Initial Environmental Examination (Draft)

Project No.: 41123-015
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Cambodia: Road Network Improvement Project
(Road Improvements for National Road 1 and National Road 6)

Prepared by the Ministry of Public Works and Transport for the Asian Development Bank (ADB)

CURRENCY EQUIVALENT

As of 1 April 2017

Currency unit		Riel (R)
R1.00	=	$0.00025
$1.00	=	R4,031

ABBREVIATIONS

ADB	Asian Development Bank
AH1	ASEAN Highway 1
AP	affected person
BOD	biochemical oxygen demand
CBPWL	Central Building and Public Works Laboratory
CC	cylinder capacity
CCCSP	Cambodia Climate Change Strategic Plan
CEMP	contractor's environmental management plan
CMAC	Cambodia Mine Action Center
COD	chemical oxygen demand
DBST	double bituminous surface treatment
DPWT	District Public Works and Transport
EIA	environmental impact assessment
EMP	environmental management plan
GHG	greenhouse gas
GMS	Greater Mekong Subregion
GRC	grievance redress committee
GRM	grievance redress mechanism
IEE	initial environmental examination
IEIA	initial environmental impact assessment
ILO	International Labor Organization
IOL	inventory of loss
IUCN	International Union for Conservation of Nature
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Works and Transport
MRC	Mekong River Commission
NR	national road
OHS	occupational health and safety
PIC	project implementation consultant
PMU	project management unit
PPCR	pilot program for climate resilience
TA	project preparation technical assistance
RAMP	Road Asset Management Project
RNIP	Road Network Improvement Project
ROW	right-of-way
SEC	Southern Economic Corridor
ESO	Environment and Social Office
UNDP	United National Development Program
UXO	unexploded ordnance

WEIGHTS AND MEASURES

^{o}C	degree centigrade
cm	centimeter
km	kilometer
km^2	square kilometer
m	meter
m^2	square meter
m/s	meter per second
mm	millimeter
mg/l	milligram per liter
NTU	nephelometric turbidity unit

NOTES

In the report, “$” refers to US dollars.

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I. EXECUTIVE SUMMARY

A. Background

1. The Royal Government of Cambodia has requested the Asian Development Bank (ADB) to provide a project loan to support the Ministry of Public Works and Transport (MPWT) to improve efficiency of transport along the Greater Mekong Subregion (GMS) Southern Economic Corridor (SEC) in Cambodia.

2. Two existing national roads (NR) have been identified by the MPWT for improvement under the project. NR1 is located in the provinces of Prey Veng to Svay Rieng while NR6 traverses the provinces of Siem Reap to Battambang. NR1 and NR6 have a total length of 147 kilometers (km) and are considered as main international linkages of Cambodia to Viet Nam and Thailand.

3. The improvements to the project roads are expected to maximize the economic potential of the GMS SEC and provide increased economic and employment opportunities and year-round access to larger markets, health centers, and education facilities. The proposed project is also aligned with the overarching objective of ADB's Country Partnership Strategy 2014–2018 for Cambodia on poverty reduction and is in line with the Government's socio-economic development priorities. The Government's national strategy for growth for 2013–2018 emphasizes the need for development of physical infrastructure with other three core areas (agriculture sector promotion, private sector development and employment, and capacity building and human resource development). The project supports both these strategies.

4. This initial environmental examination (IEE) was prepared for the proposed Road Network Improvement Project (RNIP) which is classified as Environment Category B in accordance with the ADB's Safeguards Policy Statement (2009). This report was prepared based on site reconnaissance and from draft IEEs and feasibility study reports prepared by the project preparation technical assistance (TA) consultants of the PRIP and Second Road Asset Management Project (RAMP).

B. Project Design

5. The national roads, NR 1 and NR6, have suffered from overloaded truck transport and require rehabilitation to upgrade the original double bituminous surface treatment (DBST) pavement that has cracked and developed pot holes. Drainage, shoulders, signage, guard rails, drainage capacity and bridge structures of these two national roads will also be improved. The proposed improvement works will consist of: (i) road surface treatment within existing pavement widths; (ii) maintenance of 17 bridges; (iii) maintenance of existing drains; (iv) installation of some new drains along road edge; (v) installation of road signs and markings; and (vi) selected climate change features such as slope protection and storm water dissipation. Four laboratories, consisting of a Central Building and Public Works Laboratory (CBPWL) in Phnom Penh and regional laboratories in Siem Reap, Kampot Pursat, and Kratie provinces, will also be established under the operational control of MPWT.

6. In addition to improving the priority roads, the project will (i) improve the quality assurance system for civil works, (ii) strengthen controlling vehicle overloading, and (iii) improve road safety in communes along the project roads. The Project's impact will be transport infrastructure contributing to the enhancement of national competitiveness and people's welfare developed while the outcome will be transport efficiency increased on the national road sections along the GMS SEC. The RNIP has four outputs: (i) safe and climate resilient national roads completed, (ii) axle load control enhanced, (iii) quality assurance

mechanism in MPWT strengthened, and (iv) road safety enforcement in project communes increased.

7. **Climate Change Adaptation.** A climate risk and vulnerability analysis has been carried out for the project. The project area is in the central and southeastern regions of Cambodia which is characterized as flatland with vast alluvial plains. Most of the area is covered by paddy field and is prone to flooding during the wet season by runoff or overflows from Tonle Sap and Mekong River. Flood events and debris flow are the major climate risks to the project and have historically resulted in damage to the road network, travel disruption and significant economic losses. The project is applying for additional grant financing to enable integration of climate change adaptation measures into detailed engineering design (DED) to reduce the vulnerability of the project roads to future impacts of climate change. If successful, this project could make a significant contribution (estimate of USD10 million) to ADB climate adaptation finance targets.

C. Project Benefits

8. The proposed project will improve mobility and transport and is expected to contribute to long-term economic development and livelihoods in the project areas. The project road construction and maintenance works will also provide job opportunities for the poor local households including women and marginalized individuals who have no jobs, especially during off-farming season. Access to basic facilities and services will be significantly improved in the project areas after project completion. Rehabilitating and enhancing the climate resilience of the roads under the project will improve the poor's access to markets and social services, and is a core means of promoting inclusive economic growth and reducing poverty, as well as enhancing social development and equity. Improved road conditions would reduce travel time and vehicle operating costs, both of which would reduce transportation costs. Reduced transportation costs in turn are expected to contribute to reduced prices for goods and services in the project areas. Reduced input costs for agriculture and improved access to markets for farm produce are expected to have a positive impact on farming incomes. The economic analysis carried out for the project has calculated that there will be a net reduction of 45,687 tonnes of CO_2 emissions per year as a result of improved road condition.

D. Environmental Condition at the National Roads

9. The project roads are located in areas which are influenced by the Mekong River. NR1 is in the floodplain of the Mekong River while NR6 traverses the northern edge of the floodplain of Tonle Sap Lake.

10. None of the project roads are located in protected or ecologically sensitive areas. NR6 is located in the Transition Zone of the Tonle Sap Biosphere Reserve, about 13 km north of the lake. The Transition Zone is the outer zone of the reserve intended for development.[2]

11. All the project roads are in areas where aerial bombing and land armed conflict took place. To ensure safety, mine/unexploded ordnance (UXO) clearance operation is necessary to identify unexploded ordnance before the start of any civil works.

12. **National Road 1 (NR1).** NR1 is part of the ASEAN Highway 1 (AH1). NR1 extends southeast from Phnom Penh (km 0+000) through the low flatland floodplain of the Mekong River and ends at km 167+000 at Bavet City at the Viet Nam border. The 97 km section of NR1 that will be rehabilitated starts at the eastern side of Steung Slot River, a tributary of the

[2] Draft IEE Second Road Asset Management Project. TA-8784 CAM. p34. October 2016

Mekong River, and ends at the Viet Nam border in Bavet City. The road is located in the districts of Peam Ro, Preah Sach, and Kampong Trabaek in Prey Veng province and the districts of Svay Chum, Svay Rieng, Svay Teap, and Bavet in Svay Rieng province. It covers 22 communes, namely, Nak Loeung, Kampong Seung, Lvea, Krang Svay, Kampong Trabaek, Prasat, Prey Chhor, Kraol Kou, Ta Sous, Svay Chrum, Chek, Kouk Pring, Svay Tayaen, Sang Khoar, Sambour, Kandieng Reay, Prasoutr, Romeang Thkaol, Chrak Mtes, Prey Angkungn, Bati, and Bavet.

13. The project areas are characterized by agricultural land, planted with rice and other crops. The road becomes busy at town centers and when it approaches the Viet Nam border. There are a number of hotels, casinos and commercial establishments near the border in Bavet City which has been designated as a Special Economic Zone.

14. **National Road 6 (NR6).** NR6 is located in the northwestern section of Cambodia and extends west and north from Siem Reap town. NR6 originates at Phnom Penh continues through Banteay Meanchey province to join NR5 at Serei Saophoan in Banteay Meanchey but the length to be rehabilitated is limited to the portion between Siem Reap City (km 317) to the town of Kralanh at the Siem Reap provincial border (km 367). The road section is located within Siem Reap town and the districts of Puok and Kralanh. The alignment traverses nine communes consisting of Tuek Vil in Siem Reap town; Khnat, Puok, Lvea, Sasar Sdam, and Prey Chrouk in Puok district; and Sranal, Kralanh, and Kampong Thkov in Kralanh district.

15. NR6 alignment is flat and traverses mostly agricultural lands. The east-west NR6, though mostly elevated, requires more lateral drainage to manage the increasing north-south flow of heavy run-off down to the Tonle Sap wetland that routinely collects and creates flood conditions on the north side of the road.

E. Project Impacts and Mitigation Measures

16. The potential environmental impacts of the rehabilitation and improvement of the roads will be primarily from construction phase disturbance. Common impacts of the civil works along the roads will include reduced and/or blocked public access to areas and private properties due to breakage of concrete and improvement of drains, temporary removal of wooden platforms and roof extensions of shops, noise and dust caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, community and occupational health and safety risks, increased traffic congestion and traffic accidents, habitat disturbance, encroachment and damage from construction machinery, soil erosion and sedimentation of adjacent rice paddy and streams and rivers that are traversed by the roads. Localized drainage and flooding problems can also arise. Solid waste and domestic pollution from temporary worker camps can occur, as well as potential communicable diseases and local community problems caused by migrant workers. These short-term impacts and disturbances will occur at different levels of magnitude depending on the civil works activities and the road section site.

17. **Land Acquisition.** The significant design feature is that the carriageways and ROW will not be widened, and the alignments will not change. However, there will be short-term disruption to business and some domestic activities during the period of construction. Potential negative impacts of the project include the partial and temporary removal of structures used for residence and business/shops during breakage of existing pavement and installation of drains. There are no anticipated resettlement impacts since the existing ROW will not be cleared. The anticipated impacts on the affected structures are temporary and would be restored and replaced by the contractor.

18. **Setting up of Construction Staging Areas.** Construction staging areas for the workers' camps, asphalt/concrete mixing stations and pre-casting yards, and spoil disposal sites will be set up by the project contractors. In addition to temporary land acquisition for the construction staging areas, the setting up and operation of construction camps will have direct but short-term impacts on land use, pollution, and community and occupational health and safety.

19. Worker accommodation and camps will generate wastewater from toilets, bathrooms and kitchen. Solid waste from the camp is another source of pollution and health hazard. Workers may also be at risk from malaria and dengue, unsanitary camp conditions, lack of clean water and sanitary facilities.

20. Developed or cleared private land should be preferred for construction of camps. For health and safety of workers, the contractor should provide safe, suitable and comfortable accommodation, kitchen, dining and sanitary facilities (toilet and bath); ample supply of clean water; and first aid supplies and equipment. Camp surroundings should be kept clean to prevent breeding of insect vectors. For security and to maintain order in the camp and to avoid social problems with the community, camp rules have to be established and imposed by the contractors and effectively disseminated to the workforce.

21. **Hiring of Workers.** The hiring of workers from outside the local area can create social conflicts. Local communities may: (i) feel aggrieved for not having been employed in the construction; (ii) resent having outsiders within the community; (iii) view the workers as competitors for local resources like food and water; and (iv) as having a disregard for local traditions and practices.

22. Local communities should be given preference during hiring of unskilled labor. This will minimize the number of workers to be housed in the camp and will help avoid social conflicts between workers and local communities. The contractor should coordinate the hiring of workers with the village officials.

23. **Materials Sources, Borrow Pits and Quarries.** Quarrying can have long term and permanent adverse impacts such as visual impairment (scarring), change in topography, consumption of resources, change in land use, increased susceptibility to erosion and siltation, and alteration of natural drainage patterns. Direct impact of borrow pits is change in landform with indirect impacts of visual impairment, increased siltation and erosion, threats to public safety and health hazards as accumulated water can serve as a breeding ground for insect vectors. Chance discovery of culturally significant items or sites might occur during excavation of quarry or borrow pits.

24. Commercial quarry operators are present in some of the provinces traversed by the roads. The selection of the aggregate material supplier should also consider the legitimacy of the operations, i.e. licensed operator. Should the contractor opt to operate its own aggregate plant, reopening abandoned quarry sites should be preferred over opening new quarry sites.

25. The contractor should include in the Contractor's Environmental Management Plan (CEMP) a material balance estimate for cut and fill material requirements and identify possible sources for fill materials and disposal sites for spoils. In addition, the contractor should submit a quarry development plan to the project implementation consultant together with the CEMP.

26. **Clearing and Grubbing.** Direct impacts associated with clearing and grubbing have low magnitude considering the limited area that will need clearing as well as very short duration of the works. The adverse impacts that can be relatively significant are the possible

damage to adjoining structures, properties, community facilities and utilities (water line, power line, access) and unnecessary removal of trees and vegetation.

27. Clearing work should be preceded by survey and staking out of the area to be cleared and grubbed to avoid damaging trees and structures outside the construction corridor. Coordination with the local government and land owner should be carried out and all necessary permits shall be secured prior to clearing and grubbing.

28. In case of chance discovery of culturally important items, the contractor should follow the procedure for reporting as prescribed by the Law on Protection of Cultural Heritage, NS/RKM/0196/26. Upon discovery, the contractor should stop work, secure the site, report the find immediately to the engineer and project management unit (PMU) who in turn shall be responsible for reporting to the authorities.

29. **Earthworks.** The direct impacts will include generation of noise and emissions from heavy equipment, dust from excavation and bare areas and transport of materials. The clearing and excavation will generate spoils that include top soil, unsuitable material and stripped bitumen. If spoil cannot be reused by the project or the local community, there may be a need for disposal, which would result in additional landtake. The contractor should present in the CEMP an estimate of materials to be excavated, the volume that can be reused and the volume to be disposed of, as well as the disposal location.

30. The earthworks will require lane closure and possibly diversion of traffic which can result in travel delays. The rehabilitation of the national roads could require closure of lanes while opening traffic to flow on the remaining road lane. In populated areas, the activities can disrupt economic activities, like affect shops and stores fronting the road, it could also expose pedestrians and motorists to construction hazards.

31. With respect to management of excavated materials, the contractor should deposit these materials in a way that it will not damage the road, utilities services and properties and will not impair drainage. Additionally, stockpiling of materials on the shoulder shall be avoided, but if necessary, the contractor should find a location that will minimize hazards to traffic and pedestrians; a site away from water bodies and drainage channels; and should remove the materials within the shortest possible time. Requirements for height, grade and management of stockpiles should be specified in the CEMP.

32. Dust suppression should be carried out in populated areas by watering the road. Control of dust during transport of spoils and aggregate materials should include fitting of all dump trucks with tailboards and load should be covered for trips that will go through populated areas. Speed limits should be imposed for project vehicles travelling over unpaved roads in populated areas.

33. Traffic management during construction work especially where lane closure is required should include warning signs, directional signs and barriers and the assignment of signal men at both ends of the work sites. Alternate diversion routes should be provided, if possible.

34. **Impeded Access to Schools, Temples, Houses, and Commercial Establishments.** Community activities will be disrupted because of temporary closure of access to schools, temples, and commercial establishments. The contractor should inform the establishments and shop owners of the work schedule to allow them to make the necessary preparations. Contractor should provide safe passageway through the work sites into the schools, temples, residential houses and commercial areas during the construction period. Safe passageways for pedestrians should be provided by the Contractor.

35. **Bituminous Works.** The bituminous treatment of roadways will entail the application of prime coat, application of bitumen / bitumen emulsion spray and placement of aggregate base material, followed by rolling. As part of this work phase, the contractor will need a bitumen storage facility where bitumen will be temporarily stored and loaded into the bitumen tankers for application on the roads. For roadworks, the activity will occur with short duration (i.e. paving rate of 100 m per day under ideal condition). The overall magnitude of the impacts of this activity is rated to be low. Pollution due to emission of heavy equipment will be minimal since there will only be a few equipment that will operate. Fumes from the application of asphalt emulsion will be present and may cause temporary and localized health hazard.

36. To minimize dust nuisance, aggregate spreading will not be carried out during times of day where there are many people on the road such as when children are on their way to and from school or during market day. Dust suppression by water will be carried out as necessary. Mitigation for traffic impacts and public safety during bitumen works are identical to the mitigation measures for earthworks previously presented.

37. The contractor shall take all measures necessary to prevent the spillage of extraneous bitumen on or adjacent to the site. In particular, deposits of bitumen resulting from the cleaning of bitumen spray bars shall not be permitted. Drip pans should be used to collect spillages and workers handling bituminous materials should be provided with appropriate personal protective equipment. Any bitumen spillages on the site shall be removed and disposed of by means approved by the engineer.

38. **Construction of Concrete Structures.** The predicted impacts of this construction activity include: (i) generation of waste wooden formworks; (ii) waste cement packaging materials (for concrete mixed on site); (iii) disposal of excess concrete from transit mixers and disposal of wash water from transit mixers.

39. Waste formworks should be collected from the work site and disposed in approved disposal sites. The waste wooden formworks may be given away to the community for use as firewood while the waste cement packaging materials have to be collected properly. There shall be no burning of wastes. There shall be no disposal of transit mixer wash water into water bodies, canals or sewer. Disposal should comply with the sub-decree on water pollution control.

40. **Drainage and Slope Protection Works.** The excavation and installation of reinforced concrete pipe drains may cause some inconvenience in populated areas because of impeded access to houses and establishments. The drainage work will also have the potential to induce erosion and siltation.

41. For work in populated sections of the road, the contractor needs to give notice to community well in advance of the scheduled work. Excavations should be demarcated with barriers and warning signs installed. Drainage works should be done during the dry season and drainage channels cleaned after completion to prevent siltation.

42. **Construction of Laboratories.** The national and regional laboratories for construction materials testing will be located within existing compounds of District Public Works and Transport (DPWT) and MPWT, therefore, will not require land acquisition. The buildings will only require a small land area of about 350 m^2. The construction of the laboratories may result in dust, noise, generation of solid wastes and construction spoils, and temporary disturbance to normal working condition at the DPWT and MPWT offices. There may also be concerns about security because of the presence of workers in the compound.

43. To mitigate these construction impacts, the contractors for the laboratory buildings will be required to implement an environmental management plan that includes measures to control dust emission, limit noise during working hours, ensure proper management of solid wastes and construction spoils and ensure appropriate site management and behavior of the workforce in the compound.

44. **Updating of the Environmental Management Plan.** The environmental management plan (EMP) for the national roads will need to be updated following the completion of the detailed designs, if there are significant changes or additional information available. The EMP should be included as part of the construction package tender documents which, among other things, specify the requirements of the contractor EMPs which contractors are required to develop from the updated EMP to include with their bid documents. The CEMPs contain the mitigation plans and monitoring requirements that are specific to the construction packages they implement. This includes the location of project facilities such as construction camps, batching plants, disposal sites, and cut and fill balance. Sensitive environmental receptors should be avoided.

F. Information Disclosure, Consultation and Participation

45. Stakeholder consultations were conducted during the TA for the national roads under the Second RAMP. The consultations for the national roads were conducted in affected communes in the provinces of Prey Veng and Svay Rieng for NR1 and Siem Reap for NR6. Three consultation meetings were conducted for NR1 for the communes of Kampong Trabaek, Kampong Soeng, Krang Svay, Svay Chrum, Ta Suos, Kraol Kou, Prey Angkuogn, Chrak Mtes, and Kandieng Reay. These communes are located in the districts/towns of Kampong Trabaek, Preah Sdach, Svay Chrum, Svay Teap, and Bavet. Two consultation meetings were conducted in the districts of Puok and Kralanh in Siem Reap province for NR6.

46. The community and stakeholder representatives in these consultation meetings were identified by commune chiefs/commune authorities and TA national consultants during field visits and discussions with commune chiefs or commune councils.

47. In general, the stakeholders consulted for NR1 and NR6 were supportive of the planned road rehabilitation. Environment was not seen as a major issue by those who participated in the consultations. Impacts identified by the stakeholders are noise, vibration, and dust which were considered by the stakeholders as minor and temporary but should be properly managed during construction. Stakeholders also mentioned about possible increased traffic and traffic accidents after construction which will require more traffic safety signs particularly in sensitive areas like markets, schools, and temples. The people also requested adequately sized culverts to reduce flooding.

48. Participants during the consultation for the national roads, NR and NR6, voiced recognition of the previous road works and seemed to understand and accept the short-term construction disturbances such as noise and dust, and that compensation would be minimal following compensation received for the much more significant impacts and disturbances caused when the roads were widened during the last 10 years.

G. Grievance Redress Mechanism

49. The MPWT has a Grievance Redress Mechanism (GRM) which was established under the Environment and Social Safeguards Policies for Cambodia Road Asset Management Project. The GRM outlines the manner of handling grievances and that a Grievance Redress Committee (GRC) will be established before start of construction works. The GRC is chaired by the PMU3 to be assisted by the Environment and Social Office

(ESO) of MPWT[4]. The GRM follows a hierarchy wherein grievances are initially brought to the attention of the contractor and/or PMU3 through the village or commune resettlement sub-committee. If the affected person is not satisfied with the decision and actions taken, the complaint may be brought to the District Office and if the complaint is still not resolved at this level, the District Office will bring the case to the Provincial Grievance Redress Committee. When the case is still not resolved at the provincial level, the affected person may elevate the case to the Court and would follow the legal procedures under the law.

H. Key EMP Implementation Responsibilities

50. Temporary environmental impacts resulting from the civil works have been identified and mitigation and monitoring measures are specified in the EMP. The EMP will form part of the tender documents which becomes legally binding on the selected contractor.

51. To ensure that the project is carried out in accordance with the EMP requirements, MPWT will specify requirements for the implementation of the EMP in the tender documents and civil works contracts. The conformity of contractors with environmental contract procedures and specifications will be regularly monitored by the MPWT through an established Project Management Unit 3 (PMU3) as implementing agency. The PMU3 will be assisted by the Environment Safeguards Officer from the ESO of MPWT during implementation while the DPWT will provide logistical support to PMU3 when necessary.

52. The ESO, previously social and environment unit, is operational but needs capacity building. The project implementation consultant will provide on- the-job training to the field personnel of the ESO, including PMU3 and DPWT staff to build their capacity in environmental management and monitoring.

I. Overall Conclusion

53. The IEE concludes that the feasibility designs of NR1 and NR6, combined with available information on the affected environments is sufficient to assess the scope of potential environmental impacts of the road projects. Provided that significant changes do not occur to the design of the roads, and that new sensitive environmental or social receptor data are not discovered, the project will remain Category B for environment and will not require further detailed environmental impact assessment (EIA).

54. The EMP developed for the project provides impact mitigation plans, environmental monitoring plans, and specifies the institutional responsibilities and capacity needs for environmental management. The EMP will need to be reviewed and updated following the detailed design phase to ensure that any changes are assessed.

[4] The Environment and Social Office (ESO) was organized in accordance with Prakas No. 302 PRA.K.S.K.P.K. issued on 23 June 2009.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Policy Framework

55. The hierarchy of legislation in Cambodia is:
(i) Royal Decree signed by the King
(ii) Sub-decree signed by the Prime Minister
(iii) Ministerial Decision signed by a Minister
(iv) Regulation issued by a Ministry.

56. The major legislation in Cambodia is the Royal Decree which ratifies laws passed by parliament. These can be supplemented by "prakas" or ministerial decisions. These laws allow sub-decrees and regulations to be passed which can stipulate procedures and standards to be met in order to ensure compliance with the law. Many of these sub-decrees and standards have been drafted but have not yet been ratified by parliament.

57. In 1993, the Royal Government of Cambodia confirmed a new Constitution in which environmental considerations were included for the first time. Specifically, Article 59 requires the State to protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, fish and aquatic resources and it was within this constitutional context that the Ministry of Environment (MOE) was established.

58. The Government of Cambodia has established specific laws and regulations for forests, protected areas, and land management to ensure sustainable development. The key elements of the legal and policy framework on environment that are applicable to the project include the following:

- Law on Environmental Protection and Natural Resources Management, enacted by National Assembly, 1996, and promulgated by Preah Reach Kram/NS/RKM-1296/36;
- Law on Natural Protected Areas enacted by National Assembly, 2008 promulgated by Preah Reach Kram/NS/RKM/0208/007;
- Law on Fisheries Management and Administration (1989);
- Law on Forest enacted by National Assembly, 2002 promulgated by Preah Reach Kram/NS/RKM/0802/016;
- Law on Land enacted by National Assembly, 2001 promulgated by Prea Reach Kram/NS/RKM/0801/14;
- Law on Water Resource Management produced by Ministry of Water Resources and Meteorology (MOWRAM); and
- Circular No 01 SRNn issued on 3 February 2012, Royal Government of Cambodia on Cambodia Coastal Zone Development.

59. Key directives in support of the Law on Environmental Protection and Natural Resources Management include:

- Law on Protection of Natural Areas (2008); and
- Sub-decree on Water Pollution Control (1999):
  - Annex 4: Water quality standards for public water and biodiversity and
  - Annex 5: Water quality standards for public waters and health.

60. Other pertinent regulations, policy, or guidelines for the project are as follows:

- Prime Ministerial Edict. 27 September 1999, entitled "Measures to Eliminate Anarchical Land Grabbing", declares public land on the verge of roads and

railways must not be occupied. For NR1, the road reserve is 30 m from centerline and for NR6 it is 25 m from centerline;
- Directive on Managing Health Wastes in the Kingdom of Cambodia (Ministry of Health, 2008);
- Preach Reach Kept on Creation of Fisheries Communities (2005); and
- Anklets on establishment of protected forests, natural resources conservations, wildlife protection areas, protected forest for biodiversity conservation (2002 and 2004).

B. Legal and Administrative Framework

61. The national agencies that oversee environment and natural resources management are listed below.
- Ministry of Environment;
- Ministry of Agriculture, Forestry and Fisheries;
- Ministry of Water Resources and Meteorology;
- Ministry of Mines and Energy;
- Ministry of Industry and Handicraft;
- Ministry of Land Management and Urban Planning;
- Ministry of Tourism;
- Ministry of Public Works and Transport; and
- National Climate Change Committee.

62. The ministries are represented and supported at the provincial, town, and district/commune levels by counterpart line departments, agencies, and sub-offices. The counterparts are responsible to extend and implement the mandate of their parent ministries to the commune level.

63. The MOE is the primary agency mandated to implement Article 50 of the 1993 Constitution. The MOE is tasked to promote environmental protection and conservation of natural resources, thus, contributing to improvement of environmental quality, public welfare, national culture and the economy. This is embodied in the three pillars of development of the Royal Government of Cambodia. One of the three pillars is the sustainable use of natural resources and sound environmental management to reduce poverty and improve the livelihood of all Cambodians.

64. The EIA Department of the MOE oversees and regulates EIA, and coordinates the implementation of projects in collaboration with project executive agencies and concerned ministries. The MOE has the following responsibilities:
- Review, evaluate, and approve submitted environmental impact assessments in collaboration with other concerned ministries; and
- Monitor to ensure a project owner (the executing agency of the project) satisfactorily implements the EMP throughout pre-construction, construction and operational phases of the projects.

65. The Ministry of Agriculture, Forestry, and Fisheries is responsible for the management and protection of coastal mangrove forests, and wildlife and fisheries.

66. The MPWT developed an Environmental and Social Safeguards Policy (ESSP) for the RAMP in 2008 to ensure that the rehabilitation of roads meets the social and environmental safeguard requirements of the MOE and donors such as the ADB and International Development Assistance. The ESSP is supported by an implementation framework (ESSF).

67. The ESSF is applied to projects funded by all donors which includes a screening process for general environment, protected areas, resettlement, and ethnic minorities. Specific technical environmental guidelines have been prepared to ensure proper environmental management of activities within protected areas.

C. Laws, Regulations, Guidelines, and Standards

1. Law on Environmental Protection and Natural Resources Management

68. In 1996, the Law on Environmental Protection and Natural Resources Management (NS/RKM/1296/36) came into force. The law requires the government to prepare national and regional environmental plans and sub-decrees concerning a wide range of environmental issues, including environmental impact assessments (EIAs), pollution prevention and control, public participation, and access to information. The Law on Environmental Protection and Natural Resource Management (1996) is the enabling legislation which allows the MOE to pass sub-decrees and regulations to protect the environment. Several sub-decrees are already laws while there are sub-decrees which have been drafted and are expected to become law in the near future.

2. Protected Area Law (No. NS/RKM/0208/007)

69. Cambodia has a network of 23 natural protected areas managed through the MOE. These areas cover 2.2 million hectares or 18% of Cambodia's land area and include most of its important habitats. The Forest Administration has also designated protected forests (from cancelled logging concessions) bringing the total area under protection to around 25% which is more than twice the global average. Protected Areas are sites which are protected by Royal Decrees, laws and regulations. Such mandatory stipulations are promulgated in Khmer language. The Khmer version takes precedence over the translated version.

70. In 2008, Cambodia introduced the Protected Area Law (No. NS/RKM/0208/007) which defines:

(i) national parks
(ii) wildlife sanctuaries
(iii) protected landscapes
(iv) multiple use areas
(v) ramsar sites
(vi) biosphere reserves
(vii) natural heritage sites and
(viii) marine parks.

71. These have been referenced to the International Union for Conservation of Nature (IUCN) Categorization list:

(i) National Parks (IUCN Category II) – Natural and scenic area of significance for their scientific, educational, and recreational values.
(ii) Wildlife Sanctuaries (IUCN Category IV) – Natural area where nationally significant species of flora or fauna, natural communities, or physical features require specific intervention for their perpetuation.
(iii) Protected Landscapes (IUCN Category V) – Nationally significant natural and semi-natural landscapes that must be maintained to provide opportunities for recreation.
(iv) Multiple-Use Areas (IUCN Category VIII) – Areas that provide for the sustainable use of water resources, timber, wildlife, fish, pasture, and recreation with the conservation of nature primarily oriented to support these economic activities.

(v) Ramsar Sites – There are two sites in the IUCN Categories IV and VIII above and one site in the middle stretches of the Mekong River between Stung Treng and the border with Laos.

(vi) Biosphere Reserve – The Tonle Sap Multiple-Use Area was nominated as Cambodia's first Biosphere Reserve in 1997. The Boeung Chmar portion of Tonle Sap Multiple-Use area (28,000 hectares) is designated as a Ramsar site.

72. Under Article 11 of the law, each protected area is divided into four management zoning systems as follows:

- **Core Zone:** management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defense sectors.
- **Conservation Zone:** management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the core zone. Access to the zone is allowed only with prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defense sectors. Small-scale community uses of non-timber forest products (NTFPs) to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone.
- **Sustainable Use Zone:** management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community, and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the Ministry of Environment
- **Community Zone:** management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar[5] or farming. Issuing of land title or permission to use land in this zone shall have prior agreement from the Ministry of Environment in accordance with the Land Law. This management area does not cover the APSARA (Authority for the Protection and Management of Angkor and the Region of Siem Reap) authorities and other authorities designated and management area(s) to which the Royal Government has allocated the tasks.

3. Law on Historical Monuments

73. The Law on Protection of Cultural and National Heritage (1996) is the general law in Cambodia which covers all national monuments. This is supplemented by the "Decision on the Definition of Three Zones to Protect Temple and Surrounding Areas in all Provinces and Municipalities except Angkor Wat" (1996). These laws protect small temples or ancient structures.

[5] Swidden or Chamkar is also known as slash and burn or shifting cultivation.

4. Law on Wildlife

74. The Joint Prakas of MOE and Ministry of Agriculture, Forestry, and Fisheries on Prohibition of Hunting and Catching Wildlife (1996) specifically bans hunting of wild animals and birds for food, including all species of mammals, reptiles, amphibians, insects, other invertebrates, and their eggs or offspring.[6]

5. Law on Forestry Management

75. The Law on Forestry Management prohibits the hunting of wildlife within protected areas. Aside from maintaining check points and providing rangers, the MOE has an active community education program to promote environmental awareness especially within the rural communities.

6. Subsidiary Laws on Environmental Protection

76. **Environmental Impact Assessment.** Environmental impact assessment in Cambodia is guided by the Royal Government of Cambodia Sub-decree No. 72 ANRK.BK on EIA. In compliance with the sub-decree on EIA, all individuals, private companies, joint-venture companies, public companies, ministries and government agencies are obliged to conduct an environmental impact assessment for proposed projects or activities, which must be submitted for approval by the MOE. The decree provides a list of project types that proponents use to screen projects for requiring either an EIA or initial EIA (IEIA). As project owner, the MPWT will have to prepare an IEIA or EIA for the roads depending on the length of the road segment to be rehabilitated pursuant to the requirements of the Royal Government of Cambodia Sub-decree and MOE. An IEIA is required for national road construction ≥ 100 km and bridges ≥ 30 tons and also for buildings with height ≥ 12 m or floor area ≥ 8,000 m^2.

77. Since the project will involve rehabilitation of existing roads and bridges which are 25-ton capacity, an IEIA will not be required. This has been confirmed in discussions with the MOE during TA. The construction of the laboratories will also not require an IEIA since the building floor area is less than 8,000 m^2. The IEE presented herein exceeds the requirements of Sub-decree No. 72 ANRK.BK on EIA.

78. **Sub-Decree on Air and Noise Pollution Control.** For dust control, the sub-decree specifies that there should be no visible emissions from stockpiles of materials, crushers or batching plants. At locations with sensitive receptors, the standard for total suspended particulates should be less than 0.33 milligrams/cubic meter at 24-hour average. All vehicles should be well-maintained and should comply with the air quality regulations.

Table 1: Ambient Air Quality Standard

No.	Parameter	1 Hour Average mg/m^3	8 Hour Average mg/m^3	24 Hour Average mg/m^3	1 Year Average mg/m^3
1	Carbon monoxide	40	20	-	-
2	Nitrogen dioxide	0.3	-	0.1	-
3	Sulfur dioxide	0.5	-	0.3	0.1
4	Ozone	0.2	-	-	-
5	Lead	-	-	0.005	-
6	Total Suspended Particulate	-	-	0.33	0.1

mg/m^3 = milligrams per cubic meter

[6] http://www.cambodiainvestment.gov.kh/.6 February 2017

Table 2: Gas Emission Standard for Mobile Sources

No.	Kind of Vehicle	Kind of Fuel	Level of Emission				
			Carbon Monoxide (%)		HC (ppm)		Dark fume %
			A	B	A	B	-
1	Motorcycle 2 stroke combustion	Petrol	4.5	4	10000	3000	-
2	Motorcycle 4 stroke combustion	Petrol	4.5	4	10000	2400	-
3	All kind of vehicles	Petrol	4.5	4	1200	800	-
4	All kind of vehicles	Diesel	-	-	-	-	50

Source: Annex 4, Anukret No. 42/ANK/BK. July 10, 2000

Table 3: Sulfur and Lead Standard Permitted to Fuel and Other Combustion Substances

No.	Combustion Substance	Sulfur	Lead
1	Dark fuel	1.0%	
2	Diesel	0.2%	
3	Petrol	-	0.15 grams per literl
4	Coal	1.5%	

79. The national air quality standard is less stringent than the World Health Organization (WHO) air quality guideline in terms of the 24-hour averaging period for sulfur dioxide and nitrogen dioxide. The WHO air quality guide was adopted by the World Bank Group's Environment Health and Safety (EHS) standard. The emission standards for total suspended particulates such as dust are regulated under Cambodia's ambient air quality standard where the maximum 24-hour average is 0.33 milligrams per cubic meter.

80. The noise regulations do not stipulate a level for noise from construction sites but refer to mixed commercial and/or industrial and residential property or type of land use in the immediate vicinity that may be affected by noise. Maximum permissible noise from vehicles passing through public and residential areas is in Table 4 while the maximum permissible ambient noise in shown in Table 5. However, the sub-decree also does not specify the method for noise measurement.

81. When compared with the World Bank EHS guidelines, the maximum permissible noise levels that are outlined in the sub-decree are more stringent than the World Bank EHS guidelines. Based on the sub-decree, noise levels in areas in the vicinity of hospitals, libraries, and schools from 0600 to 1800 should not exceed 45 decibles [dB(A)] whereas the World Bank EHS guidelines specify the maximum allowable limit as 55 dB(A). However, for residential and commercial areas, the World Bank EHS guidelines imposes stricter noise limit of 60 dB(A) and 65 dB(A), respectively, while the sub-decree imposes a limit of 60 dB(A) and 70 dB(A), respectively.

Table 4: Maximum Permitted Vehicle Noise in Public and Residential Area

No.	**Category of Vehicle**	**Maximum Noise Level Permitted (dB(A))**
1	Motorcycles, cylinder capacity of the engine does not exceed 125 cm^3	85
2	Motorcycles, cylinder capacity of the engine exceeds 125 cm^3	90
3	Motorized tricycles	90
4	Cars, taxis, passenger vehicle of not more than 12 passengers	80
5	Passenger vehicle constructed for carriage of more than 12 passengers	85
6	Truck permitted maximum weight does not exceed 3.5 tons	85
7	Truck permitted maximum weight does not exceed 3.5 tons	88
8	Truck engine is more than 150 kilowatt	89
9	Tractor or any other truck not elsewhere classified of described in this column of the table	91

Table 5: Maximum Permitted Noise Level in Public and Residential Area (dB(A))

No.	Area	Period of Time		
		From 0600 to 1800	From 1800 to 2200	From 2200 to 0600
1	Quiet areas: Hospitals; Libraries; Schools; Kindergarten	45	40	35
2	Residential area: Hotels; Administration offices; House	60	50	45
3	Commercial and service areas and mix	70	65	50
4	Small industrial factories intermingling in residential areas	75	70	50

82. **Sub-Decree on Water Pollution Control (No. 27 ANRK.BK 1999).** All discharges of liquid wastes from construction camps, work sites or operations, to streams or water courses should conform to the following standards:

Parameter	Unit	Allowable limits for pollutant substance discharging to	
		Protected public water area	Public water area and sewer
Biochemical oxygen demand (BOD)	mg/l	<30	<80
Chemical oxygen demand (COD)	mg/l	<50	<100
Total suspended solids	mg/l	<50	<80
Detergent	mg/l	<5.0	<15
Total dissolved solids	mg/l	<1000	<2000
Temperature	^{o}C	<45	<45
pH		6 – 9	5 – 9
Oil and grease	mg/l	<5.0	<15
Dissolved Oxygen (DO)	mg/l	>2.0	>1.0

Appendix D presents further details of effluent standards as outlined in sub-decree no. 27.

83. There is no legal standard for performance of septic tanks but these should be checked for correct operation, i.e., absence of smell; not overflowing; and no surface water logging.

84. **Sub-Decree on Solid Waste Management (No. 36 ANRK.BK 1999).** Under Article 7 of the sub-decree on solid waste management, the disposal of waste in public sites or anywhere that is not allowed by authorities is strictly prohibited. There are no quantitative parameters but good sensible practices are expected that include:

(i) All general waste and food waste should be disposed to a Government approved landfill.
(ii) All demolition waste must be disposed to a Government-approved location.
(iii) All waste oil and grease should be disposed by a registered sub-contractor. The final destination of the oily wastes should be established.

85. **Hazardous Waste Management.** There is no specific regulation for hazardous substances in Cambodia. The aspect is covered in Sub-Decree on Water Pollution Control Annex 1 and Sub-Decree on Solid Waste Management, which give details of classifications of hazardous substances. Any hazardous substance must be stored correctly and only disposed in a manner approved by the MOE.

D. International Conventions and Treaties

86. Cambodia is signatory to many international environmental treaties and conventions which provide a comprehensive legal framework related to coastal management. These include: the Coordinating Body of the Seas of East Asia (1995), Association of South East Asian Nations (1999), Marine Pollution (MARPOL, 1994), Biodiversity Convention (1994), Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (1997), Ramses Convention (1999) and Climate Change Convention (1995) (MOE 2006).

87. Occupational and Community Safety and Health (OHS) guidelines for Government follow the recent OHS Programme for Cambodia (2010-2013) that was developed by the International Labor Organization (ILO). The guidelines provide the framework for instituting OHS at the workplace and in the community.

88. The Royal Government of Cambodia promulgated the Cambodia Climate Change Strategic Plan 2014–2023 (CCCSP) in response to the country's commitment to the United Nations Framework Convention on Climate Change. The CCCSP was prepared following the guidelines of the Council of Ministers and consultations stakeholders. The CCCSP is designed to address a wide range of climate change issues concerning adaptation, greenhouse gas (GHG) mitigation, and low-carbon development.[7] The MPWT's Climate Change Action Plan for Transport Sector 2014–2018 identified priority climate adaptation actions that include: (i) develop national road construction and maintenance design standards for national roads, taking into account climate change impact; (ii) repair and rehabilitate existing road infrastructure taking into account climate change impact and various other actions in relation to raising capacity and public awareness of climate change impacts; and (iii) capacity building and institutional strengthening for addressing climate change impacts.

89. The Royal Government of Cambodia is one of the pilot countries participating in the Pilot Program for Climate Resilience (PPCR) – one of the three sub-programs of the Strategic Climate Fund (SCF)[1]. The PPCR provides incentives for scaled-up action and transformational change in integrating consideration of climate risks and resilience in national development planning, consistent with poverty reduction and sustainable development goals. The priority sectors for PPCR in Cambodia include water resources, agriculture and infrastructure. In June 2011, the PPCR sub-committee endorsed Cambodia's Strategic Program for Climate Resilience with a funding envelope of up to $86 million ($50 million in grants and up to $36 million in concessional credit). Of this, an allocation of $17 million ($10 million loan and $7 million grant) was endorsed for "Climate-proofing of Roads in Prey Veng, Svay Rieng, Kampong Chhnang and Kampong Speu Provinces" as part of the ADB-funded PRIP. The PRIP includes piloting of approaches to strengthen civil works design and planning, as well as to reduce risks of damages resulting from climate change impacts through implementing ecosystem-based adaptation measures and emergency management responses[8].

90. For all other applicable environmental standards and criteria such as ambient air quality, vibration, noise, contaminated soil, and workplace and community safety, the standards and protocols of the World Bank Group EHS (2007) will apply particularly for standards which impose stricter limits such as noise in the immediate vicinity of residential and commercial areas.

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[7] Cambodia Climate Change Strategic Plan 2014-2023. www.bb.undp.org. 6 February 2017

[8] PRIP Climate change outputs include Climate Modeling Report, Flood Risk Management Interface Manual v10, Infrastructure Rehabilitation for Climate Resilience, Knowledge Management Report, Non mandatory guidelines for FPR v1,6, Reinforcing community flood resilience, Road Design Standard v6-hun-1 and Vulnerability Report v5. (http://prip.mpwt.gov.kh/documentation).

E. ADB Safeguard Policy Statement

91. **Environmental Assessment.** The ADB Safeguard Policy Statement along with the recent Good Practice Safeguard Sourcebook which clarifies the rationale, scope and content of an environmental assessment and supported by technical guidelines. Projects are initially screened to determine the level of assessment that is required according to the following three environmental categories (A, B, or C).

92. Category A is assigned to projects that normally cause significant or major environmental impacts that are irreversible, diverse or unprecedented such as hydroelectric dams (an EIA is required). Category B projects have potential adverse impacts that are less adverse than those of category A, are site-specific, largely reversible, and for which mitigation measures can be designed more readily than for category A projects (an IEE is required). Category C projects are likely to have minimal or no negative environmental impacts. An environmental assessment for Category C projects is not required but environmental implications need to be reviewed.

93. The project is classified as Category B and an IEE has been conducted as part of project preparation of the national roads in accordance with ADB Safeguards Policy Statement.

94. **Climate Risk and Vulnerability Assessment.** The ADB also requires the identification of climate change risks to proposed project early in the project cycle and to identify actions to screen projects for climate risks, assess these risks, and address them in the project design. Technical guidelines have been developed by the ADB to aid in the climate risk and vulnerability assessment.[9] Likewise, the Guidelines on Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects[10] was issued to present a step-by-step methodology to help project teams incorporate climate adaptation into transport sector investment projects.

[9] https://www.adb.org/sites/default/files/publication/148796/climate-risk-management-adb-projects.pdf
[10] https://www.adb.org/sites/default/files/institutional-document/32772/files/guidelines-climate-proofing-roads.pdf

III. DESCRIPTION OF THE PROJECT

A. General

95. The RNIP is a proposed loan to the Government of Cambodia by the Asian Development Bank (ADB) through the (MPWT. The project will have four outputs, namely:

- Output 1: Safe and climate-resilient roads improved
- Output 2: Axle load control enhanced
- Output 3: Quality assurance system in MPWT strengthened
- Output 4: Road safety along project roads improved.

96. Two national roads (NR1 and NR6) with a total length of 147 km have been selected under Output 1. This will involve rehabilitation and improvement of NR1 and NR6 to a climate-resilient condition to ensure all-year access and to help reduce the communes' vulnerability to climate change. These roads are located in the provinces of Prey Veng, Svay Rieng, and Siem Reap. Table 6 lists the proposed roads and their respective administrative areas. Figure 1 shows the locations of the proposed national roads to be improved under the project.

Figure 1: Locations of National Roads 1 and 6

Basemap Source: Political Map of Cambodia, www.nationsonline.org

Table 6: List of Proposed National Roads

Road No.	Province	From	To	Total Length (km)
NR1	Prey Veng, Svay Rieng	Km 62.1 (junction with NR-11 inside Neak Loeang)	Km 159.00 (the western edge of Bavet city)	97
NR6	Siem Reap	Km 317.1 (junction with airport road north edge of Siem Reap)	Km 367.0 (south end of river bridge)	50
Total				147

km = kilometer; NR = national road

B. Project Rationale

97. **Poor Condition of Existing Roads.** Currently, the roads are either paved with asphalt concrete or DBST. The roads have varying widths of 5 m to over 6 m while drainage structures are often narrower than the remainder of the road and the carriageway is restricted at these locations.

98. Sections of NR1 and NR6 are prone to flooding, which will be exacerbated by climate change effects. NR6 is bound on one side by Tonle Sap Lake and on the other side receives the catchment runoff from the Dangrek Escarpment and flash floods from the watercourses crossed. The northern section of NR1 crosses the Steung Slot River, a major watercourse which swells during heavy rainfall events and causes flooding in certain sections of the road. Improvement of these roads is needed for providing quality and safe travel to road users. Figures 2 and 3 presents the typical condition of NR1 and NR6, respectively.

99. **GMS Road Connectivity.** The national roads have been identified based on the following selection criteria: (i) connectivity to the GMS corridors; (ii) government national road improvement program; (iii) vulnerability to climate change effects; (iv) lower resettlement impact; and (v) closer geographic location. The national roads NR1 and NR6 are sections of the GMS SEC which will traverse the provinces of Prey Veng, Svay Rieng, and Siem Reap.

100. Through the rehabilitation and improvement of the identified national roads, the economic potential of the GMS SEC will be maximized while increased economic and employment opportunities and year-round access to larger markets, health centers, and education facilities are expected to increase.

Existing bridge at NR1

Traffic and road condition at NR1

NR1 and its intersection with PR312

Shops along NR1

Figure 2: Typical Condition of NR1

101. **Road Safety.** Road fatality is one of the leading causes of death in the country. In addition to improving the priority roads, the project aims to help the Government in resolving sector issues: (i) lack of sustainability of road asset from inadequate construction quality and vehicle overloading and (ii) high level of road crashes that has a particular impact on vulnerable road users. In Cambodia, more than 6 persons die per day and many others are injured due to road crashes, most of them are youths from 15 to 29 years old.[11] The project aims to improve MPWT's quality assurance mechanism, provide necessary equipment and facilities for better controlling vehicle axle loads, and improve road safety on the project roads and in communes along the project roads. The planned road safety measures include black spot improvement, safe school zones, and campaigns to increase the villagers' understanding of road traffic regulation and rules.

Road and drainage condition at NR6 section

Western end of NR6 at Siem Reap provincial boundary

Figure 3: Typical Condition of NR6

102. **Reduce Vulnerability to Climate Change.** There are two major flood types in Cambodia: (i) flashfloods, resulting from heavy downpour upstream of the Mekong River which affect the provinces along the Mekong and the southeastern areas of the country and (ii) central area large scale floods, resulting from a combination of runoff from the Mekong River and heavy rains around the Tonle Sap Lake, which affect the provinces around the lake and the southern provinces. In some upland areas with significant slopes and a water course, the type of flooding is flash flooding which occurs over several hours. In low-lying areas with no natural gradient, flooding can last for months. Whilst roads should remain above the flood level, there are other factors to consider. Roads provide access to communities along the roads. Even if the roads are above the flood level, agricultural areas and even villages may not be. During floods, villagers move their animals to refuges on high

[11] Feasibility Study on Second Provincial Roads Improvement Project (ADB Loan No. 2839-CAM/8254)

ground and roads are important means of access to these refuge areas. If a road becomes flooded, water will flow across the road. Even if the bituminous surface layer is not damaged, water overflowing can damage the embankment and under scour the road.

103. Climate resilience related adjustments will be made in the design and civil works through provision of road embankments and roadside ditches, use of less moisture susceptible materials or hydraulically-stabilized materials, and using green engineering to improve the water conservation characteristics of the watershed. Damaged box and pipe culverts have been designated for replacement if the existing structures are not able to function properly. An application has been submitted for Nordic Development Funds from the Project Readiness Improvement Trust Fund. These funds would support integration of climate adaptation measures in the detailed engineering design of an estimated cost of $10 million (about 20% of total civil works cost) which include increased road elevation, increased drainage capacity, reinforced embankment slope protection, localized full replacement of pavement structure, and additional urban drains and outlets.

C. Output 1: Safe and Climate Resilient National Roads

104. This will involve the improvement of about 147 km roads through rehabilitation of national roads (NR1 and NR6). The design principles that will be adopted for the improvement of the roads are:

(i) Retention of existing lane widths
(ii) Retention of the existing horizontal and vertical alignments
(iii) Application of overlays in areas found to be in sound condition after appropriate repairs
(iv) More intrusive rehabilitation in areas found to be in warning and severe categories
(v) Adjustment of any areas found to have substandard cross fall[12]
(vi) Acceptance of existing shoulder widths except in cases where the standard minimum dimension is not available
(vii) Avoidance of tree removal other than in cases where unsafe sight distance restrictions occur.

105. The national roads will have two 3.5 m lanes and 1.5 m paved shoulders on both sides, resulting in a total width of 10 m. However, in some of the major developed areas, the number of existing traffic lanes is 4 and shoulder widths increase to up to 2.5 m.

106. The upgrading of the national roads will consist of the following interventions:

- Road surfacing with 100% asphalt concrete pavement within existing pavement widths
- Maintenance of 17 bridges
- Maintenance of existing drains
- Installation of some new drains along road edge
- Installation of road signs and markings
- Selected climate change features such as slope protection and storm water dissipation.

107. Rehabilitation and upgrading will not increase the width of carriageways and shoulders with the focus being on enhancing existing road assets. Only the grade (elevation)

[12] Cross slope, cross fall or camber is a geometric feature of pavement surfaces: the transverse slope with respect to the horizon. Cross slope is provided to provide a drainage gradient so that water will run off the surface to a drainage system such as a street gutter or ditch. Inadequate cross slope will contribute to aquaplaning.

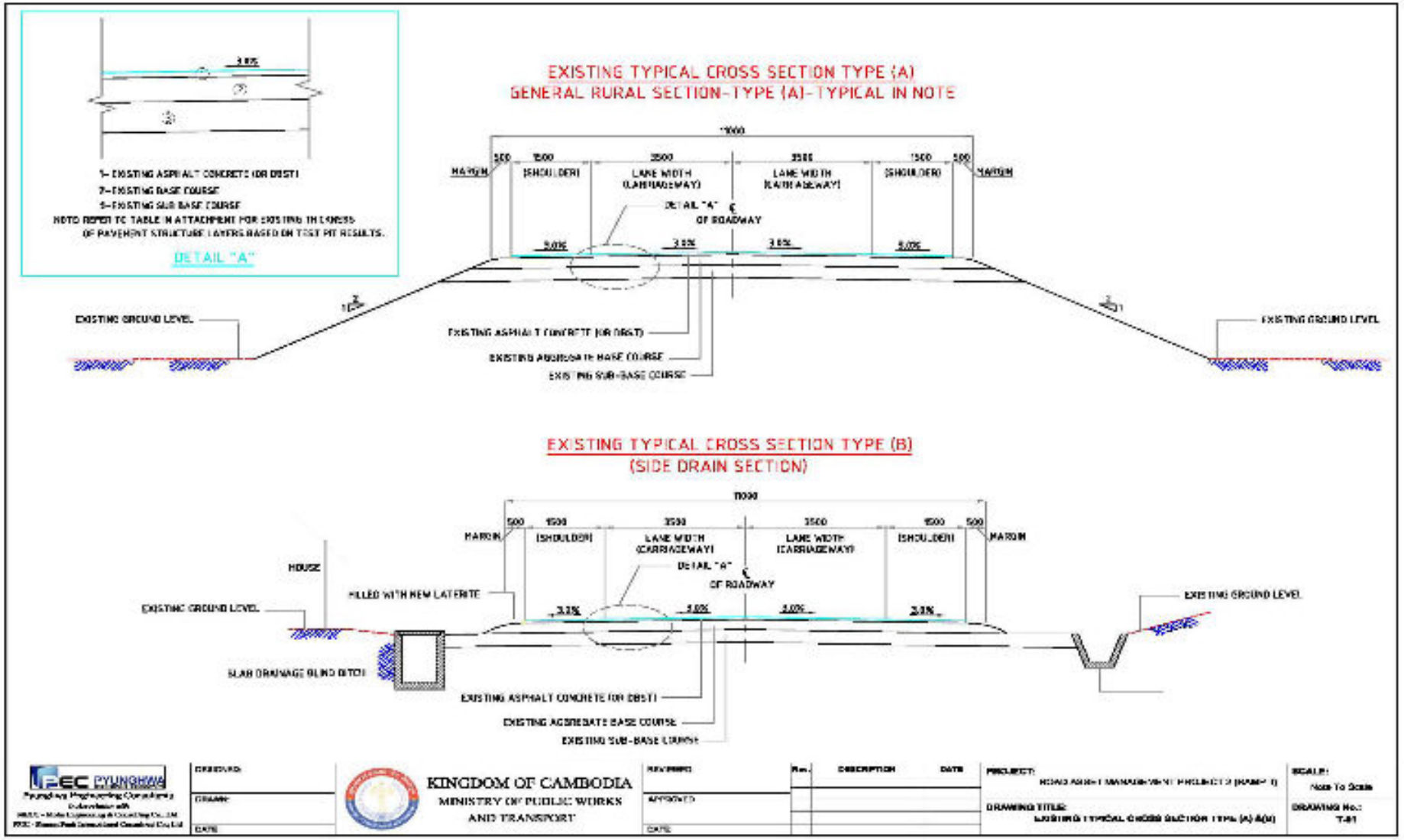
of some road sections will be raised to combat periodic flooding. The existing and proposed rehabilitated cross-sections of the national roads are shown in Figures 4 and 5.

108. The present pavement surfaces will be rehabilitated using asphalt concrete surfaces in areas where continuing settlement problems exist as an interim measure. All existing bridges found under the MPWT's regular inspection program, to be presently in structurally sound condition will receive maintenance intervention only. Improvements in both transverse and roadside drainage system capacity will also be undertaken to reduce the impact of flood events. Measures will also be introduced that will improve the ability of the roadways to withstand impact of increased future flooding as a result of climate change.

109. As the horizontal alignments of the road sub-sections are to be retained with no widening of the cross section, no work outside of the defined ROW is required. As a result, there will be no impacts on private properties and no resettlement issues to resolve.

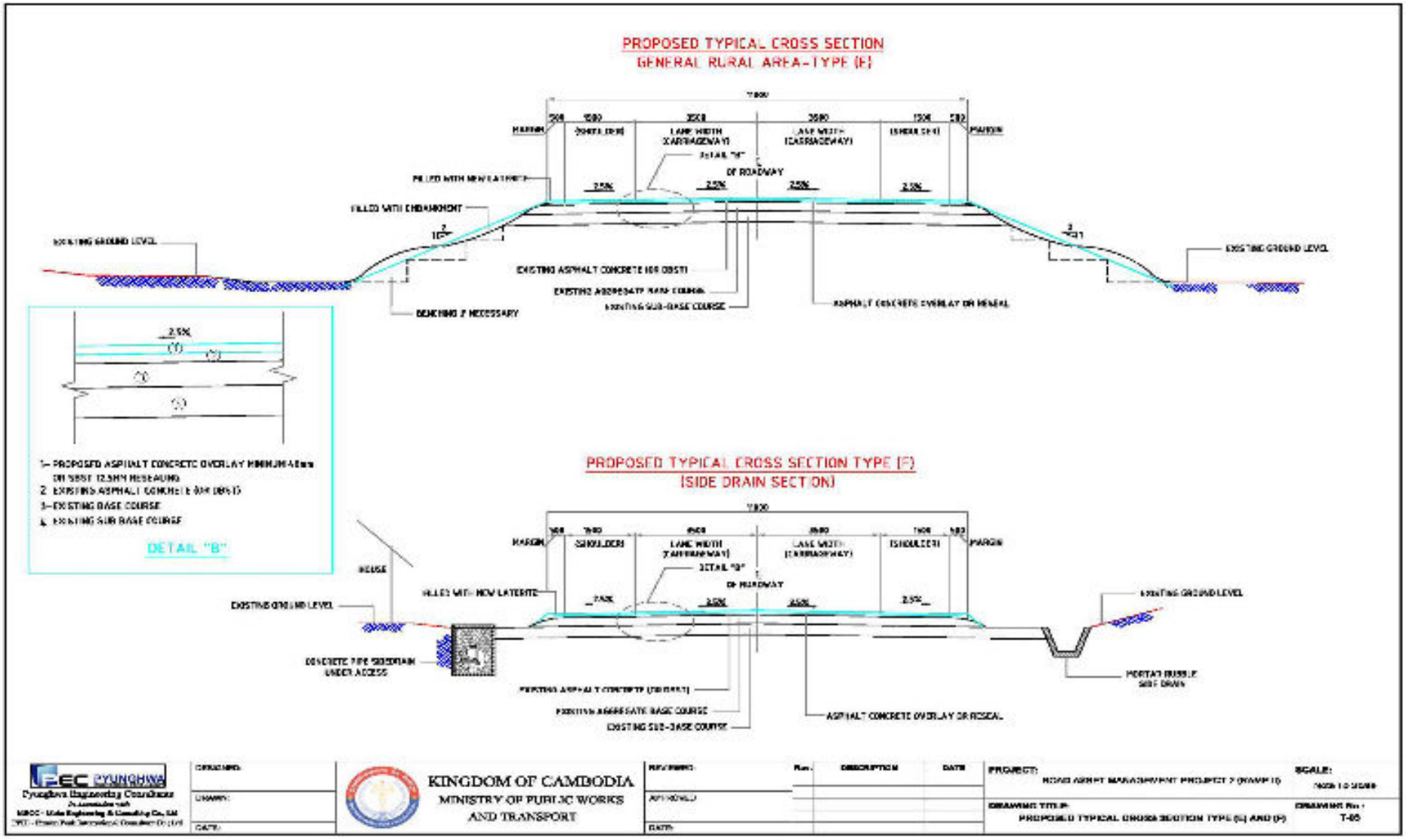
110. Specific activities and construction work expected to be undertaken includes:

- Sample recovery and laboratory testing of embankment and underlying materials in areas where differential settlement problems have been observed;
- Removal and repair of sections of road found to be in poor condition or subject to ongoing settlement with re-compaction of sub-grades and replacement of sub-base and base course layers;
- Remedial interventions (i.e. patching and crack sealing) on sections of road;
- Application of 40 or 50 millimeter (mm) thick asphalt concrete overlays
- Application of surface treatment in areas confirmed to be subject to settlement;
- Bridge maintenance (10 structures of single, twin, triple and multi-span configurations for NR1 and 17 structures of single, twin and triple span configurations for NR6);
- Cleaning of box and pipe culverts and roadside ditches;
- Clearing of vegetation in roadside areas and drainage channels;
- Installation of added cross culvert capacity by upsizing and duplication of some units;
- Installation of added longitudinal drainage capacity (concrete "U" drains) in appropriate urban areas;
- Installation of appropriate road signs and markings; and
- Selected provision for future climate change including slope protection and improved storm water retention capacity.



Source: Draft final design report of RAMP-II prepared by PYUNGHWA Engineering Consultant Co. (PEC).

Figure 4: Typical cross-sections of National Roads 1 and 6



Source: Draft final design report of RAMP-II prepared by PYUNGHWA Engineering Consultant Co. (PEC)

Figure 5: Indicative rehabilitated cross-sections of National Roads 1 and 6

111. **Pavement Design.** The material from the existing pavement will be scarified to a depth of 100 mm from surface, spread over the full width and re-compacted. Alternatively, both side earth shoulders can be widened first to design width, filled to top 200 mm of shoulder width by use of subgrade material having 4 days soaked california bearing ratio (CBR)[13] not less than 10 percent and compacted to the specified degree. The compacted surface will be brought to the level of the existing pavement surface and specified cross-fall. The asphalt concrete will protect the pavement below as it will have a waterproof seal. It will also provide sufficient skid resistance properties.

D. Output 2: Enhancement of Axle Load Control

112. The roads are regularly being damaged by overloaded trucks leading to much sooner maintenance than planned. MPWT established 27 weigh stations[14] and purchased 38 portable weigh scales to control axle loads. However, the operation of some weigh stations became ineffective due to lack of weigh station maintenance. In addition, the weigh scales purchased are now outdated. Recognizing the importance of sustaining the axle loads control program, the project will (i) strengthen the governing documents by amending, preparing and disseminating procedures, rules and technical documents; (ii) upgrade four existing weigh stations up to fully operational condition by replacing some damaged equipment and calibrating and maintaining others, and providing solar panels to provide uninterrupted electricity to weigh station buildings, (iii) establish a 24 hours surveillance center in MPWT to provide real time information from the permanent weigh stations by purchasing and installing (a) monitoring and data transmission equipment and software and (b) office equipment and furniture, refurbishing offices, preparing standard operating procedures to be followed by the center and weigh stations, and providing on-the-job training for staff; (iv) pilot controlling of axle load at three sources and selected roads by purchasing portable weigh scales and vehicle for mobile teams, improving the current work process, and providing on-the-job training to mobile teams; (v) help control the truck modification by providing awareness campaigns to garage owners, and improving the enforcement approach; and (vi) introducing particular conditions to the civil works contract to enforce contractors to obey the load limits.

E. Output 3: Strengthening of quality assurance system in MPWT

113. The CBPWL, under the operational control of MPWT, is the only laboratory in Cambodia providing material tests. Many of the laboratory equipment available at the CBPWL are relatively old mechanical/electro mechanical devices. The CBPWL is located at Khan Resey Keo which is approximately 8 km from the MPWT head office in Phnom Penh. The CBPWL facilities is located in a two story building with an approximate floor area of 1,600 m^2, of which about 350 m^2 is dedicated as the laboratory space and the remaining floor area occupied by office and administrative spaces. An on-the-job training program will also be included to train/re-train the laboratory engineers on all the tests proposed to be conducted in the refurbished CBPWL.

114. The project will also establish a national laboratory at DPWT campus in Pursat province with a network of regional laboratories in Siem Reap, Kampot, and Kratie provinces. The regional laboratories will be under the operational control of the proposed national laboratory. The logistic requirement of collecting and transporting samples from areas outside of Phnom

[13] CBR refers to the California Bearing Ratio which is a penetration test to evaluate the mechanical strength of the natural ground, subgrades and base courses beneath new carriageway construction.
[14] Seven of the weigh stations have been financed by ADB while two were financed by JICA.

Penh to the national laboratory can be minimized by establishing regional test laboratories spread in the provinces. All the regional laboratories will be within DPWT premises. The main laboratory in Pursat will have a building floor area of 800 m^2 and warehouse area of 300 m^2. The regional laboratories in Kratie, Siem Reap, and Kampot will each have a floor area of 400 m^2. The project will procure new and advanced test equipment for CBPWL and each regional laboratory that includes equipment for soil test, aggregates test, concrete test, cement test, asphalt and pavement test, non-destructive test, and traffic engineering/ road survey equipment.

F. Output 4: Improvement of road safety along project roads

115. This output focuses on community-based road safety activities through three pillars, i.e. data compilation and analysis, safety school zone, and law enforcement. Since Cambodia has a relatively well-established data collection system of Road Crash Victim Information within MPWT's National Road Safety Council, road crash data at commune level will be compiled and analyzed for formulating effective road safety activities for communes. These data along with school characteristics will be gathered to design safety school zones. Also, law enforcement will be supported by engaging traffic police in the project area to focus on enforcing regulations to minimize common offenses for crashes like speeding, drunk driving, and absence of helmet for motorbike drivers. Commune leaders, respected elders, parents, and monks will also be trained to socially enhance the understanding of community members.

G. Follow-on road maintenance phase

116. After completion of the road asset rehabilitation phase, the maintenance works phase will begin which through a performance-based contract. The activities of the maintenance phase are summarized in Table 7.

Table 7: Road Maintenance Activities

Aspects	Activities
• Road management services	• Road patrol services, including regular and periodic record keeping and reporting • Road corridor safety management, standby for accidents and emergency events, liaising with road traffic inspectors, recording encroachment events, traffic management • Traffic counting • Accident recording • Updating inventory database for road pavement and structures
• Road operations services	• Repair of potholes • Sealing of longitudinal and transverse cracks • Sealing of alligator cracks • Cleanliness of the pavement surface and shoulders • Correction of depressions • Repair of edge breaks • Repair of shoulders
• Signs, safety and lighting	• Repair of information, warning and traffic regulations signs • Painting of road markings; • Repair and painting of kilometer posts, marker posts and highway posts • Repairing and painting of land acquisition and right of way markers • Repair (and if required painting) of barriers and guardrails; • Replacement and repair of lighting units (where this is not maintained by local authorities)
• Drainage, vegetation and slopes	• Cleaning, repair and restoration of curbs and covered drainage channels • Cleaning and repair of lined and unlined open drainage ditches, channels, chutes and cut-off drains; • Cleaning and minor repairs to culverts, inlet structures and outfalls; • Vegetation control and tree cutting' • Removal of slides and repair of erosion on cut and fill slopes channels
• Structures	• Maintenance of bridges • Maintenance of retaining walls and protection work; • Clearance of riverbeds
• Emergency Repair Works	• Repair of damage or destruction of a culvert due to extreme rainfall events • Road severing following a complete or partial washout of a road section • Road section inundation due to flooding.

IV. DESCRIPTION OF THE ENVIRONMENT

117. Numerous site visits have been undertaken to the project areas and engineering surveys have also been carried out on each of the roads proposed for improvement. During the TA, an inventory was made of bridges and drainage structures, as well as geological survey measuring existing subgrade strengths and existing pavement strengths. The widths of the existing roads were measured including the widths at structures where the roads often narrowed. The surface material and conditions were also surveyed. All existing bridges were checked for length, widths, types and current condition while drainage structures such as box culverts and pipe culverts were surveyed for location, widths, lengths, sizes and current conditions.

118. The project's area of influence was considered to be 100 m from the centerline for the purposes of assessment. This area was determined based on the distance of potential impacts, particularly in respect of dust and noise. The following describes the baseline conditions for each of the project roads.

A. National Road 1

119. NR1 is part of AH1. NR1 extends southeast from Phnom Penh (km 0+000) through the low flatland floodplain of Mekong river and ends at Km 167+000 at Bavet City at the Viet Nam border. From Bavet City, the road continues as AH1 towards Ho Chi Minh City, which is about 118 km from the Cambodia-Viet Nam border. The route crosses the Mekong River and its tributaries in several locations and traverses the provinces of Kandal, Prey Veng, and Svay Rieng.

120. The 97 km section of NR1 that will be rehabilitated starts at the eastern side of Steung Slot River, a tributary of Mekong river, and ends at the Viet Nam border in Bavet City. The road is located in the districts of Peam Ro, Preah Sach, and Kampong Trabaek in Prey Veng province and the districts of Svay Chum, Svay Rieng, Svay Teap, and Bavet in Svay Rieng province. It covers 22 communes, namely, Nak Loeung, Kampong Seung, Lvea, Krang Svay, Kampong Trabaek, Prasat, Prey Chhor, Kraol Kou, Ta Sous, Svay Chrum, Chek, Kouk Pring, Svay Tayaen, Sang Khoar, Sambour, Kandieng Reay, Prasoutr, Romeang Thkaol, Chrak Mtes, Prey Angkungn, Bati, and Bavet. Figure 6 shows the location of NR1.

121. Vehicle composition is dominated by motorcycles with an average of 69% while passenger vehicles, including cars, jeeps, and vans, make up an average of 13% of traffic on NR1. The road is also being used by large trucks to transport goods to and from Viet Nam. Buses, including mini, medium and large buses make up 9% of traffic on NR1. Similarly, the goods vehicles, 2-axle trucks and multi-axle trucks make up an average of 9% of traffic.[15]

122. The vicinity is characterized with agricultural land, planted with rice and other crops. The road becomes busy at town centers and when it approaches the Viet Nam border. There are a number of hotels, casinos and commercial establishments near the border in Bavet City which has been designated as a Special Economic Zone. Figure 7 presents the general condition of the road and vicinity.

123. The national road network lies within the flatlands in the lower reaches of Mekong River and as a result, is directly affected by the regular flooding. Under extreme weather events such

[15] 2010-2015 traffic data based on the Additional Feasibility Study. CAM: Second Road Asset Management Project. Draft Final Report. October 2016

as during typhoon “Ketsana” in September 2009, flooding was intense and caused damage to the road and other corridor assets.

Starting point after the bridge over Steung Slot River in Nak Loeung commune, Peam Ro district

Existing bridge at Bour River in Preah Sdach district, Prey Veng province

Intersection of NR1 with PR312

Secondary school near intersection of NR1 and PR312

Road section with agricultural land on both sides of the road

Establishments on both sides of the road at Bavet town

Hotels and casino at the Special Economic Zone near the Viet Nam border

Figure 6: Condition at NR1 and vicinity

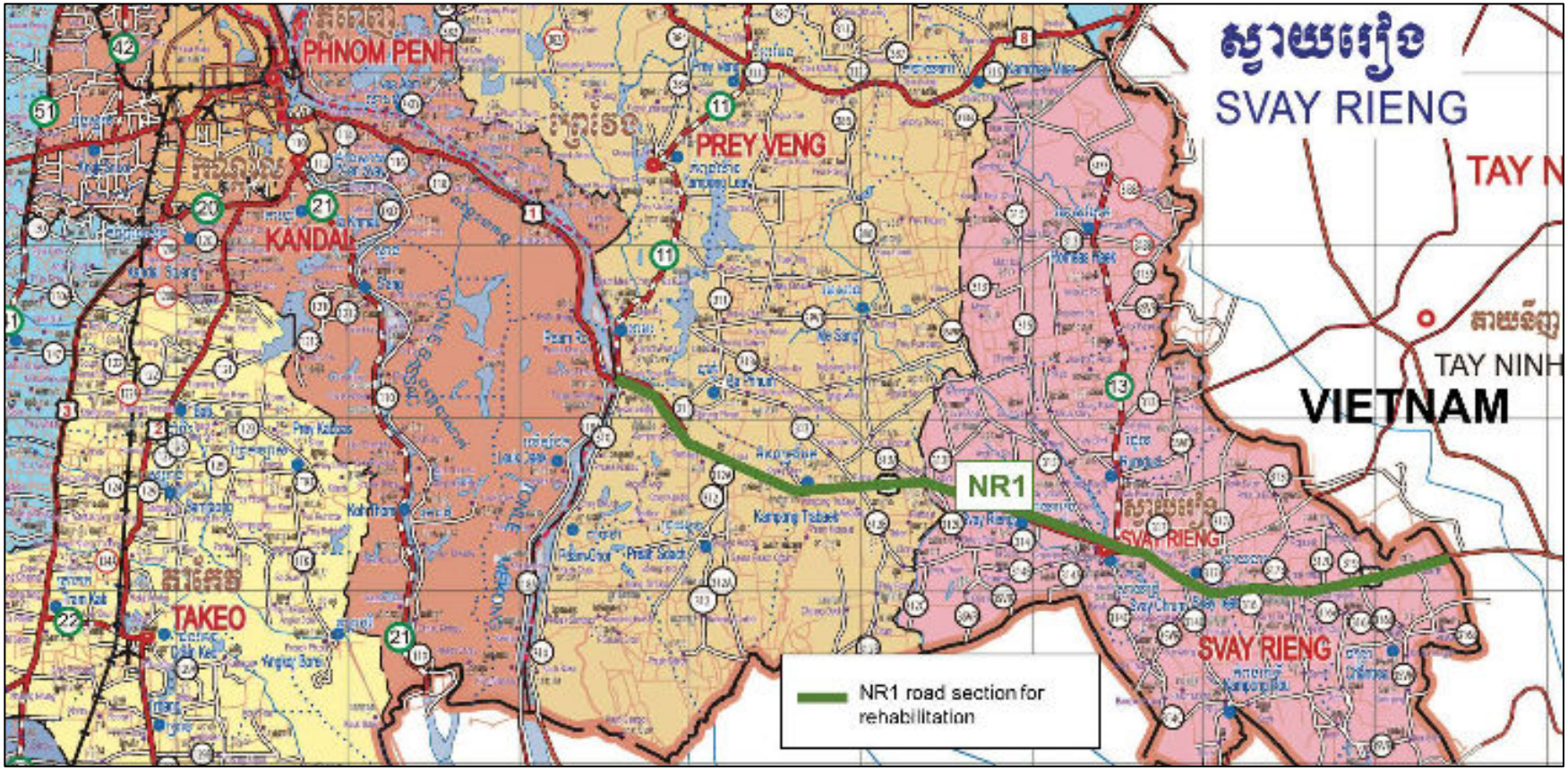


Figure 7: Location of NR1
Basemap source: www.mpwt.gov.kh

B. National Road 6

124. NR6 is located in the northwestern section of Cambodia and extends west and north from Siem Reap town. NR6 originates at Phnom Penh continues through Banteay Meanchey province to join NR5 at Serei Saophoan in Banteay Meanchey but the length to be rehabilitated is limited to the portion between Siem Reap City (km 317) to the town of Kralanh at the Siem Reap provincial border (km 367). The road section is located within Siem Reap town and the districts of Puok and Kralanh. The alignment traverses nine communes consisting of Tuek Vil in Siem Reap town; Khnat, Puok, Lvea, Sasar Sdam, and Prey Chrouk in Puok district; and Sranal, Kralanh, and Kampong Thkov in Kralanh district. Figure 8 presents the location of NR6.

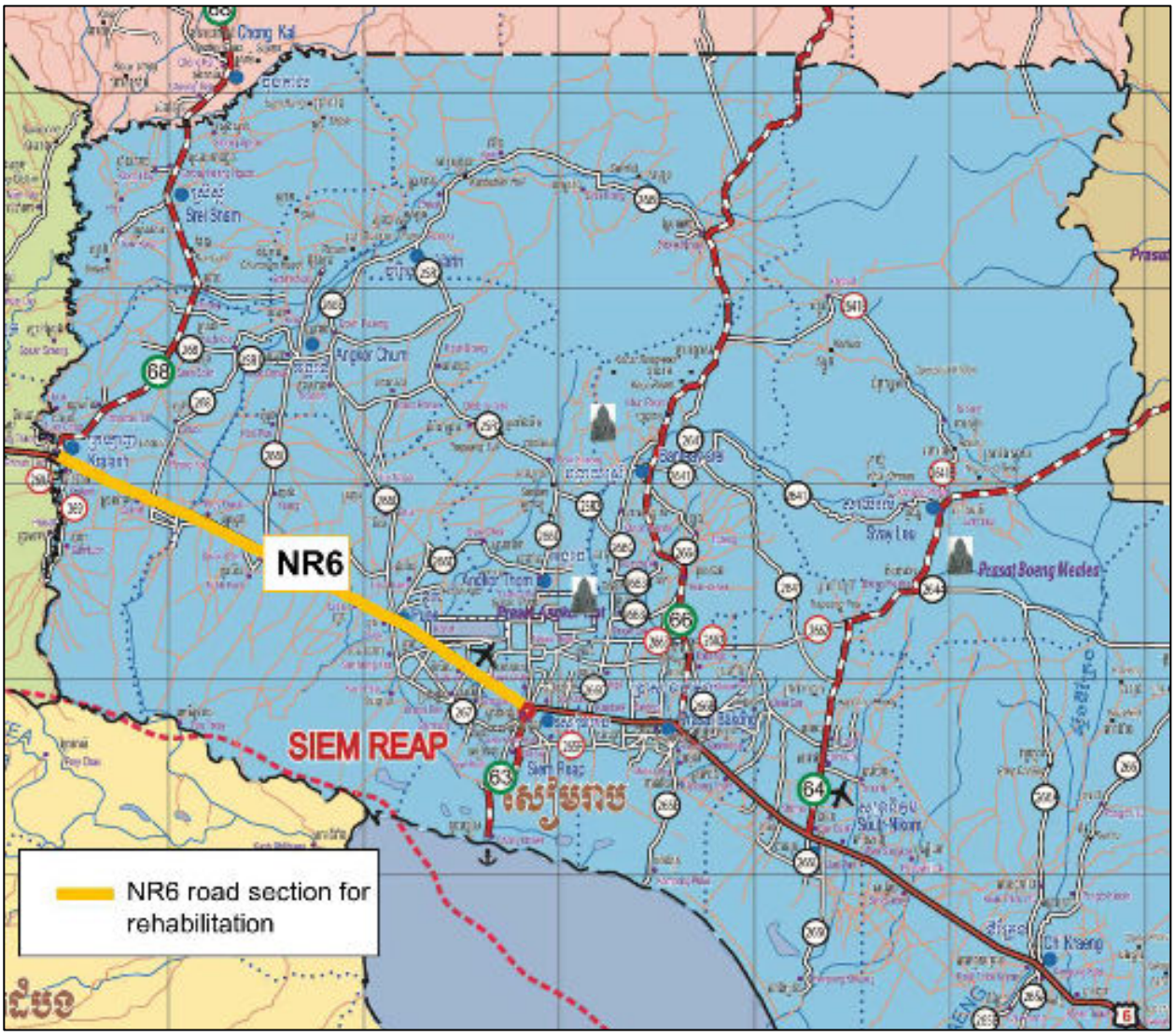


Figure 8: Location of NR6
Basemap source: www.mpwt.gov.kh

125. Vehicle composition is dominated by motorcycles with an average of 63% while passenger vehicles, including cars, jeeps, and vans, make up an average of 27% of traffic on

NR6. Buses, including mini, medium and large buses make up 4% of traffic on NR6 while the goods vehicles, 2-axle trucks and multi-axle trucks make up an average of 6% of traffic.[16]

126. NR6 alignment is flat and traverses mostly agricultural lands. The east-west NR6, though mostly elevated, requires more lateral drainage to manage the increasing north-south flow of heavy run-off down to the Tonle Sap wetland that routinely collects and creates flood conditions on the north side of the road. NR6 suffers from rutting and pot holes and needs to be rehabilitated for the increasing traffic to/from Thailand.

A secondary school along the alignment

Small shops at the side of the road

Establishments at town center in Kralanh district

End section at intersection with NR68 at Siem Reap provincial boundary

Figure 9: Condition at NR6 and vicinity

C. Physical Setting

1. Geography

127. Cambodia lies in the southwestern part of the Southeast Asian peninsula and has a land area of 181,035 square kilometer (km^2). International borders are shared with Thailand to the west, the Lao People's Democratic Republic to the north, and the Socialist Republic of Viet Nam on the east and southeast. The country is bounded to the southwest by the Gulf of Thailand and has a coastline of 440 km.

[16] 2010-2015 traffic data based on the Additional Feasibility Study. CAM: Second Road Asset Management Project. Draft Final Report. October 2016

2. Climate

128. The climate of Cambodia is dominated by the tropical monsoon which governs the wet and dry seasons. The rainy season occurs from May to October while the dry northeast monsoon occurs from November to April. The monsoon air-flow is caused by seasonally alternating high and low pressures over central Asia. In summer moisture-laden air of the southwest monsoon is drawn landward from the Indian Ocean. The flow is reversed during the winter by the northeast monsoon of dry air.

129. **Temperature.** Temperatures are fairly uniform throughout the country, with only small variations from the average annual mean of about 28°C. January is the coldest month where temperatures as low as 12°C have been recorded and April is the warmest where temperatures reach 42°C. The maximum and minimum mean temperatures are 30°C and 24°C respectively. Maximum temperatures exceeding 38°C are common and normally just ahead of the rainy season. Minimum night temperatures can fall below 20°C in January which is the coldest month. May is the warmest month.

130. **Wind.** Most of Cambodia's regions have an average wind velocity of less than 3 meters per second (m/s). Maximum wind speeds can reach in excess of 20 m/s during the wet season. During the dry season, the maximum wind speed velocities are lower and are commonly in the range of 6m/s–8 m/s.

131. **Rainfall.** The total annual average rainfall is 1,000 mm–1,500 mm, with heaviest rainfall occurring in the southeast. Rainfall from April to September in the Tonle Sap and Mekong Basin Lowlands area averages 1,300 mm–1,500 mm annually. Rainfall tends to increase with elevation, and is heaviest in the mountains along the coast in the southwest which receives from 2,500 mm–5,000 mm annually. The area of greatest rainfall drains mostly to the sea; only a small quantity goes into the rivers flowing into the basin. Tropical cyclones that often devastate coastal Viet Nam rarely cause damage in Cambodia but can form tropical depressions that result in high rainfall for a 3–4 day period.

132. **Humidity.** Relative humidity is high year-round which usually exceeds 90%. During the dry season, daytime humidity averages 50% climbing to about 90% during the rainy season (Cambodia Climate and Weather, 2015).

3. Topography

133. The topography of Cambodia is described as "bowl shaped" and expands about 181,035 km^2 (Figure 10). There are three distinct topographic regions: (i) central plains, (ii) flat coastal areas, and (iii) mountain ranges with high plateaus. The central plains form 75% of the country and consist of the alluvial plains of the Mekong River and the Tonle Sap basin.

134. The country is situated in the southwest Indochina peninsula and is rimmed by mountains consisting of the Dangrek Mountains plateau to the north to Thai border; the Annamite Range to the northeast; the Cardamom Mountains to the southwest; and by the Elephant Mountains to the south. The central region of the country or the bottom of the bowl is represented by Tonle Sap Lake and surrounding floodplain. The floodplain of Tonle Sap merges with the floodplain of the Mekong River to the southeast of Cambodia which forms the Cambodian plain covering 25,069 km^2. Knolls and low hills are scattered in the vast alluvial plains of the country. This means that the whole of northwest Cambodia acts as a catchment area draining ultimately into Tonle Sap.

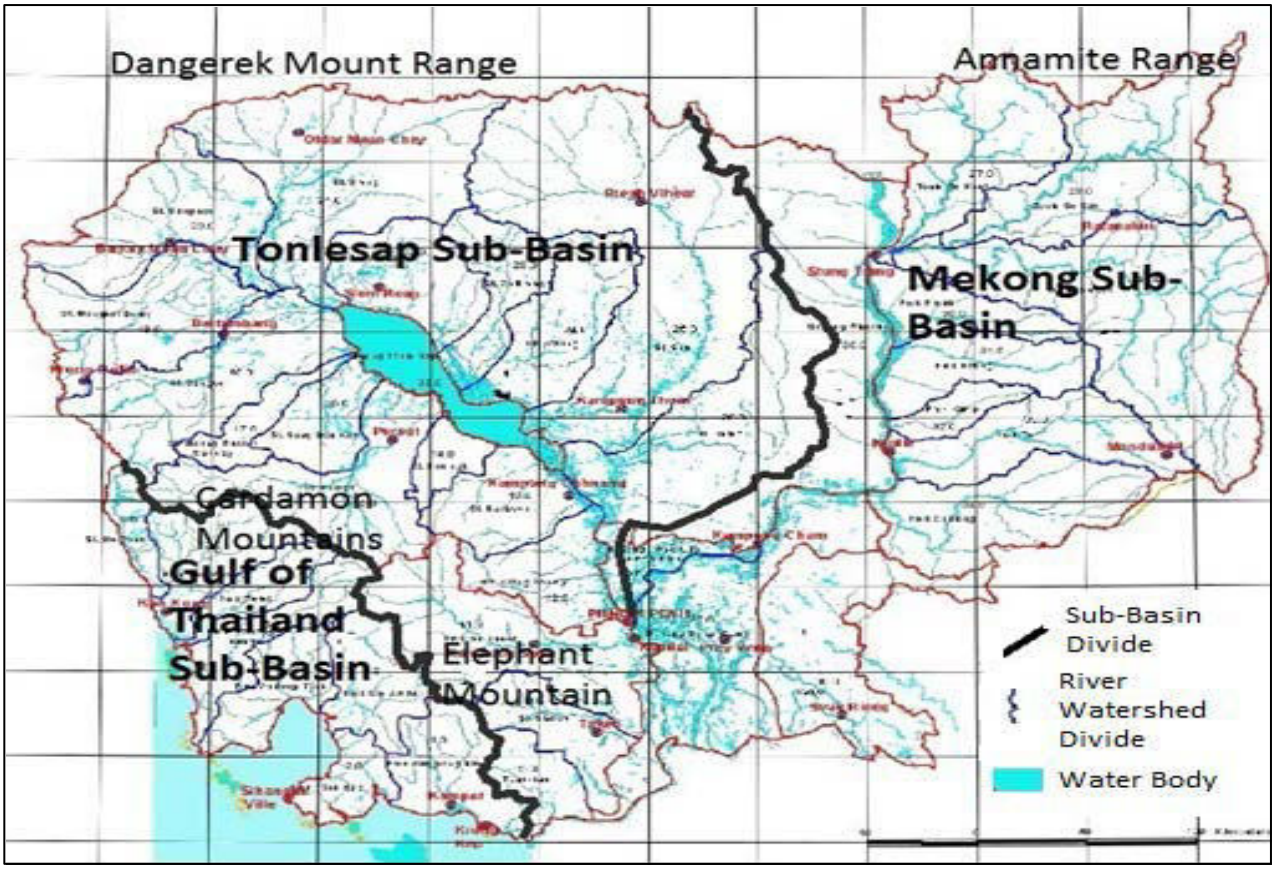


Figure 10. Major topographic features of Cambodia

D. Geology and Soils

135. There are no known geological risks in Cambodia. According to the United States Geological Survey, the whole country of Cambodia is located on a large stable tectonic region of the Sunda Plate (Figure 11). Therefore, the country is within an area with low seismic hazard.

136. The geology of the road section of NR6 is mostly composed of lake bed deposits, alluvial fans, and deltaic deposits with some pediments which is the typical characteristics of the provinces located in the Tonle Sap Lake region. In Kandal province, the geology is pediments and a small extent of flood plains and terrace alluvial deposits. Similar geological formations are found in the provinces Prey Veng and Svay Rieng.

137. The soils of Cambodia are dominated by post-Precambrian deposits (Figure 12). In the Precambrian Era, Cambodia was the bottom of the sea and covered by rock debris dominated by iron. The post-Precambrian period brought the extensive deposits of rock granite, sandstone, coal, petroleum, and other minerals. These deposits were in turn mixed with plants and animal fossils, all of which formed mountains and soils of today. Latterly, the alluvial deposits of the Mekong River brought mud and other fine silts and sand deposits broadly distributed (JICA, NR5 project, 2012).

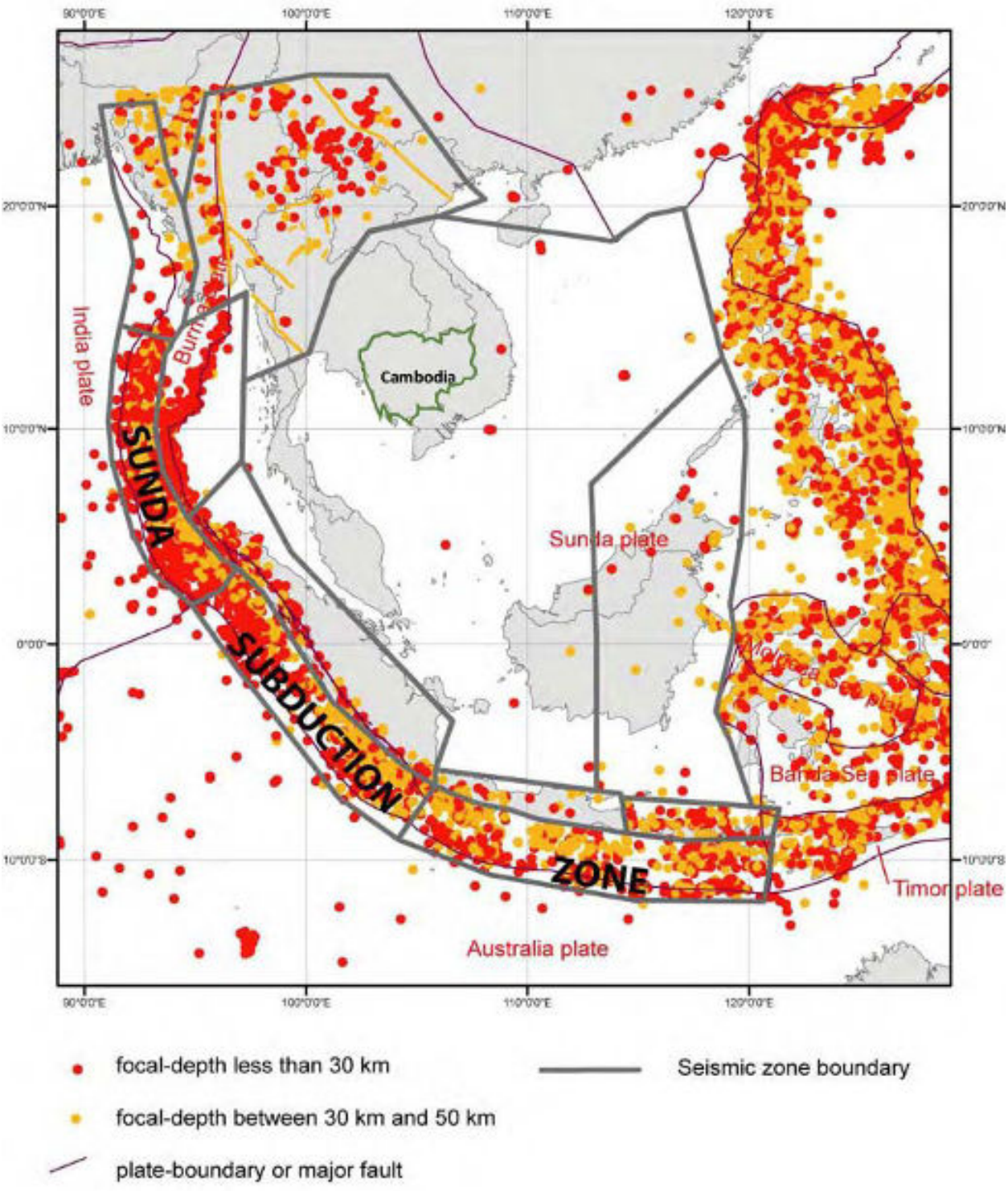


Figure 11: Seismic map of Southeast Asia

Source: United States Geological Survey, Documentation for the Southeast Asia Seismic Hazard Maps, September 2007

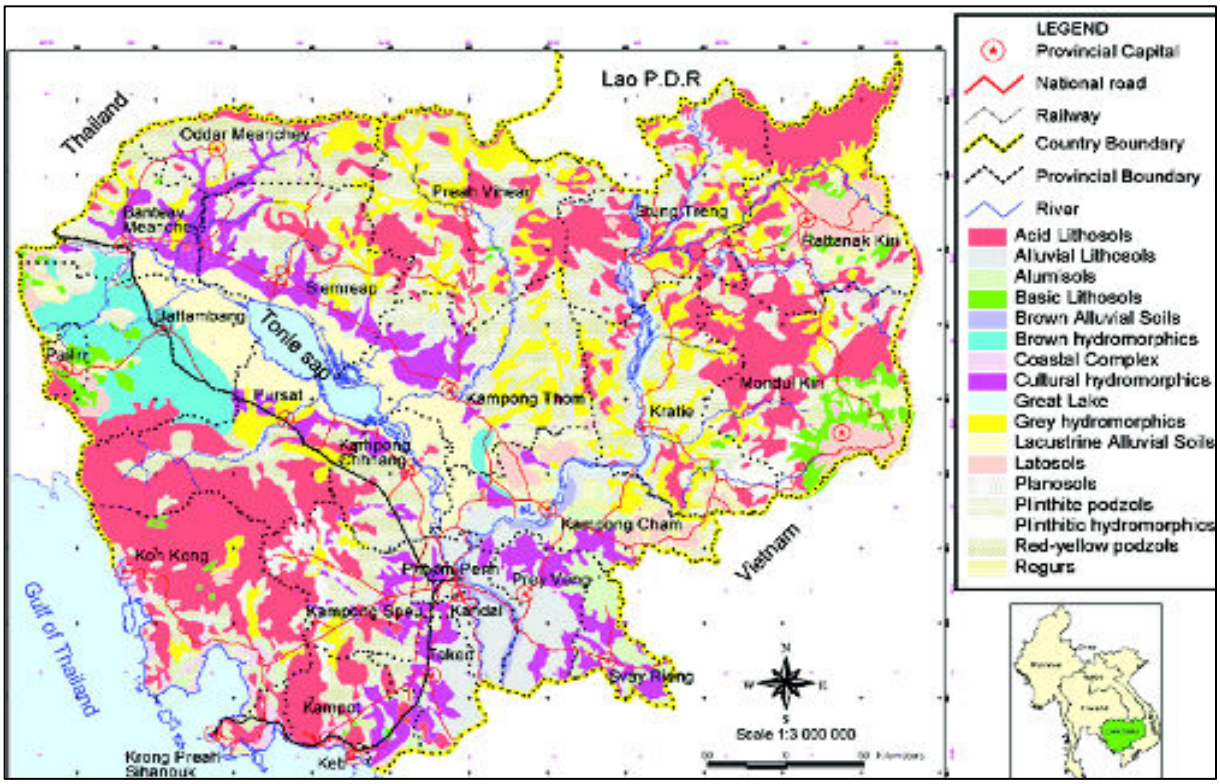


Figure 12: Soils of Cambodia

E. Air Quality and Noise

138. There is growing concern regarding increasingly poor air quality in urban areas of Cambodia. Air pollution is being linked to increases in the number of vehicles, industrial development, and overall urbanization that is occurring. As a result of the predominantly rural setting in the project areas, there are no available data on air quality and noise levels along the national roads. The general lack of air quality data outside of major centers such as Phnom Penh is because air pollution in the rural areas is relatively low[17]. In general, along the rural sections of the project roads to be rehabilitated, air quality is still good. However, the planned increases in socioeconomic development along these road corridors will bring air pollution from vehicle traffic and industrialization.

139. **Sensitive Receptors.** Along the national roads, receptors sensitive to air quality and noise impacts from the project include residential households, schools, temples, and hospitals/health clinics. These are listed in Appendix E. Table 8 summarizes the types and numbers of air and noise sensitive receptors for the national roads, indicating that 31 communes, 42 schools, 18 hospitals/health centers, and 22 temples (pagodas) are located along the national roads. For NR1, the highest numbers of sensitive receptors are in Kampong Trabaek district in Prey Veng province. For NR6, the most number of sensitive receptors are in Puok district, Siem Reap province.

[17] Communication from EIA Head of MOE, 2016 conducted by TA consultants of Second RAMP.

Table 8: Summary of Air and Noise Sensitive Receptors for the National Roads

Province	District	Commune	Number of Air and Noise Sensitive Receptors		
			School	Hospital/Health Center	Pagoda/Temple
NR1					
Prey Veng	Peam Ro	Nak Loeung	1	0	0
	Preah Sdach	Kampong Seung	1	0	2
		Lvea	2	1	2
		Krang Svay	1	0	1
	Kampong Trabaek	Kampong Trabaek	2	2	0
		Prasat	3	0	3
		Prey Chhor	1	1	1
Svay Rieng	Svay Chum	Kraol Kou	2	1	0
		Ta Sous	1	0	0
		Svay Chrum	1	1	1
		Chek	2	0	0
		Kuok Pring	0	0	0
	Kampong Rou	Svay Tayaen	0	0	0
	Svay Rieng	Svay Toea	2	1	0
	Svay Teap	Sambour	0	0	0
		Kandieng Reay	1	0	0
		Sang Khoar	0	1	1
		Romeang Thakaol	1	1	1
		Chrak Mtes	0	1	1
		Prey Angkungn	1	1	0
	Bavet	Bati	0	0	0
		Bavet	1	1	1
Sub-total			23	12	14
NR6					
Siem Reap	Siem Reap Town	Tuek Vil	2	1	1
	Puok	Khnat	3	0	1
		Puok	3	1	1
		Lvea	2	0	0
		Sasar Sdam	3	1	1
		Prey Chrouk	2	1	1
	Kralanh	Sranal	2	1	2
		Kralanh	1	1	1
		Kampong Thkov	1	0	0
Sub-total			19	6	8
TOTAL			42	18	22

F. Hydrology and Water Resources

140. The hydrologic setting of Cambodia is dominated by the Mekong River and Tonle Sap Lake system (Figure 13). The Mekong River is among the world's largest rivers in terms of length and average discharge, while Tonle Sap Lake is the largest freshwater lake in Southeast Asia. Tonle Sap, or the Great Lake, is situated in the center of the Cambodian central plain, with an elevation of 10–30 meters above sea level and covering about 6% of the country (MOE, 2009). Tonle Sap has eleven principal tributaries, the largest of which is Stung Sen River which is at the starting point of the project for NR1. The lake is connected to the Mekong River via the Tonle Sap River, and these two rivers meet at the larger Mekong River.

141. During the dry season, the Tonle Sap River flows downstream, i.e. from Tonle Sap Lake to the Mekong. Monsoon floods in the Mekong make the Tonle Sap River to change its direction in May and to flow upstream towards Tonle Sap Lake during the wet season until September or

October. Therefore, the Tonle Sap Lake functions as a natural reservoir, providing storage for the flood waters and regulating floods in the downstream Mekong Delta during the wet season, and contributing to the low flows to the Delta during the dry season.[18]

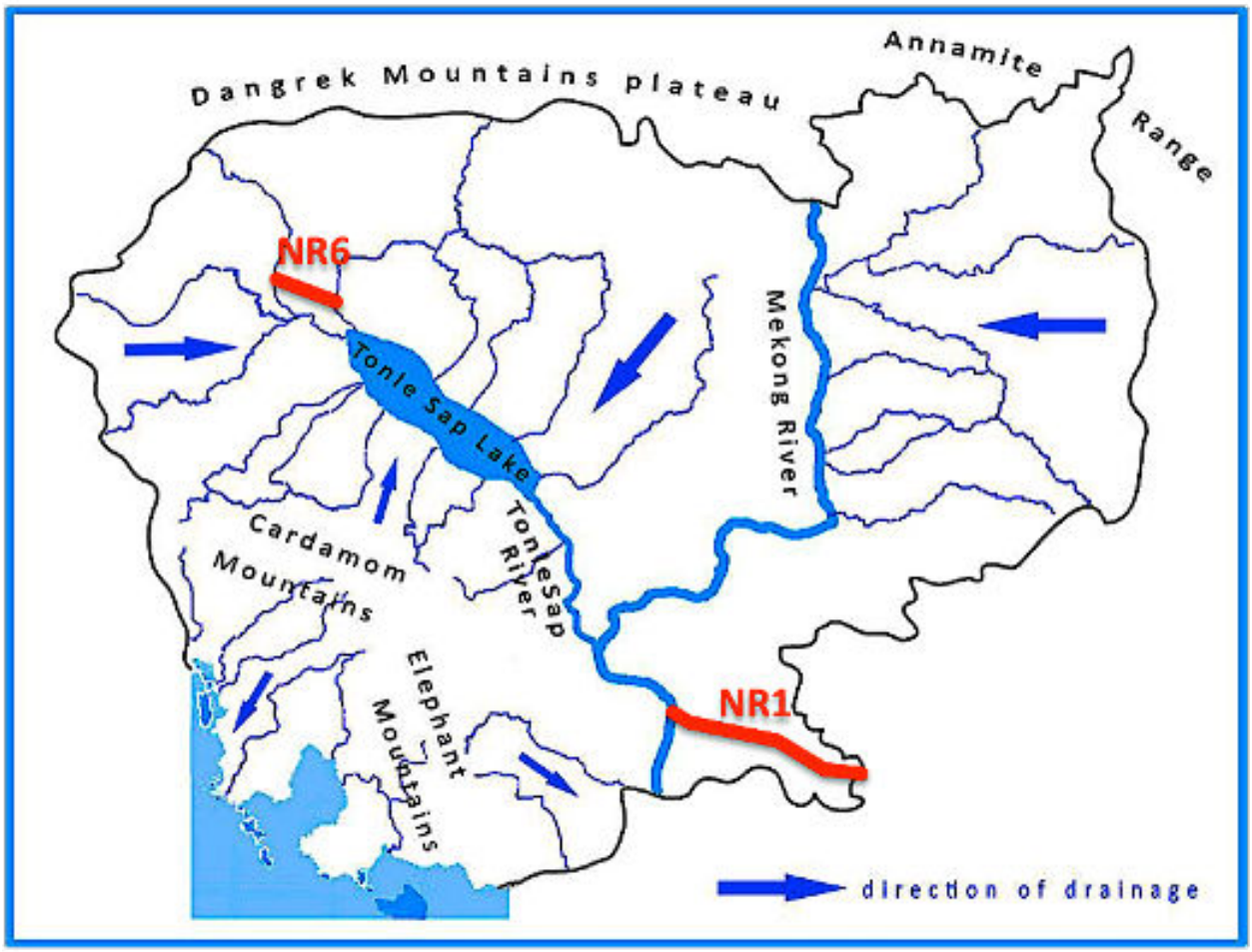


Figure 13: Flow in the Mekong-Tonle Sap Basin
Source: Draft IEE, Second Road Asset Management Project. 2016

142. The Mekong River enters Cambodia from the north from Lao PDR and flows southeast to the border with Viet Nam. The Mekong River in Cambodia is 486 km. The basin of the river and myriad of tributaries covers 86% of total country area. In Phnom Penh, the Mekong River is separated into four sections defined by Upstream-Mekong, Downstream-Mekong, Bassac, and Tonle Sap. The Tonle Sap is uniquely important in Cambodia because of two distinct annual water flow regimes which make the inland lake extremely productive. During the wet season, the inland lake fills with Mekong river water and acts as a major reservoir for fish spawning and growing, and flood control. During the dry season water flows out of the inland lake to provide aquatic habitat in the low Mekong river, and local water supply. Evaporative losses account for 20%–30% of the rainfall occurring in Cambodia.

[18] Kummu et.al. as cited from the report prepared by Egis on Reinforcing Community Flood Resilience. Climate Resilience for Provincial Road Improvement Project. MPWT and ADB. 2014

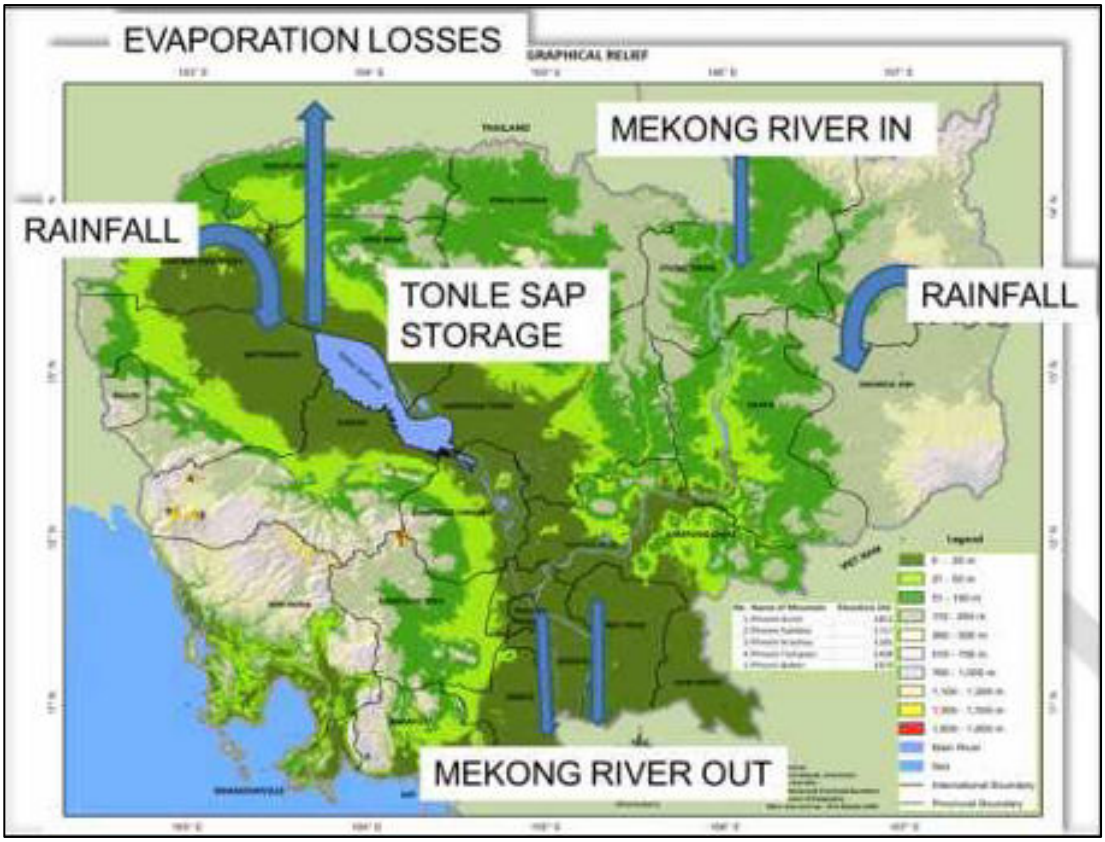


Figure 14: Mass Balance of Water Resources in Cambodia
Source: Draft IEE, Second Road Asset Management Project. 2016

143. **Flooding.** The areas adjacent to the national roads are influenced by the Mekong river. The section of NR1 to be rehabilitated traverses the floodplain of the Mekong River. The extensive network of tributaries (*preak*) and streams are governed by the rise and fall of the Mekong during the annual cycle of rainy and dry season. Along the ROW of NR1 are about 10 rivers and canals, of which 4 rivers are considered as major rivers, namely the (i) Steung Slot River in Nak Loeung commune, Peam Ro district in Prey Veng; (ii) Kampong Trabaek River in Kampong Trabaek District; (iii) Prey Chlor River in the border of Prey Veng and Svay Rieng provinces; and (iv) Vai Kok River in Svay Rieng commune, Svay Rieng town.

144. The section of NR6 to be rehabilitated traverses the northern edge of the flood plain of Tonle Sap, and can be exposed to flash flooding from runoff down from the northern Thai mountains to the bottom of the Tonle Sap basin. In August and September, the whole Tonle Sap catchment receives prolonged heavy rainfall. The Tonle Sap Lake has reached its peaks at elevation 10.34 mean sea level, which is higher than adjacent land. The incidence of local flooding events along the project roads occurs primarily during the rainy season. There are about 17 rivers and canals along the NR6 alignment, of which two are considered as major rivers, namely: (i) Puok River in Puok District and (ii) Sreng River in the border of Siem Reap and Banteay Meanchey province.

145. **Water Quality.** The Ministry of Water Resources & Meteorology (MOWRAM) and the Mekong River Commission (MRC) conduct regular water quality monitoring at designated

sampling points in the Mekong River, Tonle Sap River, and Bassac River. The data indicate that the water quality at the sampling locations is generally good in comparison with the other riparian countries, and the mean chemical composition of samples is lower than the global average, (MRC, 2003). However, water quality data for surface waters crossed and directly affected by the project roads is not well documented. The nearest river for which recent data (2016) exist is Sreng River in Kraluch district, Siem Reap which is a few kilometers west to NR6.

146. **Surface water quality near NR6.** Data collected by the MOWRAM-ADB Water Resources Management project in 2008 at the Sreng River, Kraluch district (Table 9) indicate that the levels of suspended sediment (turbidity) can be high in the Sreng river. This is likely caused by erosion from agricultural lands. The water quality data for the Sreng river are dated (2008) compared to data for Siem Reap river (Table 10), but are considered representative of the current water quality of the river given that the Sreng river basin extending northwest of NR6 is relatively unpopulated without significant industrial development.

Table 9: Water quality in Sreng River, Kraluch District, Siem Reap

No	Parameter	Unit	Result	Government Standard
1	Temperature	^{o}C	32.00	
2	Transparency	meter	0.25	
3	pH		6.65	6.5-8.5
4	Conductivity	µs/cm	53.10	
5	DO	mg/l	6.37	>2
6	Biochemical Oxygen Demand	mg/l	2.43	<30
7	Total Suspended Solids	mg/l	72.67	<50
8	Total Dissolved Solids	mg/l	50.00	<1000
9	Total Phosphorus	mg/l	0.06	0.005-0.5

mg/l = milligram per liter
Source: MOWRAM-Water Resources Management Project, 2008

147. Water quality in Siem Reap River, Siem Reap town in 2016 (Table 10) were obtained from the Ministry of Environment (MOE). The data indicates that suspended sediment, BOD, and nutrient forms of phosphorus and nitrogen can exceed national standards.

Table 10: Water quality in Siem Reap River, Siem Reap Town

No	Parameter	Unit	Result	Government Standard
1	pH		7.62	6.5-8.5
2	Total Suspended Solid	mg/l	44.00	25-100
3	Biochemical Oxygen Demand	mg/l	1.66	1.0-10
4	Chemical Oxygen Demand	mg/l	3.35	8.0
5	Chromium Hexavalent	mg/l	ND	0.05
6	Total Nitrogen	mg/l	0.73	0.1-0.6
7	Total Phosphorus	mg/l	0.11	0.005-0.05

mg/l = milligram per liter.
Source: Ministry of Environment data collected 2016

148. **Surface water quality near NR1.** There is a scarcity of available water quality data in Prey Veng and Svay Rieng provinces near the NR1. However, Prek Trabaek River which is located in Kampong Trabaek district, of Prey Veng province is a close tributary of the Mekong River. The water quality of Prek Trabaek River is comparatively good, and only affected by local agricultural activities (Kampong Trabaek River Flood Control Project, MOWRAM, 2009). The water quality data in the lower Mekong River in 2013 near Neak Luong close to NR1 are found in Table 11. Dissolved oxygen levels are within the water quality standard for rivers.

Table 11: Mekong River Water Quality

Parameter	Unit	Year					
		1985–2012			2013		
		Max	Ave	Max	Max	Ave	Min
Temperature	°C	38	27	13	32.2	27.5	19.9
Conductivity	mS/cm	841	21	1	72	19	8
Total Suspended Solids	mg/l	5716	163	<1	802	96	2
Nitrogen Dioxide	mg/l	1.4	0.23	<0.01	1.08	0.27	0.01
Ammonium	mg/l	3.0	0.05	<0.01	0.53	0.06	<0.01
Total Nitrogen	mg/l	4.9	0.59	<0.01	2.96	0.51	0.01
Total Phosphorus	mg/l	2.1	0.09	<0.01	0.69	0. 41	<0.01
Dissolved oxygen	mg/l	13.9	7.3	2.3	10.6	7.3	4.9
Chemical oxygen demand	mg/l	16.4	2.2	0.0	10.7	2.5	0.2

mg/l = milligrams per liter. mS/s = milli-Siemens per centimetre
Source: MRC, 2014, Annual summary of water quality lower Mekong river

G. Biological Resources and Biodiversity

1. Forests and Vegetation

149. There are no protected areas, natural habitats and fauna and flora of particular conservation significance in the project area of influence of the project roads.

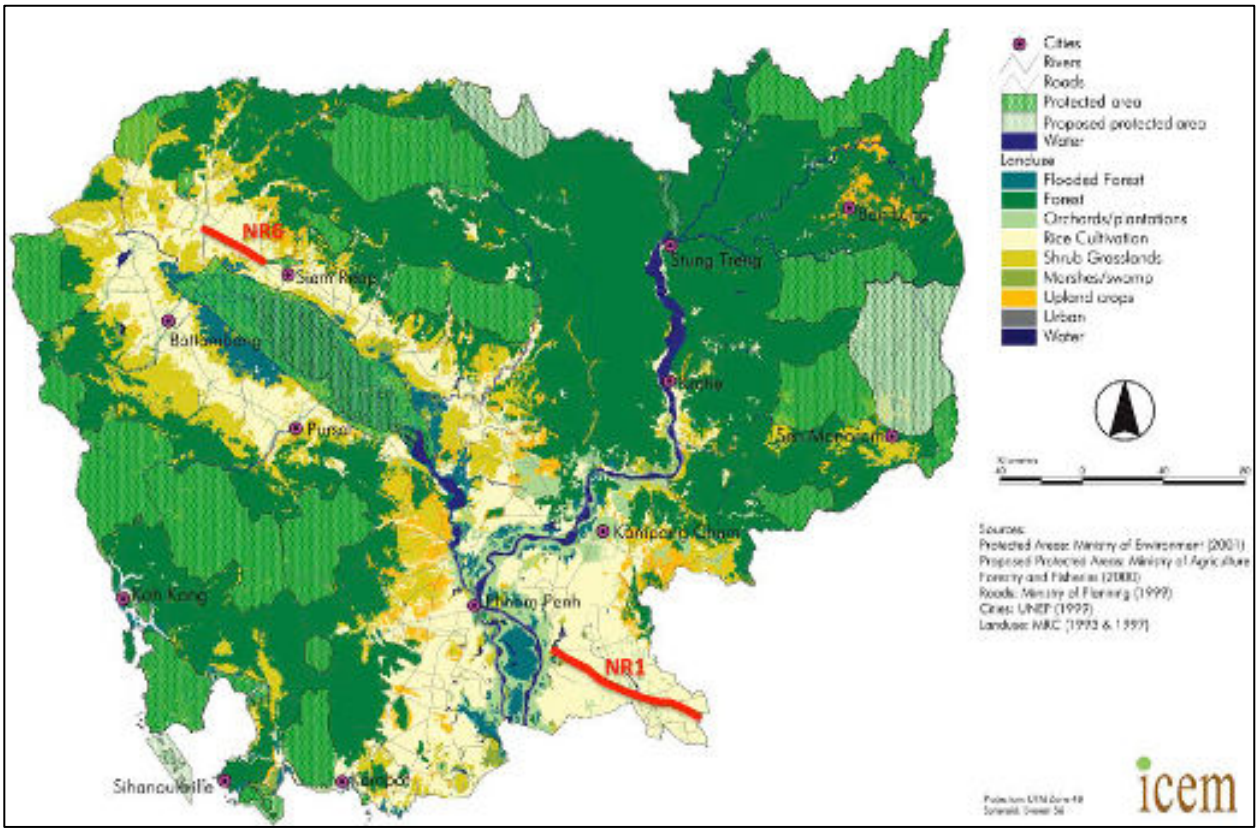


Figure 15. Forest Types of Cambodia
Basemap Source: www.mekong-protected-areas.org (20 January 2017)

150. The land uses within the ROW of the project roads consists of residential land and farm lots. There are no forest land uses in the project areas. NR1 and NR6 will not require widening and will utilize the established ROW. The national roads are situated in areas characterized as disturbed habitats and are not near any protected or forest areas. The land uses along the alignment of the national roads consist of paddy field, cropland, commercial and residential areas. Commercial and business activities are centered at district and provincial towns where major road intersections are located. A Special Economic Zone and a number of hotels can be found along NR1, near the border with Viet Nam. Land uses along the corridor of NR6 are largely rural and agricultural with busy commercial activities at town centers.

NR1

NR6

Figure 16: Typical Vegetation at NR1 and NR6

2. Protected Areas

151. Figure 17 presents the map of protected areas in Cambodia. NR1 in Prey Veng and Svay Rieng provinces is not situated near any protected or forest areas. Due to the lack of forests and extensive agricultural and community development, sensitive wildlife species are not found in the project area of influence. Sections of NR1 are located in areas considered as wetlands due to perennial flooding that occur from the swelling of Mekong River. Most of the

project areas are covered by paddy field, floodplain of Mekong River, farm, and residential areas.

152. NR6 is located in the Transition Zone of the Tonle Sap Biosphere Reserve (Figure 18). The road is about 15 km north of the core areas of the Tonle Sap Biosphere Reserve itself. The Transition Zone is the outer zone of the reserve which covers 899,600 hectares. It is intended to be flexible and allows development in keeping with the needs of the local population. The transition area forms the interface between the Tonle Sap Biosphere Reserve and common land. The southern edge of the Transition Zones forms a boundary with national road NR5. The flexible transition area is the integrated economic zone, which is managed for sustainable agriculture, human settlement and land uses, without having adverse effects on the flooded forest, water quality, and soils of the region around the Tonle Sap Lake.

153. The Tonle Sap Biosphere Reserve has three 'core areas' in Prek Toal, Battambang province, and Boeung Chhma, and Steung Sen in Kampong Thom province. The core areas comprise 21,342 hectares in Preak Toal and 14,560 hectares in Boeung Chhma which is also an internationally recognized wetland under the Ramsar Convention. Both are important breeding and feeding grounds for endangered species of large water birds. Steung Sen spans 6,355 hectares and features trees rare to the flood plain. The Ministry of Environment estimates less than 20,000 people live in or near these areas – about 10,000 in Prek Toal, about 2000 in Boeung Chhma and almost 7,000 in Steung Sen.

Figure 17: Protected areas in Cambodia
Base Map Source: www://data.opendevelopmentmekong.net

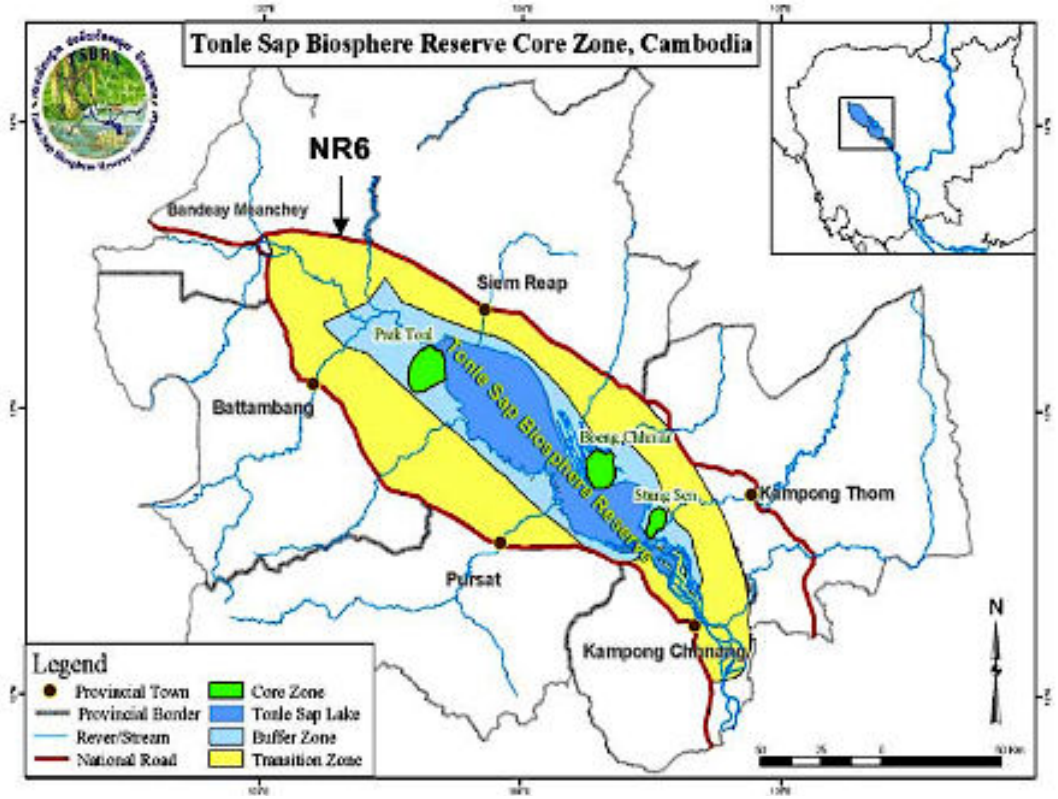


Figure 18: Tonle Sap Biosphere Reserve
Source: Draft IEE, Second Road Asset Management Project. 2016

3. Biodiversity

154. Cambodia has rich biodiversity and the forests, wetlands and other habitats support many species of flora and fauna, including 212 species of mammals, 536 species of birds, 240 reptile species, 850 freshwater and 436 marine fish species and more than 2,300 plants, 800 of these plants are used for the local manufacture of traditional Khmer medicine. The Cardamom Mountains are known to contain almost all the country's known mammals, birds, reptiles and amphibians.

155. A report on a biodiversity survey of the Oddar Meanchey and Siem Reap province northwest Cambodia (Caleb et al. 2016) identifies eight threatened bird species in the region. This includes two critically endangered species, one endangered species, two vulnerable species, and three near-threatened species (IUCN, 2014).[19]

4. Fish Resources

156. Tonle Sap Lake is one of the most productive inland fisheries in the world and reportedly has a potential fish production of 65 kg/hectares/year based on the dry season area estimates (Food and Agriculture Office, 1994). Cambodia‘s inland fisheries are totally dependent on the seasonal flow of the Mekong and other rivers that inundate the floodplains, forest, and shrub-lands. The increase of the area and depth of the Tonle Sap Lake during the wet season from

[19] Draft IEE. Second Road Asset Management Project. 2016

2,500 km^2–3,000 km^2 to 10,000-15,000 km^2 (MOE 2004,) and from 1 m–2 m to 8 m–10 m has an immense effect on the fish production.

157. **Fish Migration.** The important spawning areas for migratory fish are located in the northeast of Cambodia, while the important for spawning and feeding grounds for fish are the floodplains along the Tonle Sap Great Lake and the Mekong Delta, (Cambodia's Inland fisheries, MRC 2004).

158. During the flood period, fish migrate from downstream of Tonle Sap Lake and Mekong River to the floodplain areas of Tonle Sap and Mekong tributaries where pH and oxygen are optimum for spawning, feeding, and growth. When water levels recede at beginning of dry season fish migrate off the floodplain and find refuge in deep pools in along the Mekong River, channels, and streams.

Figure 19: Important bird areas in Cambodia
Base Map Source: https://data.opendevelopmentmekong.net

159. **Fish Species.** There are about 500 fish species found in the Mekong River system in Cambodia, however, the fisheries focus on approximately 10 species (Cambodia's Inland fisheries, MRC 2004). Most of the species are well adapted to the season, widely fluctuating water levels and water chemistry defined by temperature, pH, and dissolved oxygen (MOE, United National Development Program [UNDP, 1999). Some important inland fish species in the Lower Mekong River and floodplain areas of Cambodia are listed in Table 12.

Table 12. Common fishes in Mekong River and flood-plains of Cambodia

Khmer/local name	Species/Scientific name	Family name
Trey Kraiy	Chitala	Notopteridae
Trey Slat	Notopterus notopterus	Notopterrus
Trey Reil	Henicorhynchus siamensis	Cyprinidae
Trey Kros	Osteochilus Microcehalus	Cyprinidae
Trey Chrakang	Puntioplites Proctozysron	Cyprinidae
Trey Chhpen	Hypsibarbus Lagleri	Cyprinidae
Trey Thman	Hampala Macrolepidota	Cyprinidae
Trey Leang	Thynnichthys Thynnoides	Cyprinidae
Trey Khaek	Morulius Chrysophekaion	Cyprinidae
Trey Krom	Osteochilus Melanopleurus	Cyprinidae
Trey Chhkork	Cyclocheilichthys Enoplos	Cyprinidae
Trey Kahei	Barbodes Altus	Cyprinidae
Trey Chan Va	Rasbora Myersi	Cyprinidae
Trey Chanva Moul	Rasbora Aurotaenia	Cyprinidae
Trey Pon Loug	Leptobarbus Hoeveni	Cyprinidae
Trey Khnang Veng	Dangila Lineata	Cyprinidae
Trey Proma	Boesemania Microlepis	Sdaennidae
Trey Phtong	Xenentodon Cancila	Belonidae
Trey Andat Chhke	Euryglossa Orientalis	Soledae
Trey Kampot	Chonerthinos Nefastus	Tetraodontidae
Trey Kass	Micronema Micronema	Siluridae
Trey Sanday	Wallago Attu	Siluridae
Trey Kromorm	Ompok Bimaculatus	Siluridae
Trey Ta Aun	Ompok Hypophthalmus	Siluridae
Trey Kdainhay	Belodontichthys Dinema	Siluridae
Trey Pra	Pagasianodon Hypophthalmus	Pangasiidae
Trey Por	Pangasiys Lamaudiei	Pangasiidae
Trey Chhveat	Pangasiys Pleurotaenia	Pangasiidae
Trey Chhlaing	Mystus Nemurus	Begridae
Trey Kachoch	Mystus Wotffi	Begridae
Trey Chhloch	Macrognathus Siamensis	Mastacembelidae
Trey Khcheng	Mastacembelus Armatus	Mastacembelidae
Trey Kachrouk	Botia Modesta	Cobitidae
Trey Deap/Chhdor	Channa Micropeltes	Channidae
Trey Rous	Channa	Channidae
Trey Andaing	Clarias batrachus	Claridae
Trey Kantrawb	Pristolepis fasciata	Nandidae
Trey Kampheach	Trichogaster Microlepis	Belontiidae
Trey Kanthor	Trichogaster Microlepis	Belontiidae
Trey Kranch	Anabas Testudineus	
Trey Damrey	Oxyeleotris Marmorata	

Sources:Cambodia fish species, 2001 and 2006, FD/MAFF; Cambodia's Inland Fish MRC[20]

H. Socioeconomic Conditions

1. Population

160. Cambodia has a total population of about 15.41 million in 2015, with a population growth rate of 1.79%.[21] The country's population has grown over 0.73 million in just over 2 years, compared to its population in 2013 with 14.68 and 3.16 million households. The rural population of Cambodia accounts for about 80.5% (over 2.5 million households) and 19.50% urban.[22]

[20] Cited from the Draft IEE, Second Road Asset Management Project. 2016

[21] World Economic Forum. Global Gender Gap Index Report 2015.

[22] Cambodia Demographic and Health Survey. 2014. Ministry of Planning. National Institute of Statistics, and Ministry of Health. Phnom Penh, Cambodia.

Average household size in Cambodia is 4.7.[23] The country's annual population growth rate declined to 1.5% from 2010 to 2012 and the average family size ranges from 4.7 to 5.2 persons. The female population in Cambodia was estimated at 51.3% compared to male population from 1998 to 2015.

161. The proportion of the population living in rural areas is about 80.5% and 19.5% in urban areas.[24] The total population in the project areas is 287,455 people, with 54,824 households as of December 2016. The majority of the population is Khmer by ethnicity and less than 1% is Cham (Khmer Islam). There are 276 persons who are Cham (living in the project area within 4 provinces and 107 Vietnamese (residing in the communes of Prey Veng and Svay Rieng). The female-headed households in the project area are 10,201 which accounts for about 18.3% of the total households in the project area.

Table 13. Demographics by Communes/Districts in the Project Area

Road	Province	District	Commune	Population	Number of Households
NR1	Prey Veng	Peam Ro	Neak Loeung	7,830	1,417
		Preah Sdach	Kampong Soeng	8,267	1,478
			Krang Svay	8,903	1,614
			Lvea	8,267	1,472
		Kampong Trabaek	Kampong Trabaek	8,787	1,616
			Prasat	11,894	2,388
			Prey Chhor	8,153	1,469
	Svay Rieng	Svay Chrum	Ta Sous	12,405	2,493
			Chek	10,087	2,126
			Kouk Pring	9,787	1,981
			Kraol Kou	12,600	2,488
			Svay Chrum	5,547	996
		Kampong Rou	Svay Tayean	10,290	1,981
		Svay Rieng Town	Svay Toea	5,422	1,116
		Svay Teap	Kandieng Reay	9,736	1,911
			Romeang Thkaol	6,296	1,302
			Sambuor	8,416	1,740
			Sangkhoar	8,363	1,428
			Chrak Mtes	10,162	2,119
			Prey Angkunh	6,645	1,422
			Bavet	11,961	2,817
			Bati	5,917	1,064
Total (NR1)				195,735	38,438
NR6	Siem Reap	Siem Reap Town	Tuek Vil	11,830	1,991
			Khnat	9,472	1847
			Prey Chruk	9869	1720
			Puok	14768	2520
			Lvea	11319	2006
			Sasar Sdam	13196	2441
			Sranal	9592	1857
			Kralanh	6077	982
			Kampong Thkov	5597	1022
Total (NR6)				91,720	16,386
TOTAL	3	8	31	287,455	54,824

Source: Draft Poverty and Social Assessment for RNIP. 2016

[23] Cambodia Demographic and Health Survey. Cambodia. 2014.
[24] Ibid.

2. Economy

162. Cambodia is considered as one of the countries with fast economic growth, globally. Since 2011, Cambodia's economy has grown by 7.1% per cent, and increased to 7.3% in 2012 and 7.4% in 2013, respectively. In 2015, its gross domestic product (GDP) rate declined to 7.0%. ADB projected that it will be sustained through 2017. Cambodia industrial sector grew by 11.7% in 2015.[25] In 2013, the industrial sector's share of GDP rebounded to around 24%. The average annual growth rate spread over the past 15 years (1998-2013) was estimated at 12.4% compared to 4.7% and 8.5% for the agriculture and the service sector, respectively. The industrial sector is the best performer in terms of achieving the highest growth. In 1993, about 72% of the total labor force was in the agriculture sector as compared only to about 5% in the industrial sector. The growing economy of the country makes it more dependent on improved road network. To sustain trade and movement of goods, all-year reliable and accessible road access is necessary.

3. Poverty Assessment

163. A poverty impact assessment was conducted by the TA consultant. The draft poverty and social assessment (PSA) report indicated that there are almost 3 million poor people and over 8.1 million near-poor in the country, and mostly live in the countryside. Although the country achieved the MDG of halving poverty in 2009 but the vast majority of families who escaped poverty were able to do so by a small margin. The areas of health and sanitation, and education are still considered as development priorities in the country.

164. The draft PSA report added that urban poverty rate in Phnom Penh was 16.3% in 2012 and 14.5% in other urban areas. Rural poverty incidence fell from 24.6% in 2009 to 20% in 2012. The household poverty rate (combined ID poor[26] level 1 and 2) in the 3 project provinces are as follows: Prey Veng (23.6%); Siem Reap (17.7%); and Svay Rieng (17.3%).

4. Livelihood

165. More than 70 percent of the total population is engaged in agriculture dominated primarily on small-holding farmland (FAO 2010). Along with farming rice, households carry out a range of activities such as rearing livestock, harvesting fish and other aquatic animals, and harvesting non-timber forest products. Increasingly, rural households are involved in off-farm employment, with some members migrating to find employment in the larger towns and cities of Cambodia, as well as in neighboring countries (MOE/UNDP, 2011).

166. The communities are primarily engaged in agriculture (27.6%) and selling fruits/vegetables and fish (39%). The agricultural yields after the harvest period comprise the greater share of the household income, which they also use for their daily food consumption. Additional sources of income are livestock/poultry raising (43%) and selling products (40%).[31]

167. Income from vegetables is difficult to assess as a large proportion of vegetable cultivation takes place in home gardens. Vegetables on garden plots are grown inconsistently on plots of often unknown size, makes accurate measurement difficult. Variation in cultivation

[25] ADB. *Asian Development Outlook 2016*. Manila.
[26] Identification of Poor Households Program.
[31] Social and Poverty Assessment Report. Road Network Improvement Project. December 2014.

rates is further aggravated by farmers‟ seasonal dependency on access to water. In the wet season, major vegetable production (greater than 1,000 hectares) takes place in Kampong Cham, Kandal, Kampot, Kampong Thom, Kampong Speu, Takeo, and Battambang. In the dry season the major production areas are Kampong Chhnang, Kandal, Kampong Cham, Siem Reap, Kampong Thom, and Battambang (ADB, 2009).

168. Livestock rearing is a key part of rural livelihoods in the case of larger livestock and sources of income and food with regard to pigs and poultry (Tong, 2009). The farmers keep their animals in traditional scavenging systems as a means of risk management rather than in systems more orientated toward increased production and income, as well as large ruminants (cattle and buffalo) mainly used for drought purposes than for food. The majority the farmers raise local livestock including pigs, chicken and ducks, although small- and medium-scale commercial farms close to households for improving livelihoods and food security. Livestock (cattle, buffalo, and pigs) has great potential, but is largely constrained by limited extension and veterinary services as well as weak marketing channels throughout rural areas. Poor livestock health is a major factor in household income security (MOE/UNDP, 2011).

5. Religion and Ethnicity

169. The largest ethnic group in Cambodia are the Khmer, representing 90% of population. The Cham ethnic group, Vietnamese and Chinese account for the remaining 10%. Indigenous Cambodians are divided into the following races: Phnong, Kouy, Stieng, Mil, Kroal, Thmorn, Khaonh, Tompuonn, Charay, Kroeung, Kavet, Saouch, Lun, Kachak, and Praov and other groups consisting of Khmer, Islamic, Vietnamese, and Lao. The ethnic groups at NR1 and NR6 are composed of Khmer, Cham, and Vietnamese.

6. Tourism

170. Siem Reap is a major national tourism destination in Cambodia due to the international renowned attraction of Angkor Wat and Tonle Sap Lake. The visitor numbers to Siem Reap has been increasing in recent years. In 2004, the number of visitors to Siem Reap was 858,245, the comprising 560,897 is foreign tourists and 297,348 is domestic tourists (MPWT, 2005).

171. Cambodia tourism is expected to grow at around 15% annually in the medium term and in keeping with these trends tourism in Siem Reap is also expected to continue to increase. The predicted annual growth rate and day trip tourism from 2009 to 2020 is provided in Table 14.

Table 14. Number of Tourists (Annual and Day Trip)

No	Year	Annual Tourists	Daily Tourists
1	2009	894,011	3,649
2	2012	1,544,850	6,306
3	2015	2,669,501	10,896
4	2020	6,642,572	27,113

Source: Study report on the Siem Reap Sewerage System and Improvement of Siem Reap River, 2008[32]

I. Physical Cultural Resources

[32] Cited from the Draft IEE, Second Road Asset Management Project. 2016

172. Siem Reap province is one of the rich archaeological and cultural heritage areas in Cambodia. Well-known cultural heritage sites are the Royal Palace in Siem Reap town and the Prasat Bakong temple. There are some temples located on the north of NR6 such as: Angkor Touch, Angkor Thom, Bakheng, and Bantey Srei temple. The Angkor Temple Area is of major cultural heritage significance as reflected in its World Heritage Listing. Discussions with commune authorities indicated the absence of any sensitive archaeological and cultural resources near NR1 area except for pagodas along the alignment.

J. Greenhouse Gas Emissions

173. Cambodia is highly vulnerable to the impacts of climate change due to its high dependency on climate-sensitive sectors such as agriculture, water resources, forestry, fisheries and tourism. These sectors form the critical foundation of the country's economic growth and support the livelihoods of a great majority of its population. Increase in temperature is likely to affect agricultural productivity with rice grain yield decline of 10% for each 1°C increase in growing season according to the International Rice Research Institute. The Mekong Adaptation and Resilience to Climate Change demonstrated that rainfall will get higher in the provinces of higher elevation during the wet season, but will get drier during the dry season, which could hamper the production of coffee and rubber in Cambodia. The 435 km coastline of Cambodia is vulnerable to sea-level rises and the severe impacts of more frequent typhoons under future climate projections which could affect tourism and cause coastal erosion. Climate-related flooding is also projected to increase in its frequency and intensity especially in the central plains.

174. GHG emissions in Cambodia are currently low compared to regional and global averages. According to the Second National Communication under the United Nations Framework Convention on Climate Change, Cambodia emitted 47.6 million tons of carbon dioxide equivalent in 2000 but the forestry sector absorbed 48 million tons of carbon dioxide equivalent.[33] Energy consumption was highest in the transport sector, followed by electricity production, residential and the industrial sectors in the same period. The Ministry of Environment projects GHG emissions from the transport sector to increase from 785 Gigagrams CO_2 ($GgCO_2$) equivalent in 2000 to 11,376 $GgCO_2$ by 2050, representing a 27% increase annually.[34] Based on statistics from the MPWT, the total number of vehicles registered in 2009, including motorcycles, cars, vans, buses, and small and big trucks was 307,000, with a 19% annual growth rate.[35]

175. In 1996, the Royal Government of Cambodia ratified the United Nations Framework Convention on Climate Change and participated with the international community in the effort to address climate-related issues. Recognizing that climate change has critical implication on poverty and the people, especially rural households who depend strongly on natural resources, the CCCSP was formulated based on the analysis of institutional capacity, observed climate change impacts, and climate change projections. The CCCSP has identified eight strategic objectives:

[33] Cambodia Climate Change Strategic Plan 2014–2023. p. 9.
[34] Cambodia Climate Change Strategic Plan 2014–2023. p. 7.
[35] Cambodia Climate Change Strategic Plan 2014–2023.

(i) Promote climate resilience through improving food, water and energy security;
(ii) Reduce sectoral, regional, gender vulnerability and health risks to climate change impacts;
(iii) Ensure climate resilience of critical ecosystems (Tonle Sap Lake, Mekong river, coastal ecosystems, highlands, etc.), biodiversity, protected areas, and cultural heritage sites;
(iv) Promote low-carbon planning and technologies to support sustainable development;
(v) Improve capacities, knowledge and awareness for climate change responses;
(vi) Promote adaptive social protection and participatory approaches in reducing loss and damage due to climate change;
(vii) Strengthen institutions and coordination frameworks for national climate change response; and
(viii) Strengthen collaboration and active participation in regional and global climate change processes.

176. To address flooding implications on infrastructure, the National Strategic Development Plan has identified the following response measures:

(i) The road structure needs strengthening, especially rural roads so that floods do not affect the movement of people and transportation of foods and
(ii) Additional dikes and drainage systems should be constructed in vulnerable areas to control excessive overflow of water from swollen rivers and creeks.

177. Strategies have been identified in the CCCSP for the transport sector. Among the tasks spearheaded by the MPWT are:

(i) Improve petroleum-based fuel;
(ii) Promote capital-intensive urban transport infrastructure development and planning;
(iii) Enhance inspection and maintenance of vehicles;
(iv) Promote public transport in major cities;
(v) Efficient and proven transport technology for mitigation and low-carbon development;
(vi) Promote efficient driving;
(vii) Raise public awareness about climate change caused by GHG emissions from the transport sector; and
(viii) Shift long-distance freight movement from truck to train.

K. Current Situation of Materials Testing Laboratories

178. Based on information provided by the TA consultants, all the materials testing laboratory will be located at existing DPWT compounds/office premises. Figure 20 presents the photos of the laboratory sites.

179. The CBPWL is located in Khan Resey Keo which is about 8 km away from the MPWT head office in Phnom Penh. The existing laboratory is in a two storey building with an approximate floor area of about 1,600 m^2, of which about 350 m^2 is dedicated to the laboratory space and the rest for office and administrative spaces. According to the TA, the existing CBPWL will be upgraded to a fully functional construction materials testing laboratory until a newly proposed national laboratory becomes functional. Works will be confined to the refurbishing of the laboratory space and installation of the advanced test equipment for the CBPWL.

180. The proposed main laboratory will be in Pursat Province, covering an area of about 800 m^2 for the laboratory and another 300 m^2 for the warehouse. The site is geographically centered at 12°32'25" latitude and 103°54'52" longitude. The regional laboratories will be in Kratie, Siem Reap, and Kampot and would require about 400 m^2 of space inside the DPWT premises. All the regional laboratory locations are within the DPWT compounds and would require construction works for the laboratory facilities.

Central Building and Public Works Laboratory in Phnom Penh

DPWT compound in Pursat

Area reserved for the national laboratory in Pursat

Figure 20: Photographs of the sites of the materials testing laboratory sites in Phnom Penh and Pursat

L. Unexploded Ordnance

181. While unexploded ordnance from the aerial bombing campaigns of the 1960s and 1970s lies predominantly in the eastern and southern Provinces, north-western Cambodia has the heaviest concentration of ordnance, particularly minefields. The Cambodian Mine Action Centre (CMAC) estimates that there may be as many as four to six million mines and other pieces of UXO still in place around Cambodia.

182. Land mines or other unexploded ordnance are widespread particularly in the rural areas of the eastern and northern provinces where the project roads are located. While the two national roads that have been long established and frequently maintained, the risk of unexploded ordnance while low, may still exist.

183. There is only limited evidence of deployment in the areas of the roads under study in Prey Veng, Svay Rieng and in Siem Reap Provinces. However, it is recommended that at the detailed design stage, desk studies be undertaken to confirm previous research and any clearance operations completed, particularly at road side where drains and ditches will be excavated. This should be followed by field investigations by the appropriate authorities if found to be justified.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

184. The rehabilitation of the roads will result in positive impacts and benefits for the community and the economy. The improvement of the road surfaces and assets at NR1 and NR6 will support expected increased national and international traffic from Viet Nam and Thailand. The project is also expected to reduce chronic flooding of some road sections and excessive flooding of fields that are adjacent to the alignments.

185. **Improved transport and movement.** Based on the historical traffic volume data (2010-2015), traffic growth on NR1 by category indicates annual growths of 6.8% for motorcycles; 6.1% for cars; 9.8% for buses; and 15.8% for goods vehicles in the past 5 years. The traffic growth rate for NR6 in 2010-2015 was 6.6% for motorcycles; 6.5% for cars; 5.4% for buses; and 23.8% for goods vehicles. In comparison, Cambodia has observed a national growth in vehicle registration in the past 10 years of approximately 14.3%. According to vehicle category, the annual growth is 14.8% for motorcycles; 11.1% for cars; 11.2% for buses; and 12.0% for goods vehicles.

186. With the proposed widening of narrow roads and improvement of pavement condition, the journeys along the road alignments will be smoother and more efficient. This will result in reductions in fuel consumption as well as maintenance costs of vehicles. These factors er reduce freight transport operating costs and consumer costs.

187. **Contribution to economy.** Better road transport services will entice more economic investors to put up their business in the provinces/districts covered by the project. There are two planned and two operating industrial parks in the four project provinces. Improved transportation will benefit the industries through lower input costs. There will also be improved profitability that will facilitate improved capacity to generate new employment opportunities. For agricultural production, the mode of transportation and time required has significant implications on the cost of transporting goods. Longer transportation times by road would mean that roads freight costs are higher and that there are constraints on produce which are susceptible to spoilage.

188. **Better access to schools and hospitals.** With improved road condition, travel time will be faster, shorter, and more convenient. People will also have better access to schools, hospitals and health centers.

189. **Poverty alleviation.** Poor farming households are expected to benefit directly from lower input costs as well as higher prices for farm produce. This would be realized through a combination of improved and more accessible road transportation as well as improved market access. Poor farming households are likely to benefit from diversification of agriculture with opportunities for more profitable crops and increase of non-farm income sources. It is also possible for local people to establish shops to sell their products along the roads to local and foreign tourists.

190. **Employment opportunities from the project.** During road construction and maintenance, employment opportunities will be created for unskilled men and women. The jobs created by the project are aside from the employment opportunities that will result from more economic investments in the locality.

191. **Reduce chronic flooding and improve climate resilience.** Cambodia is highly vulnerable to climate change. Risks to roads of climate change include the following:

- damage to roads, tunnels and drainage system due to flooding
  - increase in scouring of roads, bridges and support structures
  - damage due to landslide and mudslide
  - loss of structural integrity of roads due to increase in soil moisture levels
  - temperature impacts on asphalt paving materials and expansion joints.

192. The national development plan has identified climate adaptation response measures for the transport sector that includes strengthening of road infrastructures, particularly rural roads so that floods do not affect the movement of people and transportation of goods. In addition, dikes and drainage systems are necessary in flood vulnerable areas to control excessive overflow of water from flooded rivers and creeks.

193. As part of the project design, climate change adaptation measures will be integrated into design of road embankments and roadside ditches, less moisture susceptible materials will be specified and bio-engineering measures used to improve water conservation and water retention capacity characteristics of the catchment area to reduce flooding impacts. In parallel road elevations and drainage capacity will be increased, design parameters for culverts and bridges will be evaluated during the design to determine if changes are needed.

194. **Improve road safety.** The project will include a community-based awareness and education program on road safety to raise awareness of the beneficiary communities. Through the information education campaign materials, workshops and meetings on road traffic law and enforcement, the community will become better involved and informed about regulations on road safety. Traffic safety and warning signs will also help avoid traffic accidents.

195. **Reduced GHG emissions.** The project economic analysis calculated carbon emissions from 2017 to 2035 for the national roads using the Highway Development Maintenance 4 (HDM-4)[38] software. The emissions model of HDM-4 estimates the quantities of pollutants produced as a function of road characteristics, traffic volume / congestion, vehicle technology, and fuel consumption. The analytical framework is based on the concept of pavement life cycle analysis which considers factors such as road deterioration, road work effects, road user effects, and socio-economic and environmental effects.

Table 15 presents the annual carbon dioxide emissions over ten years of operation (2021-2030) from the two national roads with and without the proposed road rehabilitation and improvement works. It is assumed that vehicle fuel consumption is reduced as road surface will be less rough and journeys will be smoother and more efficient after maintenance works. Baseline emissions (without the project) from 2021-2030 would total approximately 2,906,278 tonnes CO_2. With the project, the CO_2 emissions will be reduced by 45,687 tonnes CO_2 per year. The NR1 and NR6, with a length of 147 km were estimated to emit 453,112 tonnes in total in year 2030, resulting to 3,087 tonnes CO_2/km.

[38] The HDM-4 was produced by the International Study of Highway Development and Management tools (ISOHDM), with assistance of the World Bank, the Asian Development Bank, the Department of International Development (UK), the Swedish National Road Administration, and other sponsors.

Table 15: Annual Carbon Dioxide Emission from Motor Vehicles Traveling on the Project Roads (tonnes CO_2)

Project Road	Baseline (2021-2030)	With Project (2021-2030)	Net Emission Reduction
NR1	2,004,643	1,985,136	19,508
NR6	901,635	875,456	26,179
Total	**2,906,278**	**2,860,592**	**45,687**

196. Although, not considered to make a significant contribution, the plans to set up regional materials testing laboratories would reduce material transport distance and associated emissions. Efforts will also be made to reduce the greenhouse gas emissions of the project during design, construction and operation through adoption of resource (energy, water materials) efficient specifications and measures.

B. Impacts and Mitigation Measures during Pre-construction Phase

197. The assessment of potential impacts of the rehabilitation of the project roads is structured by the three development phases: (i) pre-construction; (ii) construction; and (iii) operational in order to distinguish the important impact periods of rehabilitation of the roads, and to prevent redundancy in the assessment and reporting. This assessment structure is used to structure the EMPs prepared for the project.

1. Land Acquisition

198. **Predicted Impacts.** The existing carriageways and ROW of NR1 and NR6 will not be widened and the alignment will not change. However, there will be short-term disruption to business and some domestic activities during the maintenance, rehabilitation and installation of new drains. Potential negative impacts of the project to properties are limited to breakage of concrete pavement and the temporary removal of wooden platforms in front of shops in Khum Prasaut, Prevy Veng Province. There are also a small number of roof extensions over shops that will be affected. The anticipated impacts to private properties and business/shops are temporary and any damage to structures would be restored and replaced by the contractor.

199. **Mitigation Measures.** Any structure that will be damaged during the course of the construction activities will be restored as part of contractor works. To allow business activities to continue during the construction works, safe access to shops and properties will be provided by the contractor. In addition, drain installation will be undertaken on a section-by-section basis to enable works to be completed in a short timeframe and to minimize disturbances to business and normal activities of communities on the road side.

2. Setting up of Construction Staging Areas

200. **Predicted Impacts.** Construction staging areas for the workers' camps, asphalt/concrete mixing stations and pre-casting yards, and spoil disposal sites will be set up by the project contractors. These construction staging areas will be temporarily set up during the construction phase. The spoil materials generated from subgrade removal/replacement will also require temporary land, usually on the roadsides. The contractor should see to it that sites for the temporary facilities will avoid farmland and that all temporary sites are restored or vegetated upon completion of the construction activities.

201. In addition to temporary land acquisition for the construction staging areas, the setting up and operations of construction camps will have direct but short-term impacts on land use, pollution, and worker and community health and safety. The occupation of land will have an indirect impact on and temporary change in land use. This impact will have low magnitude since it will be of short duration and will affect a limited land area.

202. Worker accommodation and camps will generate wastewater from toilets, bathrooms and kitchen. Solid waste from the camp is another source of pollution and health hazard. Workers may also be at risk from malaria and dengue, unsanitary camp conditions, lack of clean water and sanitary facilities.

203. **Mitigation Measures.** Developed or cleared private land should be preferred for construction camps. This will eliminate the need for clearing. Camps should not be located on productive lands, at or near sensitive habitats.

204. Pollution prevention in construction camps will require the proper management of wastes by the contractor. This should include provision of septic tanks for wastewater effluents from toilets, bathroom and kitchen. The grey water from the septic tank should be disposed in a leaching field. Discharge of wastewater into sewer or water body should conform with the standards set by the Sub-Decree on Water Pollution Control No. 27 ANRK.BK.

205. Proper solid waste management should likewise be implemented. Waste bins for segregating waste should be provided within the camp with regular collection schedule. Waste should be segregated with recyclables sold to recyclers; organic wastes composted and non-recyclable wastes disposed in authorized disposal facilities. Hazardous substances such as used oil, empty paint and chemical containers, busted lamps and spills from refueling and storage of oils will be segregated from the regular garbage and should be disposed through an authorized hazardous waste disposal facility. Oil spills and drips should be collected through an oil pit in the refueling and oil storage area.

206. Protection of health and safety of workers in the camp is part of the contractors obligation. The contractor should provide safe, suitable and comfortable accommodation, kitchen, dining and sanitary facilities (toilet and bath); ample supply of clean water; first aid supplies and personal protected equipment for workers. Camp surroundings should be kept clean to prevent breeding of insect vectors. A trained health and safety officer should be designated by the contractor to ensure the proper implementation of the environment, health and safety programs and induction and training of the workforce during the construction phase.

207. For security and to maintain order in the camp and to avoid social conflicts with the local community, camp rules should be established and effectively disseminated to the workforce. These camp rules should address health, safety and security of workers and compliance with the EMP. The house rules and prohibitions should include:

- Entry to camp is limited only to workers residing in the camp
- Curfew time should be imposed
- No consumption of alcoholic drinks and illegal drugs in camp and worksite
- No gambling in the camp and work site
- Workers are prohibited from collecting firewood and/or wildlife, i.e. no hunting and fishing
- Workers are prohibited from keeping wildlife pets
- Weapons, guns and bladed weapons are not allowed in camp and worksite.

208. The contractor should conduct training and orientation on environmental protection, grievance redress mechanism, Government's environmental regulations and requirements, ADB requirements, hygiene, health, first aid, safety and security. The training program should be defined in the CEMP. The CEMP to be prepared by the contractor should present a detailed plan of the construction camp including the layout, the sanitary facilities, septic tank, drainage, access road, fuel storage, equipment yard and spill kits.

209. The contractor should secure permits from the landowner, local government and other relevant agencies. All permits should be submitted with the CEMP to the MPWT by the contractor prior to start of any construction activities.

210. **Updating of the EMP.** The EMP for the national roads will need to be updated following completion of detailed design to ensure any changes are understood and addressed. The EMP specifies the requirements of the contractor EMPs (CEMPS, see below) which contractors are required to develop from the updated EMP to include with their bid documents. The CEMPs contain the mitigation plans and monitoring requirements that are specific to the construction packages they implement. This includes location of project facilities such as construction camps, batching plants, disposal sites, and sensitive receptors. The EMP and CEMPs are a dynamic document that may be subject to change as needed during implementation.

211. Updating the EMP involves finalization of the mitigation plans to manage potential impact areas such as erosion, sedimentation of surface waters, noise, dust and air quality, spoil disposal, traffic, and worker and public safety at the project sites. Other issues that should be covered in the updated EMP and CEMPs include:

(i) Completion of detailed designs and updated EMPs of the road upgrades;
(ii) Provision of adequate drainage in the technical design including for spoil disposal sites to prevent soil erosion;
(iii) Recycling and reuse of existing asphalt pavement for rehabilitation of road sections;
(iv) Reuse of earth cut materials for backfilling and embankment to minimize volume of borrow materials;
(v) Design climate adaptation measures that includes climate resilience-related adjustments to civil works through (i) design of road embankments and roadside ditches which are susceptible to erosion; (ii) using less moisture susceptible materials or hydraulically-stabilized materials usually with cement or lime within the road structure so that structural layers do not lose significant strength upon flooding and soaking; and (iii) by using green engineering or bio-engineering to improve the water conservation and water retention capacity characteristics of the watershed to minimize flooding and to divert runoff water away from the road;
(vi) Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross;
(vii) A cultural chance find management plan must be in place for cultural artifacts and property;
(viii) Regular use of wetting agents must be employed along all sections of the roads that are undergoing civil works to minimize dust;
(ix) Trees and other vegetation along road shoulder should be protected during installation of drains. Tree removal must be minimized. All trees removed by permit must be replaced with 3 three trees for each tree removed;
(x) All construction vehicles and equipment should be maintained in proper working order, and not operated at night if possible to minimize noise;

(xi) Speed limits should be posted and adhered to by construction vehicles, and the public;
(xii) Where possible construction vehicles should use different access roads or dedicated temporary lanes to access construction areas to minimize interference with road use by the public;
(xiii) Berms and/or silt curtains should be constructed around all excavation/trench sites and along all surface waters to prevent soil erosion and surface water sedimentation;
(xiv) Local workers should be used as much as possible to prevent or minimize influx of migrant workers, and incidence of social disease and community unrest;
(xv) The temporary worker camps must have adequate domestic waste collection facilities and sufficient portable container toilets or pit latrines if necessary that are located away from public areas and surface waters. A formal clean-up and site restoration plan must be in place for all sites for both temporary sanitation systems;
(xvi) Dedicated bunded fuel storage areas must be established away from public areas and surface waters and marked clearly;
(xvii) To minimize the impact of the road construction works on the public and workers the recent Cambodia Occupational, Health, and Safety (OHS) Programme guidelines developed for Cambodia by the International Labour Organization (ILO) should be followed. Additionally, the World Bank (IFC) Environment, Health, and Safety (EHS) Guidelines (2007) should be followed to supplement the OHS if necessary. The OHS (2009-2013) identifies the need for work place programs for occupational safety and health measures to protect workers in all vocations including the specific Convention 167 for worker safety and health for construction activities. The ILO-derived OHS provides guidance and support for the development of existing directives such as the Labour Law of 1997 which specifies Health and Safety of Workers (Articles 228-247) existing and emerging work place safety. In addition to environmental protection, the IFC-EHS Guideline for *Toll Roads* provides specific measures to protect workers and the public during construction of roads such as during excavation activities, for overhead work hazards, managing construction traffic and pedestrian safety, and hazardous materials;
(xviii) Aggregates (e.g., sand, gravel, rock) that are transported by truck must be covered;
(xix) Prolonged use of temporary storage piles along the roads should be avoided, or covered, or wetted regularly to prevent dust and erosion;
(xx) Sand extraction from adjacent streams and rivers should not occur, or only occur from DoE-licensed areas; and
(xxi) Bulk fuel should be stored and covered on 6” pads made of concrete, not on bare ground concrete pads away from the public and worker camp. Fuel storage areas and tanks must be clearly marked, protected with fencing, and lighted, and should be at least 100 m away from the public and worker camps. Contractors should be required to have an emergency plan to handle fuel and oil spillage.

3. Hiring of Workers

212. **Predicted Impacts.** The hiring of workers from outside the local area can create social conflicts. Local communities may: (i) feel aggrieved for not having been employed in the construction; (ii) resent having outsiders within the community; (iii) view the workers as

competitors for local resources like food and water; and (iv) as having a disregard for local traditions and practices.

213. **Mitigation Measures.** Local communities should be given preference during hiring of unskilled labor. This will minimize the number of workers to be housed in the camp and will help avoid social conflicts between workers and local communities.

214. The contractor should coordinate the hiring of workers with the village officials. But it is recognized that due to the rural characteristic of the project corridors, there could be scarcity of skilled labor workers in the villages/communes within the project corridor. To give locals the opportunity to be hired, the contractor should conduct a construction worker's orientation and training.

215. The contractor should maintain communication and good relations with the local community so that complaints or grievance are immediately brought to the attention of the contractor and attended to within the shortest time possible through the grievance redress mechanism.

216. The contractor should comply with the provisions of the Labor Code on Child Labor which states among others that 15 years old is the minimum age for full time employment in non-hazardous type of work. In addition, the contractor shall not use trafficked labor.

4. Materials Sources, Borrow Pits and Quarries

217. **Predicted Impacts.** Quarrying can have long term and permanent adverse impacts such as visual impairment (scarring), change in topography, consumption of resources, change in land use, increased susceptibility to erosion and siltation and alteration of natural drainage patterns.

218. Direct impact of borrow pits is clearance of vegetation, loss of soil resources and change in landform with indirect impacts of visual impairment, increased risk of erosion and siltation, threats to public safety, health hazards as accumulated water can serve as a breeding ground for insect vectors.

219. Chance discovery of archaeologically significant items or sites might occur during excavation of quarries or borrow pits.

220. **Mitigation Measures.** Commercial quarry operators are present in some of the provinces traversed by the roads. The selection of the aggregate material supplier should consider the legitimacy of the operations, i.e. licensed operator. Should the contractor opt to operate its own aggregate plant, reopening abandoned quarry sites should be preferred over opening new quarry site. For new areas, the contractor should avoid sites near water bodies and ecologically sensitive areas and aggregate plant should be located at least 500 m from settlements.

221. The contractor should include in the CEMP a material balance estimate for cut and fill material requirements and identify possible sources for fill materials and disposal sites for spoils. Only authorized or permitted sources of fill materials or quarries should be used as sources of these materials. In the event that a new quarry would be needed for fill materials, the contractor should submit a quarry development plan to the project implementation consultant together with the CEMP. It is also the responsibility of the contractor to secure mining/quarry

permits and comply with applicable Government regulations on waste (solid, liquid, and hazardous) management. The English translation of all permits should be incorporated in the CEMP and submitted no later than one month before cut and fill operations start.

C. Impacts and Mitigation Measures during Construction Phase

222. MPWT, February 2008, listed the priority environmental management concerns during the construction and periodic maintenance of national roads in the Environmental and Social Safeguards Policies of the Cambodia RAMP. The policies were developed with support from the World Bank, ADB, and the Australian Agency for International Development. Among these were:

- Resurfacing of pavements and associated pavement works and repair and surfacing of shoulders;
- Transport of materials;
- Materials stockpiling on shoulders;
- Borrow areas;
- Worksite installation (if needed); and
- Road safety and traffic management.

223. The potential environmental impacts of the rehabilitation and improvement of the national roads will be primarily from construction phase disturbances. Common impacts of the civil works along the roads will include reduced and/or blocked public access to areas, noise and dust caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, community and occupational health and safety risks, increased traffic congestion and traffic accidents, habitat disturbance, encroachment and damage from construction machinery, soil erosion and sedimentation of adjacent rice paddy and streams and rivers that are traversed by the roads. Localized drainage and flooding problems can also arise. Solid waste and domestic pollution from temporary worker camps can occur, as well as potential communicable disease and local community problems caused by migrant workers. These short-term impacts and disturbances will occur at different levels of magnitude depending on the civil works activity and the road section site.

224. The corresponding impacts and mitigating measures are discussed in the sections that follow as well as incorporated in the EMP.

1. Clearing and Grubbing

225. **Predicted Impacts.** The clearing and grubbing shall consist of clearing the designated areas of trees, vegetation, rubbish, and objectionable material on the roadside where new drains will be installed. This activity shall include grubbing stumps and roots and reusing or disposing of all material resulting from the clearing or grubbing activities. It shall also include the demolition, removal and disposal of structures that obtrude into or encroach upon or obstruct the work, except where provided for otherwise.

226. Direct impacts associated with clearing and grubbing have low magnitude considering the limited area that will need clearing as well as very short duration of the works. The adverse impacts that can be relatively significant are the possible damage to adjoining structures, properties, community facilities and utilities (water line, power line, access) and unnecessary removal of trees and vegetation.

227. The clearing and grubbing will generate vegetation wastes from the removal of trees and other plants within the working areas. These organic wastes have to be disposed properly.

228. Since clearing and grubbing will utilize heavy equipment, their operation may create nuisance in terms of noise and also pose hazards to the public.

229. **Mitigation Measures.** Clearing work should be preceded by survey and staking out of the area to avoid damaging trees and structures outside the construction corridor. Coordination with the local government and land owner should be carried out and all necessary permits shall be secured prior to works.

230. Organic waste materials from the clearing and grubbing shall be composted while large stumps may be disposed at suitable locations that are permitted by the local authority having jurisdiction over the area through which the road is being constructed.

231. In populated areas, the operation of heavy equipment shall be limited to 0600H to 1800H. Advance notice should be given to the community and warning signs and barriers used as appropriate.

232. In case of chance discovery of culturally important items, the contractor should follow the procedure for reporting as prescribed by the Law on Protection of Cultural Heritage, NS/RKM/0196/26. Upon discovery, the contractor should stop work, secure the site, report the find immediately to the engineer and PMU who in turn shall be responsible for reporting to the authorities.

2. Earthworks

233. **Predicted Impacts.** There will be associated earthworks that will occur from the placement of subsurface materials in the rehabilitation and repair of the national roads. Earthworks will consist of (i) excavation of roadway to remove unsuitable materials; (ii) channel excavation for drainage; (iii) construction of embankment; and (iv) placement of subgrade materials. The earthworks activities will involve the use of heavy equipment as well as dump trucks for the transport and delivery of materials.

234. The direct impacts will include generation of noise and emissions from heavy equipment, dust from excavation and bare areas, soil erosion and run-off from cut slopes, encroachment and damage to adjacent areas and transport of materials.

235. The clearing and excavation will generate spoils that include top soil, unsuitable material and stripped bitumen. The disposal of spoil materials requires additional land take and conversion, re-use should be optimized. The contractor should present in the CEMP an estimate of materials to be excavated, the volume that can be reused and the volume to be disposed of, as well as the disposal location.

236. The earthworks will require the closure of road lanes and possibly diversion of traffic which can result in travel delays. The rehabilitation of the national roads could require closure of lanes while allowing traffic to flow on the remaining road lane. In populated areas, the activities can disrupt economic activities, including shops and stores fronting the road, it will also expose pedestrians and motorists to construction hazards.

237. Stockpiling of materials on the shoulder can pose hazards to traffic and pedestrians, affect nearby water bodies, obstruct drainage and ditches and affect trees along the roadside. All these impacts are temporary in nature and will only persist during the construction stage. The magnitude of the impact depends on the length of the road section that will be worked on, duration of the works and the presence of human settlements and ecologically sensitive receptors in the construction corridor.

238. **Mitigation Measures.** With respect to management of excavated materials, the contractor should deposit these materials in a way that it will not damage the road, utilities services and properties and will not impair drainage. Additionally, stockpiling of materials on the shoulder shall be avoided, but if necessary, the contractor should find a location that will minimize hazards to traffic and pedestrians; a site away from water bodies and drainage channels; and remove the materials within the shortest possible time. The locations where materials stockpiling on shoulders will occur should be appropriately chosen and should be well away from any waterways, irrigation or washing/drinking water supplies. Stockpiling on carriageway should also be avoided. Requirements for height, grade and management of stockpiles should be specified.

239. The contractor shall also minimize the need for permanent disposal sites by using the spoils as fill materials, as top soil for the sodding of the embankment slopes, filling up of abandoned borrow pits. If disposal is unavoidable, non-productive lands away from water bodies should be preferred with the permission from the landowner, local community and local government.

240. To mitigate noise impacts and emissions, the construction equipment is to be fitted with noise mufflers and maintained regularly. In addition, timing of earthworks in populated sections should be limited during daytime hours, i.e. 0600H to 1800H.

241. Dust suppression should be carried out in populated areas by watering the road at least twice a day on unpaved areas, haul roads and exposed dust-prone stockpiles. Frequency of water spraying should be increased during windy conditions. Designated haulage routes should be used. Control of dust during transport of spoils and aggregate materials should include fitting of all dump trucks with tailboard and load should be covered for trips that will go through populated areas. Speed limits of less than 8 km per hour should be imposed for project vehicles travelling over unpaved roads in populated areas.

242. Traffic management during construction work especially where lane closure is required should include warning signs, directional signs and barriers and the assignment of signal men at both ends of the work sites. Alternate diversion routes should be provided, if possible. The contractor will be required to employ safe traffic measures and to limit possible disruption to non-construction traffic.

3. Materials Sources, Borrow Areas, and Crushing Plant

243. The borrow materials may be obtained by widening cuts, widening ditches or by excavating from other sources outside the planned cross section within the right-of-way or slope easements and within the limits of the project, with the expressed approval by the engineer.

244. All areas being worked shall be drained and kept drained. The contractor shall confine his operations solely to the areas provided or acquired by the contractor and shall demarcate the boundary of the area and erect temporary or permanent fencing; where the height of any

face exceeds 1 meter, the contractor shall provide, erect, and maintain at its own expense fencing and gates to prevent unauthorized access to the top of the working face. On completion of work, all faces shall be neatly trimmed to a slope flatter than 1 in 4. Where this is impracticable or where the working face is to be left exposed, the edge shall be permanently fenced.

245. The access roads to borrow areas must be maintained in good condition by the contractor and restored to its original state after completion. Additionally, upon completion of work, temporary fences and all temporary structures shall be demolished and removed and the site cleaned and topsoiled.

246. If borrow site will be used as dam, water reservoir, fish pond for use by local area, ensure that this complied with local requirements and with the engineer's approval.

247. The contractor should comply with the prescribed procedure for chance discovery of culturally important sites or items.

4. Impeded access to schools, temples, houses and commercial establishments

248. Community activities will be disrupted because of temporary closure of access to schools, temples, houses, and commercial establishments. The contractor should inform the residents, establishments and shop owners of the work schedule to allow them to make the necessary preparations. Contractor should provide safe passageway through the work sites into the schools, temples, houses and commercial areas during the construction period. Safe passageways for pedestrians and students should be provided by the Contractor.

249. For public safety, the project will include a community-based awareness and education program on road safety to raise awareness of road safety of the beneficiary communities. An information and education communications campaign will be implemented which will involve preparation of information education campaign materials, analysis of target communities along the project roads. Workshops and meetings on road traffic law and community-based enforcement will be undertaken engaging parents, elders, respected persons, monks and relevant government agencies at provincial, district and commune levels. The project will also assist the target province, district and commune authorities to allow them to implement the community-based awareness and enforcement programs for long term sustainability.

5. Aggregate and Bituminous Works

250. **Predicted Impacts.** The bituminous treatment of roadways will entail the application of prime coat, application of bitumen and/or bitumen emulsion spray and placement of aggregate base material, followed by rolling. As part of this work phase, the contractor will need a bitumen storage facility where bitumen will be temporarily stored and loaded into the bitumen tankers for application on the roads.

251. For roadworks, the activity will occur over a short duration (i.e. paving rate of 100 m per day under ideal condition). The overall magnitude of the impacts of this activity is rated to be low. Heavy equipment will include an asphalt distributor for applying the asphalt emulsion aggregate pre-coating and loading unit, aggregate spreader, roller, and road brooms. The equipment are all mobile units. Fumes from the application of asphalt emulsion will be present and may cause health hazards.

252. Dust and odor may occur during the spreading of bitumen but these activities occur over a very short duration. Pollution of water bodies near the road may happen if it rains before the prime coat dries. In this case, the runoff from the road would be tainted by asphalt emulsion. This threat can be easily managed by postponing prime coat application if rain is forecast.

253. The road lane being paved will be closed to traffic while one lane will remain open to traffic during rehabilitation of sections of the national roads. This can cause travel delays and traffic build-up in busy sections of the roads. Also, the paving will cause temporary inconvenience to pedestrians and expose the public to traffic and construction-related hazards.

254. The bitumen storage, handling and transport will also generate impacts. The storage of bitumen will pose fire hazards and pollution threats due to spillage of bitumen and solvents used for cleaning the bitumen sprayer. Spillage during handling may also occur. Improper disposal of solvents used for cleaning the bitumen distributor may also result in pollution.

255. **Mitigation Measures.** To minimize dust and odor nuisance, aggregate and bitumen spreading will not be carried out during times of day where there are many people on the road such as when children are on their way to and from school or during market day. Dust suppression by water will be carried out as necessary during application of aggregates. Mitigation for traffic impacts and public safety during aggregate and bitumen works are identical to the mitigation measures for earthworks previously presented.

256. Bitumen storage areas should be located not closer than 500 m from settlements and should not be allowed in sensitive areas such as water courses and flood prone areas. The bituminous materials storage areas and heating station shall be kept neat and tidy. The storage area shall be cleared of vegetation and where bituminous material is stored in drums these shall be stacked on their sides and only in small quantities with gaps between each stack to reduce fire risk.

257. The contractor shall take all measures necessary to prevent the spillage of extraneous bitumen on or adjacent to the site. Workers handling bituminous materials should be provided with appropriate personal protective equipment. Any bitumen spillages on the site shall be removed and disposed of by means approved by the engineer.

6. Construction of Concrete Structures

258. **Predicted Impacts.** This work shall consist of the construction of all or portions of structured Portland cement concrete, of the required class or classes, with or without reinforcement, and with or without admixture. The predicted impacts of this construction activity include: (i) generation of waste wooden formworks; (ii) waste cement packaging materials (for concrete mixed on site); (iii) disposal of excess concrete from transit mixers and disposal of wash water from transit mixers. The concrete mix and the wash water from transit mixers is highly alkaline and can cause pollution if disposed indiscriminately and without treatment. These impacts, however, can be effectively mitigated due to the relatively limited requirements for concrete materials.

259. **Mitigation Measures.** Waste formworks should be collected from the work site and disposed in approved disposal sites or given away to the community for use as firewood. The waste cement packaging materials have to be gathered and temporarily stored in an enclosed storage prior to disposal to prevent the cement packaging materials from getting windblown, to

protect from rain and to avoid leaching of residual cement materials. This could be sold to recyclers or disposed in approved disposal areas. There shall be no burning of wastes.

260. As for the disposal of excess concrete material and transit mixer wash water, these are to be returned to the cement batching plant site for appropriate reuse, treatment or disposal. There shall be no disposal of transit mixer wash water into water bodies, canals or sewer. Disposal should comply with the sub-decree on water pollution control No. 27 ANRK.BK 1999 wherein all discharges of liquid wastes including transit mixer washing should meet the allowable standard of less than 50 mg/l for suspended solids, less than 5 NTU[40] of turbidity, and pH levels within 6–9.

7. Drainage and Slope Protection Works

261. **Predicted Impacts.** This construction activity will entail the installation of drainage reinforced concrete pipes, cleaning of existing drainage systems, installation of gabions for slope protection, top soiling and sodding. These activities are generally not expected to have significant adverse impacts since the volume of these works are relatively small and will be implemented on a section-by-section basis. However, some inconvenience and temporary disturbances may be experienced in populated areas. The excavation will impede access to houses and establishments and present a community and occupational safety risk. However, this work will be limited and will have minimal impact.

262. The cleaning of drainage will generate soil and debris that needs to be disposed. The expected volume of cleared material is also expected to be minimal and can easily be spread on the slopes or disposed as fill materials. However, the drainage work will have the potential to induce siltation by exposing loose excavated soil particularly when earthworks are done during the rainy season.

263. **Mitigation Measures.** For work in populated sections of the road, the contractor needs to give notice to affected communities well in advance of the scheduled work. Excavations should be demarcated with barriers and warning signs installed. The work areas have to be kept tidy for safety of the pedestrians and the contractor should provide foot paths across excavations to allow people to cross safely.

264. Drainage works should be done during the dry season and drainage channels should be cleaned after completion to prevent siltation. Water flow should not be completely blocked and soil materials should be prevented from getting into the water channels during construction.

8. Ancillary Works

265. **Predicted Impacts.** The ancillary works will involve mostly the installation of markers and guide posts, road signs, and road markings. These activities are not expected to generate any major direct environmental impact. However, this may expose road users and the workers to traffic hazard as workers will be working the carriageway and shoulders will be fully operational.

266. **Mitigation Measures.** For traffic safety, the contractor should install warning signs at the approach of the work site. If necessary, barriers should be installed to separate the workers

[40] NTU = nephelometric turbidity unit

from the road traffic. Workers should wear high visibility vests. Warning signs and safety barriers should be visible at night.

9. Construction of Laboratories

267. The national and regional laboratories for construction materials testing will be located within existing compounds of DPWT and MPWT, therefore, will not require land acquisition. The buildings will only require a small land area of about 350 m^2. Impacts that may be generated during the construction of the laboratories are on dust, noise, generation of solid wastes and construction spoils, and temporary disturbance to normal working condition at the DPWT and MPWT offices. There may also be concerns about security because of the presence of workers in the compound.

268. To mitigate these construction impacts, the contractor of the laboratory buildings will be required to implement an environmental management plan that includes measures to control dust emission, limit noise during working hours, proper management of solid wastes and construction spoils, and ensure appropriate site management and behavior of the workforce in the compound.

D. Impacts and Mitigation Measures during Operational Phase

1. Maintenance Works

269. **Predicted Impacts.** Activities include routine patrol, safety management, traffic count, recording, pavement maintenance, signs and safety and lighting repair, clearing of drainage, trimming of vegetation, and bridge maintenance. The activities are to be undertaken to maintain the service level of the roads and enhance safe travel. Works to be undertaken during the maintenance of roads are routine and are not expected to generate significant environmental impacts. The concerns during the maintenance work will include localized soil erosion problems affecting streams or other water bodies, inappropriate disposal of solid waste materials, lack of controls of noise and dust which can create nuisance for individuals and communities, traffic and safety of the workers. When drains are maintained, there may also be some vegetation and sediments that need to be removed from the canals or culverts to improve flow of water.

270. **Mitigation Measures.** Measures to avoid or minimize impacts during road maintenance are similar to controls done for road construction activity. For traffic safety, the contractor should install warning signs at the approach of the work site. If necessary, barriers should be installed to separate the workers from the road traffic. Workers should wear high visibility vest. Works should be confined to daylight hours.

2. Emergency Repair Works

271. **Predicted Impacts.** This will entail repair of road and drainage damages due to flooding and/or landslide. It may entail the use of heavy equipment depending on the scale of the repair that needs to be done. Emergency repair work may necessitate the closure or partial closure of the road or diversion of traffic to alternate routes. In the case of major damage and in the absence of alternate route, temporary closure of road until the completion of repair may occur. Also, work may have to be done during nighttime hours. In all cases, the indirect impacts are traffic safety and occupational and public safety.

272. **Mitigation Measures.** For traffic safety, the contractor should install warning signs at the approaches of the work site, provide alternate route as possible. If necessary, barriers should be installed. Workers should wear personal protective equipment including high visibility vests. Work sites should be illuminated for nighttime works and if partially completed. Road closures should be announced to make the public aware and to allow the people to adjust their travel plans accordingly.

E. Induced and Cumulative Impacts

273. Potential induced spatial and temporal cumulative impacts of the rehabilitated national roads would result from the increased traffic, and targeted regional economic development. The increase in national and international traffic on the roads and into the adjacent countryside will potentially result in an increase in consumption of local natural resources, and pollution and greenhouse gas emissions from regional socioeconomic development in the three regions serviced by the roads.

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Legislative Framework for Consultation, Participation and Information Disclosure

274. Based on the Declaration of General Guideline for Development of IEE and full EIA report of the Ministry of Environment (2009), public participation is required for all stakeholders concerned with the development of a project including ministries/institutions, local authorities, relevant departments, project owners, consulting companies, representatives of affected people and non-governmental organizations in the project areas.

275. The Ministry of Environment, following a request from the public, shall provide information on its activities, and shall encourage public participation in environmental protection and natural resource management (Article 16, Law on Environmental Protection and Natural Resources Management, MOE, 1996). The public consultation and participation process is conducted during the project preparation stage or during the conduct of environmental assessment or preparation of the EMP. This will involve the following activities:

- Gathering information on environmental and socio-economic issues related to the project sites;
- Clarify issues and the negative and positive impacts of the proposed project;
- Discussing recommendations from the stakeholders, relevant government agencies and local authorities and communities to minimize the impact on the natural and social environment at all stages the project activities; and
- Getting suggestions to ensure that the natural resources will be used in a sustainable manner for the local community and that the impact can be mitigated, especially in improving the living condition on the local residents. clarify issues and predict the negative and positive impacts.

276. The ADB Safeguard Policy Statement requires meaningful participation, consultation and information disclosure. ADB Public Communications Policy: Disclosure and Exchange of Information (2011) requires the borrower to provide information about the project to affected people in a timely manner, in an accessible place, and in a form and language understandable to the people. The ADB Environment Policy mandates the procedural requirements for effective public consultation and information disclosure in the environmental assessment process. The EMP should include a plan for public consultation activities during the finalization and implementation of the EMP.

B. Information Disclosure

277. The stakeholder consultation strategy developed for the project preparation embodies the principles of meaningful engagement, transparency, participation, and inclusiveness to ensure that affected and marginalized groups such as women and the poor were given equal opportunities to participate in the design of the project, in accordance with the requirements ADB's Safeguard Policy Statement.

278. The approach to stakeholder consultation for environmental concerns or issues with the road rehabilitation project consisted of the following avenues of inquiry and data collection:

- As part of the household and village leader interviews conducted by the social development team; and

- Individual interviews conducted by the TA during site visits and meetings with commune authorities, provincial and national environmental management agencies.

279. The main objectives of the consultations are:

- Provide information on the project, its location, and activities
- Conduct social surveys of the project site.
- Meetings with village heads, commune authorities and representatives from local communities about the project, environmental issues in the locality and receive feedback and comments about the road projects.
- Discuss the planned public consultation meetings for the proposed road projects.
- Learn potential issues and concerns from stakeholders as inputs in the development of mitigation measures.

1. Identification of Stakeholders

280. Stakeholder consultations were conducted during the TA for the national roads under the Second RAMP. The consultations for the national roads were conducted in affected communes in the provinces of Prey Veng and Svay Rieng for NR1 and Siem Reap for NR6. Three consultation meetings were conducted for NR1 for the communes of Kampong Trabaek, Kampong Soeng, Krang Svay, Svay Chrum, Ta Suos, Kraol Kou, Prey Angkuogn, Chrak Mtes, and Kandieng Reay. These communes are located in the districts/towns of Kampong Trabaek, Preah Sdach, Svay Chrum, Svay Teap, and Bavet. Two consultation meetings were conducted in the districts of Puok and Kralanh in Siem Reap province for NR6.

281. The stakeholders in these consultation meetings were identified by commune chiefs/commune authorities and TA national consultants during field visits and discussions with commune chiefs or commune councils. Participants included the following:

- Village and commune authorities along the road project sites;
- Communities living near the roads who will benefit from the project and who have an interest in identifying measures to enhance or maximize the benefits;
- Communities living near the roads who may be directly or indirectly affected/impacted or who will likely experience adverse impacts;
- Vulnerable and/or marginalized groups who have an interest in the identification and implementation of measures that support and promote their involvement and participation in the road projects.

282. The participants of the public consultations are listed in Appendix F. The meeting locations and number of participants are presented in Table 16.

Table 16: Details of Public Consultation Meetings for the National Roads

Date	Meeting Location	Participants
NR1		
11 October 2016	Kampong Trabaek commune, Kampong Trabaek district, Prey Veng province	22 participants from: Kampong Trabaek commune Kampong Soeng commune Krang Svay commune, Preah Sdach district
11 October 2016	Svay Chrum commune, Svay Chrum district, Svay Rieng province	25 participants from: Svay Chrum commune Ta Suos commune Kraol Kou commune
12 October 2016	Prey Angkougn commune, Bavet town, Svay Rieng province	25 participants from: Prey Angkuogn commune Chrak Mtes commune Kandieng Reay commune, Svay Teap district
NR6		
14 October 2016	Lvea commune, Puok district, Siem Reap province	30 participants from: Lvea commune Puok commune Sasar Sdam commune
14 October 2016	Sranal commune, Kralanh district, Siem Reap province	26 participants from: Sranal commune Kralanh commune Kampong Thkov commune, Kralanh district Prey Chruk commune, Puok district

2. Discussion Guide

283. The proposed road improvement project in the particular district was presented to orient the participants on the location and components of the project. Open-ended questions and information requests were posed to guide the discussions with the stakeholders, as follows:

(i) What will be the benefits of the road rehabilitation?
(ii) Do you have any environmental or social concerns with the road rehabilitation?
(iii) Do you have any environmental concerns with the construction activities of the road rehabilitation? If any, please identify these environmental concerns of the construction phase activities.
(iv) Do you have environmental concerns with the completed operation phase of the rehabilitated road? If any, please identify these environmental concerns of the operation of the completed rehabilitated road.
(v) Do you think the project design or operation should be changed to prevent negative environmental or community impacts? If any, please identify changes to road upgrades that you think will prevent or reduce negative environmental or community impacts.
(vi) What are the climate change conditions or issues in the community?

284. To further orient the discussions on environmental issues and concerns of the project, a list of environmental components (Table 17) were introduced to the stakeholders ahead of the question and answer period. The stakeholders were encouraged to add their own components of environment to the discussions.

Table 17: Environmental Components Used to Guide Stakeholder Discussions

- drinking water quality and availability
- surface water quality and quantity
- groundwater quality and quantity
- air quality
- climate
- land and soil quality
- rivers, reservoirs,
- trees, other vegetation,
- terrestrial and aquatic animals, e.g., fish, birds, small mammals
- ecological protected areas (e.g., national parks, wildlife sanctuaries),
- land uses (e.g., agriculture, fisheries, forestry, navigation, aquaculture, commercial, other),
- public safety
- public movement and access
- physical cultural values (e.g., pagodas, cemeteries, monuments)

C. Consultation and Participation for the National Roads

285. The results of the public consultations on the rehabilitation of NR1 and NR6 are summarized in Tables 18 and 19. In general, the stakeholders consulted for the national roads were notably supportive of the planned road rehabilitation. Participants voiced recognition of the previous road works and seemed to understand and accept the short-term construction disturbances such as noise and dust, and that compensation would be minimal following compensation received for the much more significant impacts and disturbances caused when the roads were widened during the last 10 years. The responses of commune participants for NR1 and NR6 consultations are documented and summarized in Tables 18 and 19.

Table 18: Results of public consultations for NR1

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[41]
Kampong Trabaek commune 11 October 2016	The impact from noise and vibration is considered small and short during construction, and hopefully not an issue, but in market and urban areas dust & noise should be managed. -Along ROW dust is minimal and a temporary issue during construction for few small businesses (shops) in market. People know of ROW and were compensated from last road widening. -There are no forest and protected areas located near the road. -Should study hydrology in this area and provide culvert/bridge in Tuol Roka village to manage flash flood. -In 2000, a big flood occurred in this area. The flood level at NR1 in some sections was from 0.1 m–0. 2m. The flood occurred in September to October.	Project will collaborate with local authorities and agencies to study and design crossed culvert or bridge. Will consider water flow levels and required structures in rehabilitation design
Kampong Soeng Commune 11 October 2016	-Noise and vibration are not issues (very minimal). -Dust is an issue during construction. -There are a few shops, cottages and small house on the ROW, but they know and they will move out during construction with no compensation (IRC compensated ready). -Increased traffic and traffic accidents should be managed after construction. Accidents happen at Kampong Soeng Market. -Provide traffic safety signs on sensitive areas (market, Prek Chhik Pagoda). -Provide suitable culvert or bridge in Prey Khla village to reduce flash flood up to downstream The existing culvert is small.	Project will inform and collaborate with local authorities and communities on type, and location of potential impacts before construction starts. Managing increased traffic during and after construction is part of the design including signage and speed limits. Improved drainage is part of road rehabilitation design
Krang Svay Commune 11 October 2016	-We are happy and support this project. -There are no significant impacts from noise, vibration, and dust (air). -The few crops, cottages, and structures located in ROW are not issues, because they know, and had agreement with commune authority that they will move out when needed.	The project will conduct hydrological assessment as part of the rehabilitation design.

[41] A representative of PMU-3 or design engineer was not able to attend consultations. The responses were made by the TA consultants.

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[41]
	-Study road in Krang Svay section, where project can build culvert or bridge to reduce run-off from upstream.	
Svay Chrum Commune 11 October 2016	-Noise and vibration are not issues. -Air pollution from dust only during construction is small. -There are a few houses and structures in the ROW that will be impacted. -Small and temporary affect to a few small businesses (shops) in market, but the people know about the ROW and the IRC compensated the people already. -Post-construction issues are as follows: -Increased road traffic accidents on the improved road -Increased number of vehicles on the road. -Increased overloaded trucks will impact road structures. -Widening of road in market will reduce traffic jams. -Provide culvert in Trabaek village to reduce flood from upstream villages. -Provide drainage along the road on the markets and urban areas.	anaging increased traffic during and after construction is part of the design including signage and speed limits. Enforcement of truck load limits and placement of road side truck scales is part of design. Improved surface and lateral drainage with culverts is part of road rehabilitation design
Ta Suos Commune 11 October 2016	-We are happy and support this project. -There are no significant impacts from noise, vibration, and dust (air). -There are no protected areas or forests located near the road. -The same as Svay Chrum commune regarding shops, houses, and structures along ROW which have agreement with government. -In front of Svay Chrum Pagoda near the market is location for traffic accidents. Will road rehabilitation reduce accident there? -Some existing culverts are too small and can't manage water during flooded time. -Post-construction traffic volume and accidents will increase.	Improved surface and lateral drainage with culverts is part of road rehabilitation design Managing increased traffic during and after construction is part of the design including signage and speed limits.
Kraol Kou Commune 11 October 2016	-We are happy and support this project. The road is very important for our people. -The noise, vibration, and air (dust) are small impacts during construction	Managing increased traffic during and after construction is part of the design including signage and speed limits.

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[41]
	stage. -There are no anticipated adverse impacts related to water pollution (surface and ground). -There were no concerns with the right of way because the local authorities (commune and village) were informed about the law on right of way. -Traffic speeds should be considered due to insufficient speed limit signs. -Hydrological study in this area is needed and the box and pipe culverts along road need to be improved.	Improved surface and lateral drainage with culverts is part of road rehabilitation design
Prey Angkuogn Commune 12 October 2016	-Construction noise, and vibration should be managed in market areas. -Dust is a small issue during construction stage. -Road construction will not impact surface water quality. -There a few houses and structures located on the ROW that should be consulted before construction to collaborate with local authorities and to identify social impacts (houses, shops, and structures are on the ROW) for mitigation plan design. -The removal of houses, shops, and structures without compensation was addressed by IRC during the previous project, thus is not an issue for this project. -The village area is higher than national road. There are issues on run-off or during flash flood, so the project should build drainage on both side of road in market and urban areas. -Hydrological study to improve culverts or bridges for water flow during flood.	The construction impacts of noise, dust, and erosion to surface waters will be prevented or minimized with mitigation measures. - Local communities will be contacted to inform people about project plan. - Will report to project designing team about the culverts and drainage system. The project will conduct hydrological assessment as part of the rehabilitation design.
Chrak Mtes Commune 12 October 2016	-Same as Prey Angkuong Commune, only small construction stage impacts on noise, vibration, air (dust) are expected. -. -There are no forests and sensitive resources located near NR1. -The impacts will be small on a few shops, houses, and business structures area located on the ROW in Chiphou Market. -There will be an increase in traffic volume and road accidents during and after construction. Provide safety traffic signs on sensitive locations.	Project will inform and collaborate with local authorities and communities on type, and location of potential impacts before construction starts. Managing increased traffic during and after construction is part of the design including signage and speed limits. Improved surface and lateral drainage

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[41]
	-Collaborate with local authorities to reduce negative impacts. -Build or improve drainages along the road and road culverts /drainage crossings for water flood from upstream to downstream. A large flood occurred in 2006.	with culverts is part of road rehabilitation design
Kandieng Reay Commune 12 October 2016	-We need a good road and we support this project. -Small impacts during construction stage such as noise, air from dust, and water quality. -Small impacts from noise and air pollution (dust) to communities in urban and market areas. There are no sensitive ecological resources that will be affected. -About 60 families have business shops in ROW. -Lack of drainage for water flow in market and urban areas exists. -After construction phase, increased traffic volume can increase accidents. -Provide or improve water flow structures (crossed road) for reducing flood from the upstream villages.	The construction impacts of noise, dust, and erosion to surface waters will be prevented or minimized with mitigation measures. The project will conduct hydrological assessment. Compensation will be made for short-term disturbances to businesses. Managing increased traffic during and after construction is part of the design including signage, and speed limits. Improved surface and lateral drainage with culverts is part of road rehabilitation design.

IRC = interministerial resettlement committee; m = meter; ROW – right-of-way.

Table 19: Summary of public consultations for NR6

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[42]	Response of EMP
Lvea Commune 14 October 2016	-Expected noise and vibration during road construction is not considered an issue. -Small impact of air pollution (dust) will occur on road-side communities. -There are no protected or sensitive resources located near the NR6. -A few houses and business shops are located on the ROW but the small impacts do not need compensation	Project will inform and collaborate with local authorities and communities, on type, and location of potential impacts before construction starts. The slope of connections to intersecting rural roads will be re-designed to be lower and improved.	Noise, vibration, traffic, and dust mitigation measures during construction phase are included in EMP, and will be applied at all construction areas. MOE standards for ambient air quality will be met: a) road watering will be applied, as well as covering all excavate piles and aggregate

[42] The Project Management Office (PMO) or design engineer did not attend consultations

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[42]	Response of EMP
	because the IRC compensated affected persons during the last road project. -The dissemination of right of way was conducted by local authority and it is not allowed to build a temporary building on the right of way. -The NR6 is elevated, so project should improve or reduce slope from NR6 to intersecting rural roads in important locations such as village, school, and hospitals. -Build or improve drainage along road in urban and market areas to reduce flash flood.	Improved surface and lateral drainage with culverts is part of road rehabilitation design.	b) Equipment is required to be serviced and maintained in good working condition.
Puok Commune 14 October 2016	-The negative impacts from project are the same views obtained from Lvea Commune concerning noise vibration and air pollution. The stakeholders said that these are normal for road construction. -Traffic jams on construction sections of NR6 will increase especially in Puok Market. -The few small houses and shops located on the ROW are not big issues because authorities will order to move out before construction starts. -In wet season, floods occur in Puok Village. Request to have gentle slope at the access roads to NR6. -Spray water on roads during construction to prevent dust. -Add more side drains, more box and pipe culvert to avoid flood along the NR6. -Build or improve drainage system along the national road in markets or urban area. -Improve or reduce slope from NR6 to intersecting rural roads in important locations (e.g., villages, school, and hospitals)	Managing increased traffic during and after construction is part of the design including signage, and speed limits. Improved surface and lateral drainage with culverts is part of road rehabilitation design The construction impacts of noise, dust, and erosion to surface waters will be prevented or minimized with mitigation measures. The slope of connections to intersecting rural roads will be re-designed to be lower and improved.	Noise, vibration, traffic, and dust mitigation measures during construction phase are included in EMP, and will be applied at all construction areas. MOE standards for ambient air quality will be met: a) road watering will be applied, as well as covering all excavate piles and aggregate b) equipment is required to be serviced and maintained in good working condition. Traffic mitigation management and safety plan implemented during & after construction

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[42]	Response of EMP
Sasar Sdam and, Prey Chruk Commune 14 October 2016	-We support project and agree with ideas from Lvea and Puok Communes concerning impacts from noise, vibration, and air pollution (dust) which will be small and occur only during construction sections and period. -There are no protected areas or sensitive resources located near the NR6 (no impact). -There are a few small houses and shops located on the ROW, but they have no adverse issues. They will move out before construction starts without compensation because IRC compensated for last project in 2005-2006. -Build proper cross road culvert to reduce flash flood in Prey Chruk Village, Prey Chruk Commune. -Impacts on local traffic flow in construction zones. -Provide or improve drainage along the road in market and urban areas to allow water flow during wet season.	Managing increased traffic during and after construction is part of the design including signage and speed limits. The project will conduct hydrological assessment. Improved surface and lateral drainage with culverts is part of road rehailitation design	Noise, vibration, traffic, and dust mitigation measures during construction phase are included in EMP, and will be applied at all construction areas. MOE standards for ambient air quality will be met: a) road watering will be applied, as well as covering all excavate piles and aggregate b) equipment is required to be serviced and maintained in good working condition. Traffic mitigation management and safety plan implemented during and after construction
Sranal Commune 14 October 2016	-No problem for noise, vibration and air pollution (dust). There are very small impacts in this area during construction. -There are a few cottages and shops located in the ROW. We will inform our communities to move out without compensation. -Water flow structures and drainage in Sranal Commune are not issues. -Traffic accidents occur in commune area which could increase when the road improvement is completed. -Provide drainage system along the road in urban and market areas. -From 2007. NR6 did not experience flood. The flooding occurred in village areas and rice fields in 2011, 2013 and 2016.	The project will conduct hydrological assessment. Improved surface and lateral drainage with culverts is part of road rehabilitation design	Noise, vibration, traffic, and dust mitigation measures during construction phase are included in EMP, and will be applied at all construction areas. MOE standards for ambient air quality will be met: a) road watering will be applied, as well as covering all excavate piles and aggregate b) equipment is required to be serviced and maintained in good working condition. Traffic mitigation management and safety plan implemented during and after construction
Kralanh and Kampong Thkov Commune	-We agree with ideas and comments from Sranal Commune concerning impacts of project on environmental and	The construction impacts of noise, dust, and erosion to	Noise, vibration, traffic, and

Consultation Meeting/Commune	Issue or Concern Identified or Comments and Requests	Response of Project[42]	Response of EMP
14 October 2016	social resources such as: -Small impacts of noise, vibration, and air (dust). -Small issues on social resources (shops, houses, and structures) are located in ROW of NR6. -Potential effect on traffic flow on construction section after construction. Traffic and traffic speed will increase, and cause more traffic accidents near schools, market, & urban areas. -Provide more crossing road culverts in Kampong Thkov Village, Kampong Thkov Commune to reduce flood from upstream villages. -Provide or improve drainage along the road in urban and market sections. -Request to have gentle or reduce slope from NR6 to intersecting roads to village, school, and hospital.	surface waters will be prevented or minimized with mitigation measures. Managing increased traffic during and after construction is part of the design including signage and speed limits. Improved surface and lateral drainage with culverts is part of road rehabilitation design The slope of connections to intersecting rural roads will be re-designed to be lower and improved.	dust mitigation measures during construction phase are included in EMP, and will be applied at all construction areas. MOE standards for ambient air quality will be met: a) road watering will be applied, as well as covering all excavate piles and aggregate b) equipment is required to be serviced and maintained in good working condition. Traffic mitigation management and safety plan implemented during and after construction

EMP = environmental management plan; IRC = interministerial resettlement committee; MOE = Ministry of Environment; NR = national road; ROW = right-of-way.

D. Future Plans for Information Disclosure and Public Participation

286. The stakeholder consultation strategy that was developed and implemented for the IEE will be continued with the start of the pre-construction phase of the road upgrades. The first step will be to disclose of the draft IEE to the affected stakeholders that were consulted to obtain their review and comment.

287. The IEE must be easily available to the stakeholders contacted during project preparation, in written and verbal forms, and in local language. At a minimum the Executive Summary of the IEE should be translated to Khmer and distributed to all commune offices who participated in public consultations. The IEE should be available on the MOE/Department of Environment and MPWT/DPWT web sites, at their respective offices, district offices, and road rehabilitation site offices. Similarly, all project reporting with specific reference to stakeholder consultation minutes, environmental monitoring, and reports on EMP implementation released by the executing agency/PMU3/ESO should be available at the same offices and web sites. The IEE will also be available on the ADB web site. After road rehabilitation begins, all environmental and EMP reporting submitted by the executing agency/PMU3 will also be available on the project and ADB website.

288. As indicated in the IEE the primary concern of the public and institutional stakeholders of the road upgrades were disturbances during construction phase of the upgrades. These issues will be reviewed during follow-up consultations throughout the pre-construction, construction, and operation of the completed rehabilitated roads.

VII. GRIEVANCE REDRESS MECHANISM

289. According to MPWT (2008) (Environment and Social Safeguards Policies for Cambodia Road Asset Management Project) grievances related to any aspect of a project will be handled through negotiations and are aimed at achieving consensus. All complaints received in writing (or written when received verbally) from the affected persons will be documented by each level grievance committee, established by the project authorities at varying governance levels, i.e. commune, district and/or provincial levels. The project affected persons will be exempted from all administrative and legal fees incurred in pursuant to the grievance redress procedures. The GRC would comprise of representatives of project affected persons, community leaders and independent assigned nongovernment organizations (NGO), in addition to the representatives of commune and district officials, and project authorities.

290. In accordance with this guideline, the PMU of MPWT shall undertake the following prior to start of site works:

- Establish a GRM prior to site works
- Make public the existence of the GRM through public awareness campaigns
- Ensure that names and contact numbers of representatives of the PMU/MPWT as well as ESO and contractors are placed on the notice boards outside the construction site and at subnational level of local government offices (e.g. provincial, district and commune levels).

291. The GRC shall be established before commencement of site works and shall be chaired by PMU to be assisted by the ESO. The GRC shall have members from the PMU/MPWT (e.g. PDRD) commune councils, local NGO, and women's organization. Grievances can be filed in writing or verbally with any member of the GRC. The committee will have 15 days to respond with a resolution. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the Government's judicial or administrative remedies.

292. The PMU of Ministry of Public Work and Transport shall make public the existence of this grievance redress mechanism through public awareness campaigns. They shall set-up a hotline for complaints and the hotline shall be publicized through the media and numbers placed on the notice boards outside the construction site and at subnational level of local government offices (e.g., provincial, district, commune levels). Locally affected people will still be able to express grievances through the commune councils and these would be referred through the usual channels in those committees.

293. The GRC will receive, follow-up and prepare monthly reports regarding all complaints, disputes or questions received about the Project and corresponding actions taken to resolve the issues. The GRC will also use the punitive clauses of the 1996 Law on Environmental Protection and Natural Resources Management in conjunction with MOE to prosecute offending parties.

294. As provided for by MPWT (2008), the process of grievance redress resolution should be as follows:

295. **First stage:** affected persons will present their complaints and grievances to the Village or Commune Resettlement Sub-committee or IRC working group and, if he or she wishes, to the nominated NGO working on the GRC. The NGO will record the complaint in writing and accompany the affected persons to meet the Village or Commune Resettlement Sub-

Committee. The Sub- Committee will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved affected persons does hear from, or if the affected persons is not satisfied with the decision taken in the first stage, the complaint may be brought to the District Office.

296. **Second stage:** The District Office has 5 days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the District Office will bring the case to the Provincial GRC.

297. **Third stage:** The Provincial GRC meets with the aggrieved party and tries to resolve the situation. Within 10 days of the submission of the grievance, the Committee must make a written decision and submit copies to implementing agency, the IRC and the affected persons.

298. **Final stage:** If the aggrieved affected households does not hear from the Provincial GRC or is not satisfied, he/she will bring the case to Provincial Court. This is the final stage for adjudicating complaints. The Court must make a written decision and submit copies to implementing agency, IRC and the affected persons. If any party is still unsatisfied with the Provincial Court judgment, he/she can bring the case to a higher-level court.

299. Figure 21 shows the simplified GRM flow chart.

300. The PMU3 will be responsible for checking the procedures and resolutions of grievances and complaints. The project supervision consultant may recommend further measures to be taken to redress unresolved grievances. The environmental specialists of the project implementation consultant will provide the necessary training to improve grievance procedures and strategy for the grievance committee members when required.

301. The executing agency will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints if the affected persons win their case. Other costs incurred by legitimate complaints will also be refunded by the project if the affected persons win their case.

302. In cases where affected persons do not have the writing skills or are unable to express their grievances verbally, affected persons are encouraged to seek assistance from the recognized local groups, NGOs, other family members, village heads, or community chiefs to have their grievances recorded in writing and to have access other documentation, and to any survey or valuation of assets, to ensure that where disputes do occur, all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned affected persons are provided with copies of complaints and decisions or resolutions reached.

303. If efforts to resolve disputes using the grievance procedures remain unresolved or are unsatisfactory, affected persons have the right to directly discuss their concerns or problems with ADB's Southeast Asia Department (SETC) through the ADB Cambodia Resident Mission (CARM). If affected persons are still not satisfied with the responses of CARM and SETC, they can directly contact the ADB Office of the Special Project Facilitator. The existence of the GRM shall not impede the complainant's access to the Government's judicial or administrative remedies.

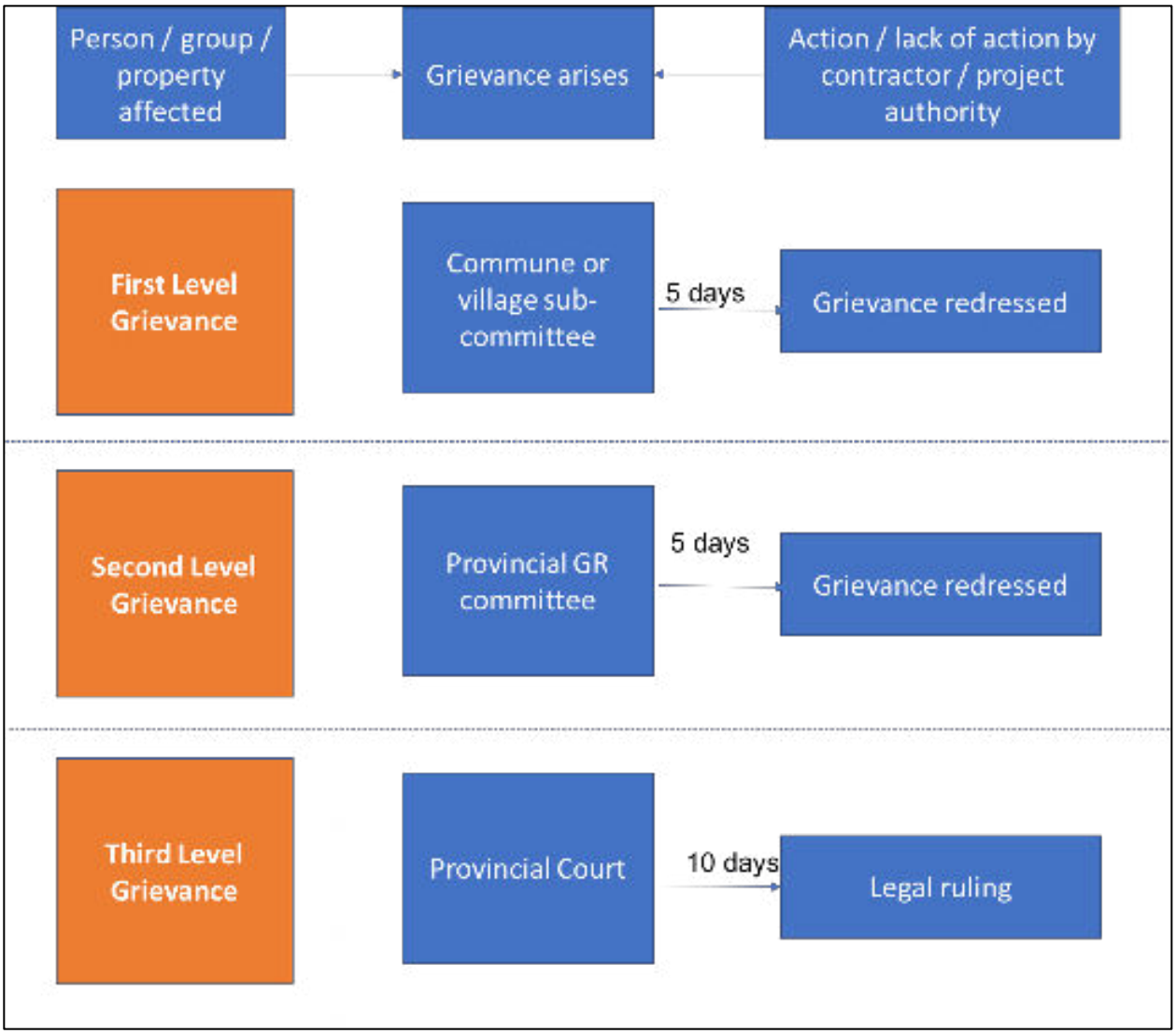


Figure 21: Grievance Redress Mechanism

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

304. An environmental management plan (EMP) has been prepared to give guidance on how to address the environmental impacts identified in connection with the implementation of the project. The EMP outlines the mitigation and monitoring programs to be taken to avoid, reduce, and minimize adverse environmental impacts. The full EMP is presented in Appendix A.

305. The management measures in the EMP are divided into those that will occur during pre-construction, construction and operation of the project. The EMP also identifies the institutions and offices that will implement and monitor the project's performance to ensure compliance with environmental regulations and implementation of the mitigation measures. This has been developed based on the previous IEE developed for the Second RAMP, discussions with the MPWT and ADB, and from results of public consultation activities.

306. The EMP and the specific safeguard requirements will be included in the bidding and contract documents to ensure that good engineering and environmental practices will be applied during construction and road maintenance. The contractors will be made aware of obligations and that their safeguard performance during construction will be supervised and monitored by the PMU3.

307. After the appointment and mobilization of the contractor, a contractor's environmental management plan (CEMP) will be prepared by the contractor to give specific details on the locations of the borrow areas, borrow roads, worker's camps, and other facilities. The CEMP must be submitted to the PMU3 and/or the ESO and detailed design implementation and supervision consultant for approval before works commence.

B. Institutional Arrangements for Environmental Management

1. Ministry of Public Works and Transport – PMU3

308. The MPWT is the executing agency of the project and is the primary point of contact with ADB. The General Department of Public Works and Transport through its PMU3 as implementing agency will assume overall responsibility in implementation and compliance with loan assurances, including all the requirements specified in the EMP.

309. The established PMU3 of MPWT will act as the implementing agency and will be responsible for the management of the project. The PMU3 will have the overall responsibility in the supervision of the implementation of the environmental management and monitoring measures, coordinating the project GRM, and in reporting to ADB. It will ensure that the EMP is included in the tender documents for civil works such that the EMP will form part of the contract between MPWT and the selected contractor and the requirements of the EMP will be contractually binding on the contractor. The conformity of contractors with environmental contract procedures and specifications will be regularly monitored by the MPWT. Specific safeguards related tasks of the PMU3 are the following:

(i) Initial and coordinate effective communication between all stakeholders of the project;
(ii) Encourage civil societies participation in all stages of project design and implementation;
(iii) Public disclosure of project outputs;

(iv) Ensure compliance with all safeguard policy provisions in accordance with agreed formats and frameworks;
(v) Submit to the MOE the prepared IEE for information;
(vi) Ensure that the project's environmental management plan included in the IEEs are incorporated in the bidding documents and contract documents for all civil works;
(vii) Oversee monthly environmental monitoring of the project and submit semi-annual environmental monitoring reports to ADB for disclosure on ADB's website;
(viii) Oversee project compliance with relevant national and provincial government agencies on environmental matters as they arise;
(ix) Oversee the preparation of contractor's EMP and ensure that these are consistent with the project EMP, standards are feasible, monitored and maintained;
(x) In close coordination with the ESO:
- Secure approval of the resettlement plan and resettlement framework by the IRC;
- Secure prior approval by IRC and ADB of any variations in the approved resettlement plan and resettlement framework;
- Oversee implementation of the resettlement plan and resettlement framewrok by the relevant national and provincial government agencies under the project;
- Monitor implementation of the EMP, ensure that the EMP is implemented appropriately by the contractor and submit semi-annual environmental monitoring reports to ADB for disclosure on ADB's website; and
- Monitor implementation of the resettlement plan and resettlement framework and submit semi-annual social monitoring reports to ADB for disclosure on ADB's website.

(xi) Work closely with the General Department of Resettlement of the Inter-Ministerial Resettlement Committee in the preparation, updating and implementation of the resettlement plan'
(xii) Oversee the implementation of the GRM and monitor resolution of grievances and complaints; and
(xiii) Implement and report quarterly on the gender action plan, HIV/trafficking program, and communication, consultation and participation plan, and related capacity building activities.

2. Project Implementation Consultants

310. The PMU3 will engage project implementation consultants to supervise the civil works packages as well as the implementation of resettlement, environmental, and social safeguards measures. The project implementation consultant team will include an international environment specialist and a national environment specialist who will ensure that the ADB EMP is included in the bid and contract documents for civil works and that the environmental measures specified in the EMP are incorporated in the detailed design. Specifically, the project implementation consultant (environment specialists) will undertake the following:

(i) assist and supervise each contractor in preparing the CEMP prior to commencement of civil works based on the project EMP but with specific details particular to each contract package such as location of associated project facilities (construction camps, material sources, batching plants, sensitive receptors, spoils disposal areas, etc.) and other construction details for each contract package;

(ii) ensure that all associated project facilities have the required permits prior to commencement of civil works;
(iii) orient resident engineers and resident inspectors on EMP provisions to ensure that they will be able to adequately supervise on a day-to-day basis the contractors and sub-contractors with regard to proper and timely implementation of mitigation measures specified in the EMP;
(iv) monitor implementation of environmental mitigation measures and environmental performance of contractors based on the EMP schedule and assist MPWT in the preparation of semi-annual environmental monitoring reports for submission to ADB. The monitoring reports shall describe the progress of implementation of each environmental mitigation measure specified in the EMP, compliance issues, and corrective actions, if any;
(v) support PMU3 to establish a contract with the MOE for environmental effects monitoring to establish baseline conditions and to undertake field measurements for dust, noise and water quality during construction, as required in the EMP and to provide corresponding reports. Include interpretation of monitoring results in semi-annual environmental reports to be submitted to ADB;
(vi) coordinate with the Social Development/Safeguards Specialist (international) in preparing environmental training materials and train the ESO and PMU3 staff in the scope and details of their responsibilities so that they can inform and train staff of other offices of MPWT;
(vii) undertake environmental training for the MPWT/ESO/PMU3 staff to build their capacity on environmental management and monitoring. The training will be implemented through on-the-job training and workshops based on the provisions of the EMP; and
(viii) Ensure that the affected stakeholders and sensitive receptors (hospitals, schools, temples) are informed about the project by the PMU3 and contractors prior to start of construction and that the results of consultations are documented in the environmental monitoring reports.

3. Contractor

311. The construction contractor will be responsible for implementing the mitigation measures during construction under the supervision of the project implementation consultant and PMU3. Each contractor will appoint an EHS Officer whose responsibilities include:

(i) Prepare site-specific CEMP containing the method statements on implementation of pollution control and mitigation measures based on the updated EMP.
(ii) Submit the CEMP to PMU3 through the project implementation consultant for review and approval.
(iii) Ensure sufficient funding for proper and timely implementation of mitigation and monitoring measures.
(iv) Conduct daily inspection of the site and ensure the implementation of the CEMP during the construction phase.
(v) Act as the local entry point for the project GRM, report all complaints and their resolution to PMU3.
(vi) Prepare/submit monthly reports on mitigation and monitoring activities to the PMU3 through the project implementation consultant.
(vii) Conduct immediate investigation of any complaint brought to the notice of the contractor and ensure the timely and appropriate resolution of the complaint or incident in accordance with the GRM.

C. Inspection, Monitoring and Reporting

312. The environmental monitoring plan for the EMP is provided in Table 20. The monitoring plan focuses on all three phases, i.e. pre-construction, construction, and operation of the project and consists of environmental indicators, sampling locations and frequency, method of data collection, responsible entities, and estimated costs. The monitoring plan aims to ensure compliance with the EMP and with relevant regulations of Cambodia. It also aims to assess the effectiveness of the identified mitigation measures.

1. Baseline Environmental Monitoring

313. Due to the absence of recent air quality, noise, and water quality baseline data along the national road alignments, the contractors will be required to conduct baseline environmental monitoring of ambient air quality, noise levels, and water quality prior to start of construction activities of a particular road section. The international environment consultant will ensure the conduct of baseline water quality at the upstream and downstream of the bridge river crossings as well as the ambient air quality and noise levels at sites with sensitive receptors such as schools, hospitals, and temples which may be potentially affected by the road projects. These baseline monitoring activities will be detailed in the updated EMP and monitoring plan and will provide the basis for determining further monitoring throughout the construction phase.

314. The project implementation consultant services include an international and national environmental consultant who will be required to oversee the contractor implementation of the environmental monitoring plan.

2. Compliance Monitoring

315. The hierarchy of environmental monitoring and measurements will be carried out by contractors, project implementation consultant through the international and national environment specialists, and the PMU3. Compliance monitoring is required to assess the overall implementation of the EMP through a project performance system developed by the PMU3. Select indicators of major components of the environment that will be affected primarily by the construction phase are drawn from the mitigation and monitoring plans and summarized in Table 21.

316. Contractors through the assigned Environment, Health and Safety (EHS) Officer should conduct daily inspections of all operations in accordance with the CEMP through visual inspection and monitoring, review of construction records, and meetings with stakeholders when necessary. This will include regular checks on dust and noise control measures, waste management, worker and community safety measures, community coordination and consultation, among others. The contractor EHS officer will make the daily spot checks and weekly formal checks on site operations. This will also involve review of records of waste disposal and investigation of pollution incidents and complaints. A checklist of activities and measures will be used in the daily and weekly inspections of the project sites. These checklists prepared by the contractor's EHS Officer will be filed for records purposes and should be available at the site for inspection.

317. The following lists the monitoring parameters and the timing of monitoring:

(i) Liquid emissions from sites must be checked every three months or after heavy rain if overflowing is reported. Measurements in streams and water courses must be made;

(ii) Dust emissions on site must be checked daily by visual inspection particularly during the dry months and by examining records of water spraying. Ambient air quality must be checked over a 24-hour continuous sampling at 100m from sensitive receptors;

(iii) Noise levels and vibration must be checked every month at 100m from sensitive receptors and site perimeters or in the event of a complaint, at night and daytime;

(iv) Rehabilitation of borrow pits and quarries must be checked after closure of the facility; and

(v) Proper removal and disposal of food waste and engine oil and grease must be checked weekly by visual inspection of the construction camps and checking of records from the waste disposal contractors.

Table 20: Environmental Monitoring Plan

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
Pre-Construction Phase								
Sensitive receptors	Survey of affected sensitive receptors -distance from road -safe passage needs	Review of detailed project plans Consultation with commune	Once	Once	Along NR1, NR6	PIC in coordination with the Resettlement Specialist	PMU3/ESO	CW-1: NR1 East - $1,000 CW-2: NR1 West - $1,000 CW-3: NR6 - $1,000
Water Quality	DO 2.0-7.5mg/l; BOD 1-10mg/l; Suspended Solids <25-100mg/l; pH 6.5-8.5 Coliform <5000MPN	Sampling and analytical methods approved by MOE as per sub-decree on Water Pollution Control	Once before start of construction phase	Once before start of construction phase	At bridges with river crossing – 50m upstream and downstream of bridge NR1 (4 rivers): Steung Slot River, Kampong Trabaek River, Prey Chlor River, Vai Kok River NR6 (2 rivers): Puok River, Sreng River	PIC	PMU3/ESO	CW-1: NR1 East - $1,000 CW-2: NR1 West - $1,000 CW-3: NR6 - $1,000
Air Quality	Total	24-hour	Once before	Once before	Road	PIC	PMU3/ESO	CW-1: NR1

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
	Suspended Particulates < 0.33 mg/m^3	continuous sampling using analytical methods approved by MOE	start of construction phase	start of construction phase	sections within 100m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.			East - $4,400 CW-2: NR1 West - $3,000 CW-3: NR6 - $4,500
Noise	For quiet areas: -Leq daytime (06-18) <45 dB(A) -Leq nighttime (18-22) - <40 dB(A) -Leq early morning (22-06) - <35 dB(A) For residential areas: -Leq daytime (06-18) <60 dB(A) -Leq nighttime (18-22) - <50 dB(A) -Leq early morning (22-06) - <45 dB(A)	Use noise meter	Once before start of construction phase -Daytime (0600-1800) -Nighttime (1800-2200) -Early morning (2200-0600)	Once before start of construction phase	Road sections within 100m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.	PIC	PMU3/ESO	CW-1: NR1 East - $1,500 CW-2: NR1 West - $1,000 CW-3: NR6 - $1,000

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
Vibration	Vibration, < 1 millimeter per second	Vibration meter	Once before start of construction phase	Once before start of construction phase	Road sections within 100 m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.	PIC	PMU3/ESO	Included in noise monitoring cost
Impact of quarries and borrow pits	Inventory of present and past land uses that could cause contaminated soil and sediment runoff	Field observations Check Government permits of quarries and borrow pits	Once before start of construction phase	Once before start of construction phase	Excavation and borrow pit sites and quarry sites	PIC	PMU3/ESO	Part of pre-construction cost
Mine/UXO contamination	Mine/UXO survey	Check is mine/UXO clearing has been conducted	Once before start of construction phase	Once before start of construction phase	All road sections	PIC	PIC PMU3 ESO	Part of pre-construction cost
Construction Phase								
Water Quality	DO 2.0-7.5 mg/l; BOD 1-10mg/l; Suspended Solids 25-100mg/l; pH 6.5-8.5 Coliform <5000MPN	Sampling and analytical methods approved by MOE	Every 6 months during bridge construction	Every 6 months	50 m upstream of bridge (as control station) 50 m downstream of bridge (as impact station)	DDIS/EMC	PMU3/ESO	CW-1: NR1 East - $4,000 CW-2: NR1 West - $4,000 CW-3: NR6 - $4,000

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
					NR1 (4 rivers): Steung Slot River, Kampong Trabaek, Prey Chlor River, Vai Kok River River NR6 (2 rivers): Puok River, Sreng River			
Effluent Quality	BOD <30mg/l; COD <50mg/l; Total Suspended Solids <50mg/l; Oil & grease <5 mg/l; pH 6-9; Detergent <5 mg/l; DO <2 mg/l	Sampling and analytical methods approved by MOE	Every 6 months	Every 6 months	Effluent from construction camps	DDIS/EMC	PMU3/ESO	$1,000 per year
Groundwater Quality	DO 2.0-7.5 mg/l; BOD 1-10mg/l; Suspended Solids 25-100mg/l; pH 6.5-8.5	Sampling and analytical methods approved by MOE	Every 6 months	Every 6 months	Wells near construction camps	DDIS/EMC	PMU3/ESO	$2,000 per year

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
	Coliform <5000MPN							
Air Quality	Total Suspended Particulates < 0.33 mg/m^3	24-hour continuous sampling using analytical methods approved by MOE	Monitoring only when road section has construction activities within 100m of sensitive receptors	Every 6 months	Road sections within 100m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.	PIC	PMU3/ESO	CW-1: NR1 East - $8,700 CW-2: NR1 West - $6,000 CW-3: NR6 - $8,000
Noise	For quiet areas: -Leq daytime (06-18) <45 dB(A) -Leq nighttime (18-22) - <40 dB(A) -Leq early morning (22-06) - <35 dB(A) For residential areas: -Leq daytime (06-18) <60 dB(A) -Leq nighttime (18-22) - <50 dB(A) -Leq early morning (22-	Use noise meter	Monthly -Daytime (0600-1800) -Nighttime (1800-2200) -Early morning (2200-0600)	Every 6 months	Road sections within 300m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.	PIC	PMU3/ESO	CW-1: NR1 East - $2,500 CW-2: NR1 West - $2,000 CW-3: NR6 - $3,000

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
	06) - <45 dB(A)							
Vibration	Vibration, < 1 millimeter per second	Vibration meter	During surface compaction	Every 6 months	Road sections within 300 m from sensitive receptors (schools, hospitals, temples) Refer to Appendix E.	PIC	PMU3/ESO	Cost included in noise monitoring cost
Solid waste	Segregation of biodegradable and non-biodegradable wastes generated and disposed Inspeciton of solid waste along the construction road.	Field observation	Daily inspection	Monthly	Construction camps	Contractor	PIC, PMU3, ESO	Part of construction cost
Oil and grease	Waste oil, grease	Visual inspection/ observation	Daily inspection	Monthly	Construction sites	Contractor	PIC, PMU3, ESO	Part of construction cost
Borrow pits	Depth of borrow pits (check drowning hazard; safety rails; filled after	Visual inspection	After closure inspection	After closure inspection	Borrow sites	Contractor	PIC, PMU3, ESO	Part of construction cost

Environmental Issue	Monitoring Parameter / Standard	Means of Monitoring	Monitoring Schedule/ Frequency	Reporting	Sampling Station	Responsibility		Estimated Cost (USD)
						Implementation	Supervision	
	completion with topsoil resurface)							
Quarries	Condition of quarries	Visual inspection	After closure inspection	After closure inspection	Quarry sites	Contractor	PIC, PMU3, ESO	Part of construction cost
Tree cutting	Tree Cutting Permit Replanting of trees	Visual inspection	Prior to cutting of tree After tree removal	After tree removal	Construction sites	Contractor	PIC, PMU3, ESO	Part of construction cost
Operation Phase								
Traffic safety	Incidence of traffic accidents and pedestrian injury	Community and police reporting	Continuous	Semi-annual	All road sections	Police and commune leaders	PMU3, ESO	Part of operational cost

BOD = biochemical oxygen demand; CMAA = Cambodian Mine Action and Victim Assistance Authority;CMAC = Cambodian Mine Action Center; COD = chemical oxygen demand; DDIS = detailed design and implementation supervision; DO = dissolved oxygen; mg/m^3 = milligrams per cubic meter; NR = national road; MOE = Ministry of Environment; PIC = project implementation consultant; PMU3 = project management unit; TDS = total dissolved solids.; UXO = unexploded ordnance.

Table 21: Performance Monitoring Indicators

Major Environmental Component	Key Indicator	Performance Objective	Data Source	Responsible Person/Entity
Pre-construction Phase				
Public Consultation & Disclosure	Affected public & stakeholders of roadways	Meetings with stakeholders contacted during IEE & new stakeholders convened for follow-up consultation & to introduce grievance mechanism	Minutes of meeting, and participants list	PMU3 PIC ESO
EMP	Updated EMP	All stakeholders met during IEE re-contacted for follow-up consultation	EMP	PMU3 PIC ESO

Major Environmental Component	Key Indicator	Performance Objective	Data Source	Responsible Person/Entity
Bid Documents	Requirements of CEMP[43] based on EMP	EMP appended to bidding documents with clear instructions to bidders for CEMP	Bid documents	PMU3 PIC ESO
Training of PMU3, ESO and EHS officers of contractors	Training course(s) & schedule	By end of pre-construction phase, required course(s) that will be delivered are designed and scheduled	Course(s) outline, participants, and schedule	PIC
Updated environmental baseline	As per EMP	Document baseline conditions as per monitoring plan	Survey	PIC ESO
Mine/UXO contamination	Mine/UXO Clearance	Check possible mine/UXO presence at road ditch and drains area	CMAC, CMAA	PIC PMU3 ESO
Construction Phase				
Sensitive cultural component	Physical cultural resources such as temples	Unharmed or disturbed	Commune leaders, stakeholders	PMU3 ESO
Qualitative river quality at road crossings	Total Suspended Solids (turbidity)	Levels never exceed pre-construction baseline levels	Monitoring by EMC	PIC
Qualitative air quality	Dust, noise, vibration	Levels never exceed pre-construction baseline levels	EMC & contractor monitoring reports	PIC
Construction waste	Solid & liquid waste	Rigorous program of procedures & rules to collect and store all waste from construction camps and sites practiced.	Contractor and EMC monitoring reports	PMU3 ESO
Public & worker safety	Frequency of injuries	Adherence to GoC OHS regulations/policy to prevent accidents	Public/commune & Contractor reports	PMU3 ESO
Traffic	Frequency of disruptions & blocked roadways	Disruptions, stoppages, or detours are managed to absolute minimum.	Public input, contractor reports, EMC reports	PMU3 ESO
Operation Phase				
Increased traffic	Traffic accidents along new and rehabilitated sections of roads	Not to increase over present frequency	MPWT	MPWT

CEMP = contractor environmental management plan; EHS = environment health and safety; EMP = environmental management plan; GOC = Government of Cambodia; IEE = initial environmental examination; MPWT = Ministry of Public Works and Transport; OHS = occupational health and safety; PIC = project implementation consultant; PMU3 = project management unit; ESO = Environment and Social Office.

[43] Contractor Environmental Management Plan developed from EMP in contractor bidding document

3. Reporting and Disclosure

318. The National Environment Specialist/EMC of the project implementation consultant will make monthly visits to the site to check the reports of the contractor and to check the implementation of the mitigation measures. Semi-annual environmental monitoring reports will be prepared by the project implementation consultant for submission to the PMU3.

319. The PMU3 will then review the reports submitted to the MPWT by the project implementation consultant. The PMU3 will report the results of the project implementation consultant's independent evaluation to ADB on the project's implementation of the EMP through the semi-annual environmental monitoring reports. The reports should confirm the project's compliance with the EMP and national regulations, the results of the contractor compliance with the EMP, identify any environment-related implementation issues and corrective actions, capacity building and training activities, public consultation, and compliance with environmental management covenants under the project and site photographs.

320. Within three months after completion of each road component, an environmental acceptance monitoring and audit report of the completed road shall be prepared by the project implementation consultant. This final report on environment safeguards should provide information on the schedule of project component implementation, scope of works, implementation of mitigation measures and any additional or corrective actions, and the summary of the results of the monitoring program. The environmental acceptance report should also highlight proposed additional mitigation and monitoring measures during the operational phase that should be implemented by MPWT. The environmental acceptance reports for each national road will serve as inputs to the Project Completion Report (PCR) to be submitted to ADB.

321. Reports will be disclosed on websites of the ADB and PMU3/MPWT.

4. Institutional Capacity Building and Training

322. The capacity of the PMU3 and ESO of the MPWT as well as the EHS officers of the contractors will be strengthened on EMP implementation and supervision. All entities involved in the implementation and supervision of EMP must have an understanding of the IEE and EMP to meet MOE and ADB Safeguards Policy Statement requirements, mitigation methods and practices on environmental management. The project implementation consultant will finalize and deliver training courses to the PMU3 and contractors. The primary objective of the training is to strengthen the ability of the PMU3, ESO and contractors to oversee and implement the EMP.

323. Training on the implementation of an EMP should address two thematic areas. The first area should be principles of environmental management focused on the potential impacts of road construction and rehabilitation on the natural and social environment. The second area will focus on the environmental safeguard requirements of the ADB and the regulatory requirements of the Government of Cambodia with specific reference to the EMP and the environmental standards on water quality, air quality, noise, vibration, and soil management. Two approaches to training should be: (i) classroom coursework and (ii) "learning by doing" from work on the implementation of the EMP of previous PRIP and RAMP. Training course facilitation and coaching will be provided by the National Environment Specialist of the project implementation consultant. The training course will have the following indicative training course topics:

(i) Introduction to environmental due diligence and environmental impact assessment and management as required by the Government of Cambodia and the ADB Safeguards Policy Statement;
(ii) Specific requirements for quarry sites, borrow areas;
(iii) Identification of environmental and social issues associated with the implementation of national roads (NR1 and NR6);
(iv) GRM, roles and responsibilities;
(v) Development and implementation of EMP and monitoring plan; and
(vi) On-site training on environmental monitoring and reporting.

324. A provisional budget of USD$20,000.00 is identified for the delivery of the training course to cover the costs for venue, food, accommodation, and course materials. A total of 50–80 target participants from the PMU3, ESO, District PWT staff, and contractors is proposed. It is anticipated that regional transportation costs would be covered by the DPWT and contractors.

325. The estimated costs for implementing the EMP are provided in Table 22. The Project Administration Manual includes a breakdown by contract package.

Table 22: Estimated Costs for Environmental Management Plan Implementation

Item	Estimated Cost (US$)
1. Environmental monitoring to be undertaken by PIC environment specialists	
a. International (1 person for 1 month US$20,000/month @ 3 person-months)	60,000
b. National (1 person for 1 month @ US$5,000/month @ 6 person-months)	30,000
2. Environmental management capacity building program / training to be undertaken by PIC for PMU3, ESO, DPWT staff	20,000
3. Environmental quality monitoring	
a. Survey of sensitive receptors (distance from road, safe passage requirements)	3,000
b. Water quality	15,000
c. Air quality	34,600
d. Noise	11,000
e. Groundwater quality near construction camp	To be included in Contractors BOQ
Sub-total forenvironmental quality monitoring	63,600
TOTAL for Costed Items	173,600
4. Construction phase mitigation measures	To be included in Contractors BOQ based on EMP requirements
5. Operation phase mitigation measures	To be included in operating budget of DPWT

DPWT = department of public works and transport; PIC = project implementation consultant; ESO = environment and social office

IX. CONCLUSION AND RECOMMENDATION

A. Expected Project Benefits

326. The proposed project will improve mobility and transport and is expected to contribute to long-term economic development and livelihood in the project areas. The project road construction and maintenance works will also provide job opportunities for the poor local households including women and marginalized individuals who have no jobs, especially during off-farming season. Access to basic facilities and services will be significantly improved in the project areas after project completion. Rehabilitating and enhancing the climate resilience of the project roads will improve the poor's access to markets and social services, and is a core means of promoting inclusive economic growth and reducing poverty, as well as enhancing social development and equity. Improved road conditions would reduce travel time and vehicle operating costs, both of which would reduce transportation costs. Reduced transportation costs in turn are expected to contribute to reduced prices for goods and services in the project areas. Reduced input costs for agriculture and improved access to markets for farm produce are expected to have a positive impact on farming incomes.

327. The economic analysis carried out for the project has calculated that there will be a net reduction of 45,687 tonnes of CO_2 emissions per year as a result of improved road condition.

328. The project will facilitate faster and more convenient transport, and thus better access to education and health facilities, markets, schools, banks, government agencies, etc. It will encourage children to go to school and encourage people to go to health centers. Local producers will have greater access to markets, which will result to increase in household income. Famers could easily transport products and road construction and maintenance could generate jobs and provide cash income for the poor.

B. Adverse Impacts and Mitigation Measures

329. The national roads NR1 and NR6 are located in the provinces of Prey Veng, Svay Rieng, Siem Reap and Kandal and have a total length of 147 km. NR1 and NR6 are the main international linkages to Viet Nam and Thailand. The national roads have suffered from overloaded truck transport and require rehabilitation to upgrade the original DBST pavement that has cracked and developed pot holes. The significant design feature of the rehabilitation of the national roads is that the carriageways and shoulders will not be widened, and the alignments are not changed significantly.

330. The project roads are located in areas which are influenced by the Mekong River. NR1 is in the floodplain of the Mekong River while NR6 traverses the northern edge of the floodplain of Tonle Sap Lake. None of the project roads are located in protected or ecologically sensitive areas. NR6 is located in the Transition Zone of the Tonle Sap Biosphere Reserve and is about 15 km north of the lake. Land uses along the national road corridors are characterized by agricultural land, planted with rice and other crops, and busy town centers.

331. The potential environmental impacts of the rehabilitation and improvement of the roads will be primarily from construction phase disturbances. Common impacts of the civil works along the roads will include reduced and/or blocked public access to areas, noise and dust caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, community and occupational health and safety risks, increased traffic congestion and traffic accidents, habitat disturbance, encroachment and

damage from construction machinery, soil erosion and sedimentation of adjacent rice paddy and streams and rivers that are traversed by the roads. Localized drainage and flooding problems can arise. Solid waste and domestic pollution from temporary worker camps can occur, as well as potential communicable disease and local community problems caused by migrant workers. These short-term impacts and disturbances will occur at different levels of magnitude depending on the civil works activity and the road section site.

332. The EMP for the national roads will need to be updated following completion of the detailed designs, if there are significant changes or additional information available. The EMP should be included as part of the construction package tender documents which, among other things, specify the requirements of the contractor EMPs which contractors are required to develop from the updated EMP to include with their bid documents. The CEMPs contain the mitigation plans and monitoring requirements that are specific to the construction packages they implement. This includes location of project facilities such as construction camps, batching plants, disposal sites, and cut and fill balance. Sensitive environmental receptors should be avoided.

333. There shall also be measures to prevent soil erosion through the provision of adequate drainage in the technical design of the roads including for spoil disposal sites. Workers construction camp, asphalt/concrete mixing stations and pre-casting yards and spoil disposal sites will be located in developed or cleared private land. The camps will be provided by the contractors with safe, suitable and comfortable accommodation, kitchen, dining and sanitary facilities (toilet and bath), ample supply of clean water and first aid supplies and equipment. Camp rules will be disseminated and imposed by the contractors to avoid social problems. In addition, local communities will be given preference during hiring of unskilled labor to minimize the number of workers to be housed in the camp and to help avoid social conflicts between workers and local communities.

334. The contractor will be required to develop and implement a CEMP that will present detailed measures such as recycling and reuse of existing asphalt pavement for rehabilitation of road sections; reuse of earth cut materials for backfilling and embankment to minimize volume of borrow materials; and climate adaptation measures that includes climate resilience-related adjustments to civil works through (i) design of road embankments and roadside ditches which are susceptible to erosion; (ii) using less moisture susceptible materials or hydraulically-stabilized materials usually with cement or lime within the road structure so that structural layers do not lose significant strength upon flooding and soaking; and (iii) by using green engineering or bio-engineering to improve the water conservation and water retention capacity characteristics of the watershed to minimize flooding and to divert runoff water away from the road. The contractor will also ensure that all earthworks along the road alignments (e.g., excavations, trenches) that are suspected to have UXO are surveyed by the Government prior to construction If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works. The contractor will also be required to provide fence/barriers on open excavations was well as stable cover for trenches where public walkways or vehicles must cross. During excavation works, a cultural chance find management plan must be in place for cultural artifacts and property in compliance with the Law on Protection of Cultural Heritage, NS/RKM/0196/26. Sections of the road under construction which are subject to dust emission should have water spraying to minimize dust. In terms of traffic management, where possible construction vehicles should use different access roads or dedicated temporary lanes to access construction areas to minimize interference with road use by the public.

335. The construction and maintenance of the project roads shall adhere to the Cambodia Occupational, Health, and Safety Programme guidelines developed for Cambodia by the International Labour Organization and with the World Bank (IFC) Environment, Health, and Safety (EHS) Guidelines (2007).

C. Overall Conclusion

336. The IEE concludes that the description of the feasibility designs of NR1 and NR6 combined with available information on the affected environments is sufficient to identify the scope of potential environmental impacts of the road projects. Provided that significant design changes do not occur and that new sensitive environmental or social receptor data are not discovered, the project will remain Category B for environment and will not require further detailed EIA.

337. The EMP developed for the project provides impact mitigation plans, environmental monitoring plans, and specify the institutional responsibilities and capacity needs for environmental management. The EMP will need to be reviewed and updated at the detailed design phase to ensure that it fully addresses the potential impacts of the final detailed designs.

APPENDIX A: ENVIRONMENTAL MANAGEMENT PLAN

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
A. Mitigation measures applicable to all national roads						
Pre-Construction Phase						
Disclosure and engagement of community		a) Initiate information disclosure and joint environment and social GRM. b) Notify residents, schools, temples and commercial establishments of construction activities and schedule to minimize disruption to normal activities.	PIC	PMU3	Consultations conducted; agreements reached with affected households and landowners	MPWT
Setting up of construction camp		Prefer use of cleared land and avoid productive lands, at or near sensitive habitats Provide comfortable accommodation, kitchen, dining and sanitary facilities (toilet and bath) with septic tank, ample supply of clean water, first aid supplies and PPE, solid waste management, and hazardous substances area. Designate a trained health and safety officer Conduct training for	Contractor	PIC/PMU3	Inspect location of construction camp; check CEMP	Contractor

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		workers on environmental protection, grievance redress mechanism, Government's environmental regulations and requirements, ADB requirements, hygiene, health, first aid, safety and security.				
GoC approvals		Notify MOE about the project to ensure EIA requirements are complete and required permits and clearances are secured prior to implementation. Confirm approved solid waste disposal sites with MOE. Secure permits for cutting of trees along road alignments.	Contractor	PIC/PMU3	Check CEMP; check permits	part of construction cost
Tender and contract documents preparation		Ensure updated EMP is included in contractor tender documents and that tender documents specify contractor-defined CEMPs including budget and staff for environment safeguards.	PIC	PMU3	Check tender documents and updated EMP	Part of management cost
Capacity development		Develop and implement a training plan for PMU3/ESO and contractors to be able to fully implement the EMP and monitoring plan.	PIC	PMU3/ESO	Check if training was conducted	PIC

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
Update of EMP		Review mitigation measured defined in this EMP, update as required to reflect detailed design, disclose updated EMP on ADB and MPWT website. Ensure that the following issues are addressed in the updated EMP: a) Completion of detailed designs and updated EMPs of the road upgrades; b) Provision of adequate drainage in the technical design including for spoil disposal sites to prevent soil erosion; c) Recycling and reuse of existing asphalt pavement for rehabilitation of road sections; d) Reuse of earth cut materials for backfilling and embankment to minimize volume of borrow materials; e) Design climate adaptation measures that includes climate resilience-related adjustments to civil works through (i) design of road embankments and	PIC	PMU3	Check updated EMP	Part of management cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		roadside ditches which are susceptible to erosion; (ii) using less moisture susceptible materials or hydraulically-stabilized materials usually with cement or lime within the road structure so that structural layers do not lose significant strength upon flooding and soaking; and (iii) by using green engineering or bio-engineering to improve the water conservation and water retention capacity characteristics of the watershed to minimize flooding and to divert runoff water away from the road. f) Ensure that all earthworks along the road alignments (e.g., excavations, trenches) that are suspected to have UXO are surveyed by the Government prior to construction. If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works.				

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		g) Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross. h) A cultural chance find management plan must be in place for cultural artifacts and property. i) Regular use of wetting agents must be employed along all sections of the roads that are undergoing civil works to minimize dust. j) Trees and other vegetation along road corridors should be protected. Tree removal must be minimized. All trees removed by permit must be replaced with 3 three trees for each tree removed. k) All construction vehicles and equipment should be maintained in proper working order, and not operated at night if possible to minimize noise. l) Speed limits should be posted and adhered to				

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		by construction vehicles, and the public. m) Where possible construction vehicles should use different access roads or dedicated temporary lanes to access construction areas to minimize interference with road use by the public. n) Berms and/or silt curtains should be constructed around all excavation/trench sites and along all surface waters to prevent soil erosion and surface water sedimentation. o) Local workers should be used as much as possible to prevent or minimize influx of migrant workers, and incidence of social disease and community unrest. p) The temporary worker camps must have adequate domestic waste collection facilities and sufficient portable container toilets or pit latrines if necessary that are				

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		located away from public areas and surface waters. A formal clean-up and site restoration plan must be in place for all sites for both temporary sanitation systems. q) Dedicated fuel storage areas with oil pit must be established away from public areas and surface waters and marked clearly. r) Ensure compliance to Cambodia Occupational, Health, and Safety Programme guidelines developed for Cambodia by the International Labour Organization, World Bank (IFC) Environment, Health, and Safety Guidelines (2007). s) Aggregates (e.g., sand, gravel, rock) that are transported by truck must be covered. t) Prolonged use of temporary storage piles along the roads should be avoided, or covered, or wetted regularly to prevent				

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		dust and erosion. u) Sand extraction from adjacent streams and rivers should not occur, or only occur from DOE-licensed areas. v) Bulk fuel should be stored and covered on 6" pads made of concrete, not on bare ground concrete pads away from the public and worker camp. Fuel storage areas and tanks must be clearly marked, protected with fencing, and lighted, and should be at least 100 m away from the public and worker camps. Contractors should be required to have an emergency plan to handle fuel and oil spillage.				
Mine/UXO survey	Hazard to workers and public	Check whether areas for roadside ditches and drains are cleared of mine/UXO prior to start of construction activities.	PMU3	PMU3	Check UXO clearance	MPWT
Hiring of workers	Social conflicts	Give preference to local communities during hiring of unskilled labor	Contractor	PIC/PMU3	Check if local workers are hired	Part of management cost
Construction Phase						
Clearing and grubbbing	Soil erosion	Stabilize all cut slopes, embankments and other	Contractor	PIC/PMU3	Inspect site	Part of construction

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		erosion-prone areas through permanent stabilization measures immediately after completion of construction works. Provide adequate drainage and side drains leading to a receiving waterbody. Implement soil erosion protection measures for river embankment works, cut slopes, material stockpiles, and other areas prone to soil erosion.				cost
	Removal of vegetation and trees	Coordinate with the local authority and land owner Ensure that appropriate permits are secured for cutting of trees	Contractor	PIC/PMU3	Inspect site; check permit; validate with local authority and land owner	Part of construction cost
Earthworks and stockpiling of materials	Soil erosion and run-off	Stockpile the materials away from water bodies, irrigation, drainage channels, and washing/drinking water supplies. Remove the materials within the shortest possible time. Observe the height and grade requirements for the management of stockpiles.	Contractor	PIC/PMU3	Check site and verify EMP implementation	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
	Encroachment and damage to adjacent areas	Chose locations where materials stockpiling on shoulders will not cause damage to productive land. Minimize the need for permanent disposal sites by using the spoils as fill materials, as top soil for the sodding of the embankment slopes and for filling up of abandoned borrow pits.	Contractor	PIC/PMU3	Check site and verify EMP implementation	Part of construction cost
	Hazards to traffic and pedestrians	Provide warning signs, directional signs and barriers where lane closure is required. Assign signal men at both ends of the work sites. Alternate diversion routes should be provided, if possible.	Contractor	PIC/PMU3	Check site and verify EMP implementation	Part of construction cost
	Dust emission	Spray water at least twice a day on unpaved areas, haul roads and exposed dust-prone stockpiles. Increase frequency of water spraying during windy conditions. During removal of existing pavement and during backfilling, conduct water spraying to suppress dust.	Contractor	PIC/PMU3	Check site and verify EMP implementation	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		Control vehicle speed to less than 8 km per hour in unpaved areas. Post the notice on the construction works and the speed limit sign in these areas.				
Operation of spoil disposal and borrow areas and crushing plant	Dust, noise, soil runoff	Use spoil disposal and borrow areas that are approved by Government or by widening ditches or by excavating from other sources outside the planned cross setion within the ROW. Locate borrow areas at least 300 m from human settlement areas. Avoid borrow areas and spoil disposal sites that are susceptible to soil erosion such as long and steep slopes. Provide cut-off drains to redirect runoff. Install wash bays or conduct manual wheel washing at the exit of the borrow area Strip and store topsoil in a stockpile for reuse in site restoration.	Contractor	PIC/PMU3	Check site	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		Restore the spoil disposal sites within one month after closure.				
Road and drainage construction	Impeded access to schools, temples, houses and commercial establishments	Inform the residents, establishments and shop owners of the work schedule to allow them to make the necessary preparations Provide safe passageway through the work sites into the schools, temples, houses and commercial establishments. Require the contractor to replace or restore damaged structures such as concrete pavement, wooden platforms, roof extensions and other affected roadside facilities.	Contractor	PIC/PMU3	Check safe passageways; Verify with residents, schools, temples, and shop owners if advance notice was made by contractor	Contractor
	Traffic due to lane closure	Inform the village authorities and affected households about the construction schedule. Install warning signs at the approach of the lane section to the closed with information on the duration of the construction activity.	Contractor	PIC/PMU3	Check CEMP; check traffic rerouting plan	Part of construction cost
	Health and safety of	Provide barriers to separate the workers from	Contractor	PIC/PMU3	Check CEMP; check PPEs	Part of construction

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
	workers and road users	the road traffic Provide workers with high visibility vests Warning signs and safety barriers should be visible at night.				cost
Aggregate and Bituminous works	Exposure of people to dust and odor	Schedule the bitumen spreading activity at times when there less people on the road such as when children are on their way to/from school or during market day.	Contractor	PIC/PMU3	Check schedule of aggregate and bituminous works Inspect activities and EMP implementation	Part of construction cost
	Spill of bitumen and fire hazard	Bitumen storage areas should be located not closer than 500m from settlements and should not be allowed in sensitive areas such as water courses and flood prone areas Storage areas should be kept neat and tidy. Storage area should be cleared of vegetation and where bituminous material is stored in drums, these shall be stacked on their sides and only in small quantities with gaps between each stack to	Contractor	PIC/PMU3	Check EMP implementation	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		reduce fire risk.				
Construction of concrete structures	Generation of waste such as wooden formworks, cement packaging materials, excess concrete from transit mixers, and wash water from transit mixers	Collect formworks or disposal in approved disposal sites or give to community for use as firewood. Gather waste cement packaging materials for recycling or disposal in approved disposal areas. Prohibit burning of wastes. Prohibit the washing of cement transit mixer at the construction site including the disposal of excess concrete into water bodies, canals or sewers. Ensure compliance with the effluent standards under sub-decree on water pollution control No. 27 ANRK.BK 1999 prior to disposal of liquid wastes.	Contractor	PIC/EMU3	Check EMP implementation; site inspection	Part of construction cost
Drainage and slope protection works	Impede access to houses and other establishments	Notify affected communities and establishments well in advance of the schedule work.	Contractor	PIC/PMU3	Check EMP implementation; site inspection	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
	Community health and safety hazard	Demarcate excavations with barriers and provide warning signs Provide safe foot paths across excavations to allow people to cross safely	Contractor	PIC/PMU3	Check EMP implementation; site inspection	Part of construction cost
	Siltation due to exposed loose excavated soil	Schedule drainage works during the dry season Clean drainage channels Ensure water flow is not completely blocked and that soil materials are prevented from getting into the water channels.	Contractor	PIC/PMU3	Check EMP implementation; site inspection	Part of construction cost
Ancillary works (installation of markers, guide posts, road signs, road marking)	Expose workers and road users to traffic hazards	Install the warning signs at the approach of the work site which should be visible at night. Barriers should be installed to separate the workers from the road traffic. Workers should wear high visibility vests.	Contractor	PIC/PMU3	Site inspection	Part of construction cost
Construction of laboratories	Dust and noise	Conduct dust spraying on stockpiles, as necessary. Limit noisy activities during daytime	Contractor	PIC/PMU3	Site inspection	Part of construction cost
	Generation of construction spoils	Properly segregation construction spoils Regularly collect and	Contractor	PIC/PMU3	Site inspection	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		dispose the construction spoils in an approved waste disposal site.				
	Order and security	Ensure appropriate site management and behavior of the workforce in the DPWT compound.	Contractor	PIC/PMU3	Site inspection	Part of construction cost
D. Operational Phase						
Road maintenance	Soil erosion and run-off	Stockpile the materials away from water bodies, irrigation, drainage channels, and washing/drinking water supplies. Remove the materials within the shortest possible time. Observe the height and grade requirements for the management of stockpiles.	Contractor	PMU3	Check site and verify EMP implementation	Part of construction cost
	Encroachment and damage to adjacent areas	Chose locations where materials stockpiling on shoulders will not cause damage to productive land.	Contractor	PMU3	Check site and verify EMP implementation	Part of construction cost
	Hazards to traffic and pedestrians	Provide warning signs, directional signs and barriers where lane closure is required. Assign signal men at both ends of the work sites. Alternate diversion routes should be provided, if possible.	Contractor	PIC/PMU3	Check site and verify EMP implementation	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
	Dust emission	Spray water at least twice a day on unpaved areas, haul roads and exposed dust-prone stockpiles. Increase frequency of water spraying during windy conditions. During removal of existing pavement and during backfilling, conduct water spraying to suppress dust. Control vehicle speed to less than 8 km per hour in unpaved areas. Post the notice on the construction works and the speed limit sign in these areas.	Contractor	PMU3	Check site and verify EMP implementation	Part of construction cost
	Impeded access to schools, temples, houses and commercial establishments	Inform the residents, establishments and shop owners of the work schedule to allow them to make the necessary preparations Provide safe passageway through the work sites into the schools, temples, houses and commercial establishments.	Contractor	PMU3	Check safe passageways; Verify with residents, schools, temples, and shop owners if advance notice was made by contractor	Contractor
Aggregate and Bituminous works	Exposure of people to dust and odor	Schedule the bitumen spreading activity at times when there less people on the road such as when children are on their way to/from school or during	Contractor	PMU3	Check schedule of aggregate and bituminous works Inspect activities	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		market day.			and EMP implementation	
	Spill of bitumen and fire hazard	Bitumen storage areas should be located not closer than 500m from settlements and should not be allowed in sensitive areas such as water courses and flood prone areas Storage areas should be kept neat and tidy. Storage area should be cleared of vegetation and where bituminous material is stored in drums, these shall be stacked on their sides and only in small quantities with gaps between each stack to reduce fire risk.	Contractor	PMU3	Check EMP implementation	Part of construction cost
Construction of concrete structures	Generation of waste such as wooden formworks, cement packaging materials, excess concrete from transit mixers, and wash water from transit mixers	Collect formworks or disposal in approved disposal sites or give to community for use as firewood. Gather waste cement packaging materials for recycling or disposal in approved disposal areas. Prohibit burning of wastes. Prohibit the washing of	Contractor	PMU3	Check EMP implementation; site inspection	Part of construction cost

Activity	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Means of Verification	Source of Funds
		cement transit mixer at the construction site including the disposal of excess concrete into water bodies, canals or sewers. Ensure compliance with the effluent standards under sub-decree on water pollution control No. 27 ANRK.BK 1999 prior to disposal of liquid wastes.				

CEMP = contractors' environmental management plan; DOE = department of environment; DPWT = department of public works and transport; EIA = environmental impact assessment; EMP = environmental management plan; GRM = grievance redress mechanism; IRC = interministerial resettlement committee; km = kilometer; m = meter; MOE = Ministry of Environment; PIC = project implementation consultant; PMU = project management unit; PPE = personal protective equipment; ROW = right-of-way; ESO = environmental and social office; UXO =unexploded ordnance.

APPENDIX B: RAPID ENVIRONMENTAL ASSESSMENTS

Rapid Environmental Assessment (REA) Checklist

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES), for endorsement by Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title:	CAM: Road Network Improvement Project
Sector Division:	SERD/Transport

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area adjacent to or within any of the following environmentally sensitive areas?			
▪ cultural heritage site		X	
B. Protected Area		X	
▪ wetland		X	
▪ mangrove		X	
▪ estuarine		X	
▪ buffer zone of protected area		X	
▪ special area for protecting biodiversity		X	
▪ **Potential Environmental Impacts** Will The Project Cause…			
▪ encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?		X	
▪ encroachment on precious ecology (e.g. sensitive or protected areas)?		X	
▪ alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?	X		The EMP specifies mitigation measures to prevent or minimize soil runoff caused by all civil construction works.
▪ deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?	X		The EMP specifies mitigation measures to manage wastes from construction camps.
▪ increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?	X		The EMP specifies mitigation measures to prevent or minimize creation of local dust caused by all civil construction works

Screening Questions	Yes	No	Remarks
a)risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation during project construction and operation?		X	
▪ noise and vibration due to blasting and other civil works?	X		The EMP specifies mitigation for controlling noise including time of day operation restrictions.
▪ dislocation or involuntary resettlement of people?		X	The affected persons have been consulted and are aware of the road ROW.
▪ dislocation and compulsory resettlement of people living in right-of-way?		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		X	
▪ hazardous driving conditions where construction interferes with pre-existing roads?	X		Traffic management and safety during construction/rehabilitation phase, and during operation of rehabilitated roads is specified in EMP.
▪ poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?		X	
▪ creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents?		X	
▪ accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials?		X	
▪ increased noise and air pollution resulting from traffic volume?	X		Noise and air pollution from increased traffic during and after construction phases of roads rehabilitation will be managed and minimized with construction vehicle controls, and working condition maintenance of all vehicles.
▪ increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?		X	
▪ social conflicts if workers from other regions or countries are hired?		X	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	

Screening Questions	Yes	No	Remarks
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	
▪ community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.		X	

EMP = environmental management plan; ROW = right-of-way.

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: CAM: ROAD NETWORK IMPROVEMENT PROJECT
Sector: Transport
Subsector:
Division/Department: Transport / SERD

Screening Questions		Score	Remarks
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	The project roads are being rehabilitated in part to address periodic flood events due to poor drainage and lowland elevations
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	1	Size and number of lateral culvert drains need to be upgraded to address periodic flood events
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	Quality of asphalt and elevation of road bed and shoulders need to consider increased heavy rainfall events
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Result of Initial Screening: Medium

Other Comments: n/a
Prepared by:

Appendix C: Indicative TORS For Environmental Specialists of Project Implementation Consultant

A. International Environmental Specialist.

1. With assistance from the national environmental specialist the international consultant will be responsible for the following:

   (i) ensure that an environmental management plan (EMP) based on the Asian Development Bank (ADB)-approved initial environmental examination is included in the bid and contract documents for civil works;
   (ii) ensure that environmental design measures specified in the EMP are incorporated in the detailed design;
   (iii) assist and supervise each contractor in preparing a contractor's environmental management plan (CEMP) prior to commencement of civil works; the CEMP will be based on the project EMP but with specific details particular to each contract package, such as the location of associated project facilities (construction camps, material sources, batching plants, sensitive receptors, spoils disposal areas, etc.) and other construction details for each contract package;
   (iv) ensure that all associated project facilities have the required permits prior to commencement of civil works;
   (v) orient resident engineers and resident inspectors on EMP provisions to ensure that they will be able to adequately supervise on a day-to-day basis the contractors and sub-contractors with regard to proper and timely implementation of mitigation measures specified in the EMP;
   (vi) monitor implementation of environmental mitigation measures and environmental performance of contractors based on the EMP schedule, and assist the Ministry of Public Works and Transport (MPWT) in the preparation of semi-annual environmental monitoring reports for submission to ADB. The monitoring reports shall describe the progress of implementation of each environmental mitigation measure specified in the EMP, compliance issues, and corrective actions, if any;
   (vii) Support PMU3 to establish a contract with Ministry of Environment (MOE) for environmental effects monitoring to establish baseline conditions and to undertake field measurements for dust, noise, vibration, and water quality prior to construction, as required in the EMP and to provide corresponding reports. Include interpretation of monitoring results and trends in semi-annual environmental reports to be submitted to ADB ;
   (viii) coordinate with the International Social Development/Safeguards Specialist in preparing environmental training materials and train the Environment and Social Office (ESO) and project management unit (PMU) 3 staff in the scope and details of their responsibilities so they can inform and train staff of other offices of MPWT;
   (ix) undertake environmental training for the MPWT/ESO/PMU3 staff to build their capacity on environmental management and monitoring. The training will be implemented through on-the-job training and workshops based on the provisions of the EMP.
   (x) ensure that the affected stakeholders and sensitive receptors (hospitals, schools, temples) are informed about the project by the PMU3 and contractors prior to start of construction.
   (xi) Ensure that the results of the consultations are documented in the environmental monitoring reports.

B. National Environmental Specialist.

2. The national environmental specialist will provide assistance to the international environmental specialist including acquisition of information new information to update the project EMP at detailed design, and work with the PMU3 with overall environmental management of the implementation of the project.

3. The national consultant will assist with:

(i) updating the EMP to ensure that EMP addresses the detailed designs and engineering of each national road (NR1, NR6);
(ii) deliver initial training to PMU3 on the purpose, content, and roles and responsibilities for implementation of updated EMP;
(iii) ensure relevant safeguards of the EMP are addressed in the bidding documents in paccurate local language and in evaluation criteria for awarding contracts;
(iv) help PMU3 to ensure that contractors prepare their respective site-specific plans based on the updated EMP and the actual site conditions;
(v) help the international consultant oversee the implementation of all safeguards of the EMP relating to construction phase activities including handling of construction spoil and waste, water and air quality protection, public nuisance impacts (noise, dust, traffic, blocked access, workers, and camps), and public safety;
(vi) assist coordination with the PMU3 on all relevantenvironmental regulatory compliance issues (e.g. noise and dust from construction sites, sanitation in workers campsite etc);
(vii) with PMU3 prepare TORs for the follow-up interviews and consultations with the same affected stakeholder and local residents contacted during the feasibility design stage on issues and concerns arising during project construction;
(viii) assist PMU3 to address vehicle traffic issues;
(ix) with the international consultant, advise PMU3 on environment-related concerns arising during construction phase, and recommend corrective measures;
(x) coordinate with the MOE and PMU3 relative to the identification of environmental monitoring stations and the conduct of environmental baseline sampling for air quality, noise, vibration and water quality as required in the EMP; in coordination with PMU3, ensure dissemination to stakeholders the results of environment quality monitoring and implementation of safeguards, especially among households or small businesses near the civil construction works areas; and
(xi) assist with all reporting for the EMP.

4. The consultant should have a university degree in the environmental sciences and at least 5 years with environmental assessment of infrastructure projects in Cambodia including: (a) understanding of ADB and national environmental safeguard requirements; (b) experience working with international consultants; and (c) delivering training and capacity development programs to subproject implementing units.

Appendix D: Environmental Standards for Cambodia

From Government Sub-decree on Water Pollution Control (1999)
http://www.wepa-db.net/policies/law/cambodia/02.htm

Table 1. Effluent standard for pollution sources discharging wastewater to public water areas or sewer access

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	^{0}C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD5 (5 days at 200 C)	mg/l	< 30	< 80
4	Chemical Oxygen Demand	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 50	< 80
6	Total Dissolved Solids	mg/l	< 1000	< 2000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate	mg/l	< 3.0	< 6.0
16	Cyanide	mg/l	< 0.2	< 1.5
17	Barium	mg/l	< 4.0	< 7.0
18	Arsenic	mg/l	< 0.10	< 1.0
19	Tin	mg/l	< 2.0	< 8.0
20	Iron	mg/l	< 1.0	< 20
21	Boron	mg/l	< 1.0	< 5.0
22	Manganese	mg/l	< 1.0	< 5.0
23	Cadmium	mg/l	< 0.1	< 0.5
24	Chromium +3	mg/l	< 0.2	< 1.0
25	Chromium +6	mg/l	< 0.05	< 0.5
26	Copper	mg/l	< 0.2	< 1.0
27	Lead	mg/l	< 0.1	< 1.0
28	Mercury	mg/l	< 0.002	< 0.05
29	Nickel	mg/l	< 0.2	< 1.0
30	Selenium	mg/l	< 0.05	< 0.5
31	Silver	mg/l	< 0.1	< 0.5
32	Zinc	mg/l	< 1.0	< 3.0
33	Molybdenum	mg/l	< 0.1	< 1.0
34	Ammonia	mg/l	< 5.0	< 7.0

35	dissolved oxygen	mg/l	> 2.0	> 1.0
36	Polychlorinated Biphenyl	mg/l	< 0.003	< 0.003
37	Calcium	mg/l	< 150	< 200
38	Magnesium	mg/l	< 150	< 200
39	Carbon tetrachloride	mg/l	< 3	< 3
40	Hexachloro benzene	mg/l	< 2	< 2
41	DTT	mg/l	< 1.3	< 1.3
42	Endrin	mg/l	< 0.01	< 0.01
43	Dieldrin	mg/l	< 0.01	< 0.01
44	Aldrin	mg/l	< 0.01	< 0.01
45	Isodrin	mg/l	< 0.01	< 0.01
46	Perchloro ethylene	mg/l	< 2.5	< 2.5
47	Hexachloro butadiene	mg/l	< 3	< 3
48	Chloroform	mg/l	< 1	< 1
49	1,2 Dichloro ethylene	mg/l	< 2.5	< 2.5
50	Trichloro ethylene	mg/l	< 1	< 1
51	Trichloro benzene	mg/l	< 2	< 2
52	Hexaxhloro cyclohexene	mg/l	< 2	< 2

Remark: The Ministry of Environment and the Ministry of Agriculture, Forestry and Fishery shall collaborate to set up the standard of pesticides which discharged from pollution sources.

Table 2: Water Quality Standard in public water areas for bio-diversity conservation

I. For River

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	BOD5	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 5000

II. Lakes and Reservoirs

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	Chemical Oxygen Demand	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	– 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05

III. Coastal Water

No	Parameter	Unit	Standard Value
1	pH	mg/l	7.0 – 8.3
2	Chemical Oxygen Demand	mg/l	2 – 8
3	Dissolved Oxygen	mg/l	2 - 7.5
4	Coliform	MPN/100ml	< 1000
5	Oil content	mg/l	0
6	Total Nitrogen	mg/l	– 1.0
7	Total Phosphorus	mg/l	0.02 – 0.09

Table 3. Water Quality Standard in public water areas for public health protection

No	Parameter	Unit	Standard Value
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

APPENDIX E: LIST OF AIR AND NOISE SENSITIVE RECEPTORS FOR NR1 AND NR6

National Road 1

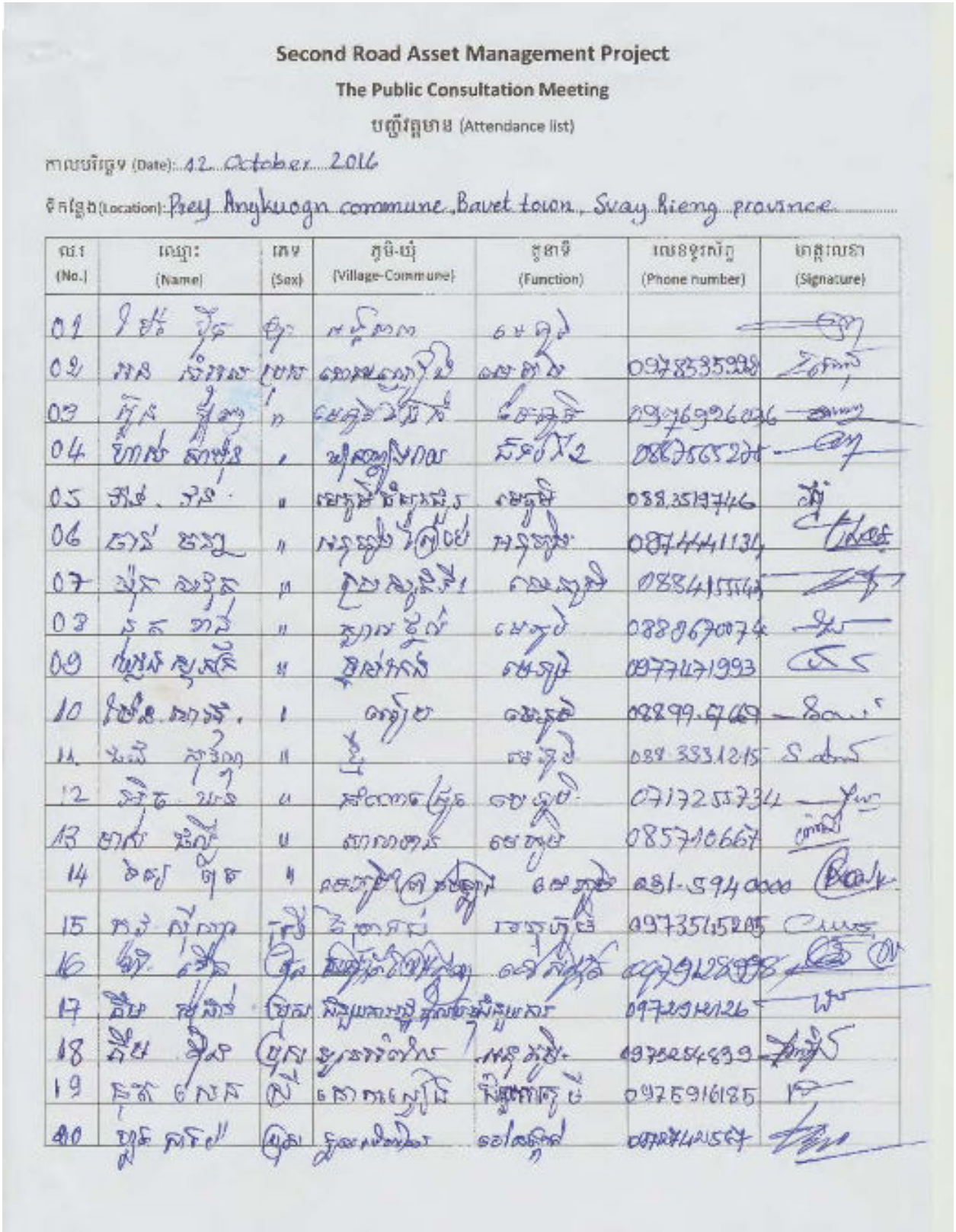
Province/District	Commune	School	Hospital	Pagoda/Temple
NR1				
Prey Veng Province				
Peam Ro	Nak Loeung	Steung Slot Primary School	-	-
Preah Sdack	Kampong Seung	Preah Chi Thom Primary School	-	Rottana Ream Pagoda Preah Chhithom Pagoda
	Lvea	Ta Kok High School Samdach Ouv Lvea Primary School	Lvea Health Center	
	Krang Svay	Krang Svay Primary School	-	1. Krang Svay Pagoda
Kampong Trabaek	Kampong Trabaek	Kampong Trabaek Primary School Kampong Trabaek Secondary School	Kampong Trabaek Health Center Kampong Trabaek District Referral Hospital	-
	Prasat	Prasat Primary School Kampong Trabaek High School Wat Ampil Primary School	-	1. Prasat Pagoda 2. Ka Pak Pagoda 3. Ampil Pagoda
	Prey Chhor	Prey Chhor Primary School	1. Prey Chhor Health Center	
Svay Rieng Province				
Svay Chum	Kraol Kou	1. Kraol Kou Primary School 2. Kraol Kou High School	1. Kroal Kou Helath Center	
	Ta Sous	1. Prek Toup Primary School	-	-
	Svay Chrum	1. Hun Sen Svay Chrum High School	1. Svay Shrum District Referral Hospital	1. Svay Chrum Pagoda
Svay Rieng	Chek	1. Thmar Sar Primary School 2. Hun Sen Check High School	-	-
	Svay Rieng	1. Teacher Training Center 2. Svay Rieng High School	1. Svay Rieng Hospital	-
	Sang Khoar	-	1. Sangkhoar Health Center	1. Sang Khoar Pagoda
Svay Teap	Sambour	-	-	-

Province/District	Commune	School	Hospital	Pagoda/Temple
	Kandieng Reay	1. Moeng Sam Phom Primary School	-	-
	Prasoutr	1. Samky Rangsei Primary School	1. Prasoutr Health Center	1. Samky Rangsei Pagoda
Bavet	Chrat Mtes	-	1. Chark Mtes Health Center	1. Sovanna Ream Pagoda
	Prey Angkungn	1. Chhi Phu High School	1. Chhi Phu Referral Hospital	-
	Bavet	1. Por Thmei Primary and Secondary School	1. Bavet Health Center	1. Por Thmei Pagoda

National Road 6

Province/District	Commune	School	Hospital	Pagoda/Temple
NR6				
Siem Reap Province				
Siem Reap Town	Tuek Vil	1. Seang Nam Sandan Primary School 2. Chey Primary School	Health Center	Prey Thom Pagoda
Puok District	Khnat	1. Phay Primary School 2. Khnat Primary and Secondary School 3. Samdech Krong Preah Primary School	-	Khnat Pagoda
	Puok	1. Puok High School 2. Tea Bagn Primary School 3. Puok Primary School	1. Puok District Referral Hospital	1. Svay Dangkom Pagoda
	Lvea	1. Daun Tror Primary and Secondary School 2. Tuol Vieng Primary School	-	-
	Sasar Sdam	1. Pak Pan Primary School 2. Sasar Sdam High School 3. Sasar Sdam Primary School	1. Sasar Sdam Health Center	1. Sasar Sdam Pagoda
	Prey Chrouk	1. Prey Chrouk Primary School 2. Prey Chrouk Secondary School	1. Prey Chrouk Health Center	1. Balang Rangsei Pagoda
Kralanh District	Sranal	1. Moha Samki Primary School 2. Sranal Primary School	1. Sranal Health Center	1. Or Chum Banteay Chey Pagoda 2. Sranal Pagoda
	Kralanh	1. Kralanh High School	1. Kralanh Health Center	1. Kralanh Pagoda
	Kampong Thkov	1. Phum Kam Ru Secondary School	-	-

APPENDIX F: PARTICIPANTS OF PUBLIC CONSULTATIONS



Second Road Asset Management Project

The Public Consultation Meeting

បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 12 October 2016

ទីកន្លែង (Location): Prey Angkuoan commune, Bavet town, Svay Rieng province

លរ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	មុខងារ (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
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ទីកន្លែង (Location): Prey Angkuogn commune, Bavet town, Svay Rieng province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
21	[illegible]	[illegible]	[illegible]	[illegible]	0887968059	[signature]
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29	[illegible]	″	[illegible]	[illegible]	0973939616	[signature]

Second Road Asset Management Project

The Public Consultation Meeting

បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 11 តុលា 2016

ទីកន្លែង (Location): [illegible]
Svay Chrum Commune, Svay Chrum district, Svay Rieng province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
01	[illegible]	ស្រី	[illegible]	[illegible]	088454441	[illegible]
02	[illegible]	ប.	[illegible]	[illegible]	077976576	[illegible]
03	[illegible]	ប	[illegible]	[illegible]	088.536[illegible]	[illegible]
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16	[illegible]	ប្រុស	[illegible]	[illegible]	0976393283	Mouk
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Second Road Asset Management Project

The Public Consultation Meeting

បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 11 October 2016

ទីកន្លែង (Location): Svay Chrum commune, Svay Chrum district, Svay Rieng province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
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Second Road Asset Management Project

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បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 11 [illegible] 2016

ទីកន្លែង (Location): [illegible]
Kampong Trabaek Commune, Kampong Trabaek district, Prey Veng province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
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Second Road Asset Management Project

The Public Consultation Meeting

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កាលបរិច្ឆេទ (Date): 11 [illegible] 2016

ទីកន្លែង (Location): [illegible]
kampong Trabaek commune, kampong Trabaek district, Prey Veng province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
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Second Road Asset Management Project

The Public Consultation Meeting

បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 14 October 2016

ទីកន្លែង (Location): Lvea commune, Puok district, Siem Reap province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	តួនាទី (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
01	[illegible]	[illegible]	[illegible]	[illegible]	099393918	[illegible]
02	[illegible]	[illegible]	[illegible]	[illegible]	0934294[illegible]	[illegible]
03	[illegible]	[illegible]	[illegible]	[illegible]	012·1303081	[illegible]
04	[illegible]	[illegible]	[illegible]	[illegible]	08884-67155	[illegible]
05	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
06	[illegible]	[illegible]	[illegible]	[illegible]	012813458	[illegible]
07	[illegible]	[illegible]	[illegible]	[illegible]	017506164	[illegible]
08	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
09	[illegible]	[illegible]	[illegible]	[illegible]	0887270050	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	0976484392	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	0976978429	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	078752645	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	0121803071	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	092219645	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	0888460238	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	092935927	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	012.992.861	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	089952496	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	092219418	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	093583882	[illegible]

Second Road Asset Management Project

The Public Consultation Meeting

បញ្ជីវត្តមាន (Attendance list)

កាលបរិច្ឆេទ (Date): 14 October 2016

ទីកន្លែង(Location): Svea commune, Puok district, Siem Reap, province

ល.រ (No.)	ឈ្មោះ (Name)	ភេទ (Sex)	ភូមិ-ឃុំ (Village-Commune)	មុខងារ (Function)	លេខទូរស័ព្ទ (Phone number)	ហត្ថលេខា (Signature)
21	[illegible]	ស	[illegible]	[illegible]	078991763	[illegible]
២២	[illegible]	ស	[illegible]	[illegible]	031939505	[illegible]
២៣	[illegible]	ប	[illegible]	[illegible]	089698961	[illegible]
២៤	[illegible]	ប	[illegible]	[illegible]		[illegible]
25	[illegible]	ស	[illegible]	[illegible]	097693009	[illegible]
26	[illegible]	ស	[illegible]	[illegible]	031426924	[illegible]
27	[illegible]	ស	[illegible]	[illegible]	017340042	[illegible]
២៨	[illegible]	ប	[illegible]	[illegible]	096686162	[illegible]
២៩	[illegible]	ស	[illegible]	[illegible]	093614785	[illegible]
30	[illegible]	ប	[illegible]	[illegible]	012458698	[illegible]