The road links with, but is outside of, Phou Khao Khouay NBCA. The NBCA covers 1,390 km² and is largely forested, although only 32 percent of the forest is dense or mature. Approximately 10 vulnerable species are reported (e.g., elephant, gaur, leopard, and tiger).

C. Socioeconomic Conditions

1. Population

20. The populations in the project areas are characteristic of the national population. The average annual population growth rate between 1985 and 1995 was 2.5 percent. This implies a doubling of population in less than 30 years. Demographically, the Lao PDR is a young country.

⁵ Published in Kmer (no English translation) in 2000 by the Division of Resource Conservation, the Department of Forestry and Wildlife Conservation Society and funded by the Japan Official Development Assistance.

Over 44 percent of the population are under the age of 15. The population composition and density of the Project areas is given in Table 1.

Table 1: Populations and Densities of the Project Areas

Province	No. of Persons ('000)			Area (km ²)	Density of Persons/km ²
	Male	Female	Total		
Attapeu	44.8	47.6	92.4	10,320	9.0
Houaphan	128.9	130.3	259.2	16,500	15.7
Vientiane	278.2	277.0	555.2	3,920	141.6
Xaisomboun	28.8	28.4	57.2	7,105	8.1
Total	480.7	483.3	964.0	37,845	25.5

Source: Final Report, vol. 3, TA 2889-LAO: *Rural Access Roads Improvement Project*, June 1999.

21. The target population of road users consists of several categories of beneficiaries. The primary beneficiary group is the rural population. The estimated total target population to be reached by the Project is close to 19,700. Table 2 shows the number of villages and households in the project areas. Average household sizes range from a low of 5.7 people in Attapeu to 6.8 in Houaphan.

Table 2: Villages and Households in the Project Areas

Province	Population	No. of Villages	No. of Households
Attapeu-Senamnoy	4,136	5	664
Na Sack-Khock Khao Do	5,187	4	569
Thong Khoun-Long Xan	7,656	116	1,206
Huay Hung-Xam Tai	2,734	11	502
Total	19,713	136	2,941

Source: Final Report, vol. 3, TA 2889-LAO: *Rural Access Roads Improvement Project*, June 1999.

2. Land Use

22. The rural communities targeted by the Project are almost entirely agricultural and at most, remain at subsistence-level. Although shifting cultivation is illegal, it is the primary mode of production in the upland and lowland areas traversed by the road sections. The Senamnoy-Attapeu project area covers six villages, five of which are along the road alignment. Land use includes gardens, and paddy and swidden fields. This area has been allocated for voluntary relocation, following a government policy to reduce shifting cultivation. On the other hand, land in the Na Sack-Khock Khao Do project area is mostly used for paddy and swidden fields, with farmers in Na Sack benefiting from an irrigation system. A similar land use pattern is seen in the villages along the Thong Khoun-Long Xan and Huay Hung-Xam Tai project roads.

3. Quality of Life

23. Based on housing, water supply, and sanitation facilities, the 1995 census showed the standard of living is low in the country. More than 60 percent of the houses in the districts in the project areas are bamboo or semipermanent. Almost 80 percent do not have electricity, and use fuelwood for energy. On the other hand, all of the houses along the project roads do not have electricity and use deep wells and rivers as their source of drinking water. Only a few houses have pit latrines and septic tanks.

24. Health conditions, as indicated by the infant mortality rate, are not good, particularly in the rural areas where health services are inadequate. Health centers are normally located only in the district capitals. Table 3 shows the health conditions in the four districts where the project areas are located based on the 1995 census. Village-level data are not available.

Table 3: Health Conditions in the Districts of the Project Areas

District	Crude Death Rate (per 1000)	Infant Mortality Rate (Deaths/1000 Live Births)
Samakhixay (Attapeu-Senamnoy)	10.83	93
Xanakhon (Na Sack-Khock Khao Do)	6.04	72
Xaisomboun (Thong Khoun-Long Xan)	13.24	136
Viengxay (Huay Hung-Xam Tai)	7.7	125

Source: Final Report, vol. 3, TA 2889-LAO: *Rural Access Roads Improvement Project*, June 1999.

4. Education

25. As of 1995, literacy rates in the Lao PDR averaged 60 percent with a wide variation between urban and rural rates. Literacy of males in the districts of the project areas ranged from 44 to 89 percent, while that of females ranged from 15 to 75 percent. Educational facilities in rural areas are very minimal. Almost all villages in the project areas have only primary education; none have secondary schools.

5. Economic Conditions

26. In 1999, the gross domestic product of the Lao PDR was approximately \$281 per capita, 60 percent of which came from agriculture that was mostly subsistence-level. The project areas are also dominated by agriculture. The agriculture sector in the target districts generates about 85 percent of employment. Small-scale industries (e.g., rice mills and manufacture of rechargeable vehicle batteries, furniture, and rattan and bamboo crafts) are spread throughout the project areas. Silk yarn and silk weaving activities were found only in the villages along the Huay Hung-Xam Tai and Na Sack-Khock Khao Do Project areas.

27. Annual household incomes in the four districts where the project roads are located range from \$25 in Viengxay to \$350 in Xanakhon.

6. Unexploded Ordnance

28. The Lao PDR suffered intense bombing and battles between 1964 and 1973. Over 2 million tons of bombs were dropped, equivalent to about 300 kilograms (kg) per person. The Handicap International 1996 survey estimates that more than half the villages in Attapeu still have unexploded ordnance (UXO), primarily in the form of small antipersonnel bombs. In Houaphan, the project survey team found such bombs in 12 of the 30 villages surveyed. In 1998, nine people were reported injured and five killed by UXO in these villages. Most villages claim that no clearing of UXO has been done. In Vientiane Province, two of the four villages along the project road had UXO, primarily unexploded mortar shells. No injuries or deaths were reported in 1998. Xaisomboun Special Region was moderately affected by UXO.

D. Environmental Management Policy

29. The Government's long-standing commitment to environmental protection is affirmed in the constitution. This is reflected in the Economic Policy Framework for 1994-2000, wherein the Government has included the following among its broad development objectives: (i) halt the degradation of the natural resource base; (ii) improve returns from sustainable management and conservation of forest resources; (iii) minimize impacts on the environment and cultural heritage; (iv) promote ecotourism, incorporating the environment and traditional Lao culture into tourism activities; (v) promote sustainable use of forest, land, and water resources; and (vi) conserve biodiversity.

30. To protect the Lao PDR's biodiversity, the Government identified 20 NBCAs through Prime Minister's Decree No. 164/1993 (Map 1). All of them were established without resettlement or relocation of people. Although there are no strategic guidelines on social infrastructure development in NBCAs, infrastructure, including roads, are common in NBCAs.

IV. ALTERNATIVES

31. No viable alternative alignments are available to the proposed road sections connecting Attapeu to Senamnoy, Huay Hung to Xam Tai, and Na Sack to Khock Khao Do. Not improving the Senamnoy-Attapeu section will hinder the development of this area. Not improving the Huay Hung-Xam Tai section will leave potential environmental problems such as landslides and erosion. Although no alignment can be established without crossing and impacting Nam Xam NBCA, the decision to rehabilitate the present road is the least-cost alternative. Not improving the Na Sack-Khock Khao Do section will continue to leave Khock Khao Do isolated from its district capital city (Xanakhon) and hinder its potential agricultural development and access to better health and educational facilities. Alternatives for improving this section will involve vegetation clearing activities for road widening. The clearing may disturb the movement patterns of certain wildlife in this project area. A rapid biodiversity assessment is being carried out to develop more detailed mitigative measures to ensure that the road improvement in this section will be undertaken without disturbing wildlife. The Thong Khuon-Long Xan alternative involves a reduction in the original road length to avoid passing through environmentally sensitive areas. The final alignment connects Thong Khuon through Long Xan to Thabok via the Nam Leuk power house road, which will avoid disturbance within PKK NBCA. The Project selected the alignment to avoid works within PKK NBCA which could have significant environmental impacts. The current volume of traffic will not significantly change after road improvement and thus will not affect PKK NBCA.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

32. Potential impacts from the project roads include encroachment on sensitive or protected ecology (through logging, NTFP collection, and habitat destruction; erosion and water quality degradation; dust; noise; and displacement of people. This section addresses potential impacts pertaining to each road and proposes the necessary mitigation measures. The indicative locations, where mitigation measures will be carried out in each road section, are presented in Appendixes 1-4. Appendix 5 summarizes the environmental impacts of the Project as a whole. The mitigation program is summarized in Appendix 6.

33. As part of the mitigation program, the project will include a training program to strengthen the capacity of DOR's Environment and Social Unit (ESU) to: (i) identify environmental problems and initiate appropriate action; and (ii) supervise road development,

particularly implementation of environmental mitigation measures. Another training program will be provided for the provincial and district agriculture and forestry offices to monitor wildlife hunting and trafficking, illegal logging, and encroachment on ecologically sensitive areas.

34. The Project will displace 405 households, which will have to move several meters from their existing locations, although most will still be within their property. A total of 167 households will give up narrow strips of rice land that will be replaced with adjoining land. An REMDP was prepared for the project based on a detailed socioeconomic survey carried out during April-May 2000, which included a census of all households affected by the project. The resettlement will particularly take place in the Na Sack-Khock Khao Do and Thong Khoun-Long Xan project areas. The resettlement will be carried out without causing any loss in income, employment opportunities, or social or cultural well-being as a consequence of the Project. Displaced people will be compensated for loss of land, housing, and livelihood according to the framework in the REMDP and in conformity with present draft regulations on resettlement procedures. The Government will bear the land acquisition and resettlement costs. This SEIA's conclusions assume resettlement will be carried out in this manner.

A. Attapeu to Senamnoy, Attapeu Province

35. The road will link two road sections previously funded by an ADB activity (footnote 2), and the environmental mitigation measures have been specified and agreed on under that project. Thus, the road will not cause impacts that cannot be mitigated. A more detailed assessment of potential impacts and mitigation is in Appendix 1. Mitigation measures will be established to minimize clearing for widening right of way; control erosion due to cutting and filling; and assure that a proper drainage system is installed to avoid flooding, minimize stream crossings, and provide road side stabilization erosion. The land use controls will be implemented to prevent further population influx to the ecologically sensitive areas. An independent group will monitor road construction and operation to ensure that all mitigation measures will be strictly adhered to.

B. Na Sack to Khock Khao Do, Vientiane Province

36. The central 23-km section of the Na Sack-Khock Khao Do road poses some environmental risks. This section is currently inaccessible to motor vehicles. Although the forest has been degraded, villagers reported seeing or hearing a number of endangered species in the area. Due to the foot traffic and shifting cultivation, large animals have moved away from the current path of the road; however, many of them regularly cross the sparsely populated areas of the track.

37. Because endangered species (e.g., elephant and tiger) may travel through the area, the roughly 3.5-m wide road should not impede their movement or use of the area. Many of them are not limited to this particular area, and are spread throughout rural Lao PDR. Although such species are more likely to have their home ranges in Muang Khi, about 50 to 100 km north of the project road, the project area may be part of their home range. The road will open the bamboo forest, and some species may have difficulty crossing the road. Wild elephants, if present, are likely to travel on the road, partly because young vegetation will be readily available along the edges. Large predators will not be affected if their prey are not driven away by increased population along the road and disturbances to wildlife habitats (e.g. destruction of salt licks or watering areas, and introduction of noxious exotic plants) are avoided. The risk of accidents arising from wildlife crossing the road will increase.

38. The impacts related to road design or alignment, construction, or operation can be mitigated. Locations where these mitigation measures will be applied are in Appendix 2.

C. Huay Hung to Xam Tai, Houaphan Province

39. A portion of this road crosses about 17 km of the Nam Xam NBCA. However, this section of the NBCA has relatively small areas of forests, several population centers, and much evidence of pioneering and rotational swidden agriculture. Local people indicate the presence of protected species. The existing road does not appear to be used for logging, however, hunters use the area. To avoid environmental problems related to increased hunting, logging, and encroachment into the NBCA, staff from the provincial and district agriculture and forestry offices will be trained to strengthen their capability to manage Nam Xam NBCA.

40. Other impacts related to road design or alignment, construction, or operation can be minimized if not eliminated with the application and monitoring of standard mitigation techniques. Locations where these mitigation measures will be applied are in Appendix 3. Stringent mitigation measures will be established regarding alignment, right of way clearing, stream crossings, erosion control, and prevention of further population influx to the NBCA. The final alignment will not vary much from the current road in the NBCA. Earthworks will be kept to a minimum within the NBCA. The locations of the salt licks along the roadway will be identified and avoided, since they draw wildlife. An independent group will monitor road construction and operation to ensure that all mitigation measures are strictly adhered to.

D. Thong Khoun to Long Xan, Xaisomboun Special Region

41. Impacts related to road design or alignment, construction, or operation can be minimized and eliminated, if suitable mitigation techniques alignment are applied and monitored and because the alternative alignment will avoid traversing the PKK NBCA. Appendix 4 presents locations where impacts may occur along the road, unless mitigated.

E. Feeder Roads

42. Feeder roads were not included as a project component during EIA preparation. The environmental impacts of the Project's other road improvements are relevant to the feeder roads. However, due to the small scope of work, the magnitude of the impacts is expected to be low. To avoid serious environmental impacts, environmental criteria and guidelines have been developed in selecting the feeder roads to be included in the Project and guiding the rehabilitation works of these roads. No funds will be disbursed for work on any feeder road until an environmental assessment has been prepared and approved by the Government and ADB.

VI. ECONOMIC ASSESSMENT

43. The subproject roads will have an economic internal rate of return (EIRR) ranging from 8.8 percent for the Houaphan road to 33.8 percent for the Na Sack-Khock Khao Do road. The overall project EIRR is estimated to be about 17 percent.

44. The benefits, although difficult to quantify, are anticipated to be quite substantial in terms of maintaining or improving environmental quality and the quality of life of villagers along the project roads. The value of improved health due to reduced dust from roads could be calculated. However, placing even an approximate monetary value on many of the most important aspects of environmental quality is largely a subjective process, particularly where the environmental

conditions involved are exempt from any market process (e.g., the value of a viable population of endangered species such as tiger, gaur, and elephant).

45. Financial costs for mitigating the direct impacts of the initial four roads of the Project will be included under the civil work costs. The latter cover costs for providing soil stabilization measures, proper drainage and culverts, mitigation measures for temporary dust and air pollution problems, proper handling of construction wastes, proper rehabilitation of borrow pits, and closure of temporary construction camps. In addition, the construction supervision services will include nine person-months of environment specialists to monitor and supervise the implementation of mitigation measures during construction.

46. To build MCTPC's capacity in handling environmental and social problems associated with road development, technical assistance grant of \$200,000 will be provided to strengthen the capacity of DOR's ESU.

47. Part of the Project will include medium-term monitoring of the environmental impacts of road development projects. This program is expected to cost approximately \$250,000 and will be carried out by an independent party, such as an internationally recognized agency familiar with conservation issues in the Lao PDR.

48. The REMDP estimates that the financial costs related to the compensation for the resettlement plan will be approximately \$200,000.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PROGRAM

A. Institutional Framework and Responsibilities

49. Implementation of mitigation measures for impacts on the physical and biological environment during the construction stage will be the responsibility of the contractor. An environmental engineer will be part of the consultant team that assists the Government in preparing contractual documentation so that the bid documents, bills of quantity, and other contractual obligations of the contractor clearly identify environmental responsibilities and describe penalties for noncompliance. DOR will implement the REMDP. Responsibilities for implementing environmental monitoring and management are in Table 4.

B. Environmental Monitoring Program

50. The environmental monitoring program covers environmental and social parameters, focusing on (i) adverse environmental impacts, (ii) implementation of the resettlement plan, and (iii) implementation of the environmental mitigation plan. The monitoring program will be implemented during the whole project cycle, from the detail design to operation. The impacts of the Project and road development, in general, on the country's environmental performance (e.g., deforestation, wildlife trafficking, and encroachment on critical ecosystems) will also be monitored by an internationally recognized agency familiar with conservation issues in the Lao PDR. The results of the monitoring program will be used to improve the Project's environmental performance and, to some extent, as inputs to improve the country's road development program. In addition, ADB will field periodic monitoring missions to ensure that mitigation is being properly undertaken.

Table 4: Summary of Responsibilities for Environmental Monitoring and Management

Project Stage	Responsible Organization	Responsibilities
Detailed Design	<p>Consultants and DOR</p> <p>ESU of DOR</p> <p>DOR, and Environment Department of Science, Technology and Environmental Agency (STEA)</p>	<p>Incorporate mitigation measures into the engineering design and technical specifications, and environmental requirements into the bidding documents.</p> <p>Review and approve environmental mitigation and management measures; and review the bidding documents to ensure that the contractors will abide by all the contract conditions to handle and mitigate environmental impacts.</p> <p>Review the project SEIA and EIA reports and issue environmental clearance for the Project.</p>
Construction	<p>Contractor</p> <p>Construction supervision consultant (environment specialists)</p> <p>ESU of DOR</p> <p>Independent monitoring organization</p>	<p>Implement required environmental measures.</p> <p>Supervise contractors implementing environmental mitigation.</p> <p>Undertake environmental performance inspection.</p> <p>Undertake environmental performance evaluation to provide inputs for ensuring compliance with Government policies on environmental management, to be carried out continuously during project operation.</p>
Operation	<p>ESU of DOR</p> <p>Independent monitoring organization</p> <p>DOR, and Environment Department of STEA</p>	<p>Undertake monitoring of social and environmental parameters as direct impacts of the Project.</p> <p>Undertake environmental monitoring of indirect impacts of the Project and the environmental impacts of road development.</p> <p>Review monitoring reports and use the results to improve the Project's environmental performance.</p>

VIII. PUBLIC INVOLVEMENT

51. More than 25 meetings were held during the feasibility study and detailed engineering stages. They were participated in by the public, local and regional officials, members of nongovernment organizations and other donor agencies, and national agency staff, among others. Focused group meetings were held during the socioeconomic and environmental surveys to ascertain the opinion of the public about the candidate roads and to inform them about the project scope. Over 75 officials, village chiefs, and villagers were interviewed.

52. Topics discussed during the focused group sessions were extremely diverse, ranging from village-related issues (e.g., why the village moved to its present location, status of village water supplies, and agricultural production) to subjects related to the village use and current state of stocks of NTFP gathered, wildlife, fish and aquatic resources, timber and wood use, tourism in the village area, knowledge of protected areas, present road problems, and potential problems if the road were improved. The information gathered is reflected in the EIA. Public opinions and suggestions have also been incorporated in the design process, as appropriate.

53. In general, villagers were very positive in their desire to see their roads upgraded. They felt that regulations concerning environmental resources can and should be enforced to prevent undue environmental impacts. This attitude was also reflected in the discussions with central and provincial government officials for environmental issues. Although somewhat more cautious in their endorsement, members of environmental groups in Vientiane agreed that the roads would benefit the local villagers, and that the location of the four roads should not cause undue environmental concern.

IX. CONCLUSIONS

54. The Project will improve roads that are currently in place, except that the central part of the Na Sack-Khock Khao Do road will be reconstructed. The target regions are among the most deprived in the country with regard to health care, education, and other services. They also exhibit high levels of mortality and illiteracy. The proposed road improvements will increase access to health programs and education.

55. Although biological resources along the project roads, including those in NBCAs, have been degraded through intense human activities (e.g., logging, hunting, fishing, agriculture, and military activities), hunting, logging, and encroachment on ecologically sensitive areas may increase. Therefore, an independent monitoring group will provide neutral inputs to improve the Project's environmental performance and the country's environmental management.

56. Improving road surfaces to all-weather quality will reduce dust and erosion. The roads will provide significant benefits to the affected villages, and the Project is supported by a great majority of the users. Quality-of-life benefits (e.g., improved access to health and educational facilities) will ensue. Improved access to markets may also reduce pressure on NTFP by making other products more marketable. The road improvement will reduce the need for remote villages to rely on opium as a cash crop.

57. The overall finding is that the Project will not cause significant environmental problems. Environmental impacts resulting from the road improvements in Attapeu, Houaphan, Vientiane, and Xaisomboun provinces can be mitigated. Stringent mitigation measures for the project road in Houaphan, which passes through an NBCA, will reduce the environmental concerns related

to the management of NBCA. Similarly, the project road in Vientiane passes through a remote area along a currently nonmotorable track. The area may have valuable and endangered wildlife, but with appropriate mitigation measures, the road can be built without undue impact on these resources.

58. These findings show that although the Project's environmental impacts are manageable through the proposed mitigation measures, continued evaluation of the Project's environmental performance should be carried out. The proposed monitoring plan that will be carried out by the independent group is critical since it will provide neutral evaluation of the Project's environmental performance.

APPENDIXES

Number	Title	Page	Cited On (page,para.)
1	Potential Impacts and Mitigation: Attapeu to Senamnoy, Attapeu Province	14	8,35 7,32
2	Potential Impacts and Mitigation: Na Sack to Khock Khao Do, Vientiane Province	15	8,35 7,32
3	Potential Impacts and Mitigation: Huay Hung to Xam Tai, Houaphan Province	16	8,35 7,32
4	Potential Impacts and Mitigation: Thong Khoun to Long Xan, Xaisomboun Special Region	18	8,35 7,32
5	Summary of Impacts	20	7,32
6	Mitigation Program	21	7,32

POTENTIAL IMPACTS AND MITIGATION: ATTAPEU TO SENAMNOY, ATTAPEU PROVINCE

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks
14+733 -- 18+500	Dense forest	M		M	M				2 streams
18+500 -- 19+300	Agriculture (rice)								
19+300 -- 22+700	Production forest	M		M	M				4 streams
22+700 -- 23+300	Agriculture (rice)								
23+300 -- 27+000	Forest	M		M	M			M	4 streams
27+000	Sork						M		near road, not on it
28+000	Haisok						M		near road, not on it
29+000	Sapouan						M		near road, not on it
29+000 -- 31+000	Forest								
31+000 -- 32+000	Agriculture								
32+000 -- 44+000	Forest & Agriculture (upland fields)	M		M	M				11 small streams
33+000	Khoum Kham						M	M	near road, not on it
40+000	Mee Xai						M		near road, not on it
44+000 -- 47+675	Forest	M			M				
47+000	Beng Phou Kham					M	M		

M = mitigation required; UXO = unexploded ordnance.

POTENTIAL IMPACTS AND MITIGATION: NA SACK TO KHOCK KHAO DO, VIENTIANE PROVINCE

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks^a
0+000 -- 0+200	Nongsavan					M	M		5 houses
0+200 -- 1+100	Agriculture (track only)				M				1 stream
1+100 -- 1+500	Na Sack					M	M	M	35 houses
1+500 -- 2+600	Agriculture (track only)				M				1 stream
2+600 -- 5+500	Production forest plus bamboo (track only)	M			M				
5+500 -- 6+000	Agriculture (track only)				M				
6+000 -- 12+000	Forest (track only)	M		M	M				3 streams
12+000 -- 33+000	Bamboo (track only)	M			M				
33+000 -- 46+000	Agriculture: paddy and shifting (track only)				M				
46+000	Khock Khao Do			M		M	M	M	Mekong River

M = mitigation required; UXO = unexploded ordnance.

^a Houses enumerated are within 20 m from the road (track) centerline.

POTENTIAL IMPACTS AND MITIGATION: HUAY HUNG TO XAM TAI, HOUAPHAN PROVINCE

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks^a
0+000 -- 10+600	Forest (soft wood and bamboo)	M		M					
0+000 -- 10+600	bamboo						M		
0+000 -- 10+600	Na Yang						M		near road, not on it
11+000 -- 22+600	Forest (some shifting agriculture)	M		M	M				crosses Nam Soy
12+000	Done Khoune					M	M	M	5 houses
22+600 -- 24+900	Na Ngang					M	M	M	5 houses
24+900 -- 30+000	Forest (some shifting agriculture.)	M			M				
30+000	Dan Xai					M	M	M	7 houses
30+000 -- 52+000	Dense forest: mostly largerstrimia floribunda + soft wood + bamboo	M		M	M	M			Nam Xam NBCA, crosses Nam Xam ^b
48+400	Phieng Mai, Dan Xam	M				M	M		within NBCA
48+400 -- 49+500	Agriculture: paddy								
49+500	Muang Khan					M	M		22 houses
49+500 -- 52+500	Agriculture: paddy				M				
52+500 -- 53+200	Phieng Done	M				M	M		30 houses; in NBCA
53+200 -- 54+800	Agriculture				M				
54+800 -- 56+000	Sop Keu, Kuang					M	M		12 houses
56+000 -- 56+500	Agriculture				M				
56+500 --59+600	Forest	M		M	M				1 stream
59+600 -- 59+900	Somkern					M	M		10 houses
59+900 -- 71+500	Forest	M		M	M				1 stream
60+200	Phiengday					M	M		9 houses

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks ^a
64+700	Phenghome					M	M		15 houses
68+700	Kho					M	M	M	15 houses
71+500 -- 72+500	Agriculture				M				
69+700	Thin					M	M		39 houses
70+500	Phonsavan; Xam Tai					M	M		50 houses

M = mitigation required; NBCA = National Biodiversity Conservation Area.

- ^a Houses enumerated are within 20 m from the road (track) centerline.
^b Road crosses NamXam NBCA for about 16 km (along the river).

POTENTIAL IMPACTS AND MITIGATION: THONG KHOUN TO LONG XAN, XAISOMBOUN SPECIAL REGION

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks^a
0+000 -- 0+800	Thong Khoun (project start)					M	M	M	
0+800 -- 1+100	Mai (junction to Houay Mo)					M	M	M	7 houses
1+100 -- 1+900	Agriculture								
1+900 -- 4+700	Forest - cleared over 25 years ago				M				
4+700 -- 5+200	Thong Hak					M	M	M	11 houses
5+200 -- 5+900	Forest - cleared over 25 years ago			M	M				follows stream
5+900 -- 6+200	Agriculture: paddy								
6+200 -- 13+200	Forest - cleared over 25 years ago				M				
13+200 -- 14+200	Forest (no road) – cleared over 25 years ago	M							
14+200 -- 17+200	Agriculture								
17+200 -- 23+300	Bamboo Forest	M							
23+300 -- 23+700	Pakkhang					M	M		
23+700 -- 25+800	Bamboo forest (no road)	M		M	M				crosses Nam Cha
25+800 -- 26+100	Muang Long Mai					M	M		
26+100 -- 28+900	Forest (no road) Cleared within 3 years	M							
28+900 -- 29+500	Muang Long					M	M		
29+500 -- 35+700	Mostly bamboo forest (no road)	M			M				
35+700 -- 37+800	Forest (track) – cleared over 25 years ago	M		M	M				follows Nam San
37+800 -- 40+000	Mostly bamboo forest (track)	17							
40+000 -- 41+300	Shifting agriculture (track)								

Km	Location / Land Use	Encroach on Precious Ecology	Encroach on Cultural Resources	Impair Fisheries, Aquatic Ecology	Erosion, Siltation, Water Quality	Dust, Noise	Socially Sensitive Area	UXO Presence	Remarks ^a
41+300 -- 44+800	Mostly bamboo forest (track)	M		M					follows Nam San
44+800 -- 45+600	Agriculture (track only)								
45+600 -- 46+100	Xiang Mee					M	M	M	
46+100 -- 46+500	Agriculture (track only)								
46+500 -- 46+800	Xiang Mee^b					M	M	M	
46+800 -- 64+800	Production forest	M		M	M				follows Nam San
53+500	Napho					M	M	M	
64+800 -- 65+300	Agriculture (paddy + shifting)								
65+300 -- 67+800	Production forest	M		M	M				follows Nam San
67+800 -- 69+000	Vang Luang					M	M	M	45 houses
69+000 -- 69+700	Production forest	M		M					follows Nam San
69+700 -- 70+700	Phone Lao					M	M	M	48 houses
70+700 -- 71+500	Xam Khone					M	M	M	50 houses
71+500 -- 72+700	Khonwath					M	M		41 houses
72+700 -- 73+400	Nam Khoui					M	M		31 houses
73+400 -- 74+500	Forest	M		M					crosses Nam Koui
74+500 -- 74+800	Agriculture								
74+800 -- 81+700	Forest	M		M	M	M			follows Nam Phoun, just enters Phou Khao Khouay NBCA

M = mitigation required; NBCA = National Biodiversity Conservation Area.

^a Houses enumerated are within 20 m from the road (track) centerline. There may be more houses in the villages.

^b Retired government staff awarded wood for house construction to retired staff in this area, but collectively the principal quota for woodcutting is understood not to be exceeded.

SUMMARY OF IMPACTS

Province	Physical Resources					Ecology					Human and Economic Development							Quality of Life Values									
	Topography	Soils/ Geology	Climate	Surface Water	Ground Water	Air quality/ Noise	Fisheries	Aquatic Biology	Wildlife	Forests	Endangered Species	Communities	Industry	Infrastructure	Institutions	Transportation	Land Use	Power	Agriculture	Minerals	Values	Public Health	Recreation	Aesthetics	Treasures	Cultural	UXO
Attapeu				M		M	M	M	M	M	+	+	+	+	+	M		+				+	+				M
Houaphan				M		M	M	M	M	M	+	+	+	+	+	M		+				+	+				M
Vientiane				M		M	M	M	M	M	+	+	+	+	+	M		+				+	+				M
Xaisomboun				M		M	M	M	M	M	+	+	+	+	+	M		+				+	+				M

Blank space = neutral or no impact.

+ = net beneficial impact.

M = positive or neutral impact after specific mitigation.

MITIGATION PROGRAM

Impact Type	Mitigation Measures	Responsibility		Project Phase
Potential Negative Impacts		Planning	Implementation	
Construction labor force impacts	<p>Mitigation Measure 1</p> <p>Establish minimum standards for construction worker camp layout and housing provision; provide sanitary facilities and insect control, particularly as related to malaria.</p> <p>Establish coordination procedures with local authorities to accommodate the needs of construction worker with those of the local population and systems.</p>	MCTPC	Contractor, DOR	Detailed design
Oil spills and hazardous wastes	<p>Mitigation Measure 2</p> <p>Establish standards for materials handling and transport to avoid spills; establish emergency response and containment and/or clean-up procedures to minimize adverse effect of spills.</p>	MCTPC STE A	DOR	Detailed design
Construction-related air pollution and dust	<p>Mitigation Measure 3</p> <p>Establish standards for water application during construction; establish construction vehicle maintenance requirements; require air pollution control devices on construction vehicles.</p>	MCTPC	Contractor, DOR	Detailed design
Air pollution and dust relating to operation	<p>Mitigation Measure 4</p> <p>Pave roads through towns, speed limitations, traffic management, vegetative screens to filter dust; manufacturer and/or import controls to reduce pollutant emissions.</p>	MCTPC STE A	DCTPC	Operation
Construction-related noise and vibration	<p>Mitigation Measure 5</p> <p>Requirements for construction planning – operating hours, mufflers or other sound attenuating devices on equipment; vibration attenuation in sensitive zones</p>	MCTPC	Contractor, DOR	Detailed design

Impact Type	Mitigation Measures	Responsibility		Project Phase
		Planning	Implementation	
Potential Negative Impacts				
Operation-related noise and vibration	Mitigation Measure 6 Land use controls to maximize distance between sensitive land uses and edge of roadway; in severe cases, physical barriers; building facade insulation; bypass routes.	MCTPC	DCTPC, Contractor	Detailed design and construction
Water pollution from highway runoff	Mitigation Measure 7 Direct runoff away from sensitive water bodies through roadway and/or shoulder design; use of catchment basins to allow for filtration of runoff; impoundment and treatment at particularly sensitive locations	MCTPC	DCTPC, Contractor	Detailed design and construction
Erosion	Mitigation Measure 8 Limitation of cleared area; mulching/planting and plant maintenance; slope design and stabilization; drainage works; specification of work-site details (quarrying, off-road equipment traffic)	MCTPC	DCTPC, Contractor	Detailed design and construction
Interference with natural drainage patterns	Mitigation Measure 9 Drainage works to restore beneficial natural drainage patterns, reduce flooding in flood-prone areas and impound water or encourage recharge in dry areas	MCTPC	DCTPC, Contractor	Detailed design and construction
Impact on historic archaeological sites	Mitigation Measure 10 Avoidance, preservation, and information extraction	MCTPC (Ministry of Information and Culture)	DCTPC, Contractor	Detailed design and construction
Impaired views, aesthetics	Mitigation Measure 11 Design to minimize alteration of, and maximize fit with, existing environment.	MCTPC	DCTPC, Contractor	Detailed design and construction
UXO danger	Mitigation Measure 12 Provide for the surveying and clearing of known or suspected UXO along project roadways.	MCTPC	UXO Contractor	Detailed design and construction

Impact Type	Mitigation Measures	Responsibility		Project Phase
		Planning	Implementation	
Potential Negative Impacts				
Induced development into ecologically sensitive areas	Mitigation Measure 13 Local, provincial, or national land use controls	MCTPC	DAFO, DOR	Detailed design and construction
Impair fisheries, aquatic ecology	Mitigation Measure 14 Local, provincial, or national programs promoting fish farming and controlling unsustainable fishing practices	MCTPC, Department of Agriculture	MCTPC, DAFO	Construction and Operation
Interference with wildlife migration routes	Mitigation Measure 15 Maintain forest cover as close to edge of road as possible, consistent with sight distance safety concerns.	MCTPC, Department of Forestry	DCPTC, Contractor	Detailed design and construction
Increased pressure on NTFP	Mitigation Measure 16 Provide adequate road signage to raise awareness of NTFP issues; cooperate with MAF and other agencies to enforce NTFP laws.	MCTPC, Department of Forestry	DAFO, DOR	Operation
Loss of wildlife and plant habitat through road widening	Mitigation Measure 17 Keep road improvements within ROW limits; avoid large, live trees; monitor "salvage" wood cutting; keep road section as narrow as practical, consistent with safety needs; avoid disturbing salt lick areas.	MCTPC, Department of Forestry	Contractor, DAFO, DCTPC	Detailed design and construction
Relocation / resettlement	Mitigation Measure 18 Routing; bypass construction; establishment and enforcement of resettlement and compensation standards	MCTPC	DOR	Detailed design

DAFO = district agriculture and forestry offices; DCTPC = Department of Communications, Transport, Post and Construction; DOR = Department of Roads; MCTPC = Ministry of Communications, Transport, Post and Construction; NTFP = nontimber forest products; ROW = right of way; STEA = Science, Technology and Environment Agency; UXO = unexploded ordnance.