

Environmental Management Plan

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Project 49387-002

Lao People's Democratic Republic: Second Greater
Mekong Subregion Tourism Infrastructure for Inclusive
Growth Project

Vientiane Province

This environmental management plan forms part of the initial environmental examination. It is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

ABBREVIATIONS

ADB	Asian Development Bank
AH	Affected Household
DPWT	Department of Public Works and Transport
DONRE	Department of Natural Resources and Environment
EA	Environmental Assessment
EA	Executing Agency
ECC	Environmental Compliance Certificate
EIA	Environment Impact Assessment
EMI	Environmental Monitoring Institute
EMP	Environment Management Plan
EMR	Environmental Monitoring Report
EERT	External Emergency Response Team
ERT	Emergency Response Team
ERTL	Emergency Response Team Leader
EO	Environmental Officer
IA	Project Implementing Agency
GMS	Greater Mekong Sub-Region
Government	Government of Lao PDR
GPS	Global Positioning System
IEE	Initial Environmental Examination
MONRE	Ministry of Natural Resources and Environment
MPWT	Ministry of Public Works and Transport
O&M	Operation and Maintenance
PCU	Project Coordinating Unit
PIU	Project Implementation Unit
PMCESPMCES	Project Management & Civil Engineering Support Consultant
SS	Safeguard Specialist
UDAA	Urban Development and Administration Authority
USD	United States Dollar
UXO	Unexploded Ordnance

WEIGHTS AND MEASURES

km	Kilometre
kg	Kilogram
ha	Hectare
mm	Millimeter

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I. INTRODUCTION

1. The environmental management plan (EMP) for the five subprojects in Vientiane province provided herein is one of two provincial-level EMPs that have been prepared for the Second GMS Tourism Infrastructure for Inclusive Growth project. This EMP was prepared for five subprojects in Vientiane province. The other EMP was prepared for two subprojects in Champasak province. An Initial Environmental Examination (IEE) of all subprojects was prepared separately. The EMPs are comprehensive and are developed as stand-alone management tools that are supported by the parent IEE.

A. Vientiane Province Subprojects

2. The subprojects in Vientiane province are listed in Table 1.

Table 1. Subprojects of Vientiane province

- | |
|---|
| <ul style="list-style-type: none">• Nam Ngum Reservoir Access Improvements• Kaeng Yui Waterfall Access Improvements• Western Loop Rural Access Road and Bridge Improvements• Vang Vieng Urban Renewal• Vang Vieng Solid Waste Management Improvements |
|---|

II. INSTITUTIONAL ARRANGEMENTS & RESPONSIBILITIES

3. At the feasibility stage, the primary management framework for the implementation of the environmental management plan (EMP) is summarized below. The Ministry of Information Culture and Tourism (MICT), the executing agency (EA) for the project, will take overall responsibility for the EMP. The EA will establish a Vientiane-based Project Coordination Unit (PCU) within the Tourism Development Department of MICT which, among other things, will appoint a Safeguards and Monitoring Coordination Officer for the EMP.

4. The Implementing Agencies (IA) are the provincial Department of Information, Culture and Tourism (DICT), Department of Public Works and Transport (DPWT), and Vang Vieng Urban Development Administration Authority (UDAA). A Project Steering Committee (PSC) will be established to provide policy and compliance oversight, comprised of representatives from the DICT, DPWT, Department of Finance (DOF), Department of Planning and Investment (DFI), Department of Natural Resources and Environment (DONRE), UDAA, and representatives of other departments and agencies as required.

5. There will be two Project Implementation Units (PIU). One PIU will reside in DICT and will oversee the Nam Ngum Reservoir Access Improvements subproject, with support from Keo Oudom Office of Public Works and Transport for infrastructure design and construction supervision. The other PIU resides in the Vang Vieng UDAA, with support from Vientiane Province DPWT, will be responsible for all other infrastructure subprojects in Vang Vieng. The PIUs will appoint 1-2 Safeguard Specialists, to be responsible for day to day implementation of the EMPs. The PCU will coordinate inter-agency safeguard support to the PIUs, and will liaise with the ADB on safeguard reporting and issues.

6. The PIU's Safeguards Specialist will oversee the work of the contractor's Environmental Officer (EO) for implementation of the CEMP¹ for each construction package. External support to the PIU for implementation of the EMP will be provided by the Project Management and Civil Engineering Support Consultant's (PMCES) International and National Environment Specialists (IES/NES) and an external Environmental Monitoring Institute (EMI). The EMI will conduct field sampling and laboratory analyses of water quality, air quality and other analysis required by the EMP that cannot be performed directly by the contractor or PMCES.

7. The responsibilities of the different agencies in the management framework are listed in Annex A. Below is a summary of responsibilities for implementation of the EMP.

8. Responsibilities of the EA include:

- Coordinate environmental and social safeguards and monitoring for IA/PIU;
- Oversee successful operation of Grievance Redress Mechanism (GRM) and try resolve any submitted stakeholder grievances at project level if possible.
- With support from IA/PIU prepare reports on Grievance Redress Mechanism (GRM) as needed;
- Liaise with ADB on the implementation of the EMP;
- With support from IA/PIU complete and submit semi-annual environmental monitoring reports to ADB and
- Coordinate with IA, and ADB if necessary, on issues arising from the implementation of EMP and any required corrective actions or updates.

9. Responsibilities of IA include:

- Oversee and provide support for implementation of EMP by PIUs
- Liaise with PCU and EA on issues with safeguards of EMP identified by PIUs
- With assistance from PIU prepare reports to EA on EMP implementation including semiannual environmental monitoring reports for ADB

10. The responsibilities of the Safeguards Specialist (SS) of PIU include:

- Assist IES/NES of PMCES with updating the EMP to meet final detailed subproject designs;
- Notify DONRE to verify Government approvals of project are met, and that EMP is compliant with Environmental Compliance Certificate (ECC) of project;
- Assist PMCES with inclusion of CEMP requirements in contractor bid documents including bid evaluations based on updated EMP;
- With IES/NES of PMCES review and approve submitted CEMPs of contractors;
- Undertake day to day management of EMP implementation activities;
- Work with EMI on implementation of monitoring plan of EMP;
- Ensuring compliance with loan covenants and assurances in respect of all subprojects, including EMPs (as well as IPPs, GAPs and resettlement plans);
- Lead follow-up meetings with all affected stakeholders;
- Prepare and submit quarterly reports on EMP implementation to PCU;
- Oversee implementation of CEMP by contractor;

- Coordinate with IES/NES of PMCES for EMP implementation;
- Undertake regular construction site inspections to ensure contractor implements CEMP properly; and
- Ensure EO of contractor submits monthly reports on construction mitigation and monitoring.

11. The responsibilities of the IES/NES of the PMCES/PMCES are detailed in the indicative Terms of Reference for the two positions in Annex B. Key responsibilities for the EMP are listed below:

- Updating the EMP to meet final detailed designs of subprojects;
- Provide technical direction and support to PIUs for EMP implementation;
- Support PIUs with review of contractor CEMPs
- Oversee design and delivery of capacity development and training of PIU and contractor's EO;
- Provide advice and support to EMI with their monitoring activities;
- Receive monitoring reports from EMI and with SS/PIUs prepare semiannual monitoring reports for IAEA for ADB; and
- Review location of any possible contaminated sites near subprojects.
- Prepare and conduct biodiversity study of Phu Hong-Phu Ban District Conservation Forests near Kaeng Yui Waterfall.

12. The responsibilities of Environmental Officer (EO) of Contractor include:

- Implement contractor's CEMP for construction phase of subprojects; and
- Prepare and submit monthly reports on mitigation and monitoring activities of CEMP and any environmental issues at construction sites.

13. The responsibilities of Environmental Monitoring Institute (EMI) include:

- Implement the environmental sampling required for monitoring plan of EMP that cannot be conducted by the contractor and PIU.
- Perform required laboratory analyses for monitoring program detailed in EMP; and
- Prepare and submit quarterly reports to PIU on monitoring activities.

14. The Department of Natural Resources and Environment (DONRE) is the provincial agency which oversees environmental management of Vientiane province. The DONRE with District staff provides direction and support for environmental protection-related matters including application of the Law on Environmental Protection No. 02/99/NA (1999), EIA, and environmental standards.

15. The ADB provides guidance to EA/PCU/IA with any issues related to EMP, and reviews biannual reports on EMP activities compiled and submitted by PCU which are disclosed on the ADB website pursuant to ADB's Public Communications Policy (2011).

A. Worker and Community Health and Safety

16. Central to construction and operation phases of all subprojects is to ensure workers and the public are not harmed from construction activities and ultimately the operation of the completed subprojects.

17. Based on the New Global Strategies in Occupational Safety and Health (OSH) developed by the International Labour Organization (ILO) in 2003 the Ministry of Labour and Social Welfare (MLSW) of Government is currently developing the Lao PDR National OSH Programme². To facilitate the development of the OSH the National Occupational Health & Safety Programme (2005-2010) was initiated.

18. The emerging OSH, *inter alia*, addresses worker and public safety in the construction and operation of small-medium enterprises and notably rural roads. The EA/PCU as supported by the PIUs must obtain and implement the directives of the OSH Programme. Pertinent associated laws and policy include the Labour Law of Lao PDR, and Decree No. 24/PR of the President of Republic, dated 21 April 1994, promulgating law No. 002/NA of 14 March 1994, concerning Labour.

19. To supplement the National Occupational Health & Safety Programme the IFC/World Bank Environment, Health, and Safety Guidelines (2007) should also be consulted. The IFC EHS guidelines provide the international standard for worker and public safety.

20. DONRE with District staff provides direction and support for environmental protection-related matters including application of the Law on Environmental Protection No. 02/99/NA (1999), EIA, and environmental standards.

21. The ADB assists the PCU with timely guidance at each stage of project implementation following agreed implementation arrangements, and will review and approved detailed design documents, updated IEEs/EMPs, project progress reports, semi-annual safeguard monitoring reports and project completion report. ADB will field one or two missions per year depending on need.

B. Regulatory Framework and Guidelines for Subproject

22. Specific regulations and guidelines for the Vientiane subprojects are summarized in Table 2. The regulations and guidelines, *inter alia*, identify how access road upgrades and river bridge and shoreline works should be implemented to prevent or minimize negative impacts on the environment. Environmental standards are found in Annex C.

Table 2. Design Regulations, guidelines and standards applicable to Vientiane subprojects.

Road Upgrades
<ul style="list-style-type: none"> • Lao PDR Road Design Manual with reference to AASHTO A Policy on Geometric Design of Highways and Streets, 5th edition. • RDA's Lao Bridge Design Manual, 1998 with reference to AASHTO LRFD Bridge Design Specifications, 4th, Edition, 2007 • Transport Research Laboratory's (TRL) Road Note 31, 4th edition. • Road Development Authority (RDA's) standards incorporating relevant standards from the AASHTO Highway Drainage Guidelines. • MPWT (2006). Specifications for drainage system, culverts, street lighting and tree planting

² ILO, 2009. Asean-Oshnet, Occupational Safety and Health Practices.

(Mekong) Riverbank Works
<ul style="list-style-type: none"> • The Manual and Study on Mekong Riverbank Protection around the Vientiane Municipality, Lao PDR. Draft Final Report. JICA September 2004 • California Bank and Shore Rocks Slope Protection Design, Practitioner's Guide and Field Evaluations of Riprap Methods Final Report No. FHWA-CA-TL-95-10, Caltrans Study No. F90TL03, Third Edition - Internet October 2000, Prepared in Cooperation with the US Department of Transportation Federal Highway Administration • Highway Design Manual, Chapter 870 Channel and Shoe Protection Erosion Protection Control, 26 June 2006. • NRCS Stream Restoration Design Handbook, Stone Sizing Criteria, National Handbook, 210-NEH, August 2007.
Occupational and Public Health and Safety
<ul style="list-style-type: none"> • MSLW, Lao PDR Occupational, Safety, and Health Guidelines Programme, Draft 2005-2010 • IFC/World Bank, 2007. Environment, Health, and Safety Guidelines (EHS)
Environmental Standards
<ul style="list-style-type: none"> • Agreement on National Environmental Standards, Order No. 2734/PMO-MONRE, 7 Dec 2009. Annex C excerpts standards relevant to the 5 subprojects

III. SUMMARY OF POTENTIAL IMPACTS

23. The potential environmental impacts of the subprojects in Vientiane province from IEE are summarized in Table 3. The required mitigation measures for the three phases of development (pre-construction, construction, and operation) are detailed in Table 4.

Table 3. Summary of potential impacts of Vientiane subprojects

Pre-construction Phase
<ul style="list-style-type: none"> • Land acquisition for road upgrades which is detailed in separate Resettlement plan. • Potential disruption of waste picking at dumpsite during initiation of relocation of huts at dumpsite & siting for MRF.
Construction Phase
<p>Common disturbances and potential impacts of road upgrades & bridge components of the 5 subprojects (Table 1):</p> <ul style="list-style-type: none"> • Reduced and/or blocked public access, disrupted business and recreation, noise, dust, caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, public and worker accidents, disruption of traffic, increased traffic accidents, land erosion and sedimentation of Nam Song river and Nam Ngum reservoir inshore zone, drainage and flooding problems, solid and domestic waste from worker

<p>camps, social issues and community problems caused by migrant workers. These short-term impacts will vary in magnitude with construction activities of the different subprojects.</p> <p>Pier and shoreline developments along Nam Ngum reservoir and Nam Song river:</p> <ul style="list-style-type: none"> • The impact of maximum short-term sedimentation and turbidity on water quality caused by erosion and re-suspension of sediments from civil works will occur at the specific sites. Aquatic habitat, and other uses of the affected sites such as boating and fishing near the sites will also be equally disturbed. <p>Landfill upgrade</p> <ul style="list-style-type: none"> • Disrupted waste picking livelihoods • Dust and noise created from excavation and earthworks for new waste cells & bulldozing & burying old waste • Ponding & flooding at site from disturbed established drainage • Groundwater study to be conducted during pre-construction phase to determine water table depth and design implications for lining and cell depth. • No streams were located near dumpsite so sedimentation and potential contamination of surface waters is anticipated.
Operation Phase
<p>Vang Vieng Solid Waste Management Improvements:</p> <ul style="list-style-type: none"> • Contamination of groundwater by the upgraded Vang Vieng landfill including septage facility. <p>Upgraded and new access roads of seven subprojects:</p> <ul style="list-style-type: none"> • Increased traffic and risk of traffic accidents, noise and dust along upgraded access roads. <p>New piers, bridge, and market stall-shoreline development, and foot and cycle pathways on Nam Ngum reservoir and along Nam Song river</p> <ul style="list-style-type: none"> • Water pollution from discarded solid waste from tourists, and bilge, fuel and oil from increased boat traffic in nearshore area of Nam Ngum reservoir. • Increased boat congestion along Nam Ngum reservoir recreation shoreline.

A. Public Consultation

24. The stakeholder consultation strategy that was developed and implemented for the IEE should be continued with the initiation of detailed engineering designs at start of the pre-construction phase of the subprojects. The first step will be the disclosure of the IEE to the affected stakeholders identified in the IEE for their review and comment.

1. Follow-up Consultation

25. As indicated in the IEE, a primary concern of the public and stakeholders of the subproject were disturbances during construction phase of the subproject components. Those issues plus any others will be reviewed during follow-up consultations throughout the pre-construction, construction, and operation of the completed subproject components. The indicative public consultation plan is provided in Table 4.

Table 4. Indicative Public Consultation Plan

Organizer / support	Format	Frequency	Topic	Attendees
Pre-construction - Construction Stage				
PMU / PMCES	Same Public consultation format used during IEE, including site visits and informal interviews as needed	Once near end of pre-construction stage just before construction commences (public meetings), and as needed (site visits, informal interviews) thereafter during construction phase	Presentation of planned activities and schedule; anticipated impacts and mitigation measures; GRM	Affected households, district representatives, and participants from consultations during IEE
Operational Stage				
PMU / PMCES	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Affected households, district representatives, participants of consultations during IEE
PMCES / PMU	Public satisfaction survey if desired or needed	Once just before Project Completion Report (PCR) issued	Public satisfaction with EMP implementation Comments and suggestions	Affected households, district representatives, participants of consultations during IEE

IV. MITIGATION PLAN

26. The mitigation measures of the EMP are presented in a comprehensive mitigation plan for the five subprojects in Table 5. Following the IEE, the mitigation plan is structured by the three development phases of the subproject defined by the pre-construction; construction; and post construction operational phase. The mitigation plan addresses the environmental issues and concerns raised at the stakeholder meetings.

27. The mitigation plan combines construction phase impacts common to all subprojects and subprojects components for which single mitigation measures are prescribed. In this way redundant mitigation measures are not re-stated numerous times. However, impacts and required mitigations specific to a subproject component are also identified. Or, common mitigations that are particularly important for a subproject and affected environmental component(s) are emphasized.

28. The mitigation plan identifies potential impacts, required mitigations, responsible parties, location, timing, and indicative costs. The mitigation plan is comprehensive and will be updated to meet the final detailed designs of the subproject.

29. Contractors will be required to prepare EMPs (CEMP) for their construction packages and submit the CEMPs as part of their bidding documents. The CEMPs will be developed from the EMP provide herein which will be included in the tender documents. As indicated above, the CEMPs will be approved by the PMCES and PIUs.

Table 5. Environmental impact mitigation plan

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
<i>Pre-construction, detailed design phase of all 5 subprojects</i>								
Confirmation of required compensation	No negative environmental impacts	1. Affected persons well informed well ahead of subproject implementation.	All affected persons in subproject areas	Before detailed designs initiated	See resettlement plans	See resettlement plan	EA/IA	Resettlement committees
Disclosure, & engagement of community	No community impacts	2. Initiate Information Disclosure and Grievance Redress Mechanism of IEE, and public consultation on detailed engineering designs	For all construction sites.	Before detailed designs initiated	Quarterly	No marginal cost ⁴	IA/PIU	PIU
Government approvals	No negative impact	3. Notify DONRE of subproject initiation to complete environmental assessment requirements, and obtain required project permits and certificates.	Entire subproject, Nam Ngum recreation access road	Before construction	As required	No marginal cost	PIU/DONRE	DONRE
Contact tourist & commercial boat companies	No negative impact	4. Inform tourist and commercial boat companies of schedule of civil works for river port, and all shoreline civil works.	Nam Ngum recreation area & Vang Vieng town	Before construction	As required	No marginal cost	PMCES/PIU	PMCES/PIU
Contact current waste pickers at VV dumpsite	No negative impact on waste pickers	5. Review waste recycling and inform pickers of future training and placement at new MRF of upgraded landfill.	Existing dumpsite	Before construction	As required	No marginal cost	PMCES/PIU	PMCES/PIU
Biodiversity Study	No negative impact	6. PMCES to conduct survey in Phu Hong-Phu Ban conservation forest at Kaeng Yui waterfall	Conservation forest adjacent to waterfall area	Before construction	Once	\$5,000	PMCES	IES/NES

³ Costs will need to be updated during detailed design phase.

⁴ No marginal cost indicates that costs to implement mitigation are to be built into cost estimates of bids of contractors

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Groundwater study	No negative impact on groundwater	7. Commission groundwater study at existing dumpsite including installation of bore holes for groundwater sampling as per TOR in IEE.	Existing dumpsite	Before construction	As required	See Monitoring Plan	PMCES/PIU	PMCES/PIU

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Detailed designs of subproject,	Minimize negative environmental impacts	<p>8. Work by PMCES⁵ to complete detailed designs of all components of all 5 subprojects. Ensure the following measures are included:</p> <p>a) identification of spill management prevention plans, and emergency response plans for all construction sites;</p> <p>b) no disturbance or damage to culture property and values;</p> <p>c) minimal acquisition of agriculture and forested lands;</p> <p>d) locate DONRE-approved borrow pits areas away from human settlements with fencing and access barriers;</p> <p>e) locate concrete and asphalt batch plants away from human settlements with fencing and access barriers</p> <p>f) no, or minimal disruption to water supplies along access roads, utilities, and electricity with contingency plans for unavoidable disruptions;</p> <p>g) no, or minimal disruption to normal pedestrian and vehicle traffic along all road segments with contingency alternate routes;</p> <p>h) for all areas include specific plan to notify & provide residents and merchants of construction activities & schedule to minimize disruption to normal commercial and residential activities.</p> <p>i) review and ensure climate change resilience measures integrated in subproject infrastructure designs</p>	Final siting	Before construction initiated	Once with detailed designs documents	No marginal cost	PMCES/EA	PMCES/PIU

⁵ PMCES is Project management and supervision consultant to be determined

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Update EMP	Positive environmental impacts	<p>9. Identify any new potential impacts of subprojects and include in updated IEE and EMP with special attention to all affected villages and tourist reception areas.</p> <p>10. Re-clarify with DONRE that no known rare or endangered species inhabit the subproject areas</p> <p>11. Update IEE and EMP where necessary to meet detailed designs, and to protect affected environments.</p> <p>12. Submit updated IEE and EMP to ADB to review and approval prior to bidding.</p> <p>13. Develop individual management sub-plans for: a) Construction drainage; b) Erosion; c) Noise and Dust; d) Contaminated Spoil Disposal; e) Solid and Liquid Waste Disposal; f) Construction & Urban Traffic; g) Utility and Power Disruption; h) Worker and Public Safety; i) Tree and Vegetation Removal and Site Restoration; j) Construction Materials Acquisition, Transport, & Storage, and k) Cultural chance finds.</p>	All sites	Before construction initiated	Once with detailed designs documents	No marginal cost	PMCES	EA/PIU
Confirm Government approved construction waste disposal sites	No negative impact	14. Notify DONRE, DAF, DPWT to confirm locations of sites for borrow pits and disposal areas for construction and hazardous waste for subprojects, and obtain required permits.	Entire subproject	Before construction	As required	No marginal cost	PIU/DONRE/DAF/DICT	PIU
UXO survey, & removal	Injured worker or public	15. Ensure Government and UXO LAO is consulted and clears areas where necessary	All construction sites.	Beginning of subproject	Once	See Monitoring Plan below	EA/PIU	UXO LAO
Create awareness of physical cultural resources in area	No negative environmental impact	16. DICT to review potential locations of physical resources, and explain possible PCR to contractors and PMCES	All subproject areas	Before construction begins	Once	No marginal cost	PIU/DICT	DICT

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Develop bid documents	No negative environmental impact	17. Ensure updated EMP is included in contractor tender documents, and that tender documents specify requirement for site-specific CEMP with budget. 18. Specify in bid documents that contractor must have experience with implementing EMPs and provide designated environment, health and safety staff with experience.	All subproject areas	Before construction begins	Once for all tenders	No marginal cost	PMCES/EA	PIU
Obtain & activate permits and licenses	Prevent or minimize impacts	19. Contractors to comply with all statutory requirements of Government for use of construction equipment, and operation construction plants such as concrete batching.	For all construction sites	Beginning of construction	Once	No marginal cost	PMCES	PIU & contractors
Capacity development	No negative environmental impact	20. Develop and schedule training plan for (PIU/SS) to be able to fully implement EMP, and to manage implementation of mitigation measures by contractors. 21. Create awareness and training plan for contractors whom will implement mitigation measures.	All subproject areas	Before construction begins	Initially, refresher later if needed	No marginal cost	PMCES	PMCES/PIU
Recruitment of workers	Spread of sexually transmitted disease	22. Use local workers as much as possible thereby reducing number of migrant workers	All work forces.	Throughout construction phase	Worker hiring stages	No marginal cost	EA/PIU	Contractor's bid documents
Construction phase of all 5 subprojects								
Initiate CEMP & sub-mitigation plans,	Prevent or minimize impacts	23. Prepare site-specific CEMP including individual management sub-plans for different potential impact areas that are completed in pre-construction phase (see sub-plan guidance below).	For all construction sites	Beginning of construction	Once	No marginal cost	PMCES	PIU & contractors

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Worker camps	Pollution and social problems	<p>24. Locate worker camps away from human settlements.</p> <p>25. Ensure adequate housing and waste disposal facilities including pit latrines and garbage cans.</p> <p>26. A solid waste collection program must be established and implemented that maintains a clean worker camps</p> <p>27. Locate separate pit latrines for male and female workers away from worker living and eating areas.</p> <p>28. A clean-out or infill schedule for pit latrines must be established and implemented to ensure working latrines are available at all times.</p> <p>29. Worker camps must have adequate drainage.</p> <p>30. Local food should be provided to worker camps. Guns and weapons not allowed in camps.</p> <p>31. Interaction of transient workers with local community should be discouraged. HIV Aids education should be given to workers.</p> <p>32. Camp areas must be restored to original condition after construction completed.</p>	All worker camps	Throughout construction phase	Monthly	No marginal cost	PMCES/PIU	contractor
Training & capacity	Prevent of impacts through education	33. Implement training and awareness plan for PIU/SS and contractors.	PIU office, construction sites	Beginning of construction	After each event	No marginal cost	PMCES	PMCES/PIU

<p>Implement construction materials acquisition, transport, and storage sub-plan</p>	<p>Pollution, injury, increased traffic, disrupted access</p>	<p>34. All borrow pits should be approved by DONRE, including any plans to mine sand from Nam Song river or Nam Ngum reservoir.</p> <p>35. Select pits in areas with low gradient and as close as possible to construction sites.</p> <p>36. Required aggregate volumes must be calculated prior to extraction to prevent wastage.</p> <p>37. Pits should not be located near surface waters, forested areas, critical habitat for wildlife, or cultural property or values.</p> <p>38. If sand mining from Nam Song river or Nam Ngum reservoir for shoreline work is essential then only by licensed operators.</p> <p>39. All topsoil and overburden removed should be stockpiled for later restoration.</p> <p>40. All borrow pits should have a fence perimeter with signage to keep public away.</p> <p>41. When use of borrow pits terminates pits should be dewatered and permanent fences installed with signage to keep public out, and site restored as much as possible using original overburden and topsoil.</p> <p>42. Unstable slope conditions in/adjacent to the quarry or pit caused by the extractions should be rectified with tree planting.</p> <p>43. Define & schedule how materials are extracted from borrow pits, transported, and handled & stored at sites.</p> <p>44. Define and schedule how fabricated materials for Nam Song & Nam Ngum reservoir shoreline component such as steel, wood structures, and scaffolding will have transported and handled.</p> <p>45. All aggregate loads on trucks should be covered.</p>	<p>For all construction areas.</p>	<p>Throughout construction phase</p>	<p>Monthly</p>	<p>No marginal cost</p>	<p>PMCES/PIU</p>	<p>contractor</p>
<p>Road bitumen (DBST) production,</p>	<p>Air pollution, land and water contamination,</p>	<p>46. Piles of aggregates at sites should be used/or removed promptly, or covered and placed in non-</p>	<p>For all construction</p>	<p>Throughout construction</p>	<p>Monthly</p>	<p>No marginal cost</p>	<p>PMCES & PIU</p>	<p>contractor</p>

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
and application	and traffic & access problems,	<p>traffic areas</p> <p>47. Store DBST materials well away from all human activity and settlements, and cultural (e.g., schools, hospitals), and ecological receptors. Bitumen production and handling areas should be isolated.</p> <p>48. Contractors must be well trained and experienced with the production, handling, and application of bitumen.</p> <p>49. All spills should be cleaned immediately and handled as per hazardous waste management plan, and according to Government regulations.</p> <p>50. Bitumen should only be spread on designated road beds, not on other land or near any human activities.</p> <p>51. Bitumen should not be used as a fuel.</p>	areas.	phase				

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Implement spoil management sub-plan	Contamination of land and surface waters from excavated spoil, and construction waste	<p>52. Uncontaminated spoil to be disposed of in DONRE-designated sites, which must never be in or adjacent surface waters. Designated sites must be clearly marked and identified.</p> <p>53. Spoil must not be disposed of on sloped land, near cultural property or values, ecologically important areas, or on/near any other culturally or ecologically sensitive feature.</p> <p>54. Where possible spoil should be used at other construction sites, or disposed in spent quarries or borrow pits.</p> <p>55. A record of type, estimated volume, and source of disposed spoil must be recorded.</p> <p>56. Contaminated spoil disposal must follow DONRE regulations including handling, transport, treatment (if necessary), and disposal.</p> <p>57. Suspected contaminated soil must be tested, and disposed of in designated sites identified as per DONRE regulations.</p> <p>58. Before treatment or disposal contaminated spoil must be covered with plastic and isolated from all human activity.</p>	All excavation areas	Throughout construction phase	Monthly	See Monitoring Plan for contaminated soil analyses	PMCES & PIU & DONRE	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Implement solid and liquid construction waste sub-plan	Contamination of land and surface waters from construction waste	<p>59. Management of general solid and liquid waste of construction will follow DONRE regulations, and will cover, collection, handling, transport, recycling, and disposal of waste created from construction activities and worker force.</p> <p>60. Areas of disposal of solid and liquid waste to be determined by DONRE.</p> <p>61. Disposed of waste should be catalogued for type, estimated weigh, and source.</p> <p>62. Construction sites should have large garbage bins.</p> <p>63. A schedule of solid and liquid waste pickup and disposal must be established and followed that ensures construction sites are as clean as possible.</p> <p>64. Solid waste should be separated and recyclables sold to buyers in community.</p> <p><u>Hazardous Waste</u></p> <p>65. Collection, storage, transport, and disposal of hazardous waste such as used oils, gasoline, paint, and other toxics must follow DONRE regulations.</p> <p>66. Wastes should be separated (e.g., hydrocarbons, batteries, paints, organic solvents)</p> <p>67. Wastes must be stored above ground in closed, well labeled, ventilated plastic bins in good condition well away from construction activity areas, all surface water, water supplies, and cultural and ecological sensitive receptors.</p> <p>68. All spills must be cleaned up completely with all contaminated soil removed and handled with by contaminated spoil sub-plan.</p>	All construction sites and worker camps	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU & DONRE	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Implement Noise and dust sub-plan	Dust Noise	<p>69. Regularly apply wetting agents to exposed soil and construction roads.</p> <p>70. Cover or keep moist all stockpiles of construction aggregates, and all truckloads of aggregates.</p> <p>71. Minimize time that excavations and exposed soil are left open/exposed. Backfill immediately.</p> <p>72. As much as possible restrict working time between 07:00 and 17:00. In particular are activities such as pile driving.</p> <p>73. Maintain equipment in proper working order</p> <p>74. Replace unnecessarily noisy vehicles and machinery.</p> <p>75. Vehicles and machinery to be turned off when not in use.</p> <p>76. Construct temporary noise barriers around excessively noisy activity areas where possible.</p>	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor
Implement utility and power disruption sub-plan	Loss or disruption of utilities and services such as water supply and electricity	<p>77. Develop carefully a plan of days and locations where outages in utilities and services will occur, or are expected.</p> <p>78. Contact local utilities and services with schedule, and identify possible contingency back-up plans for outages.</p> <p>79. Contact affected community to inform them of planned outages.</p> <p>80. Try to schedule all outages during low use time such between 24:00 and 06:00.</p>	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU & Utility company	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Implement tree and vegetation removal, and site restoration sub-plan	Damage or loss of trees, vegetation, and landscape	<p>81. Contact provincial forestry department for advice on how to minimize damage to trees and vegetation.</p> <p>82. Restrict tree and vegetation removal to within RoWs.</p> <p>83. Within RoWs minimize removals, and install protective physical barriers around trees that do not need to be removed.</p> <p>84. All RoWs to be re-vegetated and landscaped after construction completed. Consult provincial forestry department to determine the most successful restoration strategy and techniques. Aim to replant three trees for each tree removed.</p>	All construction sites.	Beginning and end of subproject	Monthly	No marginal cost	PMCES & PIU	contractor
Implement erosion control sub-plan	Land erosion	<p>85. Berms, and plastic sheet fencing should be placed around all excavations and earthwork areas.</p> <p>86. Earthworks should be conducted during dry periods.</p> <p>87. Maintain a stockpile of topsoil for immediate site restoration following backfilling.</p> <p>88. Protect exposed or cut slopes with planted vegetation, and have a slope stabilization protocol ready.</p> <p>89. Re-vegetate all exposed soil immediately after activity is completed.</p>	All construction sites	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor

Implement worker and public safety sub-plan	Public and worker injury, and health	<p>90. Proper fencing, protective barriers, and buffer zones should be provided around all construction sites.</p> <p>91. Sufficient signage and information disclosure, and site supervisors and night guards should be placed at all sites.</p> <p>92. Worker and public safety guidelines should be followed (Lao PDR OSH Programme section III).</p> <p>93. Speed limits suitable for the size and type of construction vehicles, and current traffic patterns should be developed, posted, and enforced on all roads used by construction vehicles.</p> <p>94. Standing water suitable for disease vector breeding should be filled in.</p> <p>95. Worker education and awareness seminars for construction hazards should be given at beginning of construction phase, and at ideal frequency of monthly. A construction site safety program should be developed and distributed to workers.</p> <p>96. Appropriate safety clothing and footwear should be mandatory for all construction workers.</p> <p>97. Adequate medical services must be on site or nearby all construction sites.</p> <p>98. Drinking water must be provided at all construction sites.</p> <p>99. Sufficient lighting be used during necessary night work.</p> <p>100. All construction sites should be examined daily to ensure unsafe conditions are removed.</p>	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor
Civil works	Degradation of water quality & aquatic resources	101. Protective berms, plastic sheet fencing, or silt curtains should be placed between all earthworks and Nam Song river or Nam Ngum reservoir, or other surface waters.	All construction sites	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
		<p>102.Erosion channels must be built around aggregate stockpile areas to contain rain-induced erosion.</p> <p>103.Earthworks should be conducted during dry periods.</p> <p>104.All construction fluids such as oils, and fuels should be stored and handled well away from Nam Song river or Nam Ngum reservoir, or other surface waters.</p> <p>105.No waste of any kind is to be thrown in Nam Song river or Nam Ngum reservoir, or other surface waters.</p> <p>106.No washing or repair of machinery near Nam Song river or Nam Ngum reservoir, or other surface waters</p> <p>107.Pit latrines to be located well away from Nam Song river or Nam Ngum reservoir, or other surface waters No unnecessary earthworks in or adjacent to water courses.</p> <p>108.All irrigation canals and channels to be protected the same way Nam Song river or Nam Ngum reservoir, or other surface waters</p>						
Civil works	Degradation of terrestrial resources	<p>109. All construction sites should be located away forested areas as much as possible.</p> <p>110. No unnecessary cutting of trees</p> <p>111. All construction fluids such as oils, and fuels should be stored and handled well away from forested and plantation areas.</p> <p>112. No waste of any kind is to be discarded on land or in forests/plantations.</p>	All construction sites	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Civil works: Cultural chance finds sub-plan	Damage to cultural property or values, and chance finds	<p>113. As per detailed designs all civil works should be located away from all cultural property and values. DICT identified potential sites and types of PCR in pre-construction phase.</p> <p>114. Chance finds of valued relics and cultural values should be anticipated by contractors. Site supervisors should be on the watch for finds.</p> <p>115. Upon a chance find all work stops immediately, find left untouched, and PIU notified to determine if find is valuable. Culture section of DICT notified by telephone if valuable.</p> <p>116. Work at find site will remain stopped until DICT allow work to continue.</p>	All construction sites	At the start, and throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor
Implement Construction and urban traffic sub-plan	Traffic disruption, accidents, public injury	<p>117. Schedule construction vehicle activity during light traffic periods. Create adequate traffic detours, and sufficient signage & warning lights.</p> <p>118. Post speed limits, and create dedicated construction vehicle roads or lanes.</p> <p>119. Inform community of location of construction traffic areas, and provide them with directions on how to best co-exist with construction vehicles on their roads.</p> <p>120. Demarcate additional locations where pedestrians can develop road crossings away from construction areas.</p> <p>121. Increase road and walkway lighting.</p>	All construction sites	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor
Implement Construction Drainage sub-plan	Loss of drainage & flood storage	<p>122. Provide adequate short-term drainage away from construction sites to prevent ponding and flooding.</p> <p>123. Manage to not allow borrow pits to fill with water. Pump periodically to land infiltration or nearby water</p>	All areas with surface waters	Design & construction phases	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
		<p>courses.</p> <p>124. Install temporary storm drains or ditches for construction sites</p> <p>125. Ensure connections among surface waters (ponds, streams) are maintained or enhanced to sustain existing storm water storage capacity.</p> <p>126. Protect surface waters from silt and eroded soil.</p>						
Specific Mitigation for Construction of Nam Ngum Reservoir Access Improvements								
Upgrade & complete access link road to NR#10	Encroachment into Phu En Protected Forest	<p>127. Follow directives of Department of Forestry for implementation of access road upgrade in Phu En protected forest.</p> <p>128. Minimize tree removal and excavations, and demarcate working areas clearly & strictly with fences to prevent lateral encroachment</p>	Phu-En forest	Beginning and throughout construction period	Monthly	No marginal cost	PMCES & PIU	Contractor / PIU
Pier & shoreline works to upgrade recreation area	Impact of demolition of waterfront buildings	129. Extra care must be taken to isolate demolition area from shoreline activities. All demolished building materials (e.g., concrete, wood, steel, glass) must be removed from area and disposed in DoNRE-approved disposal sites	Reservoir recreation area	Beginning and throughout construction period	Monthly	No marginal cost	PMCES & PIU	Contractor / PIU
	Erosion / Sedimentation / loss of nearshore aquatic habitat	130. Install berms, plastic fencing, or silt curtains to isolate shoreline from civil works activities including new pier and boat landing	All civil works sites at river	Throughout construction period	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
	Disrupted boat traffic, fishing & tourist activities	131. Establish well-marked, nearshore access lane for construction boat traffic away main traffic areas, and fishing areas. Schedule construction boat during periods of low tour and fishing boat traffic	Along shoreline & pier areas	Throughout construction period	Monthly	No marginal cost	PMCES & PIU	contractor
Specific Mitigation for Construction of Kaeng Yui Waterfall Access Improvements								
Access road, parking and footpath upgrades	Encroachment into to Phu Hong - Phu Ban Conservation Forest	132. Prevent or minimize any tree removal. 133. Establish temporary drainage, and soil erosion control measures. 134. Access of construction vehicles into forest minimized. No vehicle or equipment storage or maintenance in forest. 135. As part of construction waste management sub-plan keep all construction waste out of forest.	Subproject sites adjacent	fulltime	As needed	No marginal cost	PMCES/PIU	SS
Specific Mitigation for Western Loop Rural Access Road and Bridge Improvements								
Construction of new bridge	Sedimentation, water pollution, aquatic habitat destruction	136. Construct bridge support piers on land, not in river 137. Place berms between all shoreline works and river to prevent soil erosion and sedimentation of river 138. No equipment use or maintenance, materials storage, or work camps with 300m of river	Nam Song river in Vang Vieng	fulltime	As needed	No marginal cost	PMCES/PIU	SS/contractor
	Disrupted boat traffic	139. Bridge construction area should be well marked on shoreline. 140. Dedicated boat lane provided to ensure unobstructed traffic						
Specific Mitigation Vang Vieng Urban Renewal								

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
Footpath and drainage upgrades, & traffic flow improvements	Disruption of tourist access & movement	141. Schedule work during low tourist season 142. Provide well marked temporary alternate walkways at construction sites	All construction sites in Vang Vieng town	fulltime	As needed	No marginal cost	PMCES/PIU	SS/contractor
Specific Mitigation for Vang Vieng Solid Waste Management Improvements								
Civil works for landfill upgrade	Disruption of dumping and waste picking activity	143. Inform waste pickers of plan and detailed schedule of upgrades landfill to prevent or minimize disruption of ongoing operations.	Existing dumpsite	Throughout construction period	Monthly	No marginal cost	PMCES & PIU	SS/contractor
Operation Phase of Upgraded Managed Vang Vieng Landfill								
Operation of upgraded managed landfill	Pollution of groundwater and downstream wetlands area	144. Regularly monitor groundwater quality from wells bored during construction to ensure landfill operating properly.	Upgraded landfill	Quarterly	Annually	O&M	UDAA	
Operation Phase of Upgraded Access Roads of all 5 Subprojects								
Operation of upgraded roads	Increased traffic accidents & air pollution	145. Enforce clearly post speed limits on all roads. 146. Mandate regular vehicle inspections to ensure all vehicles kept in good working condition. 147. New road drainage culverts and ditches must be routinely cleaned and maintained	All subproject access roads	Biannually	Annually	O&M	DPWT	
Operation Phase of Upgraded Marina on Nam Ngum Reservoir								
Operation of upgraded marina	Boat accidents due to increased	148. Dedicated shoreline lanes should be set for different boat type and sizes. Enforced speed limits for all boats	At marina area	Fulltime	Biannual	O&M	DPWT	

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost ³ (USD)	Responsibility	
							Supervision	Implementation
	<p>traffic</p> <p>Water pollution from boaters & tourists</p>	<p>should be posted in area.</p> <p>149. Boats and tourists that use marina must be required to dispose of all garbage in dedicated bins at the marina.</p> <p>150. Gas and oils should be kept away from water as much as possible</p>						

V. MONITORING PLAN

30. The environmental monitoring plan for the EMP is provided in Table 6. The monitoring plan addresses all three implementation phases (pre-construction, construction, post-construction operation), and consists of environmental indicators, the sampling locations & frequency, method of data collection, responsible parties, and estimated costs. The purpose of the monitoring plan is to determine the effectiveness of the impact mitigations, and to document any unexpected positive or negative environmental impacts of the subproject. The indicative costs of monitoring shown in Table 5 will need to be reviewed and updated during detailed design phase.

1. Environmental Standards for Subproject Components

31. Environmental standards for ambient water quality in urban areas in Lao PDR (Appendix B) are provided by the National Environmental Standard Order No. 2734/PMU-WREA (2009). The environmental standards provided by the Environmental, Health and Safety Guidelines of the IFC/World Bank (2007) (e.g., ambient air quality & noise) should be followed to supplement standards that are not provided by the Government.

32. An independent environmental monitoring institute (EMI) will be required to perform the sampling and laboratory analyses for the environmental monitoring program. The SS will coordinate with the EMI under the direction of the PMCES/PIU who will provide logistical support to the EMI where necessary. The PMCES will be given a budget for the EMI which will come from the loan. The budget for the work of the EMI will become the costs for monitoring which are estimated in Table 5.

2. Performance Monitoring

33. Performance monitoring is required to assess the overall performance of the EMP. A performance monitoring system is normally developed by the EA for the entire subproject. 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 6.

3. Reporting

34. Regular reporting on the implementation of mitigation measures, and on monitoring activities during construction phase of the subproject is required. Reporting is the responsibility of PIU and should be conducted in conjunction with regular meetings with stakeholders as part of the continuation of stakeholder communications. The mitigation and monitoring plans (Tables 4 and 5) summarize proposed timing of reporting. A report on environmental monitoring and implementation of EMP will be prepared quarterly for the EA/PCU by the PIU. For the quarterly report the PIU report will compile monthly reports provided by the EO of contractor, the reports of the EMI on monitoring, and input from the IES/NES of the PMCES. The PIU reports will be compiled into the semi-annual environmental safeguards monitoring report that the EA/PIU submits to the ADB and DONRE.

35. The reports will track all indicators measured in the EMP monitoring plan, including performance monitoring indicators (Table 7) and will include relevant Government environmental quality standards.

Table 6. Environmental monitoring plan

ENVIRONMENTAL EFFECTS MONITORING							
Environmental Indicators	Location	Means of Monitoring	Frequency	Reporting	Responsibility		Estimated Cost ⁶ (USD)
					Supervision	Implementation	
<i>Pre-construction Phase – Update Baseline Conditions</i>							
Where needed update baseline on sensitive receptors (e.g., cultural property & values, new schools or hospitals, rare/endangered species, critical habitat), and aquatic resources and human uses of Nam Ngum reservoir & Nam Song river	At all areas affected by the 5 subprojects	Contact DONRE, continued community consultations	Once	Once	EA/PIU	PIU	\$2,000.
A) Dust, noise, and vibration levels B) Affected surface water quality: TSS, heavy metals (As, Cd, Pb,) oil and grease, pH, DO, COD, BOD ₅ , temperature, TDS, NH ₃ , NH ₄ , other nutrient forms of N & P C) water table depth and groundwater quality (see Appendix of IEE)	A) All civil works sites B) At Nam Song river, and Nam Ngum reservoir 2017 sampling sites C) At dumpsite	Using field and analytical methods approved by DONRE.	One day and one-night measurement during rainy & dry seasons.	One baseline supplement report before construction phase starts	PIU	A & B) Environmental Monitoring Institute C) Environmental Monitoring Institute, or separate hydrogeology firm	A) \$3,000. B) \$5,000. C) 10,000.

⁶ To be updated with EMP at detailed design stage

Inventory of present and past land uses that could cause contaminated soil.	Possible contaminated lands at all excavation sites	Using field and analytical methods approved by DONRE.	Once	Once	PIU	Environmental Monitoring Institute	\$500.
Construction Phase of all Subproject Components							
Analysis of soil quality (heavy metals (As, Cd, Pb, oil & grease, hydrocarbons).	Possible contaminated lands at all excavation sites at all 5 subproject areas	Using field and analytical methods approved by DONRE.	Once, if needed	Once	PIU	Environmental Monitoring Institute	\$3,500.
A) Dust, noise, wind, and vibration levels B) Water quality of Nam Song river, and: TSS, heavy metals (As, Cd, Pb,) oil and grease, pH, DO, COD, BOD ₅ , temperature, TDS, NH ₃ , NH ₄ , other nutrient forms of N & P C) Analysis of soil quality (heavy metals (As, Cd, Pb, Hg, Mn), hydrocarbons. D) Domestic (worker) and construction solid waste inside & outside construction sites including worker camps. E) Public comments and complaints F) Incidence of worker or public accident or injury	A & B): Baseline sites of pre-construction phase. C) At sites where, contaminated soil is suspected. D) All construction sites and worker camps E) Using hotline number placed at all construction areas F) At all construction areas	A – C): Using field and analytical methods approved by DONRE. Include visual observations of dust and noise from contractor & public reports. D) Visual observation E) Information transferred by telephone hotline number posted at all construction sites. F) regular reporting by contractors/PMU	(A – B): Quarterly during construction periods Daily visual records C) Once at start of excavations D) Monthly E) Continuous public input F) Continuous	Monthly	(A - D):		
					PIU	Monitoring Institute	A & B: \$9,000. /yr. X 2 C: \$2,500 /yr. X 2 D: \$0.0
					(E & F) & daily observations:		
					EA/PIU	contractor	E: \$1,500. /yr. X 2 F: \$0.0
Operation of Upgraded Managed Vang Vieng Landfill							
Groundwater quality	Bore wells at landfill.	Using field and analytical methods approved by DoE.	Biannually for 5 years	Biannual	DPWT/UDAA/ DONRE		\$2,500. /yr. X 3
Operation of All Roads of 5 Subprojects							
Vehicle traffic accidents	Upgraded / improved subproject roads.	Regular record keeping.	Continuous	For each event	DPWT		\$0.0

Operation of Upgraded Nam Ngum Marina						
Boat traffic accidents	Recreation area of Nam Ngum reservoir.	Regular record keeping.	Continuous	For each event	DPWT/DONRE	\$0.0
Water Pollution (garbage, oil, gas), Incidence of garbage & litter		Using field and analytical methods approved by DONRE, and visual.	Quarterly	For each event		\$2,500. /yr. X3
Operation of Upgraded Stormwater Drains in Vang Vieng						
Incidence of flooding	Along or near upgraded drains	Surveys, public complaints	Rainy season for 5 years	Quarterly	DPWT/UDAA	\$0.0. /yr.

Table 7. Performance monitoring indicators for Vientiane subprojects

Major Environmental Component	Key Indicator	Performance Objective	Data Source
Pre-construction Phase			
Public Consultation and Disclosure	Affected public and stakeholders	Meetings with stakeholders contacted during IEE & new stakeholders convened for follow-up consultation and to introduce grievance redress mechanism	Minutes of meeting, and participants list
EMP	Updated EMP	All stakeholders contacted during IEE re-contacted for follow-up consultation	EMP
Bid Documents	Requirements of EMP (CEMP) ⁷	EMP appended to bidding documents with clear instructions to bidders for CEMP	Bid documents
Training of PIU/SS	Training course(s) & schedule	By end of preconstruction phase, required course(s) that will be delivered are designed and scheduled	Course(s) outline, participants, and schedule
Construction Phase			
All subproject areas	Critical habitat, rare or endangered species <i>if present</i>	All <i>present</i> critical habitat and R & E species if unchanged, and unharmed	Monitoring by EMI ⁸
Groundwater quality at landfill	Heavy metals, coliform bacteria, TDS, H ₂ S, BOD ₅ , TN, NH ₃ , TP, nutrient forms of N & P ⁹	Government environmental standards and criteria met	Monitoring by EMI
Nam Song river, & Nam Ngum reservoir recreation area	TSS, DO, BOD, COD, pH, oil & grease, nutrient forms of T & N, metals (Pb, Fe, As) ¹⁰	Government environmental standards and criteria met	Monitoring by EMI
Air quality	Dust, noise, vibration	Levels never exceed pre-construction baseline levels	EMI & contractor monitoring reports,
Soil quality	Solid and liquid waste	Rigorous program of procedures and rules to collect and store all waste from construction camps and sites practiced.	Contractor and EMI monitoring reports
Hazardous materials and waste	Oil, gasoline, grease, alum, chlorine, soda	Rigorous program of procedures to manage and store all waste from construction camps and sites practiced.	Contractor and EMI monitoring reports
Public and worker safety	Frequency of injuries	Adherence to Government policy and site-specific procedures to prevent accidents	Contractor reports
Cultural property	Incidence of damage or complaints	No valued cultural property, or unearthed valuable relic is harmed in any way	Public input, contractor reports, public input, EMI reports
Traffic	Frequency of disruptions and/or blocked roadways	Disruptions, stoppages, or detours are managed to absolute minimum.	Public input, contractor reports, EMI reports

⁷Contractor Environmental Management Plan developed from EMP in contractor bidding document

⁸Environmental Monitoring Consultant hired to assist PMCES and implementation of Environmental Monitoring Plan

⁹ See Appendix C for environmental standards

¹⁰ Appendix C

Major Environmental Component	Key Indicator	Performance Objective	Data Source
Operation Phase of Nam Ngum Reservoir Marina			
Public safety	Incidence of boat accidents	None	DPWT
Water quality	garbage, oil & grease,	No deviation from baseline	DPWT/DONRE
Operation of Upgraded Managed Vang Vieng Landfill			
Groundwater quality	Heavy metals, coliform bacteria, TDS, H ₂ S, BOD ₅ , TN, NH ₃ , TP, nutrient forms of N & P	No deviation from baseline levels, compliance with standards Appendix B	DPWT/DONRE
Public safety	Incidence of traffic accidents on access road	No deviation from baseline frequency	DPWT
Operation of Upgraded Access Roads of a Subprojects			
Vehicle accidents, Public Safety	Incidence of vehicle accidents	None or no increase	DPWT

VI. ESTIMATED COST OF EMP

36. The marginal costs for implementing the EMP are primarily for environmental monitoring because the costs for implementing impact mitigation measures are included with the construction costs in contractor bid documents. From Table 6 the preliminary costs for the implementation of the EMP for the 5 subprojects of Vientiane province are summarized in Table 8. These costs include per diem technician fees. Note that contingencies have been provided to account for cost uncertainty to the total EMP cost

37. An estimated budget of \$10,000.00 is required for capacity building for environmental management in conjunction with other capacity development activities of the subproject. The costs will need to be updated by the PMCES in conjunction with the PIU during the pre-construction, detailed design phase of the subproject.

Table 8: Estimated costs for environmental monitoring plan of EMP

Activity Type	Estimated Cost ¹¹ (USD)
Pre-construction Phase	
Updating Environmental Baseline	
cultural receptors	\$2,000.00
environmental quality	\$8,500.00
public consultation	\$3,000.00
groundwater study at dumpsite	\$10,000.00
Biodiversity study	\$5,000.00
Construction Phase	
environmental quality	\$26,500.00
public consultation	\$3,000.00
Post-construction Operation Phase	

¹¹ To be updated with EMP at Detailed Design Phase

environmental quality	\$15,000.00
public consultation	\$3,000.00
public input	\$0.0
Capacity development and training	\$10,000.00
Total	\$86,000.00

VII. INSTITUTIONAL CAPACITY REVIEW AND NEEDS

38. Currently there is insufficient experience and capacity for environmental assessment and management solely amongst national counterparts responsible for the implementation of the EMP. i.e., DICT/PIU, and UDAA in Vientiane province. No dedicated environmental experts are appointed to UDAA. The PMCES with assistance from the SS of the subproject will develop and deliver training courses to the DICT/PIU staff responsible for the implementation of the subproject. The purpose of the course(s) is to strengthen the ability of the PIU/PMU to oversee implementation of the EMP by construction contractors, and EMI

39. The SS who will be full-time environmental member of the PIU as well as the EO of the contractor should attend training courses as required. Costs for training should be included with costs for implementation of the EMP.

40. Training on the implementation of an EMP should address two thematic areas. The first area should introduce principles environmental management focused on the potential impacts of subproject activities on the natural and social environment. The second area should be environmental safeguard requirements of the ADB and the Government with specific focus on the preparation of an EMP, and contractor EMPs (CEMP). Table 9 lists the indicative course topics and target participants. The estimated budget of USD \$10,000 is listed in Table

Table 9. Indicative training on EMP Implementation

Course Topic Areas	Target Participants	Period
Introduction to EIA, Lao PDR EIA policy framework & procedures, and environmental standards, and ADB Safeguard Policy	EA, UDAA*, PIU/SS,	Pre-construction phase: shortly after PMCES is hired
Purpose and content of an EMP. Development and implementation of the EMPs for the Vientiane subprojects. Development and implementation of contractor EMPs (CEMP)	EA, PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Protection of rivers, lakes, terrestrial habitat, and conservation & protection forests from road, bridge, and pier construction	PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Grievance Redress Mechanism, & public consultation	EA/PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Occupational and community health and	PIU/SS, contractor EOs	Construction phase shortly after

Course Topic Areas	Target Participants	Period
safety		construction packages are let
Traffic management and safety on roads and on rivers and reservoirs	PMU	Operation phase shortly before subprojects are completed

* Not included is special course for UDAA for the operation and maintenance of the upgraded Vang Vieng landfill.

41. Separate to the training plan in Table 9 will be the development of the capacity and programming of the Vang Vieng Office of Natural Resources and Environment (ONRE) for sampling environmental quality specifically at the upgraded landfill will also be developed. The scope and details of the capacity development will be finalized at detailed design.

VIII. EMERGENCY RESPONSE PLAN

42. The Contractor must develop emergency or incident response procedures during construction. In the operational phase the operator/civil authorities will have responsibility for any emergencies or serious incidents. The construction phase should ensure:

- i) Emergency Response Team (ERT) of the Contractor as initial responder;
- ii) District fire and police departments, emergency medical service, the Department of Public Health (DPH), collectively referred to as the External Emergency Response Team (EERT), as ultimate responders.

43. The Contractor will provide and sustain the required technical, human and financial resources for quick response during construction.

Table 10: Roles and responsibilities in emergency incident response

Entity	Responsibilities
Contractor Team (ERT)	<ul style="list-style-type: none"> - Communicates / alerts the EERT. - Prepares the emergency site to facilitate the response action of the EERT, e.g., vacating, clearing, restricting site. - When necessary & requested by the EERT, lends support / helps during EERT's response operations.
External Emergency Response Team (EERT)	<ul style="list-style-type: none"> - Solves the emergency/incident
Contractor Resources	<ul style="list-style-type: none"> - Provide and sustain the people, equipment, tools & funds necessary to ensure Subproject's quick response to emergency situations. - Maintain good communication lines with the EERT to ensure prompt help response & adequate protection, by keeping them informed of Subproject progress.

44. The ERT will be led by the senior contractor engineer (designated ERTL) on site with a suitably trained foreman or junior engineer as deputy. Trained first-aiders and security crew will be the core members of the ERT.

45. The Contractor will ensure that ERT members are physically, technically and psychologically fit for their emergency response roles and responsibilities.

46. Prior to the mobilization of civil works, the Contractor, through its Construction Manager, ERTL, in coordination with the PCU/PIU, will meet with the ultimate response institutions to discuss the overall construction process, including, but not limited to:

- i) subproject sites;
- ii) construction time frame and phasing;
- iii) any special construction techniques and equipment that will be used; i
- iv) any hazardous materials that will be brought to and stored in the construction premise and details on their applications and handling/management system;
- v) the Contractor's Emergency Management Plan
- vi) names and contact details of the ERT members

47. The objective of this meeting is to provide the ultimate response institutions the context for:

- i) their comments on the adequacy of the respective Emergency Management Plans
- ii) their own assessment of what types, likely magnitude and likely incidence rate of potential hazards are anticipated
- iii) the arrangements for coordination and collaboration.

48. To ensure effective emergency response, prior to mobilization of civil works, the Contractor will:

- i) set up the ERT;
- ii) set up all support equipment and facilities in working condition
- iii) make arrangements with the EERT;
- iv) conducted proper training of ERT members, and encouraged and trained volunteers from the work force; v) conducted orientation to all construction workers on the emergency response procedures and facilities, particularly evacuation procedures, evacuation routes, evacuation assembly points, and self-first response, among others; and vi) conducted drills for different possible situations.

49. To sustain effective emergency response throughout Subproject implementation an adequate budget shall be provided to sustain the capabilities and efficiency of the emergency response mechanism, the emergency response equipment, tools, facilities and supplies. Drills and reminders will take place regularly, the former at least every two months and the latter at least every month.

A. Alert Procedures

50. Means of communicating, reporting and alerting an emergency situation may be any combination of the following: i) audible alarm (siren, bell or gong); ii) visual alarm (blinking/rotating red light or orange safety flag); iii) telephone (landline); iv) mobile phone; v) two-way radio; and vi) public address system/loud speakers. Some rules relative to communicating/alerting will be:

- (i) Whoever detects an emergency situation first shall immediately:
 - call the attention of other people in the emergency site,
 - sound the nearest alarm, and/or
 - report/communicate the emergency situation to the ERT.
- (ii) Only the ERTL and, if ERTL is not available, the Deputy ERTL are authorized to communicate with the EERT. Exceptional cases to this rule may be necessary and should be defined in the Emergency Management Plans.

- (iii) When communicating/alerting an emergency to the EERT, it is important to provide them with at least: i) the type of emergency; ii) correct location of the emergency; iii) estimated magnitude of the situation; iv) estimated persons harmed; v) time it happened; vi) in case of a spill, which hazardous substance spilled; and vi) in case of fire and explosion, what caused it. Such details would allow the EERT to prepare for the appropriate response actions.

For an effective reporting/alerting of an emergency:

- (i) The names and contact details of the relevant persons and institutions should be readily available in, or near to, all forms of communication equipment, and strategically posted (at legible size) in all Subproject sites and vehicles:
 - Most relevant construction/operations staffs namely, the ERTL, Deputy ERTL, first-aiders, supervising engineers, foremen
 - EERT institutions/organizations
 - Concerned village authority/ies
 - PIU Office, SS
- (ii) All Subproject sites should have good access to any combination of audible and visual alarms, landline phones, mobile phones and two-way radio communication at all times.
- (iii) Contractor's construction vehicles should also be equipped with the appropriate communication facilities.

B. Emergency Response Situations

The following tables suggest general procedures that will be refined in the final EMP during detailed design, and described in more detail in the Emergency Management Plans of the Contractor.

Table 11: Evacuation procedure

Procedure	Remarks
<ul style="list-style-type: none"> ▪ Move out as quickly as possible as a group, but avoid panic. 	<ul style="list-style-type: none"> ▪ All workers/staff, sub-contractors, site visitors to move out, guided by the ERT.
<ul style="list-style-type: none"> ▪ Evacuate through the directed evacuation route. 	<ul style="list-style-type: none"> ▪ The safe evacuation shall have been determined fast by the ERTL/Deputy ERTL & immediately communicated to ERT members.
<ul style="list-style-type: none"> ▪ Keep moving until everyone is safely away from the emergency site and its influence area. 	<ul style="list-style-type: none"> ▪ A restricted area must be established outside the emergency site, all to stay beyond the restricted area.
<ul style="list-style-type: none"> ▪ Once outside, conduct head counts. 	<ul style="list-style-type: none"> ▪ Foremen to do head counts of their sub-groups; ERTL/Deputy ERTL of the ERT.
<ul style="list-style-type: none"> ▪ Report missing persons to EERT immediately. 	<ul style="list-style-type: none"> ▪ ERTL/Deputy ERTL to communicate with the EERT.
<ul style="list-style-type: none"> ▪ Assist the injured in evacuation & hand them over to the ERT first-aiders or EERT medical group 	<ul style="list-style-type: none"> ▪ ERT to manage injured persons to ensure proper handling.
<ul style="list-style-type: none"> ▪ If injury warrants special care, DO NOT MOVE them, unless necessary & instructed/directed by the EERT. 	<ul style="list-style-type: none"> ▪ ERTL/Deputy ERTL communicates with EERT to get instructions/directions in handling the injured.

Table 12: Response procedure during medical emergency

Procedure	Remarks
<ul style="list-style-type: none"> ▪ Administer First Aid regardless of severity immediately. 	<ul style="list-style-type: none"> ▪ Fundamentals when giving First Aid: <ul style="list-style-type: none"> - Safety first of both the rescuer and the victim. - Do not move an injured person unless: <ul style="list-style-type: none"> - victim is exposed to more danger when left where they are, e.g., during fire, chemical spill - it would be impossible for EERT to aid victims in their locations, e.g., under a collapsed structure - instructed or directed by the EERT. ▪ First AID to be conducted only by a person who has been properly trained in giving First Aid.
<ul style="list-style-type: none"> ▪ Call the EERT emergency medical services &/or nearest hospital. 	<ul style="list-style-type: none"> ▪ ERTL/Deputy ERTL or authorized on-site emergency communicator
<ul style="list-style-type: none"> ▪ Facilitate leading the EERT to the emergency site. 	<ul style="list-style-type: none"> ▪ ERTL/Deputy ERTL to instruct: <ul style="list-style-type: none"> - an ERT member on- site to meet EERT in access road/strategic location. He/she shall hold orange safety flag to get their attention & lead them to site. - Other ERT members to clear access road for smooth passage of the EERT.
<ul style="list-style-type: none"> ▪ If applicable, vacate site & influence area at once, restrict site, suspend work until further notice. 	<ul style="list-style-type: none"> ▪ Follow evacuation procedure.

Table 13: Response procedure in case of fire

Procedure	Remarks
<ul style="list-style-type: none"> ▪ Alert a fire situation. 	<ul style="list-style-type: none"> ▪ Whoever detects the fire shall immediately: <ul style="list-style-type: none"> - call the attention of other people in the site, - sound the nearest alarm, and/or - Foreman or any ERT member among the construction sub-group contacts the fire department (in this case it should be agreed on that it is alright for any ERT member in the sub-group to alert the fire department) - Report/communicate the emergency to the ERTL/Deputy ERTL.
<ul style="list-style-type: none"> ▪ Stop all activities/operations and evacuate. 	<ul style="list-style-type: none"> ▪ All (non-ERT) workers/staff sub-contractors, site visitors and concerned public to move out to safe grounds following the evacuation procedure.
<ul style="list-style-type: none"> ▪ Activate ERT to contain fire/control fire from spreading. 	<ul style="list-style-type: none"> ▪ Guided by the training they undertook, ERT members assigned to

Procedure	Remarks
	mitigate the fire shall assess their own safety situation first before attempting to control fire spread.
<ul style="list-style-type: none"> ▪ Call the nearest fire & police stations &, if applicable, emergency medical services. 	<ul style="list-style-type: none"> ▪ When alerting the EERT, ERTL will give the location, cause of fire, estimated fire alarm rating, any injuries.
<ul style="list-style-type: none"> ▪ Facilitate leading the EERT to the emergency site. 	<ul style="list-style-type: none"> ▪ ERTL/Deputy ERTL to instruct: <ul style="list-style-type: none"> - an ERT member to meet the EERT in the access road or strategic location and lead them to the site. He/she shall hold the orange safety flag to get their attention and lead them to the site. - some ERT members to stop traffic in, & clear, the access road to facilitate passage of the EERT.
<ul style="list-style-type: none"> ▪ ERT to vacate the site as soon as their safety is assessed as in danger. 	<ul style="list-style-type: none"> ▪ Follow appropriate evacuation procedure.

ANNEX A: INDICATIVE RESPONSIBILITIES OF KEY MANAGEMENT UNITS OF EMP

EMP Implementation organizations	Roles and Responsibilities
Executing agency (EA) (MICT)	<ul style="list-style-type: none"> ➤ Overall responsibility for the execution of the project ➤ Reviews the project implementation progress ➤ Reviews and endorses any proposed change in the project scope or implementation arrangements ➤ Supervises compliance with loan covenants
Project Coordination Unit (PCU), inside MICT	<ul style="list-style-type: none"> ➤ Project preparation, including the setting up of financial and management systems and procedures, and the procuring of PCU office equipment ➤ Consultant recruitment and supervision ➤ Review and approval of goods and civil works contracts, including bid documents ➤ Coordination between the concerned agencies at the national and provincial levels ➤ Coordination of activities of the PIUs and the inputs of concerned stakeholders ➤ Coordination of all reporting aspects of the project ➤ Coordination of institutional strengthening measures ➤ Ensuring compliance with ADB Loan covenants, assurances and safeguard requirements, as well as with national and provincial policies and regulations ➤ Provision of administrative and technical support to the PIUs ➤ Preparation of consolidated Project accounts to be forwarded to ADB ➤ Advice to PIUs on revenue-enhancing activities related to the recovery of costs of constructing, operating, and maintaining Project facilities and equipment; ➤ Coordination of project audits ➤ All specified monitoring, evaluation and reporting activities ➤ Communication of Project's outcomes, outputs, and activities to all stakeholders ➤ Provide coordination for safeguards and monitoring for PIU
Provincial Project Steering Committee (PPSC)	<ul style="list-style-type: none"> ➤ Ensuring that concerns of all stakeholders are adequately reflected in the project ➤ Coordination of project implementation between the concerned agencies ➤ Confirming compliance with local regulations and provincial policies ➤ Overseeing budgeting and disbursement of counterpart funds ➤ Overseeing implementation of resettlement plans, compensation schemes and all other project safeguard procedures
Project Implementation Units (PIUs) DICT, DPWT, UDAA	<ul style="list-style-type: none"> ➤ Coordination and supervision of consultants' inputs on the appraisal of feasibility studies, and conceptual and detailed designs construction ➤ Procurement of goods and civil works contracts, including the preparation of bid documents and bid evaluations ➤ Approving payments to contractors and maintaining disbursement records ➤ Ensuring that institutional-strengthening and capacity-building initiatives involving DMOs, private partners, SMEs and CBTOs are implemented in line with agreed Project designs, schedules and budgets ➤ Ensuring compliance with loan covenants and assurances in respect of all sub projects, including updating of IEEs, EMPs, IPPs, GAPs, resettlement plans ➤ Oversee implementation of EMP by contractor EO, and EMI ➤ Prepare quarterly reports on EMP implementation for PCU ➤ Coordinate with PMCES to design and deliver capacity development & training. ➤ Meetings with all concerned stakeholders ➤ Quarterly progress and monitoring-and-evaluation reporting to the PCU
Project Management & Supervision Consultant (PMCES)	<ul style="list-style-type: none"> ➤ Completes detailed designs of subprojects with PIU ➤ Update EMP to meet final detailed designs of subprojects ➤ Supervises and assists PIU with contractor management

EMP Implementation organizations	Roles and Responsibilities
	<ul style="list-style-type: none"> ➤ Provides technical advice and support when needed to PIU and EMI ➤ Designs and oversees delivery of all training and capacity development of PIU for construction and operation of completed subprojects including EMP. ➤ Provides advisory role for implementation of EMP by PIU and EMI
Environmental Monitoring Institute(EMI)	<ul style="list-style-type: none"> ➤ Implements environmental sampling for EMP ➤ Conducts laboratory analyses of environmental quality samples from field sampling ➤ Prepares periodic monitoring reports for PIU
Environmental Officer (EO) of Contractor	<ul style="list-style-type: none"> ➤ Implements the CEMP for the construction phase ➤ Maintains a daily log of environmental issues at the construction sites ➤ Prepares brief monthly summaries of mitigation activities and environmental issues at construction site to PIU.
ADB	<ul style="list-style-type: none"> ➤ Assists PCU through timely guidance at each stage of project implementation following agreed implementation arrangements ➤ Review all documents that require ADB approval ➤ Review of monitoring reports on EMP implementation to ensure EMP meets SPS (2009) ➤ Approval of procurement activities ➤ Periodic project review missions, a mid-term review and a completion mission for the project ➤ Ensuring compliance of all loan covenants ➤ Timely processing of withdrawal applications and release of eligible funds ➤ Ensuring compliance of financial audit recommendations ➤ Regularly updates project information disclosure on the ADB website

ANNEX B: INDICATIVE TOR FOR ENVIRONMENTAL SPECIALISTS OF PMCESPMCES

International Environmental Specialist (IES). With assistance from the national environmental specialist the international consultant will be responsible for updating the provincial EMPs at detailed design, and assisting the PIU with overall environmental management of the implementation of the subprojects in Vientiane province. The consultant will:

- (i) With national consultant prepare and implement a biodiversity study of the Hong Phu-Ban Phu District Conservation Forest adjacent to Kaeng Yui Waterfall subproject. Survey should follow ToR for biodiversity of Phu-En Protected Forest at Nam Ngum subproject which is appended to the IEE.
- (ii) update environmental management plans (EMP) for the 5 subprojects to ensure that EMPs address the detailed designs and engineering of subprojects. Updates to both EMPs include mitigation and monitoring plans, budget, and capacity development needs of executing agency (EA/PCU) and PIUs (/ DICT/DPWT/UDAA);
- (iii) with national consultant design comprehensive training plan for safeguards specialist/PIU and on principles of EIA, and the purpose, content, and roles and responsibilities for implementation of updated EMPs highlighting environmental issues of subprojects;
- (iv) ensure that all relevant safeguards of the EMPs are adequately addressed in the bidding documents (instruction to bidders), and in the evaluation criteria for awarding contracts;
- (v) coordinate and work with the PIUs to ensure that contractors finalize their respective site-specific CEMPs based on the updated EMPs and the actual site conditions;
- (vi) oversee the implementation of all safeguards of the three EMPs 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;
- (vii) assist with the finalization of the groundwater monitoring study at existing dumpsite site;
- (viii) coordinate with the provincial Department of Natural Resources & Environment (DONRE) on all relevant environmental regulatory compliance issues (e.g. noise and dust from construction sites, sanitation in workers campsite etc);
- (ix) prepare TOR(s) for the LAO UXO for the survey, detection, and removal of unexploded ordnance (UXO) at all civil works sites. Ensure that EA and/or PIUs consult LAO UXO and Government authorities to assist with ToR development and implementation;
- (x) with PIU/DICT, prepare TORs for the follow-up interviews and consultations with the same affected stakeholder and local residents contacted during the PPTA on issues and concerns arising during project construction;
- (xi) assist PIU with clarifying existing scope of waste picking at Vang Vieng dumpsite;
- (xii) prepare TOR(s) for external national environment monitoring institute (EMI) for conducting water and air quality sampling, and laboratory analyses for the monitoring plans for the town EMPs;
- (xiii) coordinate with PWDTs to address vehicle and boat traffic issues; (xiii) advise PIU/DICT on environment-related concerns arising during sub-projects construction, and recommend corrective measures;
- (xiv) with PIU/DICT, 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;
- (xv) assist EA and PIU/DPWTs prepare a table of contents for regular reports PIU must submit to the EA on implementation of EMPs, environmental, issues, and corrective actions;
- (xvi) assist PIU/DICT prepare simple report template for construction contractors to report monthly on mitigation activities, and environmental issues that occur during construction phase; and

- (xvii) prepare a quarterly status report on implementation of EMPs, environmental issues, and public safety protection to be submitted through the PIU and EA to the provincial DONREs as part of semi-annual environmental reporting to ADB.

The consultant should have an advanced degree in environmental sciences, and at least 7 years experience implementing and managing environmental assessment of infrastructure projects in southeast Asia countries (preferably Lao PDR). Other requirements include: a) understanding of ADB and national environmental safeguard requirements; b) experience working with and supervising the activities of provincial and national environmental management agencies with environmental safeguards; and c) designing and delivering training and capacity development programs to provincial environment, project implementing units.

National Environmental Specialist (NES). Assist the international environmental specialist update the provincial EMPs at detailed design, and work with the PIU with overall environmental management of the implementation of the subprojects in Vientiane province. The national consultant will assist with:

- (i) Assist IES prepare and implement a biodiversity study of the Hong Phu-Ban Phu District Conservation Forest adjacent to Kaeng Yui Waterfall subproject
- (ii) updating environmental management plans (EMP) for subprojects in Vientiane to ensure that EMPs address the detailed designs and engineering of subprojects.;
- (iii) deliver initial training to DICT, DPWT and UDAA on the purpose, content, and roles and responsibilities for implementation of updated EMPs;
- (iv) ensure relevant safeguards of the EMPs are addressed in the bidding documents in accurate local language and in evaluation criteria for awarding contracts;
- (v) help PIUs to ensure that contractors prepare their respective site-specific plans based on the updated EMPs and the actual site conditions;
- (vi) help international consultant oversee the implementation of all safeguards of the three EMPs 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;
- (vii) assist coordination with the provincial Department of Natural resources & Environment (DONRE) on all relevant environmental regulatory compliance issues (e.g. noise and dust from construction sites, sanitation in workers campsite etc);
- (viii) with PIU/DICT, prepare ToRs for the follow-up interviews and consultations with the same affected stakeholder and local residents contacted during the PPTA on issues and concerns arising during project construction. Of particular concern is upgrades to access roads;
- (ix) assist PWDTs to address vehicle traffic issues, respectively during road upgrades;
- (x) with international consultant advise the PIU/DICT/DPWTs on environment-related concerns arising during sub-projects construction, and recommend corrective measures;
- (xi) with PIU/DICT, 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;
- (xii) assist with all reporting for the EMP. T

The consultant should have a university degree in the environmental sciences and at least 5 years experience with environmental assessment of infrastructure projects in Lao PDR) 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 provincial project implementing units.

ANNEX C: ENVIRONMENTAL STANDARDS

Water Resources and Environment Administration No 2734 / PMO.WREA (now MONRE)
Vientiane, 7 Dec 2009

Agreement on the National Environmental Standards

Based on the Environmental Protection Law No. 02/99/NA, dated 3 April 1999.
Based on decree on mandate of Water Resources and Environmental
Administration dated 149/PM, dated 10 May 2007.

Surface water quality standards in Lao PDR

No	Substances	Symbol	Unit	Standard Value	Method of Measurement
1	Color, Odor and Taste	-	-	N	-
2	Temperature	t	°C	N'	Thermometer
3	Potential of Hydrogen	pH	-	5-9	Electronic pH Meter
4	Dissolved Oxygen	DO	mg/l	6	Azide Modification
5	COD	COD	ml/l	5	Potassium permanganate
6	BOD ₅	BOD ₅	mg/l	1,5	Azide Modification at 20 degree C, 5 days
7	Total Coliform Bacteria	Coliform Bacteria	MPN/100 ml	5000	Multiple Tube Fermentation
8	Fecal Coliform Bacteria	Fecal Coliform	MPN/ 100 ml	1000	
9	Nitrate-Nitrogen	NO ₃ -N	mg/l	<5.0	Cadmium Reduction
10	Ammonia-Nitrogen	NH ₃ -N	mg/l	0.2	Distillation Nesslerization
11	Phenols	C ₆ H ₅ -OH	mg/l	0.005	Distillation, 4-Amin anti-pyrenne
12	Copper	Cu	mg/l	0.1	Atomic Absorption Direct Aspiration
13	Nickel	Ni	mg/l	0.1	
14	Manganese	Mn	mg/l	1.0	
15	Zinc	Zn	mg/l	1.0	
16	Cadmium	Cd	mg/l	0.005	
17	Chromium, Hexavalent	Cr ⁶⁺	mg/l	0.05	
18	Lead	Pb	mg/l	0.05	
19	Mercury	Hg	mg/l	0.002	Atomic Absorption Cold Vapor

No	Substances	Symbol	Unit	Standard Value	Method of Measurement
20	Arsenic	As	mg/l	0.01	Atomic Absorption Direct Aspiration
21	Cyanide	CN ⁻	mg/l	0.005	Pyridine-Barbituric
22	Alpha -Radioactive	α	Becquere l/l	0.1	Counting machine
23	Beta -Radioactive	β	Becquere l/l	1.0	
24	Total Organochlorine	-	mg/l	0.05	Gas Chromatography
25	DDT	C ₁₄ H ₉ Cl ₅	mg/l	1.0	
26	Alpha -BHC	α BHC	mg/l	0.02	
27	Dieldrin	C ₁₂ H ₈ Cl ₆ O	mg/l	0.1	
28	Aldrin	-	mg/l	0.1	
29	Heptachlor and Heptachlor Epoxide	-	mg/l	0.2	
30	Endrin	-	mg/l	None	

Drinking Water Quality Standards

Bacteriological Parameters

Parameters	Units	Concentration
Fecal Coliform	MPN/100ml	0
Total Coliform	MPN/100ml	<2.2
Enterovirus	MPN/100ml	0

Physical -Chemical Parameters

No.	Parameters	Symbol	Unit	Concentration	
				Minimum	Maximum
1	Aluminum	Al	mg/l	0.1	0.2
2	Ammonia	NH ₃	mg/l	0.5	1.5
3	Chloride	Cl	mg/l	200	250
4	Copper	Cu	mg/l	1.0	2.0
5	Iron	Fe	mg/l	0.3	<1
6	Manganese	Mn	mg/l	0.1	0.5
7	Sodium	Na	mg/l	200	250
8	Sulphate	SO ₄ ²⁻	mg/l	200	250
9	Hydrogen Sulphide	H ₂ S	mg/l	0.05	0.1
10	Conductivity	Ec	μ s/cm	-	<1,000
11	Total dissolved solids	TDS	mg/l	500	600
12	Sodium Chloride	NaCl	mg/l	100	300-350
13	Potential of Hydrogen	pH	-	6.5	8.5
14	Temperature	T	^o C	25	35
15	Hardness	-	mg/l	50	300
16	Turbidity	-	NTU	-	<10
17	Taste and Odor	-	-	-	Acceptable
18	Color	-	TCU	-	5
19	Residual Chloride (if Chlorine disinfection is used)	Cl ₂	mg/l	-	<0.2

Health Significant Chemical Parameters

No.	Parameters	Symbol	Unit	Maximum Concentration
1	Antimony	Sb	mg/l	0.005
2	Arsenic	As	mg/l	0.01-0.05
3	Barium	Ba	mg/l	0.7
4	Boron	B	mg/l	0.50
5	Cadmium	Cd	mg/l	0.003
6	Chromium	Cr	mg/l	0.05

No.	Parameters	Symbol	Unit	Maximum Concentration
7	Cyanide	CN ⁻	mg/l	0.07
8	Fluoride	F ⁻	mg/l	1.5
9	Lead	Pb	mg/l	0.01
10	Mercury	Hg	mg/l	0.001
11	Nitrate	NO ₃ ⁻	mg/l	50
12	Nitrite	NO ₂ ⁻	mg/l	3
13	Selenium	Se	mg/l	0.01

A. Priority Parameters

No.	Parameters	Symbol	Unit	Maximum Concentration
1	Iron	Fe	mg/l	<1
2	Manganese	Mn	mg/l	<0.5
3	Arsenic	As	mg/l	<0.05
4	Fluoride	F ⁻	mg/l	<1.5
5	Nitrate	NO ₃ ⁻	mg/l	50
6	Nitrite	NO ₂ ⁻	mg/l	3
7	Nitrite Nitrogen	NO ₂ ⁻ N	mg/l	1
8	Potential of Hydrogen	pH	-	6.5-8.5
9	Coliform	-	MPN/100ml	0
10	Conductivity	Ec	µs/cm	1000
11	Residual Chloride (if Chlorine disinfection is used)	Cl ₂	mg/l	0.2
12	Total Hardness	-	mg/l	<300
13	Turbidity	-	NTU	<10
14	Taste and Odor	-	-	Acceptable

Groundwater Standards for Drinking Purposes

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value	
				Suitable	Maximum
Physical	1. Color	-	Platinum-Cobalt (Pt-Co)	5	15
	2. Turbidity	-	JTU	5	20
	3. Potential of Hydrogen	pH	-	7.0-8.5	6.5-9.2

Chemical	4. Iron	Fe	mg/l	≤0.5	1
	5. Manganese	Mn	mg/l	≤0.3	0.5
	6. Copper	Cu	mg/l	≤1.0	1.5
	7. Zinc	Zn	mg/l	≤5.0	15
	8. Sulphate	SO ₄ ²⁻	mg/l	≤200	250
	9. Chloride	Cl ⁻	mg/l	≤250	600
	10. Fluoride	F ⁻	mg/l	≤0.7	1
	11. Nitrate	NO ₃ ⁻	mg/l	≤15	45
	12. Total Hardness as	Total CaCO ₃	mg/l	≤300	500

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value	
	CaCO ₃				
	13. Non-carbonate hardness as CaCO ₃	Non CaCO ₃	mg/l	≤200	250
Toxic chemical substances	14. Total solids	TS	mg/l	≤600	1,200
	15. Arsenic	As	mg/l	None	0.05
	16. Cyanide	CN ⁻	mg/l	None	0.1
	17. Lead	Pb	mg/l	None	0.05
	18. Mercury	Hg	mg/l	None	0.001
	19. Cadmium	Cd	mg/l	None	0.01
	20. Selenium	Se	mg/l	None	0.01
Bacteria	21. Coliform bacteria	Coliform	MPN/100 ml	<2.2	<2.2
	22. E. coli bacteria	E. coli	-	None	None
	23. Standard plate count	-	Colonies/ml	≤500	-

Soil Quality Standards for Residential and Agriculture

No.	Substances	Symbol	Unit	Standard Value	Method of Measurement
I. Volatile Organic Compound					
1	Benzene	C ₆ H ₆	mg/kg	0.5	
2	Carbon Tetrachloride	CCl ₄	mg/kg	89	
3	1,2 Dichloroethane	CH ₂ Cl-CH ₂ Cl	mg/kg	230	
4	1,1 Dichloroethylene	CCl ₂ =CH ₂	mg/kg	1,700	
5	Cis 1,2 Dichloroethylene	CHCl=CHCl	mg/kg	57	
6	Trans-1,2-Dichloroethylene	CHCl=CHCl	mg/kg	520	

7	Dichloromethane	CH ₂ Cl ₂	mg/kg	28	Gas Chromatography or Gas Chromatography/. Mass Spectrometry (GC/MS) or other methods approved by DONRE
8	Ethly benzene	IC ₂ ClC-CH ₃	mg/kg	630	
9	Styrene	C ₆ H ₅ -CH=CH ₂	mg/kg	8.4	
10	Tetrachloroethylene	C ₂ Cl ₄	mg/kg	210	
11	Toluene	C ₆ H ₅ -CH ₃	mg/kg	6.5	
12	Trichloroethylene	Cl ₂ C=CHCl	mg/kg	2.5	
13	1.1.1 Trichloroethane	Cl ₃ C-CH ₃	mg/kg	3.5	
14	1.1.2 Trichloroethane	Cl ₂ CH-CH ₂ Cl	mg/kg	43	
15	Total Xylenes	(CH ₃ -C ₆ H ₄ -CH ₃)	mg/kg	63	

II. Heavy Metals

1	Arsenic	As	mg/kg	3.9	Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Gaseous Hydride or Atomic Absorption, Borohydride Reduction or other Methods Approved
2	Cadmium and its compounds	Cd	mg/kg	37	

No.	Substances	Symbol	Unit	Standard Value	Method of Measurement
					by DONRE
3	Hexavalent Chromium	Cr ⁺⁶	mg/kg	300	Coprecipitation or Colorimetric or Chelation/Extraction or other Methods Approved by DONRE
4	Lead	Pb	mg/kg	400	Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Direct Aspiration or Atomic Absorption, Furnace Techniques or other Methods Approved by DONRE
5	Manganese and its compounds	Mn	mg/kg	1,800	Cold-Vapor Technique or other Methods Approved by DONRE
6	Mercury and its compounds	Hg	mg/kg	23	Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Direct Aspiration or Atomic Absorption, Furnace Techniques or other Methods Approved by DONRE
7	Nickel, soluble salts	Ni	mg/kg	1,600	
8	Selenium	Se	mg/kg	390	

III. Pesticides

1	Atrazine	C ₈ H ₁₄ ClN ₅	mg/kg	22	Gas Chromatography or other Methods Approved by DONRE
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2	Chlordane	-	mg/kg	16	Gas Chromatography/ Mass Spectrometry (GC/MS) or other Methods Approved by DONRE
3	2,4 D	-	mg/kg	690	Gas Chromatography or High Performance Liquid Chromatography/ Thermal Extraction/ Gas Chromato- graphy/Mass Spectrometry (TE/GC/MS) or other Me- thods Approved by DONRE
4	DDT	DDT	mg/kg	17	Gas Chromatography or Gas Chromatography/ Mass Spectrometry (GC/MS) or other Methods Approved by DONRE
5	Dieldrin	C ₁₂ H ₈ Cl ₆ O	mg/kg	0.3	
6	Heptachlor	Cl ₇	mg/kg	1.1	
7	Heptachlor Epoxide	-	mg/kg	0.5	
8	Lindane	-	mg/kg	4.4	

IV. Others

1	Benzo(a)pyrene	-	mg/kg	0.6	Gas Chromatography/ Mass Spectrometry (GC/MS) or Thermal Extraction Gas Chromato- graphy/ Mass Spectrome-
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No.	Substances	Symbol	Unit	Standard Value	Method of Measurement
					try (TE/GC/MS) Chromato- graphy/ Fourier Transform Infrared (GC/FT-IR) Spec- trometry or other Methods Approved by DONRE
2	Cyanide and its compounds	CN ⁻	mg/kg	11	Total and Amenable Cyanide: Distillation, or Total Amenable Cyanide (Automated Colorimetric, with off-line Distillation), or Cyanide Extraction Procedure for Solids and Oils or other Methods Approved by DONRE
3	PCBs	-	mg/kg	2.2	Gas Chromatography or other Methods Approved by DONRE
4	Vinyl Chloride		mg/kg	1.5	Gas Chromatography or Gas Chromatography/ Mass Spectrometry (GC/MS) or other Methods Approved by DONRE

Ambient Air Quality Standard

Parameters	Symbol	Average Time Unit: mg/m ³					Method of Measurement
		Hours			1 month	1 year	
		1 hr	8 hr	24 hr			

Carbon monoxide	CO	30	10.26	-	-	-	Non dispersive infrared detection
Nitrogen dioxide	NO ₂	0.32	-	-	-	-	Chemilumine scene method
Sulphur dioxide	SO ₂	0.78	-	0.30	-	0.10	UV Fluorescence (1hr, 24hr, 1yr) or Pararos aniline (1hr,4hr)
Total Suspended Particulate	TSP	-	-	0.33	-	0.10	Gravimetric
Particulate Matter less than 10 microns	PM-10	-	-	0.12	-	0.05	Gravimetric or Beta Ray or Taper Element Oscillating Microbalance or Dichotomous
Ozone	O ₃	0.20	-	-	-	-	Chemiluminescence or UV Absorption Phoptometry
Lead	Pb	-	-	-	1.5	-	Atomic Absorption Spectrometer

Noise Standard

Standards	Method of Measurement
Maximum Sound Level (L _{max}) should not exceed 115 dB(A)	Equivalent Sound Level (L _{eq}) from Fluctuating Noise
L _{eq} 24 hour not exceeding 70 dB(A)	Equivalent Sound Level (L _{eq}) from Steady Noise

Noise Standards for Other Places

Type of Area	Standard Value in dB(A)		
	6.00-18.00	18.00-22.00	22.00-6.00
Quiet areas: hospitals, libraries, treatment places, kindergarten and schools	50	45	40
Residential areas: hotels and houses	55	55	45
Commercial and service areas	70	70	50
Small industrial factories located in residential areas	70	70	50

General Industrial Wastewater Discharge Standards Standards for General Industries

No.	Parameters	Symbols	Unit	Maximum Concentration
1	BOD ₅	BOD ₅	mg/l	40
2	Ammonia Nitrogen	NH ₃ -N	mg/l	4
3	Total Suspended Substances	TSS	mg/l	40
4	Potential of Hydrogen	pH	-	6-9.5
5	Total Dissolved Substances	TDS	mg/l	3,500
6	Phenols	C ₆ H ₅ OH	mg/l	0.3
7	Phosphorous	P	mg/l	1.0
8	Silver	Ag	mg/l	0.1
9	Zinc	Zn	mg/l	1.0
10	Sulphide	S	mg/l	1.0
11	Free Chlorine	Cl ₂	mg/l	1.0
12	Chloride	Cl	mg/l	500
13	Iron	Fe	mg/l	2.0
14	Fluoride	F	mg/l	15
15	Cyanide	CN ⁻	mg/l	0.1
16	Copper	Cu	mg/l	0.5
17	Lead	Pb	mg/l	0.2
18	Oil and Grease	-	mg/l	5
19	Nickel	Ni	mg/l	0.2
20	Mercury	Hg	mg/l	0.005
21	Manganese	Mn	mg/l	1.0
22	Arsenic	As	mg/l	0.25
23	Barium	B	mg/l	1.0
24	Cadmium	Cd	mg/l	0.03
25	Chromium	Cr ⁺⁶	mg/l	0.1
26	Total Chromium	Total Cr	mg/l	0.5

Wastewater Discharge Standards from the Urban Area
Wastewater Discharge Standards

No.	Parameters	Symbol	Standards				
			A	B	C	D	E
1.	Biochemical Oxygen Demand	BOD ₅	Not more than (mg/l)				
			30	40	50	60	200
2.	Suspended Solids	SS	Not more than (mg/l)				
			30	40	50	50	60
3.	Settle able Solids	-	Not more than (mg/l)				
			0.5	0.5	0.5	0.5	-
4.	Total Dissolved Solids	TDS	Not more than (mg/l)				
			3000	2500	2000	1500	-
5.	Chemical Oxygen Demand	COD	Not more than (mg/l)				
			120	130	150	350	400
6.	Sulphide	S ²⁻	Not more than (mg/l)				
			1.0	1.0	3.0	4.0	-
7.	Total Kjeldahl	TKN	Not more than (mg/l)				

	Nitrogen		35	35	40	40	-
8.	Fat Oil and Grease	-	Not more than (mg/l)				
			20	20	20	20	100
9.	Temperature	t	Not more than (degree Celsius)				
			40	40	40	40	40
10.	Potential of Hydrogen	pH	Not more than				
			6-9.5	6-9.5	6-9.5	6-9.5	6-9.5

ANNEX D: COST NORMS FOR ENVIRONMENTAL MONITORING

LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity

Prime Minister's Office-PMO

Water Resources and Environment Administration-WREA (now DONRE)

Water Resources and Environment Research Institute-WERI

QUOTATION

Customer

Name:
Address:
City:
Phone:

Date:
Order Date:
Rep:
FOB:

No	Description	Unit	Quantity	Unit Price US\$
1	pH	Sample	01	\$2.00
2	EC	Sample	01	\$4.00
3	Total Hardness (as CaCO ₃)	Sample	01	\$6.00
4	Biochemical Oxygen Demand (BOD ₅)	Sample	01	\$8.00
5	Chemical Oxygen Demand (COD)	Sample	01	\$8.00
6	Sulfate ion (SO ₄ ²⁻)	Sample	01	\$7.00
7	Total Dissolves Suspended (TDS)	Sample	01	\$8.00
8	Total Solid Suspended (TSS)	Sample	01	\$8.00
9	Dissolved Oxygen (DO)	Sample	01	\$6.00
10	Phosphate (PO ₄ ³⁻)	Sample	01	\$12.00
11	Chloride (Cl ⁻)	Sample	01	\$8.00
12	Nitrate	Sample	01	\$7.00
13	Nitrite	Sample	01	\$8.00
14	Magnesium (Mg)	Sample	01	\$8.00
15	Potassium (K)	Sample	01	\$8.00
16	Sodium (Na)	Sample	01	\$8.00
17	Calcium (Ca)	Sample	01	\$8.00
18	Ammonia	Sample	01	\$8.00
19	Total Nitrogen (T-N)	Sample	01	\$8.00
20	Total Phosphorus (T-P)	Sample	01	\$8.00
21	Iron (Fe)	Sample	01	\$12.00
22	Lead (Pb)	Sample	01	\$12.00
23	Mercury (Hg)	Sample	01	\$15.00
24	Arsenic (As)	Sample	01	\$15.00
25	Zinc (Zn)	Sample	01	\$12.00
26	Copper (Cu)	Sample	01	\$12.00
27	Cyanide (CN)	Sample	01	\$12.00
28	Cadmium (Cd)	Sample	01	\$12.00
29	Chromium (Cr)	Sample	01	\$12.00

30	Manganese (Mn)	Sample	01	\$12.00
31	Selenium (Se)	Sample	01	\$12.00
32	Nickel (Ni)	Sample	01	\$12.00
33	Zinc (Zn)	Sample	01	\$12.00
34	Antimony (Sb)	Sample	01	\$12.00
35	Salinity	Sample	01	\$6.00

Items	Unit	Q'ty	Unit Price	Amount
			(US\$)	(US\$)
Environmental surveys				
(1) Water Quality (River water)	sample/parameter	400	18.00	7,200.00
(2) Water Quality (Groundwater/lake)	sample/parameter	400	18.00	7,200.00
(3) Sediment Quality	sample/parameter	36	18.00	648.00
(4) Soil Quality	sample/parameter	27	20.00	540.00
(5) Air Quality	sample	210	69.00	14,490.00
(6) Noise Survey	sample	42	230.00	9,660.00

Water Quality analytical parameters

<p>Fecal Coliform, Total Coliform, Aluminium (Al), Ammonia (NH₃), Chloride (Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Sodium (Na), Sulfate (SO₄), Hydrogen Sulfide (H₂S), Conductivity, Total dissolved solids (TDS), Salt (NaCl), Hardness, Turbidity, Color, Taste and Odour, pH, Temperature (water, atmosphere), Residual chloride (if chloride disinfection is used), Antimony (Sb), Arsenic (As), Barium (Ba), Boron (B), Cadmium (Cd), Chromium (Cr), Cyanide (CN), Fluoride (F), Lead (Pb), Mercury (Hg), Nitrate (NO₃), Nitrite (NO₂), Selenium (Se): (as stipulated in Drinking Water and Household Water Quality Standard, MOH(2005)),</p> <p>BOD₅ (at 20°C), Suspended Solid (SS), Settable Solid, TDS increase from regular use, COD, Sulfide, Total Kjeldahl Nitrogen (TKN), Fat oil and grease: (as stipulated in Standard for Wastewater Discharge, STEA (1998)),</p> <p>Phenol, Silver (Ag), Zinc (Zn), Nickel (Ni) (as stipulated in Provision on Discharge of Domestic Sewage and Wastewater from Industrial Factories, MOIC(2006)),</p> <p>And, DO, total nitrogen, total phosphorous, total organic compounds.</p>
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Sediment and soil analytical parameters

<p>Cadmium (Cd), Total Cyanide (CN), Lead (Pb), Chromium (Cr(VI)), Arsenic (As), Total Mercury (Hg), Selenium (Se), Fluoride (F), Boron (B)</p>

Air quality

Air quality survey items: nitrogen dioxides (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), total suspended particle (TSP) and particle matter 10 (PM₁₀)

Noise

Noise survey: L_{Aeq} level in accordance with the related guidelines in Laos